

**MARCH 14, 2014**

**NEW FARE TECHNOLOGY SYSTEM**  
**FOR**  
**CTFASTRAK AND ALL CTTRANSIT FIXED ROUTE VEHICLES**

**ADDENDUM NO. 2**

**REQUEST FOR PROPOSALS (RFP) INSTRUCTIONS TO PROPOSERS**

Reference the attachment for a “track changes” version of the modifications to this document.

**AGREEMENT**

Reference the attachment for a “track changes” version of the modifications to this document.

**SCHEDULE A NEW FARE TECHNOLOGY SYSTEM SCOPE OF WORK**

Reference the attachment for a “track changes” version of the modifications to this document.

**SCHEDULE B PRICE PROPOSAL FORMS**

Minor quantities were adjusted for validating fareboxes and non-registering fareboxes.

**SCHEDULE F NFTS EQUIPMENT TABLE**

Replace the existing attachment with the new attachments noted as Schedule F. Minor quantities were adjusted for validating fareboxes and non-registering fareboxes.

**QUESTIONS AND ANSWERS**

Further information on Question #9 is below:

Question #9: Schedule A, 4.5, 11.8: Would it be possible to receive a copy of the table of contents of the magnetic ticket format specification – or similar outline documentation, which would better allow estimating the effort for implementing the magnetic ticket production format(s)?

Answer #9: The location of the magnetic stripe is on the front of the ticket and is approximately 0.31 inches wide with the center line of the stripe ½ inch from the edge of the ticket. The stripe

is parallel to the long edge of the ticket. The height of the reading surface above the ticket when profiled with a probe having a radius of between 0.015 in. and 0.100 in. is between 0.0000 in. minimum and 0.0006 in. maximum.

The bit density of the encoding is 120 bpi. Other densities may be used in the range of 40 to 210 bits per inch. Data is encoded on track 2. Track 3 is available for additional data encoding. Data is encoded one on the track, with no redundant data written. Approximately 30 data field are stored on the ticket (+/- 10%).

Fare processing rules will be provided by CTDOT to the successful proposer.

**REQUEST FOR PROPOSALS (RFP)  
INSTRUCTIONS TO PROPOSERS**

**NEW FARE TECHNOLOGY SYSTEM  
FOR  
CTFASTRAK AND ALL CTTRANSIT FIXED ROUTE VEHICLES**

**I. INTRODUCTION:**

The State of Connecticut, Department of Transportation (CTDOT) wishes to procure from a New Fare Technology System (NFTS) manufacturer or supplier, who may be selected from among Proposers who respond to this Request for Proposals (RFP), a NFTS for *CTfastrak* and all CTTransit fixed route vehicles. *CTfastrak* is a bus rapid transit system that CTDOT is constructing and plans to operate in central Connecticut. CTTransit is the CTDOT-owned bus service. The deployment of the NFTS will transform CTDOT's existing fare collection system from magnetic stripe technology to contactless smart cards, mobile ticketing / secure barcode media, and mobile media. The Scope of Work and other Contract Documents that are an integral part of this RFP provide a description of *CTfastrak* as well as detailed requirements for the NFTS.

The agreement (Agreement) that may result from this procurement will be for a period which comprises design, manufacturing and installation, warranty, and operations, and will commence on the Notice to Proceed date and extend through the specified Agreement duration that will include services and warranties, plus any options selected and exercised by the State that are defined elsewhere in the Contract Documents.

This RFP will be for all materials and all services described in the Scope of Work attached to the Agreement as Schedule A (Scope of Work), elsewhere in the RFP, and the Agreement. Definitions of undefined, capitalized terms included in this RFP are found in the "Definitions" section of the Agreement.

The basis for awarding the Agreement is outlined in Section VI of this RFP.

**II. SCOPE OF WORK OVERVIEW:**

This RFP anticipates the award of an Agreement for the work, materials, and services described in the Scope of Work and the other Contract Documents. The successful Contractor will provide the following, which are specified in detail in the Scope of Work:

1. CTDOT-issued Long-Term Use Smart Cards
2. CTDOT-issued Limited Use Smart Cards
3. Barcode media for transfers, short-term fare products, and Proof of Payment receipts.
4. Mobile Ticketing
5. New Validating Fareboxes
6. Stand Alone Processors
7. Non-registering Fareboxes
8. Cashbox vaulting and cash processing equipment
9. A Central Data System
10. Garage Communications Servers
11. Platform Validators
12. Multi-Function Vending Machines
13. Contracted Retail Point of Sale
14. Three configurations of Administrative Point of Sale
15. Handheld Fare Inspection
16. Networking infrastructure at CTDOT and third party garage
17. A series of Contractor-hosted web portals
18. Other services and support systems described herein
19. Any options exercised by the State

Proposals should reflect and incorporate all requirements specified in the Agreement. Pricing should be provided in accordance with the Price Proposal and its attachments. The Proposer's Technical Proposal should reflect the requirements stated in this RFP and the Contract Documents.

### III. SUBMISSION REQUIREMENTS:

Proposers should provide the following information in a Technical Proposal that should not exceed fifty (50) pages in length, prepared in the order (1 – 9) listed below, type written in 11 point minimum font:

1. Cover Letter (1 page)
2. Identification of the firm. The Contractor will be required to be registered to do business in the State of Connecticut as of the date of Notice to Proceed. The Proposer submitting the Proposal should list all principals and their percentage of ownership. If a corporation, limited partnership, or limited liability company, the Proposer should submit a current corporate, partnership, or company record print-out from Secretary of State's Office (not counted in page count).
3. Table of organization for the Proposer and the project team (including subcontractors)
4. Description of the project team, including a brief profile of the persons responsible for performing the work under the Agreement:
  - a. Organization chart, highlighting:
    - i. Design, manufacturing, installation, testing, and warranty phase
    - ii. Optional services for operations (after completion of acceptance testing and base contract warranty periods)
  - b. Resumes for key personnel (maximum of two (2) pages per person and not included in the fifty (50) page limit)
5. Experience providing and implementing similar systems in the United States in the last five years, highlighting equipment and system reliability, including performance under the environmental and operating conditions identified in the Scope of Work. In addition, team members involved on sample projects shall be cross-referenced. Experience working with proposed subcontractors on past projects should also be highlighted.
6. Client contact information and brief Project descriptions for three but no more than five similar Projects completed by the Proposer within the last 5 years, limited 1 page each, not included in the page count.
7. Technical response to the requirements for the NFTS – The Proposer will be evaluated on the extent of compliance with the Scope of Work, approach to the work, understanding of the CTDOT's NFTS needs, ability to meet project milestone schedules, compatibility with other CTDOT/CTTransit systems, other requirements specified in the Contract Documents, and elements of the Proposal that exceed the specified requirements or provide desired equipment / system enhancements that are identified in the Scope of Work. The Proposer shall also include in this section a table/matrix containing a summary of the technical response as follows:  
Specification Section, Description, Compliance (Y or N), Added Value
8. Statement of acceptance of the terms and conditions of the Contract Documents and the Agreement.
9. The following forms shall be completed, properly signed, and returned as part of the Technical Proposal, but will not be included in the page count:
  - a. Non-collusion Affidavit
  - b. OPM Ethics Form 5
  - c. OPM Ethics Form 6

Catalog cuts, product specifications and details may be provided as attachments to the Proposal and will not be included in the page count.

In addition to the Technical Proposal described above, the Proposer will provide the Price Proposal in a separate, sealed envelope labeled, "PRICE PROPOSAL."

OPTIONAL ALTERNATIVE PROPOSAL for NFTS SCHEDULE ENHANCEMENTS – may be provided in addition to the Technical and Price Proposals addressed above. This alternative proposal is not a requirement, but may provide important advantages to CTDOT. These advantages could be reflected in the scoring discussed in Section VI, Technical Evaluation of this RFP.

The Proposer is invited, but not required, to offer a proposal to deliver the entire NFTS scope through Milestone 4 at an earlier date than that specified in Table 1-1 of the Agreement. Ideally, this earlier date would be January 15, 2015, the beginning of the final start-up sequence leading to revenue service for

CTfastrak. However, other early start dates for specific elements of the NFTS scope (for example, the mobile ticketing application addressed in the Scope of Work, section 26) may provide advantages for CTDOT. The Proposer's Optional Alternative Proposal must be presented in two parts, as follows:

- Alternative Technical Proposal for NFTS Schedule Enhancements (fifteen pages in addition to the page limit specified above for the Technical Proposal) should incorporate, by reference, the full technical Scope of Work required by the Contract Documents and discussed in the Proposer's Technical Proposal. The Alternative Technical Proposal should present (1) the specific schedule enhancements proposed, (2) a detailed critical path method (CPM) schedule and management plan that clearly describes how the schedule enhancements will be implemented, (3) the process by which the Proposer will assure CTDOT that the schedule enhancements are feasible, and (4) a clear demonstration that CTDOT can expect the Proposer to achieve the proposed improvements if awarded the Contract. As a demonstration of the Proposer's confidence in the enhanced schedule, CTDOT will have the right to adjust liquidated damages for Milestones 1, 2, 3, and 4 from Table 1-1 to the dates proposed in the alternative technical proposal. ~~The state~~CTDOT will review the Proposer's Alternative Technical Proposal for NFTS Schedule Enhancements as part of the Technical Proposal Review process cited in Section VI, Selection Criteria, Technical Evaluation in this RFP. If CTDOT sees advantages as a result of its review of the Proposer's Alternative Technical Proposal for NFTS Schedule Enhancements, these advantages may be reflected in the Proposer's Technical Score.
- Alternative Price Proposal – the Proposer will prepare a complete alternative price proposal for the entire scope of work that reflects the Proposer's Alternative Technical Proposal for NFTS Schedule Enhancements commitments to CTDOT. This Alternative Price Proposal will be opened only if CTDOT sees advantages in the Proposer's Alternative Technical Proposal for NFTS Schedule Enhancements. The Proposer's Alternative Technical Score and Alternative Price Proposal Score will then be entered into the evaluation of all proposals, both base and alternative. If CTDOT chooses the Proposer as the successful proposer on the basis of the Proposer's Alternative Technical Proposal for NFTS Schedule Enhancements, the Alternative Price Proposal will replace the Price Proposal as the basis for the Contractor's compensation under the Contract.

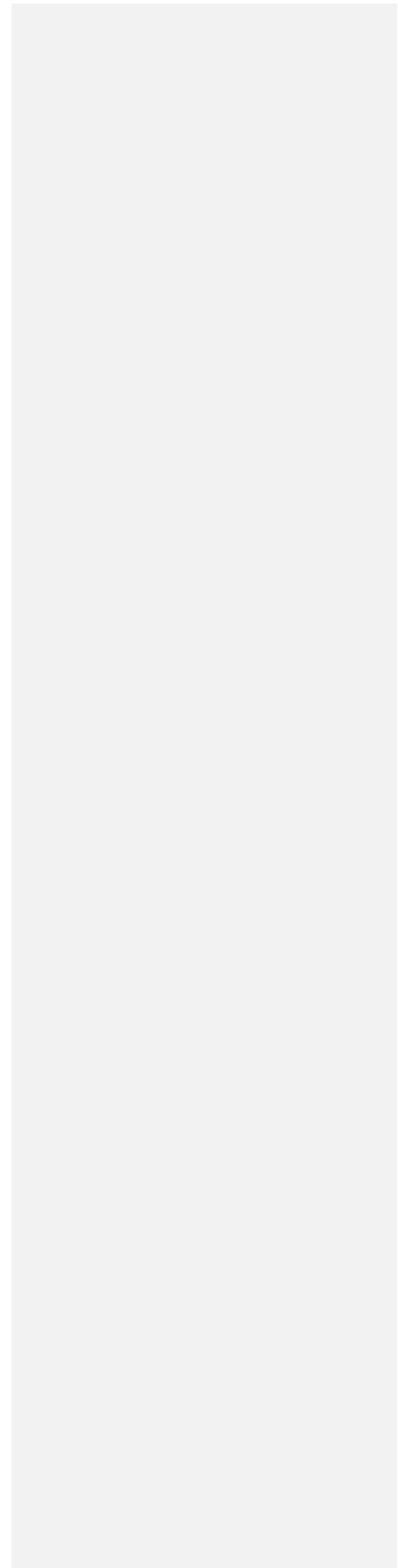
The Proposer will provide the Alternative Technical Proposal for Schedule Enhancements and the Alternative Price Proposal in separate sealed and appropriately labeled envelopes within the envelope that contains the Technical Proposal and Price Proposal.

#### IV. GENERAL INSTRUCTIONS TO PROPOSERS

1. Questions regarding the RFP shall be provided in writing or via e-mail, and submitted to: Mr. Philip Scarrozzo, 2800 Berlin Turnpike, Newington, CT 06131-7546 or [Philip.Scarrozzo@ct.gov](mailto:Philip.Scarrozzo@ct.gov)
2. Delivery of responses- RFP responses shall be in sealed envelopes upon which a clear indication has been made of the RFP reference title, as well as the date and time the bid is due. The name and address of the firm shall appear on the envelope. The Price Proposal will be provided in a separate, sealed envelope.
3. Signature and responsible persons - The Proposal shall be signed by an authorized official. The Proposal shall also provide name, title, address, and telephone number for individuals with authority to negotiate and contractually bind the Proposer, and for those who may be contacted for the purpose of clarifying the information provided.
4. Proposals shall be received by **March 14~~21~~, 2014 no later than 3:00 p.m.**, at the Connecticut Department of Transportation, 2800 Berlin Turnpike, Newington, CT 06131-7546. No proposals will be accepted after this time.
5. Please submit eight (8) copies of your proposal and one electronic (.pdf) version.

NOTE: THE DEPARTMENT OF TRANSPORTATION WILL REJECT PROPOSALS WHICH ARE SUBSTANTIALLY INCOMPLETE AND WILL NOT ALLOW THE SUBMISSION OF ANY ADDITIONAL WRITTEN INFORMATION AFTER THE RFP DEADLINE.

THE DEPARTMENT OF TRANSPORTATION RESERVES THE RIGHT TO REJECT ANY OR ALL PROPOSALS.



PRE-BID CONFERENCE IS SCHEDULED FOR, FEBRUARY 25, 2014.

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Conference to begin at 8:00 a.m. at the Connecticut Department of Transportation, 2800 Berlin Turnpike, Newington, CT.

No questions will be answered at the pre-bid conference. Questions must be submitted in writing. All questions must be submitted no later than the close of business on ~~February 27~~ March 7, 2014. Site specific questions related to equipment installation at the garages will be accepted until March 12, 2014. Except as may be determined by the State, no questions will be considered or addressed after this time. Questions will be responded to in writing with a copy provided to each prospective proposer by close of business on ~~March 31~~ March 14, 2014.

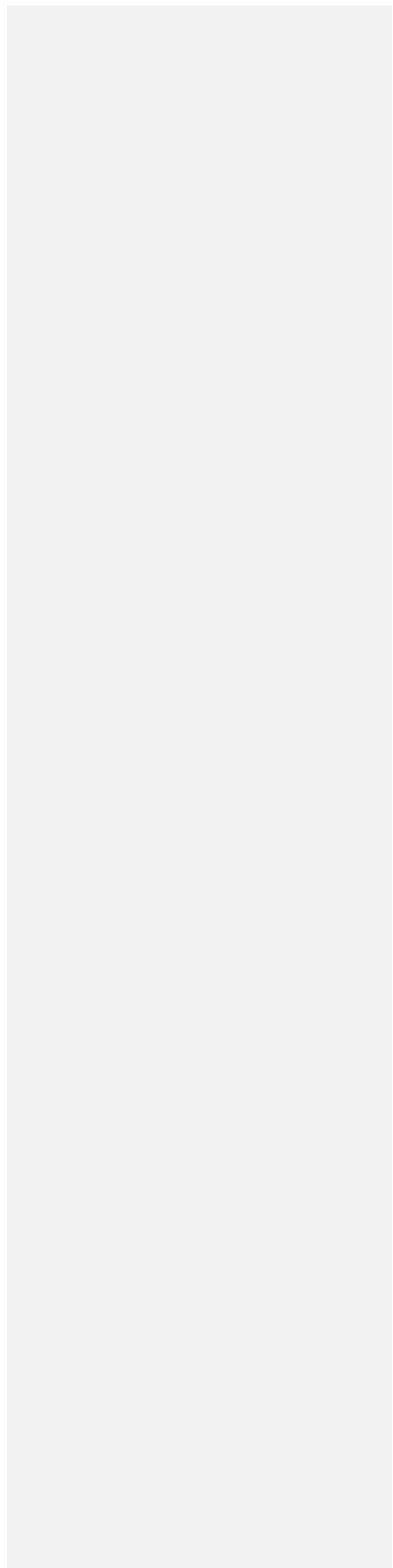
All prospective Proposers are strongly encouraged to attend the pre-bid conference. Proposers are requested to pre-register via email to [Philip.Scarozzo@ct.gov](mailto:Philip.Scarozzo@ct.gov) by noon on February 21, 2014. Pre-registration will ensure that proper notifications can be made should the conference date change due to inclement weather.

#### V. CONDITIONS OF PROPOSALS:

1. All Proposers shall adhere to the following conditions as stated below:
  - a. Acceptance or rejection by the State - The State reserves the right to accept or reject any or all Proposals submitted.
  - b. Conformance with statutes - Any Agreement entered as a result of this RFP shall be in full conformance with statutory requirements of the State of Connecticut and the Federal Government.
  - c. Ownership of Proposals- All Proposals in response to this RFP are ~~to be~~ the sole property of the State, and subject to the provisions of Section 1-210 of the Connecticut General Statutes (Re: Freedom of Information).
  - d. Oral agreements- Any alleged oral agreements or arrangements made by a Proposer with any agency or employee will be superseded by the ~~written agreement~~ Agreement.
  - e. Amending or canceling requests -The State reserves the right to amend or cancel this RFP prior to the due date and time or after, if it is in the best interests of the agency and the State.
  - f. Rejection for default or misrepresentation - The State reserves the right to reject the Proposal of any Proposer which is in default of any prior contract or for misrepresentation.
  - g. State's clerical errors in awards- The State reserves the right to correct inaccurate awards resulting from its clerical errors.
  - h. Rejection of qualified proposals - Proposals are subject to rejection in whole or in part if they limit or modify any of the terms and/or specifications of the RFP.
  - i. Changes to proposal- No additions or changes to the original Proposal will be allowed after submittal. While changes are not permitted, clarification at the request of the State may be required at the Proposer's expense.
  - j. Collusion - By responding, the Proposer implicitly states that its Proposal is not made in connection with any competing Proposer submitting a separate response to the RFP, and is in all respects fair and without collusion or fraud. It is further implied that the Proposer did not participate in the RFP development process, had no knowledge of the specific contents of the RFP prior to its issuance, and that no employee of the agency participated directly or indirectly in the Proposer's Proposal preparation.
  - k. Please be advised that when the Agreement is awarded, a minimum of ~~1.55%~~ (one and one-half five percent) of this contract award must be set-aside for certified CTDOT Disadvantaged Business Enterprises (DBE's) in accordance with the Agreement Appendix A, Section 18.
  - l. The Contractor warrants that it shall not sublet, subcontract, sell, transfer, assign, or otherwise dispose of the ~~contract~~ Agreement or any portion thereof, or of the work provided pursuant thereto, or his right, title, or interest therein, to any person, firm, partnership, or corporation without the written consent of the State. For breach or violation

of the above stipulation the State shall have the right to annul the Agreement without liability.

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~~2.~~ Rights reserved to the State:

- ~~a.m.~~ The State reserves the right to award in part, to reject any and all Proposals in whole or in part, and waive technical defects, irregularities, and omissions if, in its judgment, the best interest of the State be served.
- ~~b.n.~~ The State reserves the right to terminate any future agreement arising from this RFP.
- ~~e.o.~~ The State reserves the right to schedule interviews with any or all prospective Proposers after review of Proposals.
- ~~e.p.~~ The State reserves the right to:
  - i. award the Agreement to the Proposer with the highest Total Score identified in the “Selection Criteria” section,
  - ii. negotiate a final Agreement with that highest scoring Proposer if, in the State’s sole discretion, negotiations are necessary,
  - iii. enter negotiations with the second highest scoring Proposer if the State cannot reach agreement with that highest scoring Proposer, or
  - iv. repeat this process, if necessary, with other Proposers.

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**VI. SELECTION CRITERIA:**

The evaluation of NFTS Proposals received will use the following general criteria and relative weights:

- Technical Proposal 70%
- Price Proposal 30%

Technical Evaluation

The main criteria for evaluation of the Technical Proposals are identified below. The maximum number of points that will be awarded for each criterion is shown. These are based on verification of experience and the requirements as stated in the RFP for each criterion below:

	<i>Criterion</i>	<i>Maximum Points per Criterion (“Technical Score”)</i>
A.	Technical Response: Proposed System - Extent of Compliance with Technical Specification Requirements, Approach to the work, Understanding of the NFTS Needs, Compatibility with Other CTDOT/CTTransit Systems and Ability to Meet Project Milestones:  Considerations: <ul style="list-style-type: none"> <li>• <u>Central Data System (CDS)</u> Hardware and Software;</li> <li>• Interfaces With Existing Systems;</li> <li>• Understanding of CTDOT Needs;</li> <li>• Implementation on a Phased Schedule;</li> <li>• <u>Garage Communication Servers (GCS)</u> Networking, Hardware and Software;</li> <li>• Validating Fareboxes;</li> <li>• Non-validating Fareboxes;</li> <li>• Revenue Collection Process;</li> <li>• <u>Stand Alone Processores (SAP’s)</u>;</li> <li>• <u>Platform Validators (PV’s)</u>;</li> <li>• Administrative <u>Point of Sale (POS)</u>;</li> <li>• <u>Handheld Fare Inspection Terminal (HFIT’s)</u>;</li> <li>• <u>Multi-Function Vending Machine (MVM)</u> Equipment, Hardware and Software;</li> </ul>	40

	<ul style="list-style-type: none"> <li>• Mobile Ticketing Process; and;</li> <li>• Support Services.</li> </ul> <p>Scoring: Compliance with the Scope of Work = 20 (twenty) points. Less than full compliance with Scope of Work will cause a reduction in points that are awarded by the State's evaluators. <del>Up to 10 (ten) discretionary points may be awarded by the State's evaluators.</del> Up to 10 (ten) additional points may be awarded by the State's evaluators for additional value elements offered to the State in the Proposer's Technical Proposal.</p>	
B.	<p>Proposer Experience: Proposer qualifications, experience and references in providing and implementing similar systems. Considerations:</p> <ul style="list-style-type: none"> <li>• Proposer shall have at least 10 years of experience in providing similar systems (components, size and nature).</li> <li>• Provide examples of at least 3 and up to 5 previous projects similar to this project that were procured in the last 3-5 years.</li> <li>• Demonstrate experience with public sector transit systems.</li> <li>• Demonstrate experience in Central Management System hosting.</li> <li>• Demonstrate experience performing on-site training programs.</li> <li>• Demonstrate experience with hardware and software support.</li> <li>• Owner/client references will be a critical element of this evaluation. Up to three owner / client references are expected, although the State considers more, well documented references to be preferable.</li> </ul> <p><del>*Bidder Proposer</del> must provide contact information for owner/ client follow-up telephone interviews with State evaluators.</p> <p>Scoring: Compliance with experience criteria, as documented by references = 10 (ten) points. Less than full compliance with Experience criteria will cause a reduction in points that are awarded by the State's evaluators. Up to 10 (ten) additional points may be awarded by the State's evaluators for additional experience / qualifications offered to the State in the Proposer's Technical Proposal.</p>	20
C.	<p>Project Management: Proposed project team qualifications, experience, and certifications for personnel and organization, based on:</p> <ul style="list-style-type: none"> <li>• Demonstrated competence of each key team member, documented by client / owner references in the function assigned in the organizational chart.</li> <li>• Cross-reference each key team member with their involvement on the example projects presented under firm's experience in Section B.</li> <li>• Provide evidence of qualifications, as applicable, for each key team member. This may include degrees, certifications, licenses, or other documents to support an individual's abilities for the role proposed.</li> <li>• Approach to project management and scheduling</li> <li>• Approach to quality assurance, including the related qualifications and experience of the individual(s) proposed for this specific role.</li> </ul> <p><del>*Bidder Proposer</del> must provide contact information for this information to allow CTDOT</p>	10

	<p>to perform follow-up telephone interviews with State evaluators.</p> <p>Possible Scoring: 0 – 2 points for each of the five considerations listed above, however, the State’s evaluators may apply different weights for any of the above factors.</p>	
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The State may identify and use more detailed evaluation criteria, which will be based on the main criteria identified above.

Price Evaluation

The Proposal with the lowest proposed price for the Base System (excluding Options) will receive the maximum of twenty-five (25) points for the price. Other higher priced Proposals will receive fewer points based on the following formula.

$$\text{Price Score} = (\text{Lowest proposed price for total cost (Base System)} / \text{proposed price for total cost (Base System)}) \times 25$$

The CTDOT selection committee can award up to five (5) additional points to the Price Score for the Base System for Option pricing for any or all options that the selection committee deems advantageous to the State.

Total Score

$$\text{Total Score} = \text{Price Score} + \text{Technical Score}$$

Award may be made to the Proposer with the highest Total Score on the basis of the above criteria and calculations and on the rights reserved to the State in the Conditions of Proposal section of this RFP.

Options will be considered for inclusion in the Agreement at the State’s sole discretion.

AGREEMENT NO. X.XX-XX(XX)  
CORE I.D.# XXXXXXXXXXXX

AGREEMENT  
BETWEEN  
THE STATE OF CONNECTICUT, DEPARTMENT OF TRANSPORTATION  
AND  
(CONTRACTOR)  
TO PROVIDE A NEW FARE TECHNOLOGY SYSTEM  
FOR  
CT**FASTRAK** and all CTTRANSIT FIXED ROUTE VEHICLES

NOTE: ~~ANY REFERENCE TO DEPARTMENT OF TRANSPORTATION IN THIS AGREEMENT SHALL BE CONSTRUED TO MEAN "STATE".~~

ANY ITEM STAMPED "DNA" OR "DOES NOT APPLY" IS HEREBY DELETED PRIOR TO THE EXECUTION OF THIS AGREEMENT WITH THE CONCURRENCE OF THE CONTRACTOR

INDEX OF SPECIFICATIONS AND STIPULATIONS

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3. CONTRACTOR RESPONSIBILITIES
4. PERSONNEL
5. COMPLIANCE WITH LAWS
6. CHANGE ORDERS
7. PAYMENT TERMS
8. INTENTIONALLY OMITTED
9. COOPERATION
10. REVIEW OF WORK
11. RESPONSIBILITY FOR ACCURACY OF WORK
12. RELATIONSHIP WITH OTHERS
13. INSURANCE FOR THE CONTRACTOR AND SUBCONTRACTOR(S)
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28. REVISIONS IN ORGANIZATION
29. BREACH

- 30. TERMINATION
- 31. CONFLICTS BETWEEN DOCUMENTS AND AGREEMENT
- 32. CONNECTICUT REQUIRED CONTRACT/AGREEMENT PROVISIONS - SPECIFIC EQUAL EMPLOYMENT OPPORTUNITY RESPONSIBILITIES
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- 34. PROMPT PAYMENT TO SUBCONTRACTOR(S) AND RELEASE OF RETAINAGE
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- 36. ETHICS SUMMARY
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APPENDIX A

ATTACHMENTS

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- SCHEDULE C - REQUEST FOR PROPOSALS and INSTRUCTIONS TO PROPOSERS
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- SCHEDULE E - INFORMATION TO CONTRACTORS
- SCHEDULE F - NFIS EQUIPMENT TABLE
- SCHEDULE G - CONTRACT C7, ITS SCOPE OF WORK
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~~— OPM ETHICS FORM 3~~

~~CONSULTING AGREEMENT AFFIDAVIT — OPM ETHICS FORM 5~~

~~AFFIRMATION OF RECEIPT OF STATE ETHICS LAWS SUMMARY — OPM ETHICS FORM 6~~

~~OPM IRAN CERTIFICATION — FORM 7~~

~~GUIDE TO THE CODE OF ETHICS FOR CURRENT OR POTENTIAL STATE CONTRACTORS~~

~~NONCOLLUSION AFFIDAVIT~~

A G R E E M E N T

THIS AGREEMENT has been concluded at Newington, Connecticut, by and between the State of Connecticut, Department of Transportation, James Redeker, Commissioner, duly authorized, hereinafter referred to as "CTDOT", and \_\_\_\_\_, a \_\_\_\_\_ authorized to do business in the State of Connecticut, having a principal place of business located at \_\_\_\_\_, acting herein by \_\_\_\_\_ (NAME) \_\_\_\_\_ (TITLE) \_\_\_\_\_, hereunto duly authorized, hereinafter referred to as the "Contractor."

WITNESSETH, THAT,

WHEREAS, the State wishes to procure from ~~the Contractor~~ a ~~New Fare Technology System (NFTS) contractor, manufacturer or supplier~~ a NFTS for the Connecticut Department of Transportation, CT**fastrak**, and all CTTransit fixed-route vehicles. ~~The deployment of NFTS will transform CTDOT's existing fare collection system from magnetic stripe technology to contactless smart cards and mobile ticketing / secure barcode media.~~ This procurement includes design, manufacture, fabrication, furnishing, assembly, testing, installation, maintenance, warranty and operation of the NFTS (herein after referred to as the "Project"), as required in the Scope of Work, a copy of which is attached hereto and made a part hereof as Schedule A, the RFP, and this Agreement and its attachments, and

WHEREAS, as part of its statewide bus system, CTDOT has the right to assign this Agreement to an operator or management company that will operate CT**fastrak** as a part of that statewide system, and

WHEREAS, ~~the State~~CTDOT, pursuant to Sections 4-8, 13b-4. 13b-34(a) and 13b-36 of the General Statutes of Connecticut, as revised, is authorized to enter this Agreement and James Redeker, Commissioner of the Department of Transportation, has made the Express Finding as required by Section 13b-35 of the General Statutes of Connecticut, as revised.

Now therefore, in consideration of these presents, and for other good and valuable consideration, the receipt and sufficiency of which the parties acknowledge, the Contractor and CTDOT agree as follows:

DEFINITIONS

The following definitions shall apply to this Agreement:

- "Access Constraint" means availability of work locations, materials, or services provided by others.
- "Base System" means the NFTS as specified in the Scope of Work, and detailed in the Price Proposal Forms A through I, a copy of which is attached hereto and made a part hereof as Schedule B-
- "Central Data System" ("CDS") means the system specified in the Scope of Work Section 21.
- "Change Order" is defined in Article 6.
- "Claims" means all actions, suits, claims, demands, investigations and proceedings of any kind, open, pending or threatened, whether mature, immature, contingent, known or unknown, at law or in equity in any forum.
- "Confidential Information" shall mean any name, number or other information that may be used, alone or in conjunction with any other information, to identify a specific individual including, but not limited to, such individual's name, date of birth, mother's maiden name, motor vehicle

operator's license number, Social Security number, employee identification number, employer or taxpayer identification number, alien registration number, government passport number, health insurance identification number, demand deposit account number, savings account number, credit card number, debit card number or unique biometric data such as fingerprint, voice print, retina or iris image, or other unique physical representation. Without limiting the foregoing, Confidential Information shall also include any information that CTDOT classifies as "confidential" or "restricted." Confidential Information shall not include information that may be lawfully obtained from publicly available sources or from federal, state, or local government records which are lawfully made available to the general public.

- "Confidential Information Breach" shall mean, generally, an instance where an unauthorized person or entity accesses Confidential Information in any manner, including but not limited to the following occurrences: (1) any Confidential Information that is not encrypted or protected is misplaced, lost, stolen or in any way compromised; (2) one or more third parties have had access to or taken control or possession of any Confidential Information that is not encrypted or protected without prior written authorization from the State; (3) the unauthorized acquisition of encrypted or protected Confidential Information together with the confidential process or key that is capable of compromising the integrity of the Confidential Information; or (4) if there is a substantial risk of identity theft or fraud to the client, the Contractor, the Department or State.
- "Contract Documents" means ~~the executed documents comprising the NFTS contract between the State and the Contractor, including this Agreement, the Scope of Work, Price Proposal, and all other documents referenced in the Table of Contents for~~ appendices, schedules, or exhibits to this Agreement.
- "Contract Drawings" means the drawings provided as part of the Contract Documents.
- "Contractor Parties", or "Contractor Party" means a Contractor's members, directors, officers, shareholders, partners, managers, principal officers, representatives, agents, servants, consultants, employees, subcontractors, vendors, and subcontractors or any one of them or any other person or entity with whom the Contractor is in privity of oral or written contract and the Contractor intends for such other person or entity to perform under the Agreement in any capacity.
- "CTfastrak" means the bus rapid transit system operating in central Connecticut which will include the NFTS.
- "CTTransit" means the CTDOT bus service.
- "Engineer" as it is used in Form 816 shall be construed to mean "CTDOT".
- "Extra Work" means work, services, materials requested by the State from the Contractor that are not included in the Agreement.
- "Federal Transit Administration" or "FTA" means the division of the United States Department of Transportation (USDOT) that is funding a portion of CTfastrak via a Full Funding Grant Agreement (FFGA). The FTA, via the FFGA, imposes requirements on CTfastrak that are reflected in these Contract Document requirements.
- "Final Acceptance" means CTDOT's determination that the work under the Agreement is complete.
- "Form 816" means the CTDOT's Standard Specification for Roads, Bridges and Incidental Construction, available at [http://www.ct.gov/dot/lib/dot/documents/dpublications/816/newver/\\_July13\\_Form\\_816.pdf](http://www.ct.gov/dot/lib/dot/documents/dpublications/816/newver/_July13_Form_816.pdf), and is included in this Agreement in part, via specific references and inclusions.
- "Full Funding Grant Agreement" or "FFGA" means the contract between CTDOT and FTA to participate in the funding of the CTfastrak Project.
- "Liquidated Damages" means a dollar amount associated with Milestone schedule dates determined by CTDOT to be representative of the losses the

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State will incur as a result of the Contractor's failure to complete a portion or all of the work specified in the Agreement within the time specified in the Agreement. Liquidated Damages are not construed as a penalty.

- "Lump Sum" is the contract value less the per month costs for monthly-invoiced services.
- "Milestone" means a required completion date for a portion or all of the Contractor's work as defined by the Agreement.
- "NFTS" means the New Fare Technology System that is to be procured in accordance with this Agreement.
- "Notice to Proceed" or "NTP" means the State's written direction to the Contractor to start work on the Project pursuant to the terms and conditions of the Agreement.
- "Options" means Scope of Work elements that are not included in the Contractor's Base System; such Options are detailed in Price Proposal Forms O1 and O2, a copy of which is attached hereto and made a part hereof as Schedule B-
- "PMO" means project management oversight, including a function performed by the FTA to assure conformance with the FTA's FFGA for the Project.
- "Price Proposal" means the portion of the Contractor's Proposal that specifies the price for the Base System and Options, a copy of which is attached hereto and made a part hereof as Schedule B-
- "Project" means the design, manufacture, fabrication, furnishing, assembly, testing, installation, maintenance, warranty, and operation of the NFTS.
- "Proposal" means the documents and materials provided by the Contractor in response to the State's Request for Proposals for this Agreement. The Contractor's Proposal will include, but not be limited to the Technical Proposal and Price Proposal specified in and required by the RFP. The State, in its sole discretion, may include the Contractor's Proposal in the Contract Documents.
- "Proposer" or "Proposers" means the Contractor providing a Proposal in response to the State's Request for Proposals for this Agreement.
- "RFP" means the State's Request for proposals for this Project.
- "RST" or "Revenue Service Testing" means the Post Installation Test which is -to occur during the initial full-public use of the NFTS, intended to verify NFTS reliability, availability, and accuracy.
- "Records" means all working papers and such other information and materials as may have been accumulated by the Contractor in performing the Agreement, including but not limited to, documents, data, plans, books, computations, drawings, specifications, notes, reports, records, estimates, summaries, memoranda and correspondence, kept or stored in any form.
- "Scope of Work" means the document, so named in the Table of Contents, attached hereto as Schedule A, that establishes specific requirements for this Agreement.
- "Shop Drawings" means the drawings or sketches prepared by the Contractor for use in its manufacturing facility, assembly facility, or shop, to fabricate, assemble, and/or install parts of the NFTS, whether manufactured by it from raw materials or purchased from others in a ready-to-use condition.
- "SSMP" means the Safety and Security Management Plan, a document, so named in the Table of Contents, and included in this Agreement.
- "State" means the State of Connecticut, including the Department of Transportation ("Department" or "CTDOT"), and any office, department, board, council, commission, institution or other agency or entity of the State.
- "Technical Proposal" means the portion of the Proposal submitted in response to the RFP that provides technical information on the proposed equipment and services.
- "TVMS" means the Ticket Vending Machine System provided by Others-that will

be deployed on the new bus rapid transit corridor known as **CTfastrak** and at various satellite locations.

Additionally, any undefined, capitalized terms used in this Agreement shall have the meanings that are ascribed to them in the Scope of Work.

ARTICLE 1. FEDERAL AND STATE CODES, STANDARDS AND GUIDELINES

All work required under the terms of this Agreement shall be performed in accordance with all applicable Federal and State codes, standards and guidelines including, but not limited to:

- A. Federal Requirements: The Contractor agrees to comply with all applicable Federal Transit Administration Requirements, referred to in Appendix "A", attached hereto and hereby made a part of this Agreement.
- B. Codes, standards and guidelines as specifically listed in the Scope of Work, Paragraph 1.11.
- C. Department of Transportation P5800.5, 1990 Emergency Response Guidebook.
- D. Federal Register - Volume 56 No. 173/Friday, September 6, 1991, Appendix A to part 37 - "Standards for Accessible Transportation Facilities", ADA Accessibility Guidelines for Buildings and Facilities" or latest revised edition.

In case of conflict between the State and Federal codes, standards and guidelines listed above, the more stringent guidelines will prevail as the minimum.

ARTICLE 2. CONTRACT TIME AND LIQUIDATED DAMAGES

To meet the Milestones stipulated in Table 1-1 below, the Contractor shall work extended shifts and use premium time simultaneously at multiple project locations and multiple station locations in order to complete the Project by the completion date specified in this Agreement. The Contractor shall employ and maintain the necessary labor force and equipment to meet the deadlines set forth in this Agreement.

The Contractor may be required to perform temperature sensitive work during the winter months. Contractor shall protect this work from the cold and adverse conditions that the winter months may bring. There will be no additional compensation paid to the Contractor for this work but it shall be included in the general cost of the work.

The Contractor shall be aware of other ongoing construction projects which may impact the prosecution of the field installations on the **CTfastrak** corridor. The Contractor shall be required to coordinate the work of this contract with the following projects:

- a. Contract 1 - State Project 88-177 - CTfastrak Main Street to Stanley Street in New Britain
- b. Contract 2 - State Project 88-178 - CTfastrak Stanley Street in New Britain to Cedar Street in Newington
- c. Contract 3 - State Project 93-180 - CTfastrak Cedar Street in Newington to Sigourney Street in Hartford
- d. Contract 4 - State Project 63-670 - CTfastrak Sigourney Street in Hartford to Asylum Street in Hartford
- e. Contract 7 - State Project 88-179 - ITS System Integration
- f. Contract 13 - State Project TBD - Ticket Vending Machine System

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Failure of the Contractor to complete its work within the timeframes specified in the below Table 1-1 will result in the assessment against the Contractor of Liquidated Damages as described below. The Contractor shall comply with the following Milestones and access constraints:

**TABLE 1-1, PROJECT MILESTONES**

#	Description	Date
	Notice to Proceed (estimated)	May 2, 2014
Milestone No. 1	Phase 1: New farebox system and proof of payment system, all inspection and testing complete, excluding the Revenue Service Testing (RST)	January 15, 2015
Milestone No.2	Phase 2: Smart card deployment, all inspection and testing complete, excluding the RST	September 6, 2015
Milestone No. 3	Phase 3: Elimination of magnetic media, all inspection and testing complete, excluding the RST	March 6, 2016
Milestone No. 4	Completion of RST and <del>system acceptance</del> , <u>Final Acceptance</u> , commence warranty	May 26, 2016
	Completion of hardware warranty	2 Years after Final NFTS Acceptance
	Completion of software warranty	2 Years after Final NFTS Acceptance
	Completion of CDS services	60 months after start of revenue service
	Optional services	To be determined by CTDOT pursuant to the Scope of Work

**Milestone No. 1 - January 15, 2015**

Contractor shall complete all Phase 1 installation and testing per the Scope of Work, excluding Section 31.3 Revenue Service Testing (RST) and have ready for service the new farebox system and proof of payment system.

**Liquidated Damages for Late Completion of Milestone No. 1:** \$8,500 per day for each day following January 15, 2015 with no maximum payment.

**Milestone No. 2 - September 6, 2015**

Contractor shall complete all Phase 2 installation and testing per the Scope of Work, excluding Section 31.3 Revenue Service Testing (RST) and

have ready for service the new smart card system.

**Liquidated Damages for Late Completion of Milestone No. 2:** \$5,000 per day for each day following September 6, 2015 with no maximum payment.

**Milestone No. 3 - March 6, 2016**

Contractor shall complete Phase 3, elimination of magnetic media, the installation, inspection and testing complete per the Scope of Work, excluding Section 31.3 the Revenue Service Testing (RST).

**Liquidated Damages for Late Completion of Milestone No. 3:** \$2,000 per day for each day following March 6, 2016 with no maximum payment.

**Milestone No. 4 - May 26, 2016**

Contractor shall complete Phase 4, completion of RST and ~~system acceptance, Final Acceptance and commencement of the~~ warranty, including all work required on this Agreement for Final Acceptance. This work includes completion of all installation, testing and reporting as required in the Scope of Work. CTDOT's granting of Final NFTS Acceptance shall be subject to the terms defined in the Scope of Work, and shall be predicated on successful completion of all prerequisite dependent Milestones and activities as described throughout the Scope of Work.

**Liquidated Damages for Late Completion of Milestone No. 4:** \$1,000 per day for each day following May 26, 2016, with no maximum payment.

**Access Constraint 1 - Availability of buses for the On-Board Equipment Installation - beginning October 1, 2014 and continuing through January 15, 2015. Coordination of access with other Contractors and CTDOT/Operators is essential. Indoor (within bus garage facility) installation work shall be accomplished during Garage Availability Periods.**

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**Access Constraint 2 -Availability of Hartford Garage for Garage Equipment Installation and indoor bus work - October 17, 2014 through November 7, 2014.**

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**Access Constraint 3 -Availability of New Haven Garage for Garage Equipment Installation and indoor bus work - November 28, 2014 through December 12, 2015.**

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**Access Constraint 4 -Availability of both the Stamford Garage and the Waterbury (NE Transportation) Garage for Garage Equipment Installation and indoor bus work - December 12, 2014 through December 28, 2014.**

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**Access Constraint 5 -Availability of both the DATTCO Garage and New Britain Garage for Garage Equipment Installation and indoor bus work - December 28, 2014 through January 9, 2015.**

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**Liquidated Damages Terms and Conditions**

These Liquidated Damages provisions shall apply to all circumstances in which CTDOT does not verify in writing that the pertinent Agreement work has been completed by the Milestone completion dates and maximum work durations listed above. If the Contractor does not complete the pertinent work on or before the applicable dates, CTDOT will deduct from monies otherwise owed to the Contractor the pertinent Liquidated Damages daily amount listed above for each calendar day that it takes the Contractor to complete said work beyond the Milestone date.

ARTICLE 3. CONTRACTOR RESPONSIBILITIES

Contractor shall perform the services and obligations required by this Agreement,

including the Scope of Work and all other Schedules attached to and made a part of this Agreement.

The Contractor shall design, manufacture, install, maintain, warrant, and manage operations of the NFTS for CTDOT and CTTransit in an efficient and satisfactory manner in accordance with relevant State of Connecticut standards, as may be amended, the provisions of this Agreement, and all applicable laws, rules and regulations. The Contractor shall pay for all permits, licenses and fees to the city or town in which the work is to be performed.

#### ARTICLE 4. PERSONNEL

The Contractor shall be responsible for the performance of all of the work performed under this Agreement and shall utilize to the fullest extent the specialized expertise and experience of the personnel listed in the Proposal.

CTDOT, at its discretion, shall have the right to demand the removal of any Contractor/subcontractor personnel by written notice. All personnel removed shall be suitably replaced in a timely fashion. The replacement personnel submitted for CTDOT approval must possess expertise and experience that, in the opinion of CTDOT, are equivalent to that which were being provided by the removed person. CTDOT must approve all replacement personnel prior to their beginning work. The Contractor however, shall replace neither the personnel listed in the Proposal, nor their replacements, without the prior written approval of CTDOT, which CTDOT agrees will not be unduly withheld.

If the Contractor, through circumstances beyond its control, is unable to provide the services of the personnel listed in the Proposal, the Contractor shall be responsible for providing suitable other personnel for the performance of the particular items of work involved. The personnel submitted to CTDOT for approval must possess expertise and experience, which, in the opinion of the CTDOT, are equivalent to what would have been provided by the originally listed person in the Proposal (or any replacements previously approved by CTDOT).

The Contractor shall be responsible for any additional costs caused by the substitution of personnel. In no event shall any substitution of personnel result in an increase in compensation to be paid by the State or a modification to the project schedule.

#### ARTICLE 5. COMPLIANCE WITH LAWS

Contractor shall be and remain in full compliance with Federal, State and municipal laws, ordinances, rules, regulations and orders relative to the use, operation, and maintenance of the NFTS. The Contractor shall promptly notify the State of any violation of any such law, ordinance, rule, regulation or order which comes to the Contractor's attention, and take action to promptly remedy such violation.

#### ARTICLE 6. CHANGE ORDERS

- A. CTDOT may, at any time, with written notice to the Contractor, request changes to the Agreement (any such request, a "Change Order"). Such changes shall not be unreasonably denied or delayed by the Contractor. Such changes may include, but are not be limited to, modifications or other changes required by new or amended State and/or Federal laws and regulations relating to functional requirements and processing procedures, or involving the correction of deficiencies. Prior to expiration of any warranty period, any changes required because the NFTS does not fully perform in accordance with this Agreement shall be made by the Contractor without charge to the State. Any investigation necessary to determine the source of the problem requiring the change shall be done by the Contractor at its sole cost and expense.

- B. A Change Order may be issued only by CTDOT and must be in writing. As soon as possible after the Contractor receives a written Change Order, but in no event later than fifteen (15) calendar days thereafter, the Contractor shall provide CTDOT with a written statement confirming the change has no price impact on the Agreement or, if there is a price impact, the Contractor shall provide CTDOT a written statement explaining the price increase or decrease involved in implementing the requested change.
- C. No Change Order with a price impact will be effective until the Contractor receives written confirmation from CTDOT.
- D. The following sections of Form 816 apply to all : Change Orders:- NFTS

Article 1.04.02-Increased or Decreased Quantities of Minor Items, and Elimination of Minor Items  
 Article 1.04.03-Changes in Quantities and Significant Changes in the Character of Work  
 Article 1.04.04-Differing Site Conditions  
 Article 1.04.05-Extra Work  
 Article 1.08.08-Extension of Time  
 Article 1.09.03-Increased or Decreased Quantities  
 Article 1.09.04-Extra and Cost-Plus Work  
 Article 1.09.05-Eliminated Items

ARTICLE 7. PAYMENT TERMS

CTDOT will make all payments to the Contractor upon presentation of an invoice acceptable to CTDOT based on the payment schedule items listed in Table 2-1 - Schedule of Payments. All payments will be made in United States Dollars, with no adjustments for fluctuation of valuation of this currency. Work performed is eligible for payment only when: 1) schedule payment items are successfully completed in the sequential order listed in Table 2-1 - Schedule of Payments, and 2) the Contractor submits a valid invoice that can be approved for processing.

A. General

The Contractor agrees that under the provisions of this Agreement, as reimbursement for those actual, reasonable and necessary costs incurred by the Contractor, which are directly attributable or properly allocable to the Project, the Contractor may bill the State as defined herein. Payments will be made by CTDOT within forty- five (45) days after receipt of properly prepared invoices submitted as specified herein. All payments shall be governed by the following:

1. For payment purposes only, CTDOT will adjust the NFTS pricing on Table 2-1 - Schedule of Payments in accordance with any executed Options and Change Orders.
2. In no event shall the amount set forth in the invoices forwarded to CTDOT exceed 100% of the cost incurred by the Contractor to the date of the invoice.
3. The Contractor shall provide written certification of completion at the time of each payment schedule item, certifying the successful completion of the item. Additionally, for payment approval by CTDOT, all requests for payment must be in compliance with all requirements of the Contract Documents.
4. Documentation must be on file with the Contractor and forwarded, to CTDOT, to support the Contractor's invoice costs. The Contractor's invoice will show a complete breakdown of the work components, CORE CT Contract Identification Number, and a completed Invoice Summary and Processing (ISP) form. In addition, the invoices must contain the level of detail as required by CTDOT. All invoices must meet or exceed generally

- accepted accounting standards, and must be in a format suitable for CTDOT's audit requirements. CTDOT shall promptly pay the Contractor for all valid, complete and correct invoices or items set forth in such invoices, which are not in dispute.
5. The Contractor shall maintain books and records as related to this Project in such a manner that supports each invoice based upon the actual costs incurred.
  6. Incomplete or incorrect entries in such records will be grounds for disallowance by CTDOT of any fees or expenses based upon such entries. If an audit should disclose any invoices that were submitted by the Contractor, and paid, exceed 100% of the Contractor's actual costs, this excess shall be returned to the State.
  7. If the NFTS does not meet all of the requirements set forth in the Scope of Work, CTDOT may conditionally accept the NFTS and place it in revenue service pending receipt from Contractor of furnished materials and/or labor necessary to effectuate corrective action.
  8. If Options are accepted, the Contractor and CTDOT will negotiate and agree upon mutually satisfactory payment terms in accordance with the provisions of this Agreement.

**B. Invoice Rejection**

An invoice, or portion thereof, submitted by the Contractor may be rejected by CTDOT for any or all of the following reasons:

1. The amount invoiced is inconsistent with Table 2-1 - Schedule of Payments, herein.
2. The invoice is for performance of work under the Agreement that is in dispute or the Contractor has failed to otherwise comply with stated Agreement provisions.
3. The item or services presented in the invoice, have not been accepted, and/or completed to CTDOT's satisfaction.
4. The quantity of items delivered by the Contractor is less than the quantity ordered by CTDOT.
5. The items or services delivered by the Contractor, and being invoiced, do not meet the quality requirements of this Agreement.
6. The Contractor has not submitted satisfactory documentation or other evidence required by CTDOT for processing of invoices.

**C. Schedule of Payments**

Excluding payments associated with monthly-invoiced services (e.g., CDS and CTDOT authorized Options), payments of the Agreement lump sum shall be made according to Table 2-1 below. The percentage for each payment schedule item shall be based on the total executed Agreement value, less the total contracted value of monthly-invoiced services. Completion of all Milestones shall be subject to CTDOT approval, according to the terms stipulated in the Scope of Work.

**TABLE 2-1, SCHEDULE OF PAYMENTS**

Phase 1	
Task / Event	Payment % of Lump Sum
Phase 1 Preliminary Design Review Complete	3.00%
Phase 1 Final Design Review Complete	10.00%

Phase 1 First Article Configuration Inspection	5.00%	
Phase 1 Factory Acceptance Test Complete	10.00%	
Phase 1 Pilot Test Complete	5.00%	
Phase 1 System Acceptance	10.00%	43.00%
Phase 2		
Phase 2 Preliminary Design Review Complete	2.00%	
Phase 2 Final Design Review Complete	5.00%	
Phase 2 Factory Acceptance Test Complete	5.00%	
Install Phase 2 Farebox Software in Pilot Garage, Retail Sales System for Pilot, Customer Service Center	6.00%	
Phase 2 Pilot Garage Test Complete	3.00%	
Phase 2 System Acceptance	3.00%	24.00%
Phase 3		
Phase 3 Design Review Complete	5.00%	
Manufacture Phase 3 First Articles (Barcode Ticket Dispenser), Develop Phase 3 Farebox and updated mobile ticketing Software	3.00%	
Phase 3 Factory Acceptance Test Complete	10.00%	
Phase 3 system fully in Service Complete	10.00%	
Full System Acceptance / Commence System Warranty to be provided in equal payments during the length of the warranty	5.00%	33.00%
TOTAL (Excluding payments associated with monthly-invoiced services (e.g., CDS and Proposal Options)		100.00%

Payments associated with monthly-invoiced services (e.g., CDS and CTDOT authorized proposal options) will be made at the monthly amount specified in the Price Proposal Form for CMS and, if authorized by CTDOT, any proposal options.



D. Basis of Payment

Basis for payment for all work and services described within the Agreement shall be as follows:

1. For each payment, the Contractor will be required to provide a waiver and release of lien document for all work performed. In the event the Contractor has subcontracted any of the work, all subcontractors, prior to final payment, shall furnish the Contractor a valid waiver and release of lien document in a form acceptable to CTDOT for all work performed or the equipment or material furnished by each subcontractor.
2. The acceptance by the Contractor of the final payment shall operate as and shall be a release of the State, and every member, agent, and employee thereof, from all claim and liability to the Contractor for anything done or furnished for, or relating to, the work, or for any act or neglect of the State or any person relating to or affecting the work.

E. Payment for Change Orders

The Contractor shall prepare invoice(s) for only executed valid Change Order(s) that are eligible for payment. This eligibility is determined by either completion of the work or as defined per the Change Order documentation.

ARTICLE 8. INTENTIONALLY OMITTED

ARTICLE 9. COOPERATION

Should any claims, demands, suits or other legal proceedings be made or instituted by any person against the State in connection with this Agreement, the Contractor shall give the State all pertinent information and reasonable assistance in defense or other disposition thereof. The terms of this paragraph shall not be construed as a waiver of sovereign immunity.

ARTICLE 10. REVIEW OF WORK

Contractor shall permit CTDOT and/or the Federal Transit Administration or other Federal agencies to review at any time, all work performed under the terms of this Agreement at any stage of the work.

ARTICLE 11. RESPONSIBILITY FOR ACCURACY OF WORK

Contractor assumes full responsibility for the accuracy of its work produced under this Agreement, including any supplements thereto.

ARTICLE 12. RELATIONSHIP WITH OTHERS

Contractor shall cooperate fully with all representatives of all allied disciplines involved, including, but not necessarily limited to, other contractors, state personnel, ~~CT~~TRANSITCTTransit, municipalities, official visitors, National Passenger Railroad Corporation (Amtrak), public utility companies and others engaged in the construction and readiness of CT**fastrak** and related projects; attend such meetings, discussions, hearings as may be requested from time to time by CTDOT to effectuate this cooperation; and comply with all directives given by CTDOT.

ARTICLE 13. INSURANCE FOR THE CONTRACTOR AND SUBCONTRACTOR(S)

The Contractor shall carry, and shall ensure that its subcontractor(s) carry, for the duration of this Agreement, and any extensions of this Agreement, with the State being named as an additional insured party, for paragraphs A and B below, the following minimum insurance coverage at no direct cost to the State. In the event the Contractor secures excess/umbrella liability insurance to meet the minimum requirements specified in paragraphs A and/or B below, the State of Connecticut shall be named as an additional insured.

A. COMMERCIAL GENERAL LIABILITY -

The Contractor shall carry Commercial General Liability Insurance, including Contractual Liability Insurance, providing for a total limit of One Million Dollars (\$1,000,000) for all damages arising out of bodily injuries to or death of all persons in any one accident or occurrence, and for all damages arising out of injury to or destruction of property in any one accident or occurrence, and, subject to that limit per accident, a total (or aggregate) limit of Two Million Dollars (\$2,000,000) for all damages arising out of bodily injuries to or death of all persons in all accidents or occurrences and out of injury to or destruction of property during the policy period.

B. AUTOMOBILE LIABILITY -

The operation of all motor vehicles, including those hired or borrowed, used in connection with the Agreement shall be covered by Automobile Liability Insurance providing for a total limit of One Million Dollars (\$1,000,000) for all damages arising out of bodily injuries to or death of all persons in any one accident or occurrence, and for all damages arising out of injury to or destruction of property in any one accident or occurrence. In cases where an insurance policy shows an aggregate limit as part of the automobile liability coverage, the aggregate limit must be at least Two Million Dollars (\$2,000,000).

C. WORKERS' COMPENSATION -

With respect to all operations the Contractor performs, and all those performed for the Contractor by its subcontractor(s), the Contractor shall carry, and shall ensure that its subcontractor(s) carry, Workers' Compensation Insurance and, as applicable, insurance required in accordance with the U.S. Longshore and Harbor Workers' Compensation Act, in accordance with the requirements of the laws of the State of Connecticut and the laws of the United States respectively.

D. BUILDER'S RISK -

The Contractor shall maintain comprehensive replacement cost builder's risk (completed value) insurance providing coverage for the entire work at the Project sites, including all fixtures, machinery and equipment, any heating, cooling and constituting a permanent part of the building and shall cover portions of work located away from the site, but intended for use at the site. If it is determined that all or a portion of the Project is located within an area designated as a Special Flood Hazard Area, the Contractor shall maintain flood insurance (no less than \$10,000,000 sublimit). The State of Connecticut shall be named as Loss Payee.

In conjunction with the above, the Contractor agrees to furnish to CTDOT a Certificate of Insurance, on a form acceptable to CTDOT, fully executed by an insurance company or companies satisfactory to CTDOT, for the insurance policy or

policies required hereinabove, which policy or policies shall be in accordance with the terms of said Certificate of Insurance.

The Contractor shall produce, within five (5) business days, a copy or copies of all applicable insurance policies requested by CTDOT. In providing said policies, the Contractor may redact provisions of the policy that are proprietary. This provision shall survive the suspension, expiration or termination of this Agreement.

#### ARTICLE 14. BONDING REQUIREMENTS

CTDOT requires the Contractor to obtain Performance and Payment Bonds for this Agreement. All bonds shall be reduced in the amount of the payments made to and by the Contractor at each of the payment Milestones. The values of the bonds provided for this Agreement are as follows:

Performance Bond - The Contractor shall obtain a performance bond in the amount of the Agreement.

Payment Bond - The Contractor shall obtain a Payment Bond shall in an amount not less than the amount equal to the Agreement.

#### ARTICLE 15. INDEMNIFICATION

- A. The Contractor shall indemnify, defend and hold harmless the State and its officers, representatives, agents, servants, employees, successors and assigns from and against any and all (1) Claims arising, directly or indirectly, in connection with the Agreement, including the acts of commission or omission (collectively, the "Acts") of the Contractor or Contractor Parties; and (2) liabilities, damages, losses, costs and expenses, including but not limited to, attorneys' and other professionals' fees, arising, directly or indirectly, in connection with Claims, Acts or the Agreement. The Contractor shall use counsel reasonably acceptable to the State in carrying out its obligations under this section. The Contractor's obligations under this section to indemnify, defend and hold harmless against Claims includes Claims concerning confidentiality of any part of or all of the Contractor's bid, proposal or any Records, any intellectual property rights, other proprietary rights of any person or entity, copyrighted or uncopyrighted compositions, secret processes, patented or unpatented inventions, articles or appliances furnished or used in the performance.
- B. The Contractor shall not be responsible for indemnifying or holding the State harmless from any liability arising due to the negligence of the State or any third party acting under the direct control or supervision of the State of Connecticut.
- C. The Contractor shall reimburse the State for any and all damages to the real or personal property of the State caused by the Acts of the Contractor or any Contractor Parties. The State shall give the Contractor reasonable notice of any such Claims.
- D. The Contractor's duties under this section shall remain fully in effect and binding in accordance with the Agreement, without being lessened or compromised in any way, even where the Contractor is alleged or is found to have merely contributed in part to the Acts giving rise to the Claims and/or where the State is alleged or is found to have contributed to the Acts giving rise to the Claims.

- E. The Contractor shall carry and maintain at all times during the term of the Agreement, and during the time that any provisions survive the term of the Agreement, sufficient general liability insurance to satisfy its obligations under this Agreement. The Contractor shall name the State as an additional insured on the policy and shall provide a copy of the policy to CTDOT prior to the effective date of the Agreement. The Contractor shall not begin performance until the delivery of the policy to CTDOT. The State shall be entitled to recover under the insurance policy even if a body of competent jurisdiction determines that CTDOT or the State is contributorily negligent.
- F. This section shall survive the termination of the Agreement and shall not be limited by reason of any insurance coverage.

ARTICLE 16. NEGLIGENCE OR OMISSIONS OF THE CONTRACTOR OR SUBCONTRACTOR

The Contractor shall be responsible for paying any and all fines or damages associated with negligent acts or omissions of the Contractor, its employees, or subcontractors employed by the Contractor. The cost of all such fines and damages are not transferable to the State.

ARTICLE 17. COVENANT AGAINST CONTINGENT FEES

Contractor warrants that it has not employed or retained any company or person other than a bona fide employee working solely for the Contractor, to solicit or secure this Agreement, and that it has not paid or agreed to pay any company or person, other than bona fide employees working solely for the Contractor, any fee, commission, percentage, brokerage fee, gift, or any other consideration, contingent upon or resulting from the award or making of this Agreement. In the event of a breach or violation of the above stipulation, CTDOT shall have the right to annul this Agreement without liability, or, in its discretion, to deduct from the agreed price or consideration, or otherwise recover, the full amount of such fee, commission, percentage, brokerage fee, gift, or contingent fee.

ARTICLE 18. ASSIGNMENT OR TRANSFER OF AGREEMENT

Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the Agreement or any portion of it, or of the work provided for in the Agreement, or of its right, title, or interest in the Agreement, to any person, firm, partnership, or corporation without the written consent of CTDOT. For breach or violation of the above stipulation, CTDOT shall have the right to annul this Agreement without liability.

The Contractor shall not subcontract any portion of the work required for the completion of this Agreement without the prior written approval of CTDOT. The form of any subcontract shall be as developed by the Contractor and must be approved by CTDOT.

ARTICLE 19. SAFETY AND SECURITY

The Contractor assumes full responsibility for the safety and security of its work. All work shall be performed in a manner that will ensure the safety of personnel and the work, and prevent safety hazards and exposure of personnel and equipment to hazardous or potentially hazardous conditions. All work performed in conjunction with the Project shall comply with the requirements of the Department of Labor, Occupational Safety and Health Administration (OSHA) provisions, as well as those of State and local regulations.

The Contractor shall take all steps necessary to protect public safety in and around all work areas and shall comply with all State rules and regulations including attending safety certification training. Prior to the start of revenue service on a daily basis, Contractor shall take provisions, including the following, to ensure public safety. Proper signage and barricades shall be placed around all work areas to facilitate pedestrian flow and prevent personal injury. Floor surfaces shall be left in a sound and level condition, and all tripping hazards shall be eliminated. Contractor shall take additional safety precautions when, in the opinion of CTDOT, unsafe conditions exist.

Stations and other property where and when the Contractor or its subcontractor(s) are engaged in Project activities shall be protected by the Contractor and/or its subcontractor(s) at all times. Contractor shall not create any conditions which compromise security or allow unpaid use of State services.

The Contractor shall comply with all safety and security requirements associated with the CT**fastrak** "Safety and Security Management Plan (SSMP)", a copy of the current version of which is attached hereto and made a part hereof as Schedule D. This document is reviewed and amended at regular intervals to appropriately address the site conditions of safety and security for the program. Contractor shall be responsible for complying with the most up-to-date version of the SSMP throughout the term of this Agreement.

#### ARTICLE 20. WARRANTY

Contractor unconditionally warrants and guarantees to the State all NFTS components and systems. The Warranty shall include, but not be limited to, all software, equipment, designs, workmanship, installation, services, material, devices, apparatus, components, assemblies, parts, and operational spare parts furnished under this Agreement. The Contractor shall certify in writing that all materials and workmanship supplied under the Agreement are: 1) in compliance with the Agreement requirements, 2) fit for the intended purpose, as specified in the Agreement, and 3) free of defects.

The Contractor additionally represents and warrants : 1) that the Contractor has reviewed and evaluated, or shall review and evaluate, all information furnished by the State whether in the Scope of Work, Contract Documents, design meetings, reviews or testing, 2) that the Contractor has made or shall make all inquiries necessary such that Contractor is fully aware of the business requirements and intended uses of the NFTS as set forth or referenced in the Contract Documents, 3) that all work performed by the Contractor shall satisfy such requirements in all material respects, and, 4) that the Contractor is not aware of any material discrepancies among objectives as set forth in the Scope of Work.

The design and manufacture of the NFTS will reflect its intended use as defined in the Agreement. The NFTS will meet the standards of safety and reliability for the intended environment, as specified in the Agreement, and all applicable Federal, State and local design and construction codes, ordinances and standards.

The Contractor shall maintain objective evidence that the NFTS meets the contractual ~~dDuration~~ requirements, and document any areas where the contractual requirements are not met.

##### A. General

The Contractor warrants that all of the NFTS equipment and software to be furnished under this Agreement will be free from defects in material and workmanship and meet the requirements of the Agreement.

All Contractor-supplied hardware and software will be warranted from NFTS Final Acceptance, which will be also be defined as the beginning of the "warranty count-down."

1. Software Warranty

For all Contractor-supplied NFTS software, the Contractor shall provide a warranty for a period of two (2) years after warranty count-down commences (the "Software Warranty").

The period from first NFTS delivery to the conclusion of the 2-year software warranty shall constitute the "Software Warranty Period."

All warranties supplied by the providers of software shall be conveyed to the State upon delivery.

2. Hardware Warranty

For NFTS equipment, the Contractor shall provide a warranty for a period of two (2) years after warranty count-down commences (the "Hardware Warranty").

The period from first NFTS delivery to the conclusion of the 2-year hardware warranty shall constitute the "Hardware Warranty Period."

B. Work To Be Performed Under Warranty

As described in the Scope of Work and as modified by any exercised options for hardware maintenance services, the Contractor shall perform the remedial work to correct any and all actual and reported deficiencies, which shall include the repair or replacement, at the Contractor's option, of equipment, components, devices, and/or materials, and the reprogram/update of software defects.

Unless CTDOT exercises the Options for hardware maintenance services, CTDOT shall be exclusively responsible for performing any remedial tasks identified in the Scope of Work. CTDOT shall also manage and control the deployment of all software corrections and updates, and no software corrections or updates shall be deployed in the NFTS software without CTDOT's written authorization and prior verification in CTDOT's maintenance and test facility.

1. Software Warranty

During the Software Warranty Period, the Contractor shall provide the warranty services described in the Scope of Work.

Software Corrections

Failure of the Contractor to provide effective software corrections in the allotted time may result in reductions to the final Software Warranty close-out payment as defined below. Such reduced payments shall be at the sole discretion of CTDOT. The penalties provided for herein shall be CTDOT's sole remedy for the Contractor's failure to meet the stated warranty response times.

Late Resolution Penalties defined below shall apply only to software defects identified after commencement of the Software Warranty count-down. The Contractor shall resolve software defects identified prior to the Software Warranty count-down.

For critical and urgent defects, if a workaround is delivered on time, or if late penalties were assessed for a late workaround, no further penalties shall be assessed for late delivery of a permanent solution; nonetheless, the Contractor shall make all reasonable efforts to provide permanent solutions according to a schedule ~~agreed-upon~~ set by CTDOT.

Defect Severity	Resolution Due	Late Resolution Penalty
1 - Critical	As defined in the Scope of Work	\$250 per hour \$10,000 cap per incident
2 - Urgent	As defined in the Scope of Work	\$500 per day \$2,500 cap per incident
3 - Important	As defined in the Scope of Work	\$50 per day \$1,000 cap per incident
4 - Low	As defined in the Scope of Work	No Late Resolution Penalties apply  \$500 withholding per unresolved incident as per Paragraph F.1 below

The Contractor's obligations for software updates during the Software Warranty Period are defined in the Scope of Work.

2. Hardware Warranty

During the Hardware Warranty Period, all shipping costs shall be billed directly from the shipping company to the Contractor. For those items the Contractor deems fragile, the Contractor shall supply shipping containers in sufficient quantity to support anticipated need.

The Hardware Warranty will cover all parts and Contractor labor associated with the factory repair or replacement of the equipment during the Hardware Warranty Period.

For each defective NFTS component returned to the Contractor's facility, the Contractor shall, at its discretion, repair or replace the defective component and return the functioning unit to the State within an average of 30 calendar days, not to exceed 45 calendar days of receipt of the defective component.

Hardware items repaired or replaced under warranty shall be warrantied against further failures and defects for a period of 90 calendar days or the remaining Hardware Warranty Period, whichever is longer.

C. Warranty Exceptions

The Warranty shall not apply to any equipment which has been damaged through accident or negligence, or which has been subjected to other than normal use, or modified by CTDOT without the Contractor's prior written approval. For purposes of this Warranty, normal use shall mean conditions prevalent in the State's vehicles and on the State's rail platforms. Temperature, humidity, solar heating, precipitation (for outdoor equipment), vehicle vibration (for on-board equipment), routine cleaning activities, routine snow-removal methods (for outdoor equipment), and all other ambient conditions present in the central Connecticut region shall be considered normal operating conditions for this equipment.

D. Items Not Covered

The Warranty shall not cover the replacement of consumable parts nor items which are replaced in a usual and scheduled preventative maintenance program such as light bulbs, or items which are subject to normal wear and tear as a result normal use.

E. Unresolved Warrantable Items Remaining at Conclusion of Warranty Periods

All warrantable defects that remain unresolved upon the expiration of the Software Warranty Period and/or the Hardware Warranty Period, as applicable, shall be subject to the following resolution criteria:

1. Unresolved Warrantable Software Defects  
The final Software Warranty payment, as stipulated in Article 7, may, at CTDOT's discretion, be reduced by a value representing the sum of the maximum late resolution penalties or withholding amounts of all unresolved warrantable software defects. As the unresolved software defects are corrected and verified by CTDOT, the withheld values shall be paid; such payments may, at CTDOT's discretion, be reduced by any applicable late resolution penalties.
2. Unresolved Warrantable Hardware Defects  
The final Hardware Warranty payment, as stipulated in Article 7, may, at CTDOT's discretion, be reduced by a value representing the sum of the value of all warrantable hardware items that are pending repair or replacement. These values shall be based on the relevant prices included on the NFTS pricing forms. As hardware items are repaired or replaced, CTDOT shall pay the withheld amount upon satisfactory conclusion of the 90-day warranty for repaired / returned parts.

ARTICLE 21. SPARE PARTS FOR STATE INVENTORY

The Contractor shall guarantee that all parts and modules will be made available in the latest configuration of such parts and modules for a period of ten (10) years after completion of the warranty for a price equivalent to the negotiated contract price indexed to the United States Producer Price Index (PPI) published in the Wall Street Journal the month prior to the issuance of a purchase order for such parts.

ARTICLE 22. CONTROL OF THE WORK AND CLAIMS (from FORM 816)

The following sections of Form 816 apply to this Agreement and capitalized terms referenced in such sections have the definitions ascribed to them in Form 816. In the event of any conflict between the following sections of Form 816 and any other provision of the Agreement, the more stringent term or terms will govern, with preference given, otherwise, to the following sections of Form 816:

- SECTION 1.05 CONTROL OF THE WORK
- 1.05.01-Authority of Engineer
  - 1.05.02-Plans, Working Drawings and Shop Drawings
  - 1.05.03-Conformity with Plans and Specifications
  - 1.05.05-Cooperation by Contractor
  - 1.05.06-Cooperation with Utilities (Including Railroads)
  - 1.05.07-Coordination with Work by Other Parties
  - 1.05.08-Schedules and Reports
  - 1.05.09-Authority of Inspectors
  - 1.05.10-Inspection
  - 1.05.11-Removal of Defective or Unauthorized Work
  - 1.05.12-Payrolls
  - 1.05.13-Examining and Copying Contractor's Records
  - 1.05.15-Markings for Underground Facilities
  - 1.05.16-Dimensions and Measurements



SECTION 1.11 CLAIMS  
1.11.01-General  
1.11.02-Notice of Claim  
1.11.03-Record Keeping  
1.11.04-Claim Compensation  
1.11.05-Required Claim Documentation  
1.11.06-Auditing of Claims

ARTICLE 23. INTENTIONALLY OMITTED

ARTICLE 24. DETERMINATION OF EXTRA WORK

CTDOT shall consider as Extra Work that work which the Contractor is directed to perform beyond the scope and character of this Agreement. Upon presentation by the Contractor of a request for payment for such work, the request shall be evaluated by CTDOT and, if found valid, CTDOT shall authorize payment therefore. In the event the Contractor requests payment for Extra Work which CTDOT determines is without basis or foundation, CTDOT may reject such request. The decision of CTDOT on the request for payment of Extra Work shall be final and binding.

ARTICLE 25. PROGRESS PAYMENTS

CTDOT shall pay the Contractor for work performed in accordance with the terms specified in this Agreement. Contractor requests for payment may be submitted not more frequently than monthly in accordance with the payment schedule and shall be made on forms furnished by CTDOT in accordance with the then current format of the State.

ARTICLE 26. CONTRACT ASSIGNMENT

This contract is assignable by CTDOT at any time for the duration of the Project as identified in the Scope of Work and the Agreement.

ARTICLE 27. OWNERSHIP OF DOCUMENTS AND RIGHTS IN DATA

The Contractor warrants that the processes, design, equipment, materials, or devices used in providing the services shall be delivered free of any rightful claim of any third party for infringement of any patent, copyright, or other intellectual property or proprietary right. If a suit or proceeding based on a claimed infringement of a patent or copyright is brought against the State the Contractor shall, at its own expense, defend or settle any such suit or proceeding if authorized to do so in writing by CTDOT, and indemnify and hold harmless CTDOT, its subsidiaries, agents, and employees from all liability, reasonable damages, costs, and expenses associated therewith, including, without limitation, defense costs and attorney fees.

All documents, materials, procedures, and processes prepared and/or developed by the Contractor, its subcontractors and/or subconsultants pursuant to this Agreement shall become the intellectual property of the State. All documents, materials, procedures, and processes prepared and/or developed by the Contractor, its subcontractors and/or subconsultants shall be provided to CTDOT. Original copies, including any electronic media of such shall be delivered to CTDOT upon completion of the services or termination of the services. With CTDOT's concurrence, the Contractor shall be permitted to retain copies of such documents, materials, procedures, and processes prepared and/or developed by the Contractor, its subcontractors and/or subconsultants for the Contractor to further its general technical proficiency; however, publication and/or use of this material is subject to the terms and conditions of this agreement.

No material or technical data prepared by the Contractor under this Agreement is to be released to or used by any other person except as necessary for the performance of the contracted services. All press releases or information to be published in print or electronic media shall be distributed only after the Contractor has first received in writing, authorization from CTDOT.

Except for the Contractor's pre-existing proprietary software, CTDOT shall have the right to use, duplicate, modify, or disclose the technical data and the information conveyed therein, in whole or in part, in any manner whatsoever, and to have or permit others within the State to do so. Except for the Contractor's pre-existing proprietary software, the Contractor grants to the State and to its officers, agents, and employees acting within the scope of their official duties,

a royalty-free license to publish, translate, reproduce, deliver, and use as they deem fit all technical data supplied for this Agreement covered by copyright. No such copyrighted matter shall be included in the technical data furnished hereunder without the written permission of the copyright owner for the State to use in the manner herein described.

#### ARTICLE 28. REVISIONS IN ORGANIZATION

The Contractor shall notify the State in writing when there is a change in its Connecticut Certificate of Registration with the Connecticut Secretary of State's Office, or a change in the individual(s) in charge of the work specified herein. Neither change shall relieve the Contractor of any responsibility for the accuracy and completeness of all services and products of the work under this Agreement, including any supplements thereto.

#### ARTICLE 29. BREACH

- A. If either party breaches the Agreement in any respect, the non-breaching party shall provide written notice of the breach to the breaching party by overnight or certified mail, return receipt requested, to the most current address the breaching party has furnished for the purposes of correspondence and afford the breaching party an opportunity to cure such breach within thirty (30) days from the date that the breaching party receives the notice. In the case of a Contractor breach, CTDOT may set forth any period greater or less than thirty (30) days, so long as such time period is otherwise consistent with the provisions of this Agreement (for the purposes of this paragraph, the time period set forth by the non-breaching party shall be referred to as the "right to cure period"). The right to cure period shall be extended if the non-breaching party is satisfied that the breaching party is making a good faith effort to cure, but the nature of the breach is such that it cannot be cured within the right to cure period.
- B. In the event of a breach, CTDOT may require the Contractor to prepare and submit to CTDOT a corrective action plan in connection with an identified breach. The corrective action plan will provide a detailed explanation of the reasons for the cited deficiency, the Contractor's assessment or diagnosis of the cause, and a specific proposal to cure or resolve the deficiency. The Contractor shall submit the corrective action plan within ten (10) business days following the request for the plan by CTDOT and is subject to approval by CTDOT, which approval shall not unreasonably be withheld. Notwithstanding the submission and acceptance of a corrective action plan, the Contractor remains responsible for achieving all performance criteria as identified in the Scope of Work. The acceptance of a corrective action plan shall not excuse prior substandard performance, relieve the Contractor of its duty to comply with performance standards, or prohibit CTDOT from pursuing additional remedies or other approaches to correct substandard performance.
- C. The written notice of the breach may include an effective termination date. If the identified breach is not cured by the stated termination date, unless otherwise modified by the non-breaching party in writing prior to such date, no further action shall be required of any party to effect the termination as of the stated date. If the notice does not set forth an effective termination date, the non-breaching party shall be required to provide the breaching party no less than twenty-four (24) hours written notice prior to terminating the Agreement, such notice to be provided in accordance with Article 33 hereof.

- D. If CTDOT reasonably and in good faith determines the Contractor has not performed in accordance with the Agreement, CTDOT may withhold payment in whole or in part in an amount reasonably related to the non-performance pending resolution of the performance issue, provided that CTDOT notifies the Contractor in writing prior to the date that the payment would have been due.
- E. Notwithstanding any provisions in this Agreement, CTDOT may terminate this Agreement with no right to cure period for the Contractor's breach or violation of any of the provisions in the section concerning representations and warranties and revoke any consent to assignments given as if the assignments had never been requested or consented to, without liability to the Contractor or Contractor Parties or any third party.
- F. Termination under this Breach section is subject to the provisions of the Termination section in this Agreement.

ARTICLE 30. TERMINATION

- A. Notwithstanding any provisions in this Agreement, CTDOT, through a duly authorized employee, may terminate the Agreement whenever CTDOT makes a written determination that such termination is in the best interests of the State. CTDOT shall notify the Contractor in writing of termination pursuant to this section, which notice shall specify the effective date of termination and the extent to which the Contractor must complete its performance under the Agreement prior to such date.
- B. Notwithstanding any provisions in this Agreement, CTDOT, through a duly authorized employee, may, after making a written determination that the Contractor has breached the Agreement, terminate the Agreement in accordance with the provisions in the Breach section of this Agreement.
- C. CTDOT shall send the notice of termination via certified mail, return receipt requested, to the Contractor at the most current address which the Contractor has furnished to CTDOT for purposes of correspondence, or by hand delivery. Upon receiving the notice from CTDOT, the Contractor shall immediately discontinue all services affected in accordance with the notice, undertake commercially reasonable efforts to mitigate any losses or damages and deliver to CTDOT all Records. The Records are deemed to be the property of CTDOT and the Contractor shall deliver them to CTDOT no later than thirty (30) days after the termination of the Agreement or fifteen (15) days after the Contractor receives a written request from CTDOT for the Records. The Contractor shall deliver those Records that exist in electronic, magnetic or other intangible form in a non-proprietary format, such as, but not limited to, ASCII or .TXT.
- D. Upon receipt of a written notice of termination from CTDOT, the Contractor shall cease operations as CTDOT directs in the notice, and take all actions that are necessary or appropriate, or that CTDOT may reasonably direct, for the protection, and preservation of the goods and any other property. Except for any work which CTDOT directs the Contractor to perform in the notice prior to the effective date of termination, and except as otherwise provided in the notice, the Contractor shall terminate or conclude all existing subcontracts and purchase orders and shall not enter into any further subcontracts, purchase orders or commitments.

- E. CTDOT shall, within forty-five (45) days of the effective date of termination, reimburse the Contractor for its work rendered and accepted by CTDOT or for any goods delivered by the Contractor, in addition to all reasonable actual costs incurred after termination in completing those portions of the work which the notice required the Contractor to complete. However, the Contractor is not entitled to receive and CTDOT is not obligated to tender to the Contractor any payments for anticipated or lost profits or loss of overhead. Upon request by CTDOT, the Contractor shall assign to CTDOT, or any replacement contractor which CTDOT designates, all subcontracts, purchase orders, and other commitments, deliver to CTDOT all Records and other information pertaining to its performance, and remove from State premises, whether leased or owned, all of the Contractor's property, equipment, waste material and rubbish related to its work, all as CTDOT may request.
- F. Materials obtained by the Contractor for the Project, if they have been inspected, tested as required, and accepted by CTDOT, but have not been incorporated into the Project construction, shall, if CTDOT and the Contractor so agree, be purchased by CTDOT from the Contractor at their actual cost shown on receipted bills. To this cost shall be added all actual costs for delivery at such points of delivery as may be designed by the State, as shown by actual cost records. If CTDOT does not agree to purchase such materials, CTDOT shall reimburse the Contractor for any reasonable restocking fees and handling costs incurred by the Contractor in returning said materials to the vendor.
- G. For breach or violation of any of the provisions in the section concerning representations and warranties, CTDOT may terminate the Agreement in accordance with its terms and revoke any consents to assignments given as if the assignments had never been requested or consented to, without liability to the Contractor or Contractor Parties or any third party.
- H. Upon termination of the Agreement, all rights and obligations shall be null and void, so that no party shall have any further rights or obligations to any other party, except with respect to the sections which survive termination. All representations, warranties, agreements and rights of the parties under the Agreement shall survive such termination to the extent not otherwise limited in the Agreement and without each one of them having to be specifically mentioned in the Agreement.
- I. Termination of the Agreement pursuant to this section shall not be deemed to be a breach of the Agreement by CTDOT or the State.
- J. Termination of the Contract shall not relieve the Contractor of its responsibilities for the completed Project, nor shall it relieve the Contractor's surety of its obligation concerning any claims arising out of the work performed, until the requirements of this section and Form 816 Article 1.08.13 have been met.

ARTICLE 31. CONFLICTS BETWEEN DOCUMENTS AND AGREEMENT

In case of conflict between the terms of this Agreement and the terms or requirements of documents mentioned herein, the more stringent requirement, as determined by the State, shall govern.

ARTICLE 32. CONNECTICUT REQUIRED CONTRACT/AGREEMENT PROVISIONS - SPECIFIC EQUAL EMPLOYMENT OPPORTUNITY RESPONSIBILITIES

Contractor hereby acknowledges and agrees to comply with the Connecticut Required Contract/Agreement Provisions entitled "Specific Equal Employment Opportunity Responsibilities", dated March 3, 2009, as may be amended from time to time, a copy of which is attached hereto and made a part hereof as Schedule H.

ARTICLE 33. NOTICE BETWEEN PARTIES TO AGREEMENT

Any "Official Notice" from one such party to the other such party (or parties), in order for such Notice to be binding thereon, shall:

- A. Be in writing (hardcopy) addressed to:
  - 1. When CTDOT is to receive such Notice -  

Commissioner of Transportation  
Connecticut Department of Transportation,  
2800 Berlin Turnpike  
P.O. Box 317546,  
Newington, Connecticut 06131-7546;
  - 2. When the Contractor is to receive such Notice-  

TBD
- B. Be delivered in person with acknowledgement of receipt or be mailed by the United States Postal Service - "Certified Mail" to the address recited herein as being the address of the party(ies) to receive such Notice; and
- C. Contain complete and accurate information in sufficient detail to properly and adequately identify and describe the subject matter thereof.

The term "Official Notice" as used herein, shall be construed to include, but not be limited to, any request, demand, authorization, direction, waiver, and/or consent of the party(ies) as well as any document(s), including any electronically - produced versions, provided, permitted, or required for the making or ratification of any change, revision, addition to or deletion from the document, contract, or agreement in which this "Official Notice" specification is contained.

Further, it is understood and agreed that nothing hereinabove contained shall preclude the parties hereto from subsequently agreeing, in writing, to designate alternate persons (by name, title, and affiliation) to which such Notice(s) is (are) to be addressed; alternate means of conveying such Notice(s) to the particular party(ies); and/or alternate locations to which the delivery of such Notice(s) is (are) to be made, provided such subsequent agreement(s) is (are) concluded pursuant to the adherence to this specification.

ARTICLE 34. PROMPT PAYMENT TO SUBCONTRACTOR(S) AND RELEASE OF RETAINAGE

Contractor hereby acknowledges and agrees to comply with the policies enumerated in "Commissioner's Letter dated October 26, 1988 Re: Prompt Payment to Subcontractor(s)", a copy of which is attached hereto and made a part hereof as Schedule I.

The Contractor shall pay the subcontractor for work performed within thirty (30) days after the Contractor receives payment for the work performed by the subcontractor. Also, any retained monies regarding a subcontractor's work shall be paid to the subcontractor within thirty (30) days after satisfactory completion of all the subcontractor's work.

For the purpose of this Article, satisfactory completion shall have been accomplished when:

- The subcontractor has fulfilled the contract requirements of both the State and the subcontract for the subcontracted work, including the submission of all submittals and audit requirements stipulated in this Agreement, when applicable, and
- The work done by the subcontractor has been reviewed and accepted by the Contractor and final approval of the subcontractor's work has been determined and agreed upon.

If the Contractor determines that a subcontractor's work is not complete, the Contractor shall notify the subcontractor and CTDOT, in writing, of the reasons why the subcontractor's work is not complete. This written notification shall be provided to the subcontractor and CTDOT within twenty-one (21) days of the subcontractor's completion of work.

The above requirements are also applicable to all sub-tier subcontractors and the above provisions shall be made a part of all subcontract agreements.

Failure of the Contractor to comply with the provisions of this Article will be considered when opportunities for similar work arise in the future.

ARTICLE 35. CONNECTICUT DEPARTMENT OF TRANSPORTATION SUBCONSULTANT PAYMENT LOG

Contractor understands and agrees that if requested, a "Connecticut Department of Transportation Subconsultant Payment Log" Form shall be completed quarterly (January, April, July, and October) and furnished to CTDOT for each subcontractor the Contractor utilizes under this Agreement. Instructions for completing and processing this form are stipulated on its reverse side. A copy of said form is attached hereto and made a part hereof as Schedule J. (All references to "Subconsultant" or "subconsultant" appearing in the "Subconsultant Payment Log" attached to and made a part of said Commissioner's Letter shall be construed to mean "Subcontractor" or "subcontractor.")

ARTICLE 36. ETHICS SUMMARY

Pursuant to the requirements of Section 1-101qq of the Connecticut General Statutes, the summary of State ethics laws developed by the State Ethics Commission pursuant to section 1-81b of the Connecticut General Statutes is incorporated by reference into and made a part of the Agreement as if the summary had been fully set forth in the Agreement.

ARTICLE 37. CODE OF ETHICS FOR PUBLIC OFFICIALS AND LOBBYISTS

The Contractor hereby acknowledges and agrees to comply with the policies enumerated in "Connecticut Department of Transportation Policy Statement No. F&A-10 Subject: Code of Ethics Policy", June 1, 2007, a copy of which is attached hereto and made part hereof as Schedule K. The Contractor ~~is also required to complete~~acknowledges and agrees that it has completed the "Certification Regarding Lobbying", a copy of which is attached hereto and made part hereof as Schedule O.

The Contractor shall comply with the provisions contained in Section 1-86e of the Connecticut General Statutes, which provides as follows:

- (a) No person hired by the state as a consultant or independent contractor shall:
  - (1) Use the authority provided to the person under the contract, or any confidential information acquired in the performance of the contract, to obtain financial gain for the person, an employee of the person or a member of the immediate family of any such person or employee;
  - (2) Accept another state contract which would impair the independent judgment of the person in the performance of the existing contract; or
  - (3) Accept anything of value based on an understanding that the actions of the person on behalf of the state would be influenced.
- (b) No person shall give anything of value to a person hired by the state as a consultant or independent contractor based on an understanding that the actions of the consultant or independent contractor on behalf of the state would be influenced.

ARTICLE 38. CORE AGREEMENT/CONTRACT PURCHASE ORDER

This Agreement itself is not an authorization for the Contractor to provide goods or begin performance in any way. The Contractor may provide goods or begin performance only after it has received a duly issued purchase order against the Agreement. A Contractor providing goods or commencing performance without a duly issued purchase order in accordance with this section does so at the Contractor's own risk.

CTDOT shall issue a purchase order against the Agreement directly to the Contractor and to no other party.

ARTICLE 39. PAYMENT OF RECOVERABLE COSTS DUE THE STATE

CTDOT shall have the right to set-off against amounts otherwise due the Contractor under this Agreement or under any other agreement or arrangement that the Contractor has with the State (a) any costs that the State incurs which are due to the Contractor's non-compliance with this Agreement and (b) any other amounts that are due and payable from the Contractor to the State. Any sum taken in set-off from the Contractor shall be deemed to have been paid to the Contractor for purposes of the Contractor's payment obligations under Connecticut General Statute Section 49-41c.



ARTICLE 40. EXECUTIVE ORDERS

That this Agreement is subject to the provisions of Executive Order No. Three of Governor Thomas J. Meskill, promulgated June 16, 1971, concerning labor employment practices, Executive Order No. Seventeen of Governor Thomas J. Meskill, promulgated February 15, 1973, concerning the listing of employment openings, and Executive Order No. Sixteen of Governor John G. Rowland, promulgated August 4, 1999, concerning violence in the workplace, all of which are incorporated into and are made a part of the Agreement as if they had been fully set forth in it. The Agreement may also be subject to the applicable parts of Executive Order No. 7C of Governor M. Jodi Rell, promulgated July 13, 2006, concerning contracting reforms and Executive Order No. 14 of Governor M. Jodi Rell, promulgated April 17, 2006, concerning procurement of cleaning products and services and Executive Order NO. 19 of Governor M. Jodi Rell, promulgated June 19, 2008 concerning use of System Development, in accordance with their respective terms and conditions. If Executive Orders 7C, 14 and 19 are applicable, they are deemed to be incorporated into and are made a part of the Agreement as if they had been fully set forth in it. At the Contractor's request, CTDOT shall provide a copy of these orders to the Contractor.

ARTICLE 41. STATE ELECTIONS ENFORCEMENT COMMISSION CAMPAIGN CONTRIBUTION AND SOLICITATION BAN

For all State contracts, as defined in Conn. Gen. Stat. §9-612(g)(1) having a value in a calendar year of \$50,000 or more, or a combination or series of such agreements or contracts having a value of \$100,000 or more, the authorized signatory to this Agreement expressly acknowledges receipt of the State Elections Enforcement Commission's notice advising state contractors of state campaign contribution and solicitation prohibitions, and will inform its principals of the contents of the notice, as set forth in "Notice to Executive Branch State Contractors and Prospective State Contractors of Campaign Contribution and Solicitation Limitations", a copy of which is attached hereto and hereby made a part of this Agreement as Schedule L.

ARTICLE 42. CONTRACTOR ASSURANCES

~~That as~~As a condition to receiving federal financial assistance under the Agreement, if any, the Contractor shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. §§ 2000d - 2000d-7), all requirements imposed by the regulations of the United States Department of Transportation (49 CFR Part 21) issued in implementation thereof, and the "Title VI Contractor Assurances", a copy of which is attached hereto and hereby made a part of this Agreement as Schedule M.

ARTICLE 43. JURISDICTION AND FORUM LANGUAGE

The parties deem the Agreement to have been made in the City of Hartford, State of Connecticut. Both parties agree that it is fair and reasonable for the validity and construction of the Agreement to be, and it shall be, governed by the laws and court decisions of the State of Connecticut, without giving effect to its principles of conflicts of laws. To the extent that any immunities provided by Federal law or the laws of the State of Connecticut do not bar an action against the State, and to the extent that these courts are courts of competent jurisdiction, for the purpose of venue, the complaint shall be made returnable to the Judicial District of Hartford only or shall be brought in the United States District Court for the District of Connecticut only, and shall not be transferred to any other court, provided, however, that nothing here constitutes a waiver or compromise of the sovereign immunity of the State of Connecticut. The Contractor waives any objection which it may now have or will have to the laying of venue of any Claims in any forum and further irrevocably submits to such jurisdiction in any suit, action or proceeding.

ARTICLE 44. LITIGATION

Except as stipulated in Form 816, the Contractor agrees that the sole and exclusive means for the presentation of any claim against the State arising from or in connection with this Agreement shall be in accordance with Chapter 53 of the Connecticut General Statutes (Claims against the State) and the Contractor further agrees not to initiate legal proceedings in any State or Federal Court in addition to, or in lieu of, said Chapter 53 proceedings.

ARTICLE 45. WHISTLEBLOWER

**That the following clause is applicable to those Agreements with an aggregate value of Five Million Dollars (\$5,000,000.00) or more.** This Agreement may be subject to the provisions of Section 4-61dd of the Connecticut General Statutes. In accordance with this statute, if an officer, employee or appointing authority of the Contractor takes or threatens to take any personnel action against any employee of the Contractor in retaliation for such employee's disclosure of information to any employee of the contracting state or quasi-public agency or the Auditors of Public Accounts or the Attorney General under the provisions of subsection (a) of such statute, the Contractor shall be liable for a civil penalty of not more than five thousand dollars for each offense, up to a maximum of twenty per cent of the value of this Agreement. Each violation shall be a separate and distinct offense and in the case of a continuing violation, each calendar day's continuance of the violation shall be deemed to be a separate and distinct offense. The State may request that the Attorney General bring a civil action in the Superior Court for the Judicial District of Hartford to seek imposition and recovery of such civil penalty. In accordance with subsection (f) of such statute, each large state contractor, as defined in the statute, shall post a notice of the provisions of the statute relating to large state contractors in a conspicuous place which is readily available for viewing by the employees of the Contractor.

ARTICLE 46. DISCLOSURE OF RECORDS

**The following clause is applicable to those Agreements with an aggregate value of Two Million Five Hundred Thousand Dollars (\$2,500,000.00) or more.** This Agreement may be subject to the provisions of section 1-218 of the Connecticut General Statutes. In accordance with this statute, each contract in excess of two million five hundred thousand dollars between a public agency and a person for the performance of a governmental function shall (a) provide that the public agency is entitled to receive a copy of records and files related to the performance of the governmental function, and (b) indicate that such records and files are subject to FOIA and may be disclosed by the public agency pursuant to FOIA. No request to inspect or copy such records or files shall be valid unless the request is made to the public agency in accordance with FOIA. Any complaint by a person who is denied the right to inspect or copy such records or files shall be brought to the Freedom of Information Commission in accordance with the provisions of Sections 1-205 and 1-206 of the Connecticut General Statutes.

ARTICLE 47. TANGIBLE PERSONAL PROPERTY

- A. The Contractor on its behalf and on behalf of its subcontractors; as defined below, shall comply with the provisions of Conn. Gen. Stat. §12-411b, as follows:
  - 1. For the term of the Agreement, the Contractor and its Affiliates shall collect and remit to the State of Connecticut, Department of Revenue Services, any Connecticut use tax due under the provisions of Chapter 219 of the Connecticut General

Statutes for items of tangible personal property sold by the Contractor or by any of its Affiliates in the same manner as if the Contractor and such Affiliates were engaged in the business of selling tangible personal property for use in Connecticut and had sufficient nexus under the provisions of Chapter 219 to be required to collect Connecticut use tax;

2. A customer's payment of a use tax to the Contractor or its Affiliates relieves the customer of liability for the use tax;
  2. The Contractor and its Affiliates shall remit all use taxes they collect from customers on or before the due date specified in the Agreement, which may not be later than the last day of the month next succeeding the end of a calendar quarter or other tax collection period during which the tax was collected;
  3. The Contractor and its Affiliates are not liable for use tax billed by them but not paid to them by a customer; and
  3. Any Contractor or Affiliate who fails to remit use taxes collected on behalf of its customers by the due date specified in the Agreement shall be subject to the interest and penalties provided for persons required to collect sales tax under chapter 219 of the general statutes.
- B. For purposes of this section of the Agreement, the word "Affiliate" means any person, as defined in Section 12-1 of the Connecticut General Statutes, that controls, is controlled by, or is under common control with another person. A person controls another person if the person owns, directly or indirectly, more than ten percent of the voting securities of the other person. The word "voting security" means a security that confers upon the holder the right to vote for the election of members of the board of directors or similar governing body of the business, or that is convertible into, or entitles the holder to receive, upon its exercise, a security that confers such a right to vote. "Voting security" includes a general partnership interest.
- C. The Contractor represents and warrants that each of its Affiliates has vested in the Contractor plenary authority to so bind the Affiliates in any agreement with the State of Connecticut. The Contractor on its own behalf and on behalf of its Affiliates shall also provide, no later than 30 days after receiving a request by the State's contracting authority, such information as the State may require to ensure, in the State's sole determination, compliance with the provisions of Chapter 219 of the Connecticut General Statutes, including, but not limited to, §12-411b.

#### ARTICLE 48. SOVEREIGN IMMUNITY

Nothing in the Agreement shall be construed as a modification, compromise or waiver by the State of any rights or defenses of any immunities provided by Federal law or the laws of the State of Connecticut to the State or any of its officers and employees, which they may have had, now have or will have with respect to all matters arising out of the Agreement. To the extent that this section conflicts with any other section, this section shall govern.

#### ARTICLE 49. PUBLICITY

The Contractor shall refer all inquiries and requests for information regarding the Contractor's task or any other aspect of the work to the State. The Contractor shall refrain from divulging any information whatsoever unless

authorized to do so by the State.

ARTICLE 50. NONDISCRIMINATION CLAUSE

"Non-discrimination. References in this section to "contract" shall mean this Agreement.

(a) For purposes of this Section, the following terms are defined as follows:

- i. "Commission" means the Commission on Human Rights and Opportunities;
- ii. "Contract" and "contract" include any extension or modification of the Contract or contract;
- iii. "Contractor" and "contractor" include any successors or assigns of the Contractor or contractor;
- iv. "gender identity or expression" means a person's gender-related identity, appearance or behavior, whether or not that gender-related identity, appearance or behavior is different from that traditionally associated with the person's physiology or assigned sex at birth, which gender-related identity can be shown by providing evidence including, but not limited to, medical history, care or treatment of the gender-related identity, consistent and uniform assertion of the gender-related identity or any other evidence that the gender-related identity is sincerely held, part of a person's core identity or not being asserted for an improper purpose.
- v. "good faith" means that degree of diligence which a reasonable person would exercise in the performance of legal duties and obligations;
- vi. "good faith efforts" shall include, but not be limited to, those reasonable initial efforts necessary to comply with statutory or regulatory requirements and additional or substituted efforts when it is determined that such initial efforts will not be sufficient to comply with such requirements;
- vii. "marital status" means being single, married as recognized by the state of Connecticut, widowed, separated or divorced;
- viii. "mental disability" means one or more mental disorders, as defined in the most recent edition of the American Psychiatric Association's "Diagnostic and Statistical Manual of Mental Disorders", or a record of or regarding a person as having one or more such disorders;
- ix. "minority business enterprise" means any small contractor or supplier of materials fifty-one percent or more of the capital stock, if any, or assets of which is owned by a person or persons: (1) who are active in the daily affairs of the enterprise, (2) who have the power to direct the management and policies of the enterprise, and (3) who are members of a minority, as such term is defined in subsection (a) of Connecticut General Statutes § 32-9n; and
- x. "public works contract" means any agreement between any individual, firm or corporation and the State or any political subdivision of the State other than a municipality for construction, rehabilitation, conversion, extension, demolition or repair of a public building, highway or other changes or improvements in real property, or which is financed in whole or in part by the State, including, but not limited to, matching expenditures, grants, loans, insurance or guarantees.

For purposes of this Section, the terms "Contract" and "contract" do not include a contract where each contractor is (1) a political subdivision of the state, including, but not limited to, a municipality, (2) a quasi-public agency, as defined in Conn. Gen. Stat. Section 1-120, (3) any other state,

including but not limited to any federally recognized Indian tribal governments, as defined in Conn. Gen. Stat. Section 1-267, (4) the federal government, (5) a foreign government, or (6) an agency of a subdivision, agency, state or government described in the immediately preceding enumerated items (1), (2), (3), (4) or (5).

- (b)(1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, mental retardation, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such Contractor that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or of the State of Connecticut; and the Contractor further agrees to take affirmative action to insure that applicants with job-related qualifications are employed and that employees are treated when employed without regard to their race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, mental retardation, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by the Contractor that such disability prevents performance of the work involved; (2) the Contractor agrees, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, to state that it is an "affirmative action-equal opportunity employer" in accordance with regulations adopted by the Commission; (3) the Contractor agrees to provide each labor union or representative of workers with which the Contractor has a collective bargaining Agreement or other contract or understanding and each vendor with which the Contractor has a contract or understanding, a notice to be provided by the Commission, advising the labor union or workers' representative of the Contractor's commitments under this section and to post copies of the notice in conspicuous places available to employees and applicants for employment; (4) the Contractor agrees to comply with each provision of this Section and Connecticut General Statutes §§ 46a-68e and 46a-68f and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes §§ 46a-56, 46a-68e and 46a-68f; and (5) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor as relate to the provisions of this Section and Connecticut General Statutes § 46a-56. If the contract is a public works contract, the Contractor agrees and warrants that he will make good faith efforts to employ minority business enterprises as subcontractors and suppliers of materials on such public works projects.
- (c) Determination of the Contractor's good faith efforts shall include, but shall not be limited to, the following factors: The Contractor's employment and subcontracting policies, patterns and practices; affirmative advertising, recruitment and training; technical assistance activities and such other reasonable activities or efforts as the Commission may prescribe that are designed to ensure the participation of minority business enterprises in public works projects.
- (d) The Contractor shall develop and maintain adequate documentation, in a manner prescribed by the Commission, of its good faith efforts.
- (e) The Contractor shall include the provisions of subsection (b) of this Section in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions including sanctions for noncompliance in accordance with Connecticut General Statutes §46a-56; provided if such Contractor becomes involved in, or is threatened

with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter.

(f) The Contractor agrees to comply with the regulations referred to in this Section as they exist on the date of this Contract and as they may be adopted or amended from time to time during the term of this Contract and any amendments thereto.

(g) (1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of sexual orientation, in any manner prohibited by the laws of the United States or the State of Connecticut, and that employees are treated when employed without regard to their sexual orientation; (2) the Contractor agrees to provide each labor union or representative of workers with which such Contractor has a collective bargaining Agreement or other contract or understanding and each vendor with which such Contractor has a contract or understanding, a notice to be provided by the Commission on Human Rights and Opportunities advising the labor union or workers' representative of the Contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment; (3) the Contractor agrees to comply with each provision of this section and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes § 46a-56; and (4) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor which relate to the provisions of this Section and Connecticut General Statutes § 46a-56.

(h) The Contractor shall include the provisions of the foregoing paragraph in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions including sanctions for noncompliance in accordance with Connecticut General Statutes § 46a-56; provided, if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter."

#### ARTICLE 51. AUDIT AND INSPECTION OF PLANTS, PLACES OF BUSINESS, AND RECORDS

- A. The State and its agents, including, but not limited to, the Connecticut Auditors of Public Accounts, Attorney General and State's Attorney and their respective agents, may, at reasonable hours, inspect and examine all of the parts of the Contractor's and Contractor's Parties' plants and places of business which, in any way, are related to, or involved in, the performance of this Agreement.
- B. The Contractor shall maintain, and shall require each of the Contractor Parties to maintain, accurate and complete Records. The Contractor shall make all of its and the Contractor Parties' Records available at all reasonable hours for audit and inspection by the State and its agents.
- C. The State shall make all requests for any audit or inspection in

writing and shall provide the Contractor with at least twenty-four (24) hours' notice prior to the requested audit and inspection date.

If the State suspects fraud or other abuse, or in the event of an emergency, the State is not obligated to provide any prior notice.

- D. The Contractor shall keep and preserve or cause to be kept and preserved all of its and the Contractor Parties' Records until three (3) years after the latter of (i) final payment under this Agreement, or (ii) the expiration or earlier termination of this Agreement, as the same may be modified for any reason. The State may request an audit or inspection at any time during this period. If any Claim or audit is started before the expiration of this period, the Contractor shall retain or cause to be retained all Records until all Claims or audit findings have been resolved.
- E. The Contractor shall cooperate fully with the State and its agents in connection with an audit or inspection. Following any audit or inspection, the State may conduct and the Contractor shall cooperate with an exit conference.
- F. The Contractor shall incorporate this entire Section verbatim into any contract or other agreement that it enters in to with any Contractor Party.

#### ARTICLE 52. AGENT FOR SERVICE OF PROCESS

The Secretary of the State of the State of Connecticut is hereby appointed by the Contractor as its agent for service of process for any action arising out or as a result of this Agreement, such appointment to remain in effect throughout the life of this Agreement including any supplements hereto and all renewals thereof, if any, and six (6) years thereafter.

#### ARTICLE 53. STATE COMPTROLLER SPECIFICATIONS

In accordance with Conn. Gen. Stat. § 4d-31, this Agreement is deemed to have incorporated within it, and the Contractor shall deliver the Goods and Services in compliance with, all specifications established by the State Comptroller to ensure that all policies, procedures, processes and control systems, including hardware, software and protocols, which are established or provided by the Contractor or Contractor Parties, are compatible with and support the State's core financial systems, including but not limited to, accounting, payroll, time and attendance, and retirement systems.

#### ARTICLE 54. RIGHTS TO AND INTEGRITY OF PUBLIC RECORDS

In accordance with Conn. Gen. Stat. § 4d-34, (a) neither the Contractor nor Contractor's Parties shall have any Title in or to (1) any public records which the Contractor or Contractor's Parties possess, modify or create pursuant to a contract, subcontract or amendment to a contract or subcontract, or (2) any modifications by such contractor, subcontractor, employee or agent to such public records; (b) neither the Contractor nor Contractor's Parties shall impair the integrity of any public records which they possess or create; and (c) public records which the Contractor or Contractor's Parties possess, modify or create pursuant to this Agreement or other contract, subcontract or amendment to a contract or subcontract shall at all times and for all purposes remain the property of the State. For purposes of this section, "public records" shall have the meaning set forth in Conn. Gen. Stat. § 4-33, as it may be modified from time to time.

#### ARTICLE 55. PUBLIC RECORDS AND FOIA

In accordance with Conn. Gen. Stat. § 4d-35, any public record which a state agency provides to the Contractor or Contractor's Parties shall remain a public record for the purposes of subsection (a) of section 1-210 and as to such public records, the State, the Contractor and Contractor's Parties shall have a joint and several obligation to comply with the obligations of the state agency under the Freedom of Information Act, as defined in section 1-200, provided that the determination of whether or not to disclose a particular record or type of record shall be made by such state agency.

#### ARTICLE 56. DISCLOSURE OF PUBLIC RECORDS

In accordance with Conn. Gen. Stat. § 4d-36, neither the Contractor nor Contractor's Parties shall disclose to the public any public records (a) which they possess, modify or create pursuant to this Agreement or any contract, subcontract or amendment to a contract or subcontract and (b) which a state agency (1) is prohibited from disclosing pursuant to state or federal law in all cases, (2) may disclose pursuant to state or federal law only to certain entities or individuals or under certain conditions or (3) may withhold from disclosure pursuant to state or federal law. This provision shall not be construed to prohibit the Contractor from disclosing such public records to any Contractor's Parties to carry out the purposes of its subcontract. For purposes of this section, "public records" shall have the meaning set forth in Conn. Gen. Stat. § 1-200, as it may be modified from time to time.

#### ARTICLE 57. PROFITING FROM PUBLIC RECORDS

In accordance with Conn. Gen. Stat. § 4d-37, neither the Contractor nor Contractor's Parties shall sell, market or otherwise profit from the disclosure or use of any public records which are in their possession pursuant to this Agreement or any contract, subcontract or amendment to a contract or subcontract, except as authorized in this Agreement. For purposes of this section, "public records" shall have the meaning set forth in Conn. Gen. Stat. § 1-200, as it may be modified from time to time.



ARTICLE 58. CONTRACTOR'S OBLIGATION TO NOTIFY DAS CONCERNING PUBLIC RECORDS

In accordance with Conn. Gen. Stat. § 4d-38, if the Contractor or Contractor Parties learn of any violation of the provisions of Conn. Gen. Stat. §§ 4d-36 or 4d-37 they shall, no later than seven calendar days after learning of such violation, notify the Chief Information Officer of DAS of such violation.

ARTICLE 59. GENERAL ASSEMBLY ACCESS TO RECORDS

In accordance with Conn. Gen. Stat. § 4d-40, the Joint Committee on Legislative Management and each nonpartisan office of the General Assembly shall continue to have access to DAS records that is not less than the access that said committee and such offices have on July 1, 1997.

ARTICLE 60. CONTINUITY OF SYSTEMS

This Section is intended to comply with Conn. Gen. Stat. §4d-44.

- (a) The Contractor acknowledges that the Base System and associated services are important to the function of State government and that they must continue without interruption. Pursuant to Conn. Gen. Stat. §4d-44, if the work under the Agreement, any subcontract, or amendment to either, is transferred back to the State or to another contractor at any time for any reason, then the Contractor shall cooperate fully with the State, and do and perform all acts and things that CTDOT deems to be necessary or appropriate, to ensure continuity of state agency information system and telecommunication system facilities, equipment and services so that there is no disruption or interruption in performance as required or permitted in the Agreement. The Contractor shall not enter into any subcontract for any part of the performance under the Agreement without approval of such subcontract by DAS, as required by Conn. Gen. Stat. §4d-32, and without such subcontract including a provision that obligates the subcontractor to comply fully with Conn. Gen. Stat. §4d-44 as if the subcontractor were in fact the Contractor. The Contractor shall make a full and complete disclosure of and delivery to DAS or its representatives of all Records and "Public Records," as that term is defined in Conn. Gen. Stat. §4d-33, as it may be amended, in whatever form they exist or are stored and maintained and wherever located, directly or indirectly concerning the Agreement.
- (b) The parties shall follow the following applicable and respective procedures in order to ensure the orderly transfer to the State of:
  - (1) Such facilities and equipment: Unless a shorter period is necessary or appropriate to ensure compliance with subsection (a) above, in which case that shorter period shall apply, the Contractor shall deliver to CTDOT, F.O.B. Newington, Connecticut or other State location which CTDOT identifies, all facilities and equipment related to or arising out of the Agreement, subcontract or amendment, no later than 10 days from the date that the work under the Agreement is transferred back to the State or to another contractor for any reason. The Contractor shall deliver the facilities and equipment to CTDOT, during the CTDOT's business hours, in good working order and in appropriately protective packaging to ensure delivery without damage. Concurrent with this delivery, the Contractor shall also deliver all related operation manuals and other documentation in whatever form they exist and a list of all related passwords and security codes;
  - (2) All software created or modified pursuant to the Agreement,

subcontract or amendment: Unless a shorter period is necessary or appropriate to ensure compliance with subsection (a) above, in which case that shorter period shall apply, the Contractor shall deliver to CTDOT, F.O.B. Newington, Connecticut or other location which CTDOT identifies, all Deliverables, no later than 10 days from the date that the work under Agreement is transferred back to the State or to another contractor for any reason. The Contractor shall deliver such Deliverables to CTDOT, during CTDOT's business hours, in good working order, and if equipment shall be delivered, in appropriately protective packaging to ensure delivery without damage. Concurrent with this delivery, the Contractor shall also deliver all Deliverable-related operation manuals and other documentation in whatever form they exist, if delivery of such manuals and documentation is required by this Agreement, and a list of all Deliverable passwords and security codes; and

(3) All public records, as defined in Conn. Gen. Stat. §4d-33, which the Contractor or Contractor Parties possess or create pursuant to the Agreement, subcontract or amendment: Unless a shorter period is necessary or appropriate to ensure compliance with subsection (a) above, in which case that shorter period shall apply, the Contractor shall deliver to CTDOT, F.O.B. Newington, Connecticut or other State location which CTDOT identifies, all Public Records created or modified pursuant to the Agreement, subcontract or amendment and requested in writing by CTDOT (provided that Contractor may redact confidential information of Contractor, its personnel or third parties to the extent permitted by applicable law) no later than the latter of (1) the time specified in the section in this Agreement concerning Termination for the return of Public Records and (2) 10 days from the date that the work under the Agreement is transferred back to the State or to another contractor for any reason. The Contractor shall deliver to CTDOT those Public Records in electronic, magnetic or other intangible form in a non-proprietary format, such as, but not limited to, ASCII or TXT. The Contractor shall deliver to CTDOT, during CTDOT's business hours, those Public Records and a list of all applicable passwords and security codes, all in appropriately protective packaging to ensure delivery without damage.

- (c) If the Contractor employs former State employees, the Contractor shall facilitate the exercising of any reemployment rights that such State employees may have with the State, including, but not limited to, affording them all reasonable opportunities during the workday to interview for State jobs. The Contractor shall include language similar to this section in all of its contracts with its subcontractors and applicable Contractor Parties so that they are similarly obligated.

#### ARTICLE 61. PROTECTION OF CONFIDENTIAL INFORMATION

- (a) Contractor and Contractor Parties, at their own expense, have a duty to and shall protect from a Confidential Information Breach any and all Confidential Information which they come to possess or control, wherever and however stored or maintained, in a commercially reasonable manner in accordance with current industry standards.
- (b) Each Contractor or Contractor Party shall develop, implement and maintain a comprehensive data - security program for the protection of Confidential Information. The safeguards contained in such program shall be consistent with and comply with the safeguards for protection of Confidential Information, and information of a similar character, as set forth in all applicable federal and state law and written policy of DAS or State concerning the confidentiality of

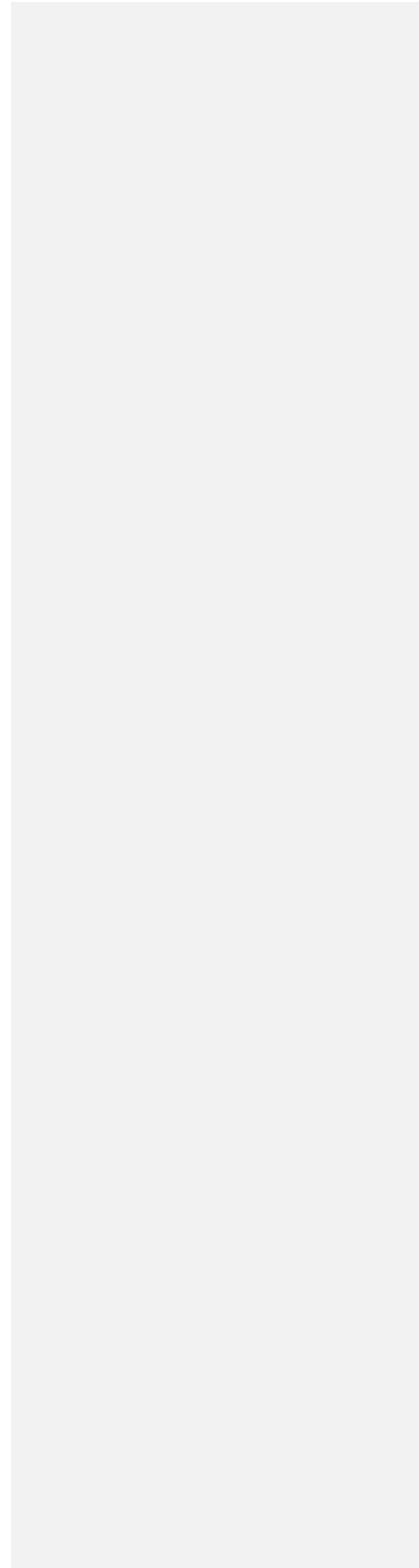
Confidential Information. Such data-security program shall include, but not be limited to, the following:

- (1) A security policy for employees related to the storage, access and transportation of data containing Confidential Information;
  - (2) Reasonable restrictions on access to records containing Confidential Information, including access to any locked storage where such records are kept;
  - (3) A process for reviewing policies and security measures at least annually;
  - (4) Creating secure access controls to Confidential Information, including but not limited to passwords; and
  - (5) Encrypting of Confidential Information that is stored on laptops, portable devices or being transmitted electronically.
- (c) The Contractor and Contractor Parties shall notify DAS, the Client Agency and the Connecticut Office of the Attorney General as soon as practical, but no later than twenty-four (24) hours, after they become aware of or suspect that any Confidential Information which Contractor or Contractor Parties have come to possess or control has been subject to a Confidential Information Breach. If a Confidential Information Breach has occurred, the Contractor shall, within three (3) business days after the notification, present a credit monitoring and protection plan to the Commissioner of Administrative Services, the Client Agency and the Connecticut Office of the Attorney General, for review and approval. Such credit monitoring or protection plan shall be made available by the Contractor at its own cost and expense to all individuals affected by the Confidential Information Breach. Such credit monitoring or protection plan shall include, but is not limited to reimbursement for the cost of placing and lifting one (1) security freeze per credit file pursuant to Connecticut General Statutes § 36a-701a. Such credit monitoring or protection plans shall be approved by the State in accordance with this Section and shall cover a length of time commensurate with the circumstances of the Confidential Information Breach. The Contractors' costs and expenses for the credit monitoring and protection plan shall not be recoverable from DAS, the Client Agency, any State of Connecticut entity or any affected individuals.
- (d) The Contractor shall incorporate the requirements of this Section in all subcontracts requiring each Contractor Party to safeguard Confidential Information in the same manner as provided for in this Section.
- (e) Nothing in this Section shall supersede in any manner Contractor's or Contractor Party's obligations pursuant to HIPAA or the provisions of this Contract concerning the obligations of the Contractor as a Business Associate of Covered Entity.



# **New Fare Technologies System**

## Scope of Work





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# 1 Project Overview

## 1.1 General

These Contract Documents specify the requirements for the design, manufacture, fabrication, furnishing, assembly, testing, and installation of the New Fare Technologies System (NFTS) and related services for the Connecticut Department of Transportation, [doing business as](#) [\(CTDOT\)](#). The NFTS project shall also support proof of payment fare collection for CTDOT's new Bus Rapid Transit Corridor, known as *CTfastrak*, serving downtown Hartford.

The Contractor shall provide the NFTS that is based on service-proven elements as defined herein. The Contractor shall provide materials that are new and free of defects, and which conform to the requirements of this Scope of Work.

## 1.2 Base System Description

The deployment of the NFTS will transform CTDOT's existing fare collection system from magnetic stripe technology to contactless smart cards and secure barcode media. The new system shall include:

- CTDOT-issued Long-Term Use Smart Cards, operating as account-based media.
- CTDOT-issued Limited Use Smart Cards, operating as card-based media.
- Barcode media for transfers, short-term fare products, and Proof of Payment receipts.
- A new Validating Farebox (VF) which shall accept coins, bills, contactless smart cards, barcode media, and magnetic media in both read-only and read/write mode forms. The Validating Farebox shall also dispense and accept machine-readable transfer documents.
- Stand Alone Processors (SAPs) which shall accept contactless smart card and barcode media, for use on vehicles where no Validating Farebox is installed.
- Non-registering Validating Fareboxes (NRFs), which shall accept and securely store cash fare payments, for use on vehicles where no Validating Farebox is installed.
- Cashbox vaulting and cash processing equipment as necessary to support the new Validating Fareboxes.
- A Central Data System (CDS) to manage the devices, collect transaction data, track fare media inventory, provide database reports, and other central data services.
- Garage Communications Servers (GCSs) to provide efficient data communications to and from the Validating Fareboxes and vaulting systems, and with the Central Data System.
- Platform Validators (PVs) to process smart card transactions on the *CTfastrak* platforms.
- Multi-Function Vending Machines (MVMs) to provide self-service kiosks to purchase paper-based barcode tickets, short-duration Limited Use Media smart card products, and to replenish accounts associated with CTDOT-issued Long-Term Smart Card Media.
- Contracted Retail Point of Sale (RPOS) services to provide smart card sales and account replenishment services via cash registers at third party retail outlets



- Three configurations of Administrative Point of Sale (APOS) Terminals to provide sales, replenishment, personalization (custom printing), and support and administrative functions for smart card accounts and media.
- Handheld Fare Inspection Terminals (HFITs) for contactless smart card and barcode media to support proof of payment fare inspections.
- Networking infrastructure at CTDOT and third party garage facilities to provide communications between the Garage Communications Server and on-board NFTS components.
- A series of Contractor-hosted web portals to allow customers, retailers, transit benefits coordinators, and CTDOT staff to interact with the CDS.
- Other services and support systems as described herein and as necessary for a modern fare collection system.

The NFTS shall support a variety of fare policies (as identified in Section 3) and all existing CTDOT operations. Contractor shall provide all hardware, software, firmware, services, processes and procedures to provide all functionality and meet all requirements as identified within these specifications.

### 1.3 Future System Capabilities to be Supported

As delivered, the NFTS shall provide hardware (but not software) to support additional capabilities should CTDOT choose to modify the NFTS to do so. These include:

- Contact and Contactless credit card transactions using bank-issued cards compliant with the Europay / MasterCard / Visa (EMV) standard
- Interfaces to provide integration of the Validating Farebox and SAP with other on-vehicle ITS systems (provided by Others, see ITS requirements in AGREEMENT Schedule G, including CAD/AVL, mobile Ethernet routers, and a shared operator control and display device (for single-point login). The Validating Farebox and Stand Alone Processor shall incorporate interfaces and hardware to permit this integration, including J-1708, RS-485 and/or RS-232 interface hardware. Software to provide for this operation shall not be required as part of the base Contract.

### 1.4 Acceptability of Equipment

The award of this Contract does not imply CTDOT's approval of any of the equipment or materials identified in the Contract Documents. The Contractor is responsible for furnishing a completely functional system as defined herein.

If, at any time during the design, testing, or prosecution of work under this Contract, it is found that Contractor-furnished equipment or materials do not meet the specifications herein or will not provide a fully functional fare collection system as described herein, the Contractor shall, at no additional expense to CTDOT, take any and all steps necessary to furnish an acceptable NFTS.



## 1.5 Business Requirements

The NFTS shall address CTDOT's current and long-term business needs. The NFTS shall:

- A. Be able to operate and meet all of CTDOT's needs as defined within this document
- B. Provide for an integrated, state-of-the-art electronic fare payment, distribution, collection and processing system utilizing smart card and mobile ticketing / barcode technology (mobile ticketing application supplied by others)
- C. Provide complete interoperability with the Ticket Vending Machine System (provided by Others) and its fare media
- D. Provide fare media interoperability with the existing farebox issued media during the transition period
- E. Be based on published, open standards, and employ an open architecture as defined herein
- F. Provide for complete traceability of all revenues and fare media used within NFTS
- G. Be deployable in a single phase but with flexibility to activate features at CTDOT's discretion
- H. Quickly and efficiently verify the validity of all presented fare media
- I. Substantially eliminate CTDOT's exposure to revenue losses, including losses due to the use of invalid fare media, fraudulent fare media, as well as valid fare media that does not contain enough stored value or an adequate pass for the selected trip
- J. Reduce dwell times and customer waiting by maximizing transaction speed and throughput at all fare collection devices
- K. Be adaptable to innovations specific to the transit, banking, and communications industries
- L. Provide efficient administration of transit benefits programs through CTDOT's Corporate Partners
- M. Be able to securely accommodate and process fare media offered and/or distributed by authorized third parties
- N. Optimize garage operations by providing high security, high throughput, and fully automated data transfer between fare collection devices and the Central Data System
- O. Interface, with minimal installation efforts, with CTDOT's existing vehicles and infrastructure, specifically vehicle dashboards and handrails and the physical conditions at CTDOT facilities
- P. Provide data to CTDOT's existing data and reporting systems for ridership, revenue and other operational needs, including for the production of historical reports
- Q. Accommodate ongoing CTDOT improvement programs/projects including construction of new facilities, communication system upgrades, information technology improvements, and changes to business processes
- R. Support all modes of transportation and the needs of all customer categories, including programs for specific types of customers

The Preliminary and Final Design Reviews shall include a review and assessment of the system's satisfaction of CTDOT's business requirements listed above. **CDRL 14-1**

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## 1.6 Project Schedule

The Contractor shall make all reasonable efforts to complete all work and provide a system that satisfies all requirements herein to CTDOT's satisfaction such that full NFTS deployment is achieved by the milestone dates provided within the AGREEMENT..

## 1.7 System Implementation

CTDOT is seeking to implement the NFTS on an aggressive schedule, and with a maximum degree of flexibility in how the new system is put into effect. ~~CTDOT recognizes that the NFTS will require the agency to adopt many new internal procedures and organizational modifications. CTDOT acknowledges that its customers may also see numerous changes in how they interact with the agency and pay their fares.~~

~~Wishing to balance its desire for rapid NFTS deployment with the realization that both CTDOT and its customers are limited in the rate at which change can be absorbed,~~ The Contractor shall plan and implement the NFTS to satisfy the following objectives:

- The Contractor shall design, develop, test, and install all elements of the NFTS as a single, coherent program, and make all aspects of the system functional and ready for revenue service in a single coordinated phase.
- The Contractor shall develop the NFTS so that CTDOT may activate features and fare policies independently and on a schedule defined by CTDOT. For example, CTDOT may wish to initially activate only floating period passes that have identical pricing and policies as the agency's existing magnetic stripe media, and introduce new stored value products at a later date. In any case, the Contractor shall install and make ready the entire NFTS in a single coordinated phase.
- Regardless of the number of features and capabilities active at any time, the NFTS shall satisfy all functional requirements of a modern fare collection system.

## 1.8 Equipment Quantities and Locations

### 1.8.1 Base System Equipment

~~Not including spare parts and other support peripherals, for the Base System for base NFTS contract NFTS is as specified in this Agreement, including this Scope of Work, and detailed in price proposal forms A through I.~~ The Contractor shall supply and install equipment and software, ~~and provide support services~~ as identified in ~~the price proposal forms and AGREEMENT Schedule F~~ the Agreement, including this Scope of Work. ~~The Base System is considered the specified equipment without inclusion of optional additional services or equipment.~~

### 1.8.2 Optional Equipment

~~Optional equipment, also referred to as Options, are as specified in this Agreement, including this Scope of Work, and detailed in price proposal forms 01 and 02.~~ If CTDOT exercises one or more ~~Options~~ for additional equipment ~~as permitted by the Agreement~~, the Contractor shall supply additional equipment, configured identically to all other NFTS equipment supplied under this ~~contract~~ Agreement.



## 1.9 Definitions

Wherever in these Contract Documents the following terms and abbreviations are used, the intent and meaning shall be interpreted as follows:

Accuracy – The measurement of the fare collection system's precision in accounting for monies collected and dispensed, and the system's precision in collecting and reporting transaction, event, and other forms of data.

Action List – A list of unique card serial numbers that have been determined to be invalid or unacceptable, or require certain defined actions upon presentation to any NFTS device.

Autoload – A replenishment transaction to a smart card, or a modification of data encoded to a smart card, which is conducted as part of a usage transaction, paid for or directed by means usually associated with an on-line or direct interaction with a central computer system.

Availability – The time or rate, usually expressed as a percentage, that a device or system is fully operational.

Bankcard – A credit or debit card issued by a bank or financial institution.

Baseline Design – The design of the Fare Collection System or any of its components, apparatus, systems, subsystems, or materials that have received both drawing approval and First Article approval by the Contracting Officer.

Cable – A wire or group of wires contained within an overall insulating covering. Cable may also be referred to as multi-conductor cable or cable harness.

CTDOT – ~~The Connecticut Department of Transportation. The Authority that operates fixed route public transit service, and that will operate the NFTS.~~ The numbered items that begin with this acronym are the documents to be provided by the Contracting Officer to the Contractor.

Comment – Written critiques of the Contractor's submittals to the Contracting Officer.

Component – Any device having distinct electrical or mechanical characteristics and having connection points to be connected to other components to form a subassembly.

Contract Deliverables Requirement List (CDRL) – Items to be provided by the Contractor to the Contracting Officer as defined by these Contract Documents.

Contract Drawings – Drawings provided as part of or as required by the Contract Documents.

Contracting Officer ~~(CTDOT)~~ – The individual designated by the CTDOT responsible for administering and managing this contract.

Contractor's Drawings – Items such as detail drawings, graphs, diagrams, and sketches that are prepared by the Contractor to detail its work.

Days – Unless otherwise designated, days as used in the Contract Documents shall be understood to mean calendar days.

Days, Working – Normal business working days, Monday through Friday, exclusive of holidays. Office holidays are New Year's Day, Martin Luther King, Jr. Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving, Christmas Day, or days so celebrated.

Dormant Account – A smart card account that has had no transaction activity for a CTDOT-adjustable extended period of time, initially set to 2 years. If the account has no previous transaction history, the card issue or account set-up date shall be used to determine dormancy. The fare collection equipment shall deny attempts to use such cards.



**Equal** – Whenever the words “equal” or “approved equal” are used in connection with make or quality of material or equipment in these Contract Documents, the Contracting Officer’s decision as to whether any material or equipment proposed is equal to that specified shall be binding and final on both the Contractor and CTDOT.

**Factory Acceptance Tests** – A series of tests conducted at the Contractor’s facility using approved First Article devices. Factory Acceptance Tests are independent, unit tests conducted on each NFTS device and subsystem, and designed to confirm that all hardware and software will function as required herein.

**Factory Integration Test** – A test conducted at the Contractor’s facility to confirm that when installed, the complete NFTS will function as designed. The Factory Integration Test occurs after successful completion of all Factory Acceptance Tests.

**Failure** – An event leading to the inability of a component or equipment to function or perform its intended function as designed or specified.

**Failure Rate** – The frequency of failure, expressed as failures per unit of time (in days) or failures per number of cycles (number of transactions). Failure rate is the mathematical reciprocal of MTBF and MCBF.

**First Article** – The first one of any production component of the NFTS Equipment that is produced. All First Article devices shall be made and programmed according to CTDOT-approved drawings and design documents submitted by the Contractor at the Final Design Review.

**First Article Configuration Inspection (FACI)** – An inspection of the First Article in the factory to confirm that it complies with the approved design. For the inspection, the First Article need not be a functional device. All Factory Acceptance Tests shall use approved First Article units.

**Fleet Defect** - When the same hardware failure is observed in a given component or device in 10% of an NFTS device type (e.g., Validating Farebox, Administrative [Point of Sale \(POS\)](#)) within the warranty period.

**Independent Failure** – A failure that is not the result of another failure, either directly or indirectly.

**Indicated** – As used in the Contract Documents, “indicated” shall be understood to mean, “as shown in the Contract Drawings,” or “as described in the Contract Documents.”

**Interface** – The points where two or more systems, subsystems or structures meet and transfer energy, data or information.

**Lowest Level Replaceable Unit** – The lowest unit (component) of a device that is removable and replaceable from an installed position by standard attachments (e.g., bolts and nuts, quick disconnects), including units such as printed circuit boards, displays, keypads, wiring harnesses, and complete electromechanical assemblies sold by the Contractor or OEM suppliers as spare parts, etc.

**Maintainability** – The ability of the NFTS to be maintained by CTDOT’s maintenance staff, including enhancement of access to equipment and components that require maintenance.

**Mean Cycles Between Failures (MCBF)** – The mean number of operating cycles between successive independent failures.

**Mean Time Between Failures (MTBF)** – The mean operating time interval between successive independent failures.



**Modular** – Composed of standardized, interchangeable units, designed to facilitate maintenance and repair.

**Module** – A standardized, interchangeable unit, designed to facilitate maintenance and repair.

**Non-Relevant Failure** – A malfunction caused by conditions external to the machine or subsystem or caused by out of scope conditions. Non-relevant failures include:

- Accident, vandalism, maintenance errors, bent coins, and customer error
- Failure of expendable items that have exceeded specified life
- Dependent or secondary failures resulting from an independent or primary failure

**Operating Cycle** – A complete transaction for any NFTS patron device, taken from the perspective of the user. For example, a complete fare payment or a complete purchase transaction. Transactions involving dispensing multiple products or repeated use of a single product shall be considered one transaction. For other NFTS devices (such as Farebox Vaulting Systems), an operating cycle shall be a complete discrete operation of the device (such as the vaulting of a cashbox).

**Pass** – A fare product valid for unlimited rides within a designated time period (e.g., a specified number of hours, day, number of consecutive days, or a specified calendar period).

**Payment Card Industry Data Security Standard (PCI DSS)** – The definitive security standard and regulations for merchant processing of bankcards, presently version 3.0. See:

[https://www.pcisecuritystandards.org/security\\_standards/](https://www.pcisecuritystandards.org/security_standards/)

**Payment Application Data Security Standard (PA DSS)** - Applies to software vendors and others who develop payment applications that store, process, or transmit cardholder data as part of authorization or settlement, where these payment applications are sold, distributed, or licensed to third parties.

**Pilot Test** – A test of all functionality of the fully installed NFTS, but limited to selected users. The Pilot Test will occur after the System Integration Test, and is intended to further verify NFTS functionality, and verify CTDOT's readiness and exercise all CTDOT procedures and operations.

**Product Data** – Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, instructions, warnings and other information furnished by the Contractor to illustrate or explain the fabrication, assembly, installation, maintenance or operation of materials, equipment, or some portion of the work.

**Proof** (used as a suffix) – Apparatus is designated as dustproof, waterproof, etc., when so constructed, protected, or treated that its successful operation is not interfered with when subjected to the specified material or condition.

**Relevant Failure** – A malfunction that prevents a fare collection device or computer system from performing its intended function with the performance criteria specified. Relevant failures include: verified failures including intermittent failures, not excluded under non-relevant failure types; and failures due to design errors or manufacturing defects.

**Reliability** – The probability of performing a specified function without failure and within design parameters for the period of time or the number of cycles specified under service conditions.

**Revenue Service Test** – A test to occur during the initial full-public use of the NFTS, intended to verify NFTS reliability, availability, and accuracy.





-Safe/Safety – The condition in which persons are free from threat or danger, harm, or loss arising from improper design, manufacture, assembly, malfunction, or failure of the fare collection system or any of its components or elements.

Section – In this document, references to a “Section” are specific to a section and all associated subsections to that section.

Service-Proven – Identical or near identical equipment which has demonstrated successful operation in a transit industry environment similar to that anticipated for CTDOT.

Shop Drawings – Drawings or sketches prepared by the Contractor for use in its manufacturing facility, assembly facility, or shop, to fabricate, assemble, and/or install parts of the Fare Collection System, whether manufactured by it from raw materials or purchased from others in a ready-to-use condition.

Smart Card – An ISO/IEC 14443 compliant contactless card of the same dimensions as a standard credit card. The smart card includes a microprocessor executing specialized application software, Non-Volatile Random Access Memory, Read Only Memory, and a radio frequency interface.

Subassembly – Two or more components combined into a unit for convenience in assembling or servicing equipment.

System Integration Test – A test of the complete, installed, and configured NFTS, ready for revenue service. The SIT is the final test prior to commencing revenue service and is intended to verify all NFTS functionality is ready for revenue service.

Tamperproof – Items are designated as tamperproof when they cannot be easily loosened, opened, or penetrated with commonly available tools such as a flat blade or Phillips screwdriver or pliers.

Ticket – A printed or displayed fare instrument.

Tight (used as a suffix) – Apparatus is designated as watertight, dust-tight, etc., when so constructed that the enclosing case shall exclude the specified material.

Time-Out – When a prescribed amount of time has elapsed during which a specified action has not occurred.

Transaction – See Operating Cycle.

Wire – A single insulated conductor of any size.

## 1.10 Abbreviations

ABA	American Bankers Association
ACH	Automated Clearing House
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AES	Advanced Encryption Standard
ANSI	American National Standards Institute
API	Application Program Interface
APOS	Administrative Point of Sale
ASCII	American Standard Code for Information Interchange
AVL	Automatic Vehicle Location
BDW	Barcode Decoding Workstation
BIN	Bank Identification Number



BTU	British Thermal Unit
C	Degrees Centigrade
CAD	Computer Aided Dispatch
CADD	Computer Aided Design and Drafting
CCID	Credit Card Identification
CDRL	Contract Deliverables Requirement List
CDS	Central Data System
CRC	Cyclic Redundancy Check
CSCP	Contactless Smart Card Processor
dB	Decibel
DES	Data Encryption Standard
ECU	Electronic Control Unit
EMI	Electromagnetic Interference
EMV	Europay / MasterCard / Visa
EPROM	Erasable Programmable Read-Only Memory
ERD	Entity Relationship Diagram
F	Degrees Fahrenheit
FACI	First Article Configuration Inspection
FDR	Final Design Review
FIFO	First In First Out
FIPS	Federal Information Processing Standard
FIT	Factory Integration Test
FRB	Failure Review Board
FTP	File Transfer Protocol
g/m <sup>2</sup>	Grams per square meter (used as unit of paper density)
GCS	Garage Communications Server
GPS	Global Positioning System
GTFS	Google® Transit Feed Specifications
GUI	Graphical User Interface
hr	Hour
Hz	Hertz
IC	Integrated Circuit
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAN	Local Area Network
lbs	Pounds
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LLRU	Lowest Level Replaceable Unit
LMS	Learning Management System
Mbps	Megabits per second
MCBF	Mean Cycles Between Relevant Failures
MIMO	Multiple Input Multiple Output
ms	milliseconds
MTBF	Mean Time Between Relevant Failures
MVM	Multi-Function Vending Machine
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFC	Near Field Communications
NFTS	New Fare Technologies System



NFPA	National Fire Protection Association
NTP	Notice to Proceed
OCM	Operator Control Module
ODBC	Open Data Base Connectivity
OEM	Original Equipment Manufacturer
OS	Operating System
OSHA	Occupational Safety and Health Administration
PA DSS	Payment Application Data Security Standards (PCI)
PAN	Primary Account Number
PC	Personal Computer
PCI	Payment Card Industry
PCI DSS	Payment Card Industry Data Security Standards
PDR	Preliminary Design Review
PIN	Personal Identification Number
PM	Preventive Maintenance
POS	Point of Sale
PRM	Progress Review Meeting
PROM	Programmable Read-Only Memory
HFIT	Handheld Fare Inspection Terminal
RAM	Random Access Memory
RDBM	Relational Database Manager
RFI	Radio Frequency Interference
ROM	Read-Only Memory
RPOS	Retail Point of Sale
RST	Revenue Service Test
SAE	Society of Automotive Engineers
SAP	Stand Alone Processor
SCCW	Smart Card Certification Workstation
SCORM	Shareable Content Object Reference Model
SIT	System Integration Test
SNMP	Simple Network Management Protocol
SSL	Secure Sockets Layer
SQL	Structured Query Language
UID	Unique Identification (Number)
UL	Underwriters Laboratories, Inc.
UPS	Uninterruptible Power Supply
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VM	Virtual Machine
WAN	Wide Area Network
YMCK	Yellow Magenta Cyan Black

## 1.11 Reference Standards

The NFTS design shall fully support and comply with all applicable local, state, and national codes, ordinances, statutes, standards, and federal rules and regulations existing at the time of Contract Award. The Contractor shall be responsible for identifying all codes, ordinances, statutes, standards, and federal rules and regulations applicable to NFTS at the time of Contract Award. This information and an explanation of how the NFTS equipment meets these requirements shall be provided at the Preliminary Design Review. **CDRL 1-2**



At the Final Design Review, the Contractor shall identify any standards relevant to the NFTS for which an update has been published since Contract Award. For all such updated standards, the Contractor shall submit an analysis of the update's impact on the NFTS and an estimated cost to comply with the updated standard. **CDRL 1-3**

Until Final Acceptance of the entire project, the Contractor shall be responsible for identifying all relevant changes to all applicable codes and laws, and notifying CTDOT of the changes and their impact on the project.

The Contractor shall design the NFTS to be compliant with relevant standards to ensure that the NFTS:

- Presents no safety hazards for CTDOT's passengers and employees
- Will withstand the rigors of the environments in which the equipment will be installed, and the public use to which it will be subjected
- Provides for the secure storage and transmittal of data
- Is designed using state-of-the-art methods to maximize quality
- Satisfies federal, state, and other requirements for ergonomics and usability

The Contractor list for codes, ordinances, statutes, standards, and federal rules and regulations shall include, but not be limited to, the items below. The latest revision in effect for each standard at the time of NTP shall be used in conjunction with the Contract Documents.

- Americans with Disabilities Act (ADA)
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Advanced Encryption Standard
- ANSI X9.24, Financial Services Retail Key Management
- European Norm EN55022, Emissions standards for CE marking
- European Norm EN55024, Immunity standards for CE marking
- FCC Part 15 Class B – Radio Frequency Devices
- FIPS 140-2
- IEEE 802.11 b/g/n standard for wireless data communications
- IEEE 802.11i standard for wireless data network security
- International Electrotechnical Commission Standard 529 (IEC529)
- ISO/IEC 7810, Identification Cards – Physical Characteristics
- ISO 9001
- ISO/IEC-8583 – Financial transaction card originated messages
- ISO/IEC 14443 Parts 1 through 4 – Contactless Smart Card Standard
- ISO/IEC 18092 / ECMA-340, Near Field Communication Interface and Protocol-1
- ISO/IEC 21481 / ECMA-352, Near Field Communication Interface and Protocol-2
- National Electrical Code (NFPA 70)
- National Electrical Manufacturers Association Publication 250-2003
- National Electrical Safety Code (ANSI C2)
- National Fire Protection Association (NFPA) 130
- NCITS 322-2002, American National Standard for Information Technology – Card Durability Test Methods
- Occupational Safety and Health Administration (OSHA)
- Payment Card Industry Data Security Standards (PCI DSS)
- Payment Card Industry Payment Application Data Security Standards (PA DSS)
- Society of Automotive Engineers SAE J1113-13 Electrostatic Discharge



- Society of Automotive Engineers SAE J1455 Vibration and Shock
- UL Standard 60950, "Information Technology Equipment – Safety"
- World Wide Web Consortium, Mobile Web Application Best Practices
- Web Content Accessibility Guidelines (WCAG)

In the case of conflict between provisions of codes, laws, and ordinances, the more stringent requirement shall apply.



## 2 System Design Requirements

This Scope of Work defines the requirements for the design, manufacture, fabrication, furnishing, assembly, testing, inspection, and installation of NFTS for CTDOT.

### 2.1 General Requirements

The NFTS design shall support the ability to be deployed across all modes of transportation operated by CTDOT. The system shall be an integrated, electronic fare payment and collection system utilizing smart payment media. All equipment shall:

- Be ergonomic, aesthetically pleasing and designed and constructed in a manner that is easy to use, functional, and safe
- Be ADA compliant
- Facilitate easy access by authorized service and maintenance personnel
- Prevent any unauthorized access to machine components
- Be robust and suitable for non-stop continuous operation in a public transportation environment
- Provide full accountability and auditing of all transactions to a level of accuracy defined herein

Excluding hardware and software identified herein supplied by CTDOT (such as some networking infrastructure), the Contractor shall furnish all hardware, software and services necessary for the NFTS, which shall include all elements described in Section 1.2.

The Contractor shall deliver a NFTS for CTDOT to deploy across all modes of transportation operated by CTDOT, including fixed route bus and bus rapid transit services.

The Contractor shall be responsible for the design, installation, and testing of the Central Data System (CDS). The CDS shall monitor and control the functionality of all NFTS equipment, as well as to collect, store and report data. The CDS shall be the sole data repository for all NFTS transactions. Through file import/export, Application Program Interfaces (APIs), and Structured Query Language queries, the CDS shall also interface with CTDOT's existing legacy systems.

The Contractor shall supply, install, and configure hardware for Garage Communications Servers (GCS) at each garage facility. The Contractor shall design, install, configure, and test all GCS application software onto the GCS.

### 2.2 Design Life

Excluding handheld devices, NFTS equipment and associated software furnished under this Contract shall be designed to provide a minimum usable life of no less than 12 years. The design shall be capable of incorporating technology upgrades without redesign of components or modules, extensive software revisions or other similar excesses.

### 2.3 Prior Service Performance

Design of all equipment of the NFTS shall be identical to or derived from existing designs or fully functional prototypes slated for an operating environment equal to or more severe than



experienced in CTDOT's service area. Prior performance in a controlled environment is insufficient.

## 2.4 Supply and Availability

At the time of delivery, NFTS equipment, and all associated components and software shall contain no non-standard, prototype, obsolete or discontinued products.

## 2.5 Nonproprietary Technology

The NFTS shall be designed employing open standards and provide CTDOT with the necessary software and interfaces to operate their system without the need for intervention by the Contractor.

- A. Media – Smart card media shall be available for competitive purchase by CTDOT from multiple U.S. sources. The Contractor shall provide specifications and associated documentation necessary to support future CTDOT procurement of new smart card media. Either such specifications and associated documentation shall become the property of CTDOT, or the information shall be conveyed under a perpetual license as defined in the Software License Agreement accompanying this contract. **CDRL 2-1**
- B. Media Encoding Schema –The media encoding schema (*i.e.*, how data is stored on the media, the associated security algorithms/keys, and card/reader authentication schemes and other information, processes and data) shall be defined and documented by the Contractor, reviewed and approved by CTDOT at the Preliminary and Final Design Reviews as consistent with best practices. Either such specifications and associated documentation shall become the property of CTDOT, or the information shall be conveyed under a perpetual license as defined in the Software License Agreement accompanying this contract. .
- C. Equipment and System Interfaces – The equipment and system interfaces shall be defined and documented and shall be licensed to CTDOT for use and distribution as CTDOT sees fit for NFTS operation and future enhancement and expansion.

## 2.6 Materials and Workmanship

The Fare Collection System shall be constructed of the highest quality materials suitable for trouble-free use in the intended environment. The Contractor shall be responsible for all materials and workmanship. It is the Contractor's responsibility to design, select, and apply all materials and workmanship to meet the requirements in the Contract Documents. Where alternate materials are offered, it is the responsibility of the Contractor to demonstrate the alternate materials are equivalent to the specified materials and to gain CTDOT's approval for the substitution.

Housings for the Fare Collection Equipment shall have an attractive, finished appearance. No protruding screws, fasteners, or sharp edges shall be permitted on the exterior of the enclosures. All exposed fasteners shall be stainless steel. All fasteners accessible to the public shall be an approved tamper-proof design. All exposed edges shall be neatly rounded with no sharp edges or points.

Internal component arrangement shall be neat, with access for service. Wiring shall be run in cables secured to supports.



No self-tapping screws shall be used in areas where disassembly can normally be expected more frequently than once in every three years.

Paints, plastics, graphic panels, display covers, and light lenses shall be resistant to fading and ultraviolet light.

All internal fasteners that are not stainless steel shall be corrosion resistant. All external hinges, latches and locks shall be stainless steel. All materials subject to corrosion shall be painted or plated. The coating method shall prevent corrosion for the life of the equipment. Dissimilar metals in contact shall be treated to prevent electrolytic corrosion at the contact areas.

## 2.7 Environmental Conditions

All NFTS equipment shall provide continuous reliable operation in revenue service under environmental conditions experienced where the equipment is installed in all metropolitan regions served by CTDOT.

### 2.7.1 On-Board Equipment

On-board NFTS equipment will be within an environmentally conditioned environment when a vehicle is in revenue service, but not at other times.

Contractor-supplied on-board equipment shall remain operational to meet the specified technical requirements in the presence of contaminants, including but not be limited to any airborne particles (including dust generated by brakes, wheels, and rails), greases, and oils.

At minimum, contractor-supplied on-board NFTS equipment shall provide ingress protection compliant with International Electrotechnical Commission Standard 529 (IEC529) to level IP54 or equivalent.

#### A. Local Climate

The following list is intended to reflect the extremes possible inside CTDOT's vehicles. All Contractor-designed NFTS on-board equipment shall tolerate the environment in which it is installed. The equipment on the vehicle shall not suffer any degradation in performance under the following environmental conditions:





Table 2.7.12-7.1: On-Board Equipment Operating Environment

Characteristic	Operating Condition
Sunlight	None to full, direct behind a glass windshield Maximum solar radiation: 250 BTU/hr/ft <sup>2</sup>
Storage Temperature	-22°F to + 140°F
Operating Temperature	4°F to + 110°F (ambient)
Thermal Shock	Up to 50°F in 1 hour (non-condensing)
Relative Humidity	13% to 95% relative humidity at maximum 104°F, non-condensing
Shock & Vibration	As identified below
Airborne Dust	Up to 180 micrograms per cubic meter, with iron and salt particles
Inclination	0° to 10° off vertical
Water/solvents	Water spray on equipment from cleaning floors and walls, industrial cleaning solvents and standard cleaning chemicals used by CTDOT, rain, mud, snow and slush will come in contact with equipment. (CTDOT acknowledges that polycarbonate display windows may be affected by some cleaning chemicals.)

**B. Electromagnetic Interference**

EMI and RFI radiating from equipment on the vehicle, including vehicle propulsion, radio, lights, electronic destination signs, air conditioners, and generators shall not affect the operation of the NFTS equipment.

**C. Rain, Moisture & Humidity**

As a result of Customer boarding in rainy and humid conditions, on-board equipment will be subject to incidental moisture. The equipment shall function and not suffer any degradation of operation under these conditions.

Vehicle cleaning operations often result in the use of water and detergent sprays. If on-board equipment is intolerant of such activity, the Contractor shall supply a removable protective cover for each device at no additional cost to CTDOT.

**D. Shock and Vibration**

Contractor-supplied on-board NFTS equipment shall comply with SAE J1455 for shock and vibration.

**2.7.2 Platform Equipment**

NFTS equipment installed on *CTfastrak* platforms and other exterior locations (including Platform Validators and Multi-Function Vending Machines), *at CTDOT's sole discretion*, may be installed with no shelter provided over the equipment. Platform equipment shall be designed and be capable of operating or being stored without shelter under the conditions specified in Table 2.7.2. Although solar radiation will cause cabinet exterior and interior temperatures to rise considerably above ambient, all internal components shall continue to operate normally at elevated machine enclosure temperatures. If fans or other active methods are required to



maintain suitable internal operating temperatures, such devices shall be thermostatically controlled to operate only when needed.

Coin, bill, ticket, and other openings and enclosure joints will be subject to wind-driven rain and shall be designed to assure proper operation of the equipment under such adverse conditions. All exposed surfaces including the push buttons, display screen, and coin and bill components shall be unaffected by detergents and cleaning solvents used by CTDOT, including the infiltration of such materials into the machine as caused by using a sponge or brush to hand clean the unit. Means shall be provided to expel moisture within the platform devices to assure continued, reliable operation. Ticket stock shall be maintained in condition for proper feed and printing.

Airborne particulates shall not affect the operation of the platform equipment.

Platform equipment finish, graphics panels, and all surfaces, including lettering, maps, and other information displayed on the equipment shall be resistant to ultraviolet radiation and air contaminants.

The following list is intended to reflect the extremes possible in the CTDOT operating region. All Contractor-designed NFTS platform equipment shall tolerate the environment in which it is installed and stored. The equipment on the platform and other exterior locations shall not suffer any degradation in performance under the following environmental conditions:

Table 2.7.2: Platform Equipment Operating Environment

Characteristic	Operating Condition
Sunlight	Maximum solar radiation: 300 BTU/hr/ft <sup>2</sup>
Storage Temperature	20°F to + 140°F
Operating Temperature	-15°F to + 115°F (ambient)
Thermal Shock	Up to 30°F in 1 hour (non-condensing)
Relative Humidity	30% to 98%, non-condensing
Precipitation	Maximum rainfall rate: 6 inches per hour Maximum snowfall rate: 12 inches per hour Rain may include freezing rain. Rain or snow may occur simultaneously with worst case wind.
Wind	Maximum sustained for 1 minute: 75 mph Maximum gusting: 125 mph
Airborne Dust	Up to 180 micrograms per cubic meter, with iron and salt particles
Platform Inclination	0° to 3° off vertical
Water/solvents	Water spray on equipment from cleaning floors and walls, industrial cleaning solvents and standard cleaning chemicals used by CTDOT, rain, mud, snow and slush will come in contact with equipment.



### 2.7.3 Handheld Equipment

Upon CTDOT acceptance of the proposed OEM handheld equipment, CTDOT acknowledges acceptance of all environmental performance characteristics of the approved device.

### 2.7.4 Facilities Equipment

NFTS equipment installed in CTDOT garage facilities will be sheltered from precipitation and direct sun, but may have no climate controls. Equipment installed in those locations shall operate in temperatures ranging from +20° to +110°F.

NFTS equipment installed in remote locations (such as along the CT*fastrak* right of way) may not be sheltered from precipitation or direct sun, and shall operate in all temperatures and conditions experienced in the Hartford, CTDOT region.

### 2.7.5 Office and Retail Equipment

All NFTS equipment installed in office and other indoor locations which are not subject to the rigors of the elements, such as Point of Sales Terminals, shall be able to properly function and not suffer any degradation of performance under the following conditions:

Table 2.7.5: Office and Retail Equipment Operating Environment

Characteristic	Operating Condition
Storage Temperature	25°F to + 110°F
Operating Temperature	40°F to + 95°F (ambient)
Thermal Shock	Up to 30°F in 1 hour (non-condensing)
Relative Humidity	20% to 95% relative humidity non-condensing
EMI	FCC Part 15, Subpart B Class A
Airborne Dust	Up to 75 micrograms per cubic meter, typical to a business office environment
Inclination	0° to 15° off vertical
Water/solvents	Incidental water spray on equipment from cleaning floors and walls, industrial cleaning solvents and standard cleaning chemicals used by CTDOT

## 2.8 Data Security

The NFTS shall provide CTDOT with a complete, high-security system for control of revenues.

- A. The Contractor shall conduct an analysis of security features of the system at each design review, at each phase of implementation, as well as prior to presentation of the system for final acceptance, and notify CTDOT of any potential exposure in system design. The Contractor may submit documentation from previous security reviews, but CTDOT reserves the right to require additional security measures to address any identified deficiencies.



- B. In the event security is compromised at any time during the design, development, installation, and testing stages of the system, the Contractor shall immediately inform CTDOT as soon as the condition is detected.
- C. The Contractor shall ensure that all system passwords shall be safeguarded, encrypted and resettable under CTDOT control, and that no "back doors" or means of unauthorized entry are included in the system design.
- D. The ability to remove or add authorized users shall be restricted to designated users with the highest level of security clearance. Additional password authorization shall be required to perform this function. At no time shall any password be displayed on any screen in the NFTS.
- E. The NFTS shall employ the highest levels of security for all transaction types. For all electronic forms of revenue and transactions, the NFTS equipment and system elements (including communications) shall be fully compliant with the Data Security Standard of the Payment Card Industry (PCI DSS). The NFTS shall ensure that all transactional data, including but not limited to, that associated with credit card and debit card transactions, are secure and available to only valid users with the proper security clearance.
- F. Regardless of the payment method, transaction type, fare media used, or device involved, all NFTS transactions shall be individually recorded, and PCI DSS-compliant transactional information transmitted to the CDS. Information for each transaction record shall include all pertinent data to permit a complete reconstruction of the transaction and thorough detailed device level audits.
- G. All CTDOT-issued smart cards and all barcode media shall incorporate the highest levels of data security practical. For smart cards, all data and card-to-reader communications shall be encrypted using no less than 128-bit encryption keys required to perform this function.
- H. The Contractor shall develop an NFTS Security Plan, which shall include:
  - Password systems and administration
  - Communications security measures
  - Operating systems and program security
  - Data encryption methods
  - Encryption key generation, transport, and propagation security
  - Safeguards for CTDOT-sensitive data, including encryption keys, smart card encoding schema, and other CTDOT intellectual property.

The Security Plan shall describe the security methods and features incorporated into the NFTS, and the procedures to monitor and maintain NFTS security. The Contractor shall submit the System Security Plan for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 2-2**

## 2.9 Physical Security, Locks, and Keys

All NFTS equipment provided shall be constructed to provide maximum protection for equipment and revenue contained therein. All equipment shall be designed to be vandal resistant to the greatest extent possible, and shall not suffer damage as a result of reasonably foreseeable conditions.



The design and installation of all equipment shall discourage and minimize the effects of potential vandalism and theft, prevent unauthorized access to the interior of the equipment and prevent unauthorized removal of the equipment from its installed location. Several, separate levels of security access shall be provided for access to the interior of the equipment for maintenance personnel and revenue servicing personnel. Access to the equipment by authorized personnel equipped with proper keys and individual access code(s) shall be provided without undue delay.

Locks used for accessing/removing the revenue containers and for accessing/removing other interior modules shall be keyed differently from other device locks. To the greatest extent possible, locks for accessing/removing interior modules shall be keyed alike.

Locking systems for maintenance and revenue service access for devices containing cash shall employ the use of Cyber™ Locks or other CTDOT-approved electronic, high security locks. Contractor shall identify and provide all hardware and software required to support and operate the electronic locking system.

Other locks to secure devices or internal components shall be considered high security, employing designs and features designed to thwart tampering and counterfeiting keys. Commencing with initial implementation of equipment, all locks, keyways, and key codes shall become the exclusive property of CTDOT thus giving CTDOT the ability to rekey as necessary.

The Contractor shall identify the location and type of all NFTS locks and shall submit the electronic locking system design and configuration for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 2-3**

All keys shall be delivered in a single shipment no less than 30 days prior to the commencement of installation to CTDOT's Project Manager. **CDRL 2-4**

## 2.10 Fault Tolerance and Disaster Recovery

NFTS design shall provide the ability to quickly recover from power, communications and system software failures. The system shall automatically return to its operating state, without loss of data. The Contractor shall provide documentation explaining how this fault tolerance and recovery capability will be achieved at the Preliminary Design Review **CDRL 2-5**, and shall identify the files, databases, and software required to recreate an operational NFTS in the event of a disaster.

## 2.11 Modular Design

NFTS devices shall employ modular components. The design shall support the "fingertip maintenance" concept. Security-sensitive modules shall also be secured by keys or electronic locks to prevent unauthorized removal.

Power connections shall be keyed to prevent installation into the wrong receptacle, and polarity. Contractor shall provide a list of all replaceable modules at the Preliminary Design Review. **CDRL 2-6**

Each of the basic functions within each device shall be performed by modular components, which permit ready field replacement of inoperative modules to return the device to service in minimal time.

The individual modules shall be fixed in unitized frames, rails, or slides with fast latching devices, captive fasteners, or other means that do not require the use of tools to remove and



replace modules. Where required in this Scope of Work, modules shall also be secured by keyed locks to prevent unauthorized removal.

Internal control and power connections shall be made via plug-in connections. Plugs and receptacles for modules shall be keyed to prevent a module from being plugged into the wrong receptacle. Each module shall be installable in only one correct position and that position shall be readily apparent to maintenance and servicing personnel.

## 2.12 Interchangeability

All parts, components, modules, assemblies, and removable devices provided under this contract shall be fully interchangeable among devices without the need to make adjustment for proper compatibility. Mechanical parts shall not require use of matched sets of parts. Equipment enclosure mounting shall be identical for each device so that the equipment is fully interchangeable among vehicles and locations without the need to make installation adjustments.

Modules and components that are not interchangeable shall not appear to be interchangeable nor shall they be able to be installed into an incorrect slot, receptacle, rack, or location.

## 2.13 Safety

NFTS equipment shall be free from safety hazards and shall be designed to comply with relevant UL (Underwriter's Laboratory) Standards.

The exterior surfaces of Fare Collection Equipment, including all controls and appurtenances, shall have no sharp edges. Particular attention shall be given to protecting blind persons who may explore the surfaces with their fingers. The edges of all panels, graphic displays and faceplates, and the surfaces of all exposed hardware such as hinges, locks, handles, and fasteners shall be free of sharp edges or burrs.

All interior surfaces and components with which maintenance personnel could come in contact shall be free of sharp edges and other hazards. Internally, there shall be no protruding screws or exposed wires that could injure maintenance personnel.

Objects shall not excessively protrude from the platform-based equipment in the planes nominally perpendicular to the station platform, except for the MVM lighting fixture and bill entry slot rain shield. The MVM light fixture shall extend no more than four inches beyond the front face of the MVM cabinet, and shall not be positioned in such a manner as to cause a bumping hazard. All objects that protrude 1 inch or more from any exterior surface of the NFTS equipment, including the MVM light hood and the bill entry slot rain shield, shall be designed with rounded corners and edges with minimum 0.25-inch radii to reduce the chances of injury.

All components shall be electrically grounded and shall prevent electrical leakage or static charge. Electrical components shall have suitable warning graphics indicating the voltage present and other hazards.

The Contractor shall provide proof of compliance with Safety requirements, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 2-7**

Additionally, the TVMS needs to address all CT **fastrak** requirements as indicated in the Safety and Security Management Plan (SSMP). This applies to the TVM's, the TVMS in its entirety, the CMS, the Contractor's own operations, and all other activities associated with the Agreement. The current version of the SSMP is included as Schedule **E-D** to the Agreement.



## 2.14 Aesthetic Requirements

The NFTS equipment shall be designed to be attractive, with all controls, primary instructions, and operator and patron interface display and inputs on a common face of the respective enclosure. Lettering, lines, arrows, pictographs, signage, color coding, indicator lights, and colors and physical features such as raised lettering and Braille (collectively referred to a “graphics”), and lighting shall be used to present aesthetically attractive and functional equipment.

The Contractor shall submit a conceptual depiction of all NFTS equipment, including graphics panels and other aesthetic design considerations, for review and approval at the Preliminary Design Review. **CDRL 2-8**

All graphics shall be in accordance with CTDOT’s graphics standards, which incorporate standard Pantone® colors.

## 2.15 Structural and Material Requirements

All NFTS equipment materials shall be suitably robust and made of materials to function in the all metropolitan regions served by CTDOT, and to withstand normal use of a public device, without deformity, corrosion, or degradation, for the entire expected life of the equipment.

NFTS devices shall be constructed to meet the following requirements:

- Fastenings shall be concealed. This requirement may be waived, provided there are specific instances where it is proven the concealment is impractical
- Employ secure hinges that are hidden within the enclosure
- Utilize enclosures designed to form an integrated structure
- Provide for efficient exchange of devices and modules in the field with minimal use of fasteners and cable connectors
- Provide suitable protection where dissimilar metals come in contact

## 2.16 Electrical Requirements

NFTS components shall conform to all requirements of the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), Society of Automotive Engineers (SAE) and all applicable state and local electrical codes. All equipment provided shall be UL certified and copies of these certifications shall be provided to CTDOT no later than completion of the First Article Configuration Inspection (FACI). **CDRL 2-9** Compliance with equivalent European or other International standards shall be acceptable for those listed in this paragraph.

Electronics shall be solid state, assembled on modular reinforced printed circuit boards. The loss or fluctuation of power shall not cause any information or data contained in electronic memory to be lost or altered.

All electrical and electronic systems shall be designed using only materials and components of proven quality and reliability. All devices shall be de-rated to operate within the acceptable range for electrical stress versus temperature for the type of service for which the NFTS device is required.

All electrical equipment shall operate within the temperature, power, and current ratings as identified in this Scope of Work.



Variations in the supply voltage and frequency shall cause an orderly shutdown of the NFTS equipment at the point where the voltage or frequency falls outside the reliable operating voltage range of a module.

The NFTS equipment shall operate without causing harmful interference or being affected by interference such as external transients, magnetic, electrical, and radio frequency fields. Shielding and line filtration shall be provided within the NFTS devices to protect electronic components and assure full operation under electrical interference within the vehicle and facilities environment.

The equipment shall be designed to prevent radiation of radio and electrical signals to external equipment and shall not affect operation of other equipment on the vehicles or in the facilities, or to other outside systems. All equipment shall conform to Federal Communications Commission emission limits as expressed in FCC Part 15, Subpart B Class A pertaining to conducted and susceptibility, and SAE J-1113-13 pertaining to electrostatic discharge.

Apparatus creating electromagnetic interference emissions shall be designed to contain these emissions within their package area. Suppressors shall be incorporated across inductive devices to minimize switching transients.

### 2.16.1 On-Board Equipment

All on-board equipment shall operate reliably from the vehicle's direct current power source, which ranges between 9VDC through 15VDC on vehicles with nominal 12VDC power, and 9VDC through 32VDC on vehicles with nominal 24VDC power.

The equipment shall be protected against damage, loss, or modification of data caused by:

- Lower or higher voltage in the range of 0 to 50 VDC
- Reverse polarity of the input voltage
- Temporary voltage drops associated with starting of vehicles
- Fluctuating voltages between the maximum and minimum voltages identified above

Adequate protection against transient surges and supply voltage increases or decreases to levels beyond the voltage tolerance supplied shall be incorporated to the extent necessary to prevent damage to electronic components.

Loss or reinstatement of power shall not result in any corruption of the data in memory.

### 2.16.2 Platform Equipment

Power circuits provided in the stations for NFTS equipment will be rated 125 VAC, 60 Hz, 20 amp (maximum), single-phase alternating current with separate ground wires. Separate power circuits will be provided for each NFTS platform device, ensuring that a single tripped circuit breaker affects only a single device.

The platform equipment shall tolerate voltage range of +10% to -20% and frequency variability range of +1 Hz to -3 Hz. NFTS platform equipment, including any internal heaters, shall draw no more current than permitted by the National Electric Code for a 20-amp circuit.

Separate ground wires shall be used to properly ground platform-based equipment; all platform-based equipment, components and parts shall be grounded, both electrically and to the station's ground plane (where available). The grounding scheme shall be configured so that performance of the equipment is not compromised due to common mode impedance coupling. The Contractor shall submit the grounding scheme to the CTDOT for review and approval at the Preliminary Design Review. **CDRL 2-10**





High voltage transients on power or signal interface lines, including those due to nearby lightning strikes, shall not damage the platform-based NFTS equipment.

Voltage transient suppression shall be provided for the protection of components and circuitry involving semiconductor devices. The platform-based equipment shall be capable of withstanding transients of 5.0 kV peak pulse with a total energy of 750 joules without damage, improper operation or shutdown. The functional status of any such surge and transient suppressor circuitry shall be visible at all times when the outer door is open.

Each of the modular components (e.g., Coin Processing Unit, Bill Processing Unit, Ticket Printer, Electronic Control Unit, etc.) shall have appropriate circuit protection as required by the design of the equipment. Suppression means shall not result in deterioration of performance.

### 2.16.3 Facilities Equipment

Equipment and components located at the CTDOT facilities shall operate reliably on a source power of 120 VAC (+/-10%), single phase, 3-wire, 60 Hz (+/-1%). Normal operation shall include:

- Ignoring micro cuts in the power supply of up to 15 milliseconds, with a recurrence of 100 milliseconds
- Withstanding the following voltage excursions:
  - Sag: - 15%
  - Surge: +15%
  - Transient Impulse: 75 volts
  - Common Mode Noise: 5 volts
- Completing in-process transactions, retaining data integrity, and shutting down in an orderly manner in the event of loss of electrical power
- Returning to full operational status after a power failure without manual intervention or adversely affecting the current operational situation or the integrity of stored data.

For safety protection, non-current carrying metallic parts of electrical equipment shall have a maximum resistance to solid "Earth" (ground) not exceeding 2 ohms.

NFTS facilities equipment shall include adequate filters and electrical elements to regulate the supplied voltage and render it devoid of power spikes and noise. Adequate protection against transient surges shall be incorporated to the extent necessary to prevent damage to electronic components and compromised integrity of stored and transmitted data.

Where NFTS equipment receives power from a Contractor-supplied Uninterruptible Power Supply (UPS), the UPS shall provide power of sufficient quality and consistency to operate the attached NFTS equipment.

### 2.16.4 Office and Retail Equipment

NFTS equipment installed in retail and office locations shall operate reliably a source power of 120 VAC (+/-10%), single phase, 3 wire, 60 Hz (+/-1%), and other characteristics typically experienced on the commercial power grid.



## 2.17 Software Requirements

### 2.17.1 Software Design

Design criteria identified in this section, unless otherwise indicated, shall apply to all software in the NFTS. Since software is part of a total system design, it will be reviewed as part of each design review.

NFTS software shall:

- A. Be developed with flexibility in mind employing a language that is fully functional within its implementation for the selected microprocessor system, and shall be commercially available in English.
- B. Be sufficiently robust, so that the system can recover from error conditions and power losses with a minimal impact on operations.
- C. Include provisions for setting and verifying date and time, with automatic adjustments for leap year, and daylight savings time changeovers.
- D. Be fully integrated with the operating system to support all required functions of the applications programs in both a networked and a stand-alone environment.
- E. Allow for the distribution of software modifications to all NFTS devices from a centralized location.
- F. Allow the ability to revert to a previous software version.
- G. Be fully debugged, documented, and includes all approved revisions introduced up to the time of final acceptance.
- H. Where the NFTS software is a derivative of a previous developed system, ensure that all software patches and modifications for known errors have been successfully installed prior to installation.
- I. Sample all input conditions at rates sufficient to detect and remedy all unsafe or damaging conditions in the shortest possible time.
- J. Be designed to ensure that the timing requirements for safety-related tasks are always met.
- K. Perform self-diagnostic routines and respond promptly, safely, and predictably to detected faults. The self diagnostics shall include tests for program corruption and integrity in read/write memories.
- L. Respond safely and predictably when powering up or recovering from power interruptions.
- M. Permit thorough interrogation of all input, output, and internal conditions by external diagnostic equipment.
- N. Be coded in a non-proprietary language.
- O. Utilize central tables of codes and values for each function, and provide a facility update central tables prior to implementation of changes, with an effective date designating the actual implementation of each change.
- P. Provide Software error codes that contain easily understood explanatory text and include the manner in which the error can be corrected.



- Q. Except as expressly permitted, not utilize or employ hard-coding of configuration parameter values.
- R. Support code updates at the device level without mechanical intervention or component replacement to accomplish the change.
- S. Be designed using best practices that allow for an OS or database patches and upgrades with minimal testing.

### 2.17.2 Coding

Software shall be coded in a non-proprietary language. Except as expressly permitted by CTDOT, hard-coding of configuration parameter values shall be prohibited. All programs and routines shall reference central tables of codes and values for each function. A process shall be provided to facilitate updating of tables prior to implementation of changes, with a future effective date designating the actual implementation of each change. No less than seven (7) years of effective date code and values shall be maintained so that reports can be constructed from historical data spanning changes in fares and other parameters.

Software error codes shall include the manner in which the error can be corrected, and contain easily understood explanatory text. Entries shall be available for editing at the CDS level with the ability to add additional error codes as required. The procedure for these modifications shall be provided to CTDOT for review at the Preliminary Design Review and for approval at the Final Design Review. **CDRL 2-11**

All source code, including comments and development tools, shall be in English. Source code shall be well structured, modular, and clearly documented to allow easy comprehension and straightforward traceability to the Software Design Description documents. Software comments shall also include explanations of all significant memory addresses such as interrupt vectors, I/O addresses, and memory locations for RAM, ROM and other memory devices.

All CDS and Customer-interface software shall be menu-driven and easy for Customers and/or non-technical employees to use. Software shall utilize a Graphical User Interfaces (GUI), with pull down menus, icon command prompts, on-line help features, capable of activation in combination with the keyboards or keypads.

All software that is accessible through the Internet or created for CTDOT back office use shall utilize web server technologies and require no desktop installations or downloads. Internet based applications shall be built using a modern Java based framework (e.g., Struts 2, JSF, Spring). Web based applications shall follow the latest W3C standards and take advantage of Cascading Style Sheets and XML.

Microcomputers, or any other system components, shall not rely on, or employ, the use of PROMs or EPROMs. All code updates at the device level shall be implemented without requiring mechanical intervention or component exchange to accomplish the change.

### 2.17.3 Capacity

Software shall be capable of being configured to communicate with a minimum of 500 NFTS devices (simultaneous, online), and process a minimum of 3,000 media transactions per minute. This information is provided to assist the Contractor in estimating the size, communications throughput, and minimum memory requirements of the NFTS. The ability to accommodate an expansion to two times the above number of transactions shall be included in the system design.



#### **2.17.4 Testability**

All features and functions of software systems shall be testable on a systems level. Specific approval by CTDOT is required for any feature that is not testable on a systems level. For features that are only testable with special equipment, the Contractor shall supply all such equipment as test equipment, which shall become the property of CTDOT. This equipment shall provide the logic, sequencing, and emulation necessary to verify that the software functions as intended.

Type tests of all processor systems shall verify the proper operation of all software features, including diagnostics.

### **2.18 Inspection of Materials and Workmanship**

All supplies, materials, and workmanship shall be subject to inspection at the Contractor's facilities, and to inspection and test prior to acceptance by CTDOT's authorized representative, in accordance with the Contract Documents. In case of defective material or workmanship, or nonconformity to the Contract Documents, CTDOT shall have the right either to reject the equipment with or without instructions as to their disposition, or to require their correction.

### **2.19 Source of Supply**

The Contractor shall be responsible for all of the workmanship, and all of the materials, components, equipment, and accessories in the design, supply, and testing of the NFTS.

- A. The Contractor shall furnish equipment and materials from the manufacturers identified in Contractor's submittals, unless otherwise approved by CTDOT.
- B. Only new and first quality materials conforming to the requirements of the Contract Documents and approved by CTDOT shall be used in the NFTS, except for material used by the Contractor for convenience and which is not to be permanently incorporated in the NFTS.
- C. If it is found that sources of supply that have been approved do not furnish a uniform product, or if the product from such source proves unacceptable per terms of the Scope of Work at any time prior to acceptance, the Contractor shall, at no additional expense to CTDOT, take any and all steps necessary to furnish acceptable materials.
- D. The Contractor shall select and supply parts, components, subassemblies, modules, and complete assemblies, as well as software and other essential elements of the NFTS, based on projected availability and anticipated provision of long-term OEM support commensurate with the anticipated life of the NFTS.
- E. The Contractor shall alert CTDOT whenever a vital part, component, subassembly, module, complete assembly, or support for OEM software is being discontinued or whenever any such element of the NFTS is nearing obsolescence. The Contractor shall supply such alerts with sufficient advance notice to enable CTDOT to make necessary provisions to maintain NFTS functionality. Such notifications shall continue for the life of the NFTS, even beyond the completion of all warranties and contract performance periods.



## 2.20 Maintainability and Serviceability

NFTS equipment shall provide reliable operation over its design life, and shall be designed to require simple, minimal scheduled and unscheduled maintenance tasks.

The interior of the NFTS equipment shall be designed to allow easy and safe access to service equipment and subassemblies. Adequate space shall be available to insert keys, to grasp, lift, and turn internal components, and to remove and replace units, components, connections, cash storage vaults, and ticket stock. As appropriate, guides, rails, tracks, handles, and captive fasteners shall be provided to facilitate installation and removal of modules.

Any component or module that must be lifted (except cash containers when full) shall not weigh more than 20 pounds. Any exceptions to this weight limitation shall be subject to CTDOT approval.

For ease of service, all electrical connections between components and subassemblies shall be established by means of connectors to allow rapid removal of a component and/or subassembly. Plug-in connections shall be made simply, quickly, securely, and without the removal of screws or other attachment hardware. (All screws for connectors shall be captive to the connector.) Plug-in connectors shall be equipped with strain relief to prevent damage to cables and connectors.

Components requiring frequent adjustment shall be conveniently located to facilitate access and adjustment utilizing "fingertip maintenance" techniques, as defined within this document. Electrical and mechanical subassemblies and parts shall be packaged in readily replaceable assemblies.

Automatic diagnostic test routines and test equipment shall be included to aid in troubleshooting malfunctions. These test routines shall provide the ability to isolate defects to the lowest level replaceable assembly. Location of test points shall be easily identified by using color coding, number coding, or other equivalent means. All devices shall have clear labels and symbols that at a minimum indicate safety, warning, servicing steps, and wiring connections.

The means to access for service, diagnose, remove, and replace all modules shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 2-12**

### 2.20.1 Maintenance/Test Mode

All NFTS equipment with a Customer interface shall incorporate a test mode. In this mode, the equipment shall have full functionality, and process only test media. All test transaction data shall not be included in revenue summaries, and shall be separately identified. Test media may be defined by use of any suitable encoded parameter, so long as all transactions conducted with such media are by default excluded from reports and queries intended to convey passenger use and revenues.



### 2.20.2 Preventive Maintenance

For the Preliminary Design Review, the Contractor shall provide documentation that defines:  
**CDRL 2-13**

- Preventive Maintenance (PM) frequency for all NFTS devices based upon time and transactions
- A list of all Preventive Maintenance tasks to be performed, including a brief description of the work, and any parts, materials or components required
- Time required to complete each defined PM task
- Which PM tasks require tools to complete, and therefore do not satisfy the “fingertip maintenance” objective

NFTS platform equipment (e.g., MVMs and PVs) shall require preventive maintenance no more than once per month or 10,000 transactions, whichever occurs first. Each preventive maintenance visit shall be capable of being performed by one technician in less than 30 minutes. No more than one person shall be required to perform on-site preventive maintenance of NFTS platform equipment.

### 2.20.3 Corrective Maintenance

The time for entry into a machine, removal, and replacement of a module, and restoration of the machine to an operating condition shall take no longer on-board and on-site than:

Table 2.20.3: Corrective Maintenance Intervals

Device	Time to Enter, Diagnose, Restore Defective Device
Validating Farebox	Not more than 10 minutes
Stand Alone Processor	Not more than 7 minutes
Platform Validator	Not more than 10 minutes
Multi-Function Vending Machine	Not more than 20 minutes
Facilities-based Equipment	Not more than 15 minutes

During the Preliminary Design Review, the Contractor shall provide documentation that clearly defines remedial maintenance tasks that can and cannot be easily completed on-board and on-site within the defined time parameters. Each identified task shall include a brief description of the work, and the estimated time to complete the task. **CDRL 2-14**

No more than one person shall be required to perform on-board and on-site corrective maintenance on an individual unit of NFTS equipment.

## 2.21 User Interfaces

### 2.21.1 General

- A. NFTS equipment shall be designed to ensure the safe, reliable and simple interface with patrons and maintenance/servicing personnel. The equipment shall provide patrons with displays, graphics and signage, controls and mechanisms that are simple to use, easy to



understand, and conveniently located. By following instructions given on and by the equipment, an inexperienced user shall be able to understand all transaction processes and results. All such user interfaces shall be user-friendly; that is, safe, predictable, simple to use, and in accordance with other applicable human engineering principles.

- B. NFTS equipment shall accommodate the broad range of patrons that use public transportation. The range of patrons paying fares will include commuters, shoppers, children, the elderly, patrons with impaired vision, patrons in wheelchairs, patrons with limited communications skills including the illiterate, and patrons who are hearing impaired.
- C. As applicable, NFTS devices shall provide CTDOT-adjustable timeout periods to return the device to the "Ready" state in prescribed times between steps of a transaction and between transactions.
  - An intra-transaction timeout function shall limit the time between steps of a transaction, including the insertion of cash, passenger or operator selections and the commencement of payment, and other discrete steps within all transaction types.
  - An inter-transaction timeout shall limit the amount of time the NFTS device waits after completion or cancellation of a transaction before resuming the "Ready" state. While the device is waiting for the inter-transaction timeout to expire, it shall be ready to process another transaction. The NFTS device shall process any payment and fare media presented during the inter-transaction timeout period in the same manner as if the device were in the "Ready" state.
- D. All NFTS user interfaces shall provide consistent responses for like transactions, including consistent displayed messages, status lamp responses, and audio feedback. All NFTS devices that process smart card and barcode fare media shall display the results (on the respective displays and via any status LEDs) of each usage transaction to the device operator and the patron:
  - While the fare instrument is held within range of the reader
  - For a CTDOT-configurable inter-transaction timeout (described above) after the fare instrument is removed from the reader
  - For a CTDOT-configurable maximum time (default 20 seconds), even if the fare instrument remains in range of the reader
  - Until another transaction is initiated or another fare instrument is presented to the NFTS device

### **2.21.2 Usability by Persons with Impairments**

All NFTS devices shall comply with the American with Disabilities Act. Wherever the requirements defined within this Scope of Work are identified as less than the defined Federal ADA requirements, the Federal Requirements shall apply. The NFTS equipment shall comply with the most recent version of the ADA Accessibility Guidelines (ADAAG) published at the time of Notice to Proceed.

In particular, all patron-operable controls, including coin/bill/card/ticket slots, smart card interface, barcode reader interface, buttons, touch screen regions (if applicable), and Ticket/Coin Return Bin shall be between 15 and 48 inches of the finished floor. The NFTS equipment shall be designed with all patron-operable controls as high as possible within this range.



Some aspects of the fare collection equipment shall exceed ADA requirements:

- While the ADA allows operable forces to be up to 5 pounds, the force required to depress patron selection buttons and other patron-operable devices (such as the MVM Ticket/Coin Return Bin) door shall not exceed 8 ounces.
- The ADA requires variable displayed text to be at least 0.1875 inches high. Instead, all Patron Displays shall display all text sized at least 0.25 inches high.

At the Preliminary Design Review the Contractor shall submit to CTDOT for their review and approval descriptions and drawings of how the MVM will achieve ADA compliance. **CDRL 2-15**

CTDOT will provide Braille panels with instructions to operate the MVMs and install these panels in a common location at each station. The Contractor shall provide the CTDOT with the text of these instructions for review and approval at the Final Design Review. **CDRL 2-16**

### 2.21.3 Viewing Envelope of Graphics, Displays and Signage

Platform-based NFTS equipment displays (including the entire surface of the Patron Display for the MVM and PV), graphics, signage, and all other instructions, labels, and information contained on the equipment shall be visually readable within all positions of a viewing envelope defined as follows:

- Distance from vertical plane of equipment front: 6 inches to 24 inches inclusive
- Height above finished grade or floor on which NFTS is installed: between 40 and 70 inches
- Lateral positioning in front of NFTS: two thirds of equipment front face width, centered upon the Patron Display

## 2.22 Component Serialization

All major parts and equipment shall have nameplates that identify the manufacturer, part nomenclature, part number, revision number and serial number. Part numbers and serial numbers shall be permanently stamped or engraved on the nameplate. Within a type or model series, all serial numbers shall be unique. The nameplate shall have provisions for applying bar coding data to identify the stamped or engraved part number and serial number. With the approval of CTDOT, a separate identification plate, permanently affixed to each serial numbered component, may be applied below the prescribed nameplate for the barcode data. The location of the nameplate and bar coding data shall be chosen for readability and scanning without disassembly of equipment or components other than normal maintenance access covers or removal of the component.

The Contractor shall establish serialized identification procedures for use in identifying part numbers and serial numbers of parts and equipment furnished by the Contractor and all subcontractors. The Contractor shall assign designated codes and blocks of numbers for identification of both Contractor and subcontractor part numbers and serial numbers. The serial numbering scheme to be utilized shall be subject to approval by CTDOT as part of the Final Design Review. **CDRL 2-17**

Within 30 days after the Final Design Review, the Contractor shall furnish for CTDOT review and approval a list of the items to be serial numbered. **CDRL 2-18**





## 2.23 Performance Requirements

### 2.23.1 Equipment Reliability

NFTS equipment shall satisfy reliability requirements as a condition of final system acceptance. Reliability requirements, stated as Mean Cycles Between Failures (MCBF) and Mean Time Between Failures (MTBF) are provided in Table 2.23.1. A cycle as used for the calculation of reliability is as defined herein.

Table 2.23.1 – NFTS Equipment Reliability

Equipment Type	MCBF	MTBF
Validating Farebox	20,000	60 Days
Magnetic Ticket Processor and Barcode Ticket Dispenser	25,000	90 Days
Farebox Vaulting Equipment	25,000	180 Days
Stand Alone Processor	40,000	270 Days
Multi-Function Vending Machine	10,000	60 Days
Platform Validator	40,000	270 Days
Administrative POS Terminal	10,000	90 Days
Handheld Fare Inspection Terminal	5,000	180 Days

Mean Cycles Between Failures shall be calculated by totaling all transactions (*i.e.*, cycles) for all installed devices of a given type and dividing by the total number of relevant failures (as defined herein and as determined by the Failure Review Board discussed). Transaction (cycle) and failure totals shall be accumulated over a floating 8-week period (the totals shall include only the most recent 8 weeks of operation).

$$MCBF = \frac{8\text{-Week Total Number of Transactions}}{8\text{-Week Total Number of Relevant Failures}}$$

Mean Time Between Failures shall be calculated by determining the number of calendar days between relevant failures as an average of all installed devices of each type. (In this calculation, the in-service hours per day are irrelevant.) Similar to the MCBF calculation, MTBF calculations shall consider only data over the most recent 8-week period of operation.

$$MTBF = \frac{\text{Number of Installed Devices} * 56 \text{ Days}}{8\text{-Week Total Number of Relevant Failures}}$$

For example, assuming a fleet of 500 installed Validating Fareboxes: if fleet-wide, the Validating Fareboxes experience four relevant failures every day, the resulting MTBF is:

$$MTBF = \frac{500 \text{ Devices} * 56 \text{ Days}}{224 \text{ Total Relevant Failures}} = 125 \text{ Days}$$



### 2.23.2 Systems Availability

The NFTS is a mission-critical system for CTDOT.

The CDS, inclusive of all software, interfaces, databases and hardware, shall meet industry standards for reliability, availability, and accuracy. The CDS shall achieve no less than 99.9% availability measured monthly, and no less than 99.99% measured annually; the Contractor shall maintain CDS availability even during scheduled and routine maintenance through the use of redundant hosted servers or other means as necessary.

Any system or subsystem shall be considered unavailable from the time the failure is first detected until the system resumes full operational status. Correction of the problem shall not be considered complete until the system resumes full operational status. Any system (or subsystem of the CDS) remaining in a degraded mode shall not be defined as operational for calculating system availability.

Unacceptable end user system performance shall also constitute grounds for declaring the affected system or component unavailable. The Contractor shall define and document benchmarks for acceptable end user performance for CTDOT's review and approval at the Final Design Review. **CDRL 2-19**

Because the Contractor-supplied and hosted web portals will be used by the public and customer-service personnel, the web portals shall achieve no less than 99.9% availability measured monthly, and no less than 99.99% measured annually; the Contractor shall maintain web portal availability even during scheduled and routine maintenance through the use of redundant hosted servers or other means as necessary.

### 2.23.3 System Accuracy

Accuracy requirements shall be successfully achieved as a condition of final system acceptance. Section 31.3.5 defines the accuracy requirements for the NFTS and the methods used to monitor and calculate the results.



### 3 Fare Policies

The NFTS shall support a wide variety of fare policies, including existing CTDOT policies (as shown in Table 3.1) and policies that CTDOT may implement in the future.

#### 3.1 Existing CTDOT Fares

CTDOT's planned fares as of January 19, 2014 are as shown below.

Table 3.1: Current CTDOT Fares

<b>NEW BUS FARES - EFFECTIVE JANUARY 19, 2014</b>			
<b>Local</b>			
<b>Fare Media Type</b>	<b>New Fare Rate</b>	<b>Express Commuter</b>	<b>New Fare Rate</b>
One Way Cash	\$1.50	<b>Fare Media Type</b>	
Senior/Disabled One Way Cash	\$0.75	<b>One Way Cash</b>	
All-Day Local	\$3.00	Zone 2	\$2.70
10-Trip Local	\$13.50	Zone 3	\$3.50
Senior/Disabled 10-Trip Local	\$6.75	Zone 4	\$4.30
3-Day Local	\$7.50	Zone 5	\$5.15
5-Day Local	\$12.00	<b>One Way Senior/Disabled Cash</b>	
7-Day Local	\$16.50	Zone 2	\$1.35
31-Day Local	\$54.00	Zone 3	\$1.75
Senior/Disabled 31-Day Local	\$27.00	Zone 4	\$2.15
One Way Youth Cash	\$1.20	Zone 5	\$2.55
Youth 10-Trip	\$10.80	<b>10-Trip Ticket</b>	
2 Hour Transfer	\$1.50	Zone 2	\$24.30
		Zone 3	\$31.50
		Zone 4	\$38.70
		Zone 5	\$46.35
		<b>31 Day or Monthly Pass</b>	
		Zone 2	\$92.00
		Zone 3	\$119.00
		Zone 4	\$146.00
		Zone 5	\$175.00
<b>ADA Paratransit</b>			
<b>Fare Media Type</b>	<b>New Fare Rate</b>		
One Way ADA Paratransit Cash	\$3.00		
ADA Paratransit 10-Trip Book	\$24.00		
		<b>Stamford, Ct - White Plains, NY Express I-Bus</b>	
		<b>New Fare Rate</b>	
		One Way Cash Fare	\$3.00
		One Way S & D Cash Fare	\$1.50
		10-Trip Ticket	\$24.25
		All Day Pass	\$6.00
		31 Day Pass	\$90.00



## 3.2 General Fare Policy Requirements

CTDOT intends to implement fare policies that closely follow existing policies, but augmented with additional policies described herein. The NFTS shall support the following general fare policies:

- A. All fare media shall be usable by one person at a time; that is, only one passenger per smart card or barcode fare instrument.
- B. For unlimited ride passes, the system shall support CTDOT-configurable measures to prevent passback and sharing of the media. As delivered, unlimited ride passes shall be rejected for passback if used on the same vehicle within 5 minutes (300 seconds).
- C. For stored value and stored ride transactions, the system shall support separate CTDOT-configurable measures to prevent passback and sharing of media, or to prevent accidental multiple payments. As delivered, the passback parameter for stored value and stored ride transactions shall be set to 3 seconds.
- D. Upon usage of valid half fare media, or CTDOT employee fare media, when configured by CTDOT, the processing device shall notify the operator that a reduced or employee fare instrument has been used.

## 3.3 Fare Structure and Pricing

As initially deployed, the NFTS shall accurately reflect and impose the fare structure and pricing in effect at the time revenue service commences, or as defined by CTDOT no less than 90 days prior to the start of revenue service. **CTDOT 3-1**

## 3.4 Stored Value

All CTDOT-issued smart card media shall support stored value transactions, if so configured. Long-term use smart cards shall support transactions that include both unlimited ride pass usage and stored value deduction (e.g., when necessary to upgrade to a higher-level of service than allowed by the pass).

Where stored value is supported, the smart cards shall also support the value going negative as a result of a use transaction, to a maximum amount configurable by CTDOT.

As delivered, CTDOT-issued Limited Use smart card media shall *not* support stored value transactions.

## 3.5 Stored Ride

All CTDOT-issued smart card media shall support stored ride transactions, if so configured. Long-term use smart cards shall support transactions that include both stored ride usage and stored value deduction (e.g., when necessary to upgrade to a higher-level of service than allowed by the stored ride).

## 3.6 Floating Period Pass

All CTDOT-issued smart card media shall support floating period passes in any duration from 1 hour to 1 year (366 days). When purchased and initially added to a customer's account, floating



period passes shall be in a “pending” state. When first used, the pass shall be “activated” and shall be valid for the time period or number of days defined at the time of purchase. When the account associated with a long-term use smart card has an active pass, the account shall support adding a second pass of any duration in the “pending” state. When the first pass expires, upon subsequent use, the second, “pending” pass shall be activated.

The NFTS shall also support the use of barcode media as floating period passes, except that all such media shall be read-only and “active” upon purchase or customer-induced activation, or based upon information encoded (printed) on the media.

### 3.7 Fixed Calendar Pass

All accounts associated with CTDOT-issued smart cards shall support fixed calendar passes, which shall be valid for pre-defined calendar periods, such as months or university semesters.

The NFTS shall also support the use of barcode media as fixed calendar passes.

### 3.8 Transfers

All accounts associated with CTDOT-issued smart card media shall provide transfer privileges when applicable. Generally, transfers (as defined by CTDOT policy) may apply to any transaction involving stored value or stored rides.

When applicable, transfer privileges shall be limited by CTDOT-configurable parameters including:

- Time (e.g., 90 minutes)
- Direction of travel (i.e., prohibition of return trips on the same route)
- Fare to be paid (if any)

### 3.9 Fare Categories

Accounts associated with CTDOT-issued long-term smart cards shall include information that defines the user’s default fare levels. The accounts shall support no less than 8 distinct fare categories, and shall support at minimum:

- Full Fare (default)
- Half Fare
- Paratransit Fare
- Student Fare
- CTDOT Employee
- Concession Fare (for retirees, CTDOT family members, etc.)

When a CTDOT-issued smart card is presented for validation, the fare collection device shall automatically process the transaction according to the fare policies applicable to the associated account’s fare category. For example, when a card with half fare privileges is presented for use in a stored value transaction, the value of a reduced fare shall be deducted from card’s account value.

Similarly, when reloading unlimited ride passes to accounts associated with CTDOT-issued long-term smart card, only those accounts with reduced fare privileges shall be permitted to add reduced fare pass products.



User profile data for all fare categories other than the default full fare shall include an expiration date. When an account's non-full fare properties expire, the account shall revert to full-fare status, and the NFTS shall process all subsequent transactions accordingly.

### 3.10 Service-Level Pricing

The NFTS shall support fare policies that differentiate prices based on level of service, such as "Local," "Express," "Regional," etc. The NFTS shall support no less than 16 distinct service levels.

### 3.11 Zone Pricing

The NFTS shall support zone-based fare pricing, no less than 8 zones.

### 3.12 Time-of-Day Pricing

The NFTS shall support time-of-day pricing, such as peak / off-peak. The fare tables shall support no less than 8 divisions of each day, where each division may be assigned one of no less than 4 distinct fare prices, and each division may be assigned to start and end at any 15-minute increment.

### 3.13 Holiday, Weekend, and Special Day Pricing

The NFTS shall support fare structures that assign distinct pricing for holidays, weekends, and CTDOT-defined "special day" pricing (such as "ozone alert" days). The fare tables shall allow CTDOT to assign:

- Any day of the year to a pre-defined holiday fare
- Any day of the week to a pre-defined weekend fare
- Any day of the year to a pre-defined Special fare

The fare table shall support setting these fares no less than 400 days in advance.

### 3.14 "Capped" Stored Value Transactions

Accounts associated with all CTDOT-issued long-term use media shall support fare policies that enable passengers to "purchase" unlimited ride passes by accumulating the value of stored value transactions over a period of time. For example, if the price of a 1-day pass is \$4 and single-ride stored value fares are \$1.50, a passenger's first two trips in a day shall deduct the full single-ride price from the associated account, the third trip shall deduct only \$1, and any subsequent trips that day shall be free.

The NFTS shall support "capped" stored value transactions for the equivalent purchase of any CTDOT-configurable unlimited ride pass up to a minimum of 31 days in duration.

For example, if during a four-day period, a passenger uses stored value in any amount that equals the value of a (hypothetical) local 7-day floating period pass, no further stored value deductions shall be made from the account for the next 3 days whenever the card is used to board a vehicle operating in local service. If, during those 3 days, the passenger makes sufficient use of express service requiring the deduction of additional stored value to reach the price of a 7-day express floating period pass, no further stored value deductions shall be made



from the account for local and express service for the remainder of the 7-day pass originally “purchased” via capped stored value transactions.

When a CTDOT-issued smart card is used for multiple consecutive stored value transactions on the same vehicle, only the first transaction shall be credited toward the “capped” fare total.

As delivered, the NFTS shall support the purchase of 1-Day and 31-day Passes via “capped” stored value transactions.

### 3.15 Employee and Concession Fares

Employee fares shall be separately configurable for all service levels and fare sets. As delivered, all employee fare cards shall provide for free rides.

Similarly, free rides are currently offered to employee family members and retirees. These “concession” fares shall be separately configurable from employee fares.

### 3.16 On-Board Operations

The NFTS shall be configurable by authorized personnel via CDS download to process transactions in any one or more of the following operating environments:

- Tag-On Only: Require the customer to simply tag the smart card when boarding the bus
- Select and Tag: Require the customer to tell the Operator when not paying the preset fare; Operator temporarily overrides default fares for one transaction.
- Tag-On/Tag-Off: Require the customer to tag the smart card when boarding the bus and then when leaving the bus



## 4 Fare Media

The NFTS shall support account-based fare media as described for long-term use media, and card-based fare media for limited use (disposable) media. In addition, the NFTS shall support barcode media for read-only transactions, and for a transition period described herein, CTDOT's existing read/write magnetic media.

The Contractor shall supply an initial quantity of media to be issued by CTDOT as defined herein.

### 4.1 CTDOT-Issued Account-Based Smart Card Media

#### 4.1.1 Long-Term Contactless Smart Cards

All long-term contactless smart cards shall be designed to survive no less than 3 years in normal use, and shall support all defined fare policies. All NFTS long-term contactless smart cards shall be "account-based".

Long-term use cards shall support all CTDOT passenger types, including general purpose full-fare and reduced-fare passengers.

#### 4.1.2 Adhesive Contactless Smart Media

All NFTS smart card processing devices shall accept adhesive contactless smart fare media. The system shall support adhesive media in both long-term and limited use form.

#### 4.1.3 Employee ID Smart Cards

Designated employees such as Bus Operators, maintenance and administrative personnel, will receive personalized ID cards on long-term contactless smart card media. These cards shall include a photo of the employee. The employee's unique identification number shall be printed in human-readable and barcode formats and encoded on the card.

In addition to being used as an identification credential, the cards shall be used by Bus Operators to log into the system by presenting their card to the Validating Farebox or Stand Alone Processor and entering their Personal Identification Number as a password.

ID cards shall also include a 2D barcode for use in testing the barcode reader of the Validating Farebox or Stand Alone Processor. Presentation of this barcode to the reader shall result in a test transaction only.

As defined by CTDOT policy, these cards shall also support use as fare payment when the employee is travelling on CTDOT vehicles.

### 4.2 CTDOT-Issued Limited Use Smart Cards

CTDOT intends to use the limited use smart cards for single-purpose fare products of short duration such as 1-day pass, 3-day pass, 7-day pass, 2 trips, and 10 trips. These cards shall employ data encoded to define the fare product, and shall be re-encoded upon each use (as necessary). Limited use media shall not be account-based, but "card-based." Limited use media shall not be replenished when expired or depleted.





### 4.3 Third Party-Issued

The NFTS shall accept compatible contactless smart card media issued by third parties with which CTDOT has negotiated ridership agreements. For a third-party card to be accepted by an NFTS device, the unique UID (embedded chip serial number) must be present on an internal list of known good cards, stored on the device.

Each third party shall be responsible for transmitting to CTDOT (via a web portal) updated lists of known good cards (*i.e.*, the "Valid Card List"). The CDS shall transmit the updated lists to all devices no less than daily.

All third party-issued media shall function as read-only credentials; the NFTS device shall make no alterations to the data encoded on these cards.

### 4.4 Barcode Media

The NFTS shall enable CTDOT to accept barcode media printed by CTDOT and authorized third parties, and displayed on a smart phone (via an application supplied by others) as a form of fare payment.

Using standard two-dimensional (2D) barcode formats, barcode media shall display information depicting a predetermined CTDOT fare products. The 2D barcode data shall be encrypted and shall incorporate dynamic data, such as the date and time the barcode expires.

The NFTS shall include a system to generate paper tickets with 2D barcodes for use as limited duration (*e.g.*, 2-hour, 4-hour, 6-hour) passes for special events and other similar applications.

### 4.5 Magnetic Media

CTDOT's existing fare media includes read/write magnetic cards that provide floating period unlimited ride passes and stored trip fare products. In addition, the existing fareboxes dispense magnetically-encoded cards used as transfers. As installed, the NFTS shall support all existing read/write magnetic media, and shall continue to dispense magnetically-encoded transfers.

Magnetic media requirements are described in Section 11.8.2.

Comprehensive documentation of the magnetic encoding format shall be submitted to the Contractor no later than 30 days after Notice to Proceed. **CTDOT 4-1**

### 4.6 Near Field Communications Devices

All smart card processing devices included in the NFTS shall support eventual use of Near Field Communications (NFC) devices as fare payment media.



## 5 Fare Accounts

### 5.1 CTDOT-Issued Long-Term Smart Cards

All CTDOT-issued long-term smart cards shall be “account-based.” That is, each card shall be linked to an account that is managed by the NFTS Central Data System. The long-term smart cards shall function as follows:

- A. Although these account-based cards shall be generally used as read-only instruments (excluding instances when the media is to be deactivated as described herein), all CTDOT-issued long-term smart cards shall contain CTDOT-specific data encoded in secure form to ensure the authenticity of the media. Media encoding requirements shall be provided upon Contract award.
- B. Each long-term card shall be identified by a unique 8-digit sequential serial number. This number shall be encoded in the card’s non-volatile memory and shall be permanently embossed or etched onto the card. Requirements shall be provided upon Contract award.
- C. By default, a card’s account shall be identified by its sequential serial number. This serial number shall be tied to the electronic card serial number.
- D. The CDS shall support the linking of several cards to a single account.
- E. The Contractor shall provide a process by which an account is automatically created in the CDS for each long-term smart card in CTDOT’s inventory upon receipt of cards from the card manufacturer. Until a card is issued to an end user, the account shall be in the “unissued” state.
- F. Upon issuance of a card to a customer, the associated account shall be activated. If the customer registers the card, the account “profile” shall contain the user’s name and other information; otherwise, the account shall remain in the default “anonymous” state.
- G. Card holders shall be able to add value to their accounts through several methods, including one-time Internet transactions, “subscription” transactions (which occur automatically based on customer preferences), at CTDOT sales outlets, and at third-party outlets. Although not envisioned for the initial NFTS, the NFTS shall support replenishment through future self-service kiosks and Fare Vending Machines.
- H. Accounts linked to all CTDOT-issued long-term smart cards shall include information that shall at minimum indicate the following operational status conditions:
  - Unissued: The card has not been properly issued to a customer or sponsor
  - Issued: The card has been issued and activated, or the card has been reactivated after a previous suspension. The card can be used for all permissible transactions.
  - Suspended: The card or account has been suspended and cannot be used until reactivated
  - Deactivated: The card or account has been permanently deactivated and can never be used again
- I. The CDS shall track the status of all cards in inventory; whenever a transaction causes a card to change status, upon receipt of the transaction record, the CDS shall update all records of the card’s status accordingly.



- J. In addition, the CDS shall monitor the usage history of all CTDOT-issued smart cards to determine whether a card is "dormant".
- K. The CDS shall also track other intermediate states of CTDOT-issued smart cards as necessary to maintain complete knowledge of the status and whereabouts of all media inventory.

## 5.2 Third Party-Issued Smart Cards

In similar fashion, the NFTS shall accept smart cards issued by third parties with whom CTDOT has established contractual relationships. Each third party-issued card shall be assigned to an account that shall track the card's validity and acceptance. When a third party-issued card is deemed invalid (by CTDOT or the third party), the card shall be removed from the valid third party-issued card list and thereafter be rejected for use. When CTDOT deems a third party contract to be invalid or expired, all cards issued by the third party shall be removed from the valid third party-issued card list.

Unlike CTDOT-issued media, third party-issued media shall have no NFTS-specific data encoded on the card, but shall use the unencrypted Unique Identification (UID) number as the account identifier. Other schemes for providing third party-issued smart cards with secure credentials shall be considered.

## 5.3 Other Media Types

All other media types shall function without a corresponding or linked account, and shall be processed according to information encoded or printed on the media only.



## 6 Account Lists

### 6.1 CTDOT Account Master Status List

For CTDOT-issued fare media that are linked to an account, the Central Data System shall maintain a Master Status List (MSL) of all cards that are active and in circulation.

The following represent NFTS required functionality. The Contractor may provide alternative design solutions, so long as the NFTS satisfies the following functionality:

- A. Every NFTS device that process smart card media shall reference the Master Status List (MSL) in conducting all smart card transactions. Alternatively, if the CDS authorizes transactions in real-time, the MSL shall be used to authorize transactions whenever real-time communications with the CDS are unavailable.
- B. The CDS shall update the contents of the MSL as necessary to reflect the most recent transaction results as reported by all NFTS devices, sales and replenishment transactions from all sources, and deactivation, suspension, and reactivation instructions conducted by authorized users.
- C. The CDS shall broadcast MSL updates to all NFTS devices at a CTDOT-configurable frequency, from once per minute to once per day and any timeframe in between.
- D. Each entry in the MSL shall contain sufficient information to enable the NFTS device to conduct transactions in support of CTDOT fare policies described herein and to provide accurate and complete transaction results to the passenger, and as applicable, to the vehicle operator, sales clerk, and fare inspector. Using the information in the MSL associated with a card, for each account-based transaction, the fare processing device shall be able to inform the passenger and operator whether stored value was used or whether an unlimited ride pass is in effect. In addition, rudimentary account status information shall also be conveyed, such as displaying a yellow light when stored value is low and when a pass is nearing expiration. Alternatively, if agreed transaction speed requirements are satisfied, account-based card transactions shall be able to be processed in real-time via authorization on the CDS, and the MSL shall be used to authorize transactions whenever communications with the CDS are unavailable but this shall not require any additional central or vehicle/location-based hardware.
- E. For each CTDOT-issued card in the MSL, the entry shall contain at minimum the card's:
  - Sequential serial number
  - General status (e.g., Active / Suspended / Deactivated / Dormant / Nearing Expiration / Expired)
  - Stored value status (e.g., OK / Low / Zero)
  - Pass privileges, if any (e.g., Pass Type / None)
  - Pass status, if any (e.g., OK / Nearing Expiration)
- F. The MSL shall support no less than 1,000,000 entries, enabling CTDOT to support 1,000,000 long-term use smart cards in circulation.
- G. The Master Status List shall have no entries for cards in inventory in the “unissued” state, for cards that have been permanently deactivated or for cards that have expired.
- H. Using 3G/4G cellular data communications or hard-wired Ethernet connections, the fare devices shall transmit transaction results to the CDS at high frequency, likely at least once every 5 minutes, but for hard-wired devices, immediately upon completion of each



transaction (CTDOT-configurable by device type). Alternatively, account-based transactions shall be authorized in real-time by the CDS.

- I. The NFTS Central Data System shall process the received transaction records and determine when an account changes status, such as when the stored value balance falls below a "low" threshold, or when an account has earned pass privileges. In such cases, the CDS shall update the account's status on the Master Status List and with all other account changes during the current calculating period, broadcast the updated Master Status List to all devices. Updated Master Status Lists shall be transmitted at equivalently frequent intervals, perhaps every 2 to 5 minutes (configurable by CTDOT). Alternatively, account-based transactions shall be authorized in real-time by the CDS.
- J. Likewise, when a patron activates a new account or new card by adding an initial value to the account, or when an existing account is replenished, the sale or replenishment system shall report the transaction to the CDS, which shall update the Master Status List accordingly so that the new or replenished account is reflected in the MSL.
- K. If a card is reported lost, its invalid status will also be included in the Master Status List. (In such cases, the card processor shall deactivate the card by encoding or deleting data on the card. The deactivated card shall thereafter be removed from the Master Status List.)

## 6.2 Third Party-Issued Valid Card List

Third party-issued cards that are eligible for transit services on CTDOT vehicles shall be linked to special "sponsor" accounts tracked by the CDS. The CDS shall maintain and transmit to each NFTS device a Third Party-Issued Valid Card List (VCL) containing the 16- or 20-digit Unique ID (UID) of each valid third party-issued card.

The VCL shall support no less than 250,000 entries, enabling CTDOT to support 250,000 users sponsored by third parties. Alternatively, the VCL may be included as part of the MCL with the MSL size increased accordingly to 1,250,000 entries.



## 7 Smart Card Fare Processing

### 7.1 CTDOT-Issued Long-Term Use Smart Cards

#### 7.1.1 Initial Sales and Distribution

Upon issuance, the issuing device shall inform the CDS that the card has been issued; the CDS shall place the account in the “active” state. If no value is added to the account, the account shall remain “invalid” due to no value. If value is added to the account, the CDS shall record the value and place the account in the “valid” state.

Issue records shall include, at minimum:

- User profile information
- Media expiration date

The NFTS shall support issuance of cards by third party retailers, Administrative POS Terminals, Internet fulfillment services, and other future devices, such as self-serve kiosks and vending machines.

#### 7.1.2 Account Deposits

The NFTS shall support the collection and maintenance of deposits for each stored value account-based card in circulation. The value of the deposit and any deposit refund policies shall be CTDOT-configurable.

The value of account deposits shall not be used to fund usage transactions unless permitted by CTDOT-configurable operating parameters. For example, if the deposit is \$5 and a patron’s stored value account balance is \$1, if permitted by CTDOT policy, usage of the associated card for a \$1.50 fare would result in reducing the deposit to \$4.50. Thereafter, the associated card would be unusable until the account is replenished.

If the deposit value is less than the CTDOT-configurable minimum, any replenishment transactions shall first restore the account deposit to the minimum value before making additional funds available for transit use.

#### 7.1.3 Fare Products

Accounts associated with CTDOT-issued long-term smart cards shall support the simultaneous validity and use of no less than three distinct fare products. All such cards shall have an associated stored value “purse.” In addition, accounts for the CTDOT-issued long-term cards shall be capable of recording at least two other active fare products, including fixed calendar passes, floating period passes, stored ride products, and others as described herein. These additional fare products may be “active” (that is, in use) and “pending” (that is, available for future use).

Accounts for all CTDOT-issued smart cards shall record sufficient usage information to support CTDOT transfer policies, including at minimum: transfers limited by time, number of subsequent boardings, transit service levels, and combinations thereof.



Fare products recorded and tracked in accounts associated with CTDOT-issued long-term smart cards shall be reconfigurable, based on customer purchase and selection via any sales and replenishment method.

For example, an account with no active or pending floating period pass shall support the purchase and loading of any floating period pass of any duration and value (subject to account profile restrictions), regardless of any prior use of other floating period passes; the system shall support such replenishment transactions via any sales and replenishment method.

#### **7.1.4 Replenishment**

##### **7.1.4.1 POS Terminals**

The NFTS shall include two varieties of Point of Sale Terminals: Administrative and Portable Administrative. All terminals shall provide customers with the ability to purchase new smart card media and to add and replenish stored value to accounts associated with CTDOT-issued long-term smart cards. Administrative POS Terminals shall also permit customers to add stored ride passes and unlimited ride passes to their accounts.

##### **7.1.4.2 Internet Transactions**

The NFTS shall support sales and account replenishment via the Internet using dedicated web portals designed, implemented, and hosted by the Contractor. The NFTS shall support one-time Internet-based account replenishment transactions

##### **7.1.4.3 Subscribed Replenishments**

The NFTS shall support repeated “subscription” account replenishment transactions. These transactions shall automatically add stored value, unlimited ride passes, or both to a customer’s account based on CTDOT-configurable thresholds and patron-selected options. The NFTS shall enable customers to set up, modify, and discontinue subscribed account replenishment transactions via a dedicated web portal design, implemented, and hosted by the Contractor, and via the use of an Administrative Point of Sale (APOS) Terminal.

##### **7.1.4.4 Stored Value**

All CTDOT-issued long-term media accounts shall support stored value transactions. Replenishment of stored value shall be limited to a CTDOT-configurable maximum value, initially set to \$300.

##### **7.1.4.5 Replenishment Bonuses**

The NFTS shall support CTDOT-configurable bonuses when stored value is added to an account. The bonus structure shall support no less than 4 distinct bonus thresholds, and CTDOT-configurable bonus amounts at each threshold that shall support fixed dollar amounts and percentages of the added value.

##### **7.1.4.6 Floating Period Pass**

When pre-purchased, all floating period passes shall be stored in the account of associated CTDOT-issued media in the “pending” state. Such passes shall be “activated” upon first use.

Accounts that “earn” unlimited ride pass privileges based on capped fare transactions shall be activated with an activation date and corresponding expiration date calculated based on prior usage.



### 7.1.5 Usage Transactions

Using the content of the Master Status List, each NFTS device shall process CTDOT-issued account-based media as follows:

1. Search the Master Status List ([MSL](#)) for the card's sequential serial number.
2. If the card's number is not on the MSL, the NFTS device shall reject the card and display an appropriate message with an accompanying audible tone.
3. If the card's sequential serial number is on the MSL, the NFTS device shall respond according to the relevant data fields for the card's entry:
  - a. If the account has been deactivated, suspended, declared dormant, or the media is expired, the NFTS device shall indicate that the card is invalid for use.
  - b. If the card has not been deactivated but the MSL indicates that the card's account is deactivated, the NFTS device shall deactivate the card (*i.e.*, physically encode or delete data to permanently deactivate the card) and indicate that the card is invalid for use.
  - c. If the account has unlimited ride pass privileges of equal or greater value than the service type in effect, the NFTS device shall indicate the pass type used.
  - d. If the account has unlimited ride pass privileges of lesser value than the service type in effect and the account has sufficient stored value to pay the incremental fare, the NFTS device shall indicate that a pass and stored value were used to pay the fare.
  - e. If the account has unlimited ride pass privileges of lesser value than the service type in effect and the account has insufficient stored value to pay the incremental fare, the NFTS device shall indicate that a valid pass is present but incremental fare is due in cash to the farebox.
  - f. If the account has no pass privileges but the associated account has stored value, the NFTS device shall indicate that stored value was used to pay the fare.
  - g. If the account has no pass privileges and insufficient stored value, the NFTS device shall indicate that the card is invalid.
  - h. If the account is valid for use but the card media is expiring, the NFTS device shall additionally display a message warning the passenger that the card is nearing its useful life and should be replaced.
4. The NFTS device shall record the results of all transactions and transmit transaction data to the CDS as required herein.

Alternatively, the NFTS devices shall communicate with the CDS for real-time authorization and use the MSL for authorization when communication with the CDS is unavailable.

## 7.2 Read-Only Third Party Media

Third Party-Issued smart cards that are sponsored by participating institutions shall be included in the Third-Party Valid Card List (VCL). When an ISO 14443-compatible card presented to an NFTS device is identified as not a CTDOT-issued card, the NFTS device shall search the VCL for the presented card's UID.





If the presented card's UID is on the VCL, the NFTS device shall indicate the card's validity to the passenger and to the operator (as appropriate). If the presented card's UID is not on the VCL, the NFTS device shall indicate that the card is invalid for use.

For each read-only third party-issued media accepted for transit services, the device shall record the card UID number in the transaction record. The NFTS device shall transmit Third Party-issued card transaction records to the CDS at the same frequency as transaction records for CTDOT-issued smart cards.

### 7.3 CTDOT-Issued Limited Use Smart Cards

As described herein, CTDOT-issued limited use smart cards shall support transfers and only one fare product, and shall not be reloadable. The Limited Use Smart Cards shall support stored ride products and short-term duration unlimited ride passes.

When a Limited Use Smart Card is used at an NFTS device, the NFTS device shall read the card and determine its validity for use (based on CTDOT-configurable fare policies and fare sets in effect).

If the card is valid for use:

1. If the card is a previously unused (*i.e.*, "pending") floating period pass, the NFTS device shall activate the pass by encoding appropriate activation and expiration data to the card, and display corresponding information to the passenger and operator (as applicable).
2. If the card is an active floating period pass, the NFTS device shall indicate that the pass is valid and display the expiration date.
3. If the card is a stored trip card with no active transfer, the NFTS device shall deduct one trip and encode transfer expiration data to the card's non-volatile memory and display an appropriate message to the passenger and operator (as applicable), and indicate the number of remaining trips and transfer expiration time.
4. If the card is a stored trip card with an active (unexpired) transfer, the NFTS shall indicate that a transfer is in effect and display the transfer expiration time to the passenger and operator (as applicable).

If the card is not valid for use, the NFTS shall indicate that the card is invalid.

### 7.4 Issuance, Usage and Replenishment Transaction Flows

The Contractor shall submit a series of flow charts depicting all smart card issuance, usage, and replenishment transactions. The flow charts shall show all steps in the processing of a smart card transaction, as well as autoloading processes. Transaction flow charts shall cover all major transaction types and all fare policies defined.

The Contractor shall submit the flow charts for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 7-1**



## 8 Barcode Media Processing

Barcode media, principally 2-dimensional barcodes printed by CTDOT and those displayed on customer smart phones via an application supplied by others, shall support read-only transactions used for unlimited ride pass fare products. All Validating Fareboxes, Stand Alone Processors, and Handheld Fare Inspection Terminals shall incorporate optical readers capable of reading standard-format 2D barcodes with sufficient data capacity to satisfy CTDOT's fare policies.

All 2D barcodes shall incorporate security methods and unique identification numbers. When a 2D barcode is presented to a reader, the barcode shall be verified for validity and whether the barcode's unique identification number is on the current action list to be rejected.

Barcodes displayed via a Mobile Ticketing Application shall also include the date and time of generation. When a mobile ticket barcode is read, the reader shall verify that the barcode is no older than a CTDOT-configurable number of minutes. If the barcode's age exceeds this amount (initially set to 5 minutes), the reader shall reject the barcode. (CTDOT-printed barcode tickets shall not be subject to the time-of-generation verification.)

As a read-only product, all barcode media shall also be checked for passback use, as defined by barcode-specific, CTDOT-configurable usage parameters. As delivered, the NFTS shall subject barcode media to 5-minute passback prevention.



## 9 Magnetic Media Processing

### 9.1 Magnetic Media Dispensing Transactions

As delivered, the Validating Farebox, via the Magnetic Ticket Processor, shall dispense (print and encode) paper-based magnetic media on demand, based on CTDOT-configurable fare and operating policies. The Validating Farebox shall dispense magnetic media for on-board purchases of Day Passes, and for transfers issued upon cash-paying passenger request. The magnetic ticket processors shall be removed and replaced with bar code dispensers at a defined point within the project.

In addition, prior to the transition to barcode-only document dispensing, the Validating Farebox shall automatically issue Proof of Payment receipts (using the magnetic media) for all cash fares paid on the CT*fastrak* vehicles.

All dispensed magnetic media shall be physically and magnetically compatible with CTDOT's existing magnetic media.

### 9.2 Read/Write Magnetic Media Transactions

Prior to the phase-out of read/write magnetic media, the Validating Farebox shall process inserted read/write magnetic media as required to maintain consistent CTDOT fare operations. The Validating Farebox's Magnetic Ticket Processor (MTP) shall read, re-encode and print as necessary to conduct transactions consistent with existing CTDOT magnetic media transactions.

At minimum, the MTP shall conduct the following read/write magnetic media transactions:

- Deduct a trip from a stored trip card
- Activate a previously unused floating period pass
- Other read/write magnetic transactions as necessary to support existing CTDOT fare policies and operations.

### 9.3 Read-Only Magnetic Media Transactions

The Validating Farebox shall process read-only magnetic media as required to be consistent with existing CTDOT fare media and policies. The Validating Farebox shall use the Magnetic Ticket Processor and the Magnetic Swipe Reader to process read-only CTDOT magnetic media.

CTDOT magnetic media that operate as read-only shall include at minimum:

- Previously issued transfers
- Previously activated floating period passes
- Other read-only magnetic transactions as necessary to support existing CTDOT fare policies and operations.



## 10 Operator Control Module

Excluding Non-Registering Fareboxes, on-board fare processing devices shall communicate with and be controlled by an Operator Control Module (OCM) that is identical for all applications. The OCM shall be available for use as a backup sign on and operational method if and when the NFTS interfaces with the ITS on-board systems.

### 10.1 Operator Input Controls

The Operator Control Module shall utilize touch screen input controls in coordination with information displayed on the Operator Display. The touch regions shall be large enough to allow easy use by the operator, and shall be functional when used by gloved hands.

Selection of a touch region shall be accompanied by suitable visual and audio feedback to confirm each selection.

The touch screen shall be protected by an easily replaceable film (such as products used to protect smart phone touch screens) of clear plastic with a matte finish to reduce glare.

The OCM may provide physical buttons to perform functions that are fixed in nature. All such buttons shall provide tactile feedback when pressed.

### 10.2 Operator Display

The OCM shall incorporate a high visibility backlit display capable of displaying the full palette of colors and resolution of at least a VGA display. The display shall be no less than 6 inches in diagonal measure.

Display contrast and the brightness of the backlight shall be operator-adjustable without requiring the operator to logout. The display shall be of sufficient brightness to be visible in all levels of ambient lighting within the bus.

The OCM Operator Display shall indicate the results of the last transaction for the inter-transaction timeout period or until the next transaction commences, whichever occurs first, unless the operator presses a "Hold" button.



### 10.3 Transaction Status Lamps

The OCM shall include three LED lamps in red, yellow, and green, which shall be visible in all ambient lighting conditions. The operation of the LEDs shall be as follows:

Table 10.3: Operator Control Module Status Lamp Operations

Illuminated Lamp	Condition Indicated
Red	A transaction has failed due to the fare instrument or associated account being deactivated, suspended, or dormant, or having no valid pass, or having insufficient value.
Yellow	Presented fare instrument is valid, but additional attention is required because the fare instrument or associated account is a reduced fare, or the card is past its expiration date, or the pass is nearing expiration, or the remaining value is low, or some other warning condition exists. Remaining days and value thresholds shall be CTDOT-configurable.
Green	Transaction is successful.

After each transaction, the appropriate LED shall remain illuminated for the inter-transaction timeout period or until the next transaction commences, whichever occurs first, unless the operator presses a “Hold” button.

Alternatively, the OCM operator display may indicate by color representation the same information in lieu of discrete LED lamps.

### 10.4 Audio Transducer

The OCM shall be capable of emitting at least 8 distinct sounds or sound patterns. All sounds emitted by the OCM shall be of sufficient volume to be heard by the operator while the vehicle is in operation. Each illumination of LEDs shall have one or more distinct sound or sound pattern assigned. For example, it shall be possible to assign a sound for a successful transaction that also requires the operator to inspect the passenger’s fare media which is distinct from the sound emitted for a successful transaction with media that has low residual value. (In both cases, the yellow LED shall illuminate.)

For each transaction result and operating condition, the Contractor shall submit samples of the tones emitted by the OCM audio transducer in .mp3, .wav, or other standard format for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review.

#### CDRL 10-1

### 10.5 OCM Enclosure

Space on the dashboard to the right of the operator – the ideal location for the OCM – is limited. The OCM shall be as compact as possible while still providing required usability and ergonomics.



The OCM enclosure shall:

- Be sufficiently robust to withstand the public transit vehicle environment, resist vandalism, and maintain integrity for the expected life of the NFTS
- Satisfy all environmental requirements
- Be made of engineered high-impact thermoplastics or other corrosion-resistant materials
- Have no sharp edges or corners
- Have no paint or other coatings that may scratch or wear off
- Be sealed against moisture ingress
- Be of a CTDOT-approved dark color that shall minimize glare and reflections in the windshield
- Be latched or secured closed in such a way that it can be opened only when properly removed from the mounting bracket

## 10.6 OCM Mounting and Ergonomics

The Contractor shall include appropriate hardware to permit OCM mounting on the vehicle dashboard or a stanchion as required by the configuration of a particular vehicle. The installed position shall allow operators to observe fare transactions while operating the OCM, and shall not interfere with any controls, block any indicators, obstruct the operator's view, or create a safety hazard.

The OCM mounting shall be designed so that it can be quickly adjusted by each operator to the optimal viewing and operating angle. Once adjusted, the mounting hardware shall hold fast in that position and shall not allow the OCM to rattle or become loose as a result of shock and vibration encountered during normal operation.

## 10.7 OCM Functionality

As described herein, the Operator Control Module shall enable the operator to manage and monitor the NFTS device with which the OCM communicates. In addition, the OCM shall:

- Provide a "hold" function that shall extend the intra-transaction timeout for a CTDOT-configurable period, initially 10 seconds, if a transaction is in progress. The same "hold" function shall extend the inter-transaction timeout for a CTDOT-configurable period, initially 10 seconds, if a transaction is complete and the inter-transaction timeout has not expired.
- Enable the operator to review the results of at least the last 5 transactions.
- The OCM shall also provide for the vehicle operator to enter tally counts for identified situations to track defined activities.



## 10.8 Additional Design Submittals

The Contractor shall submit descriptions of the OCM for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. OCM design submittals shall include:

- OCM operator interfaces **CDRL 10-2**
- OCM enclosure **CDRL 10-3**
- OCM mounting system **CDRL 10-4**



## 11 Validating Fareboxes

### 11.1 General

#### 11.1.1 Description

- A. The Electronic Validating Farebox (“Validating Farebox”) shall support CTDOT fare policies. To do so, the Validating Farebox shall:
- Accept, process, validate, and securely store U.S. currency and coins
  - Initially accept and process existing CTDOT magnetic media
  - Accept and process contactless smart card media, both CTDOT-issued and third party-issued
  - Dispense machine-readable transfer documents (initially in magnetic form compatible with existing CTDOT media, subsequently as plain paper-based 2-dimensional barcode media)
  - Accept and process 2-dimensional barcode media, including paper tickets issued by the Multi-Function Vending Machines (MVMs), CTDOT Ticket Vending Machines (supplied by others), and tickets and transfers dispensed by the Validating Farebox
  - Accept and process 2-dimensional barcodes displayed by a future mobile phone ticketing application (supplied by Others)
- B. The Validating Farebox shall provide reliable, accurate, and maintainable service for the life of the NFTS.
- C. The Contractor shall furnish CTDOT with all hardware, software, consumables, ticket stock and supporting equipment capable of processing all CTDOT present fares based on CTDOT’s business rules.
- D. This Validating Farebox system, including all devices, shall include flexibility to ensure that CTDOT’s future fare structure, fare policy, and tariff requirements can be satisfied without software modifications; all fare structure, fare policy, and tariff modifications shall be performed through parameter modifications and the modification of the fare structure via the Central Data System (CDS). Policies requiring changes to existing screen flow processes, but not for the addition of screens, may be excluded from this requirement.
- E. Equipment design shall be operator- and customer-friendly, and shall include the use of sculptured buttons, tinted latent panels, high intensity lights, surface grain depth and direction and other similar elements to:
- Enable ease of operation by the customers and the operator
  - Minimize the time for a transaction
  - Provide for high reliability
- F. Once installed, the Validating Farebox shall meet all local, State and Federal ADA requirements in force at the date of Final Design Review.
- G. Electronic keys and locks (i.e., Cyber™ Locks or CTDOT approved equal) shall secure Validating Farebox internal components and cashbox access.

The Contractor shall provide a complete description of the functionality of the Validating Farebox for CTDOT review and approval at each stage of the design review with the final document fully describing the operation, capabilities, and functionality of the Validating Farebox





as described within this section. Sufficient detail shall be provided to permit verification that all required functions are satisfactorily included. **CDRL 11-1**

### **11.1.2 Installation Design**

The Validating Farebox design shall support flexible, ergonomic, safe, and rugged installation methods that accommodate a wide variety of vehicle configurations, within the limited space available.

The Validating Farebox shall be installed on each bus, adjacent to the operator, and in proximity of the front door. It shall be positioned so that an entering passenger may easily insert or present the required fares into the Validating Farebox. The installation position shall permit the operator to readily see the inserted fare payment method, observe the digital readouts provided, and reach and manipulate various operator controls provided.

The Validating Farebox location shall permit all of the required maintenance functions to be performed, as well as to provide easy access for the removal of the cashbox, and meet all ADA requirements for passenger entry and exit.

### **11.1.3 Fare Media Transition Support**

As described herein, CTDOT presently uses read/write magnetic fare media for passes and transfers. Upon initial installation, the NFTS shall support all existing fare products and policies. It is CTDOT's intention to transition all magnetic media to contactless smart card and barcode media no more than 12 months after NFTS installation. The Validating Farebox shall support the phase-out of magnetic media and adoption of new fare media.

The Contractor shall provide comprehensive plans and procedures to migrate from magnetic to non-magnetic media, including the migration from magnetic read/write transfers to barcode transfers, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 11-2**

### **11.1.4 Power Requirements and Wiring**

For power input, the Validating Fareboxes shall be wired to the bus battery, which may be a nominal 12 VDC or 24 VDC, depending on vehicle model. The Validating Farebox shall also sense the ignition state of the vehicle engine and respond as specified herein.

## **11.2 Passenger Interfaces**

The Validating Farebox shall provide a variety of interfaces tailored to satisfy the needs of passengers conducting transactions. The purpose and use of all passenger interfaces shall be intuitive and ergonomic.

As necessary, all passenger interfaces shall be illuminated to permit easy identification during low ambient lighting conditions. Passenger interface illumination shall not produce excess glare on the vehicle windows nor interfere with the operator's ability to see out the windows. If necessary to reduce glare during nighttime operations, passenger interface illuminations shall be automatically attenuated by use of an ambient light sensor.



### 11.2.1 Fare Processing Modules

The Validating Farebox shall include the following modules to process fares:

- Coin Processor
- Bill Processor
- Contactless Smart Card Processor
- Barcode Media Reader
- Barcode Ticket Dispenser
- Magnetic Swipe Reader
- Magnetic Ticket Processor

As delivered, the Validating Farebox shall include the Magnetic Ticket Processor ([MTP](#)) and no Barcode Ticket Dispenser- ([BTD](#)). In support of the transition to barcode media, the Contractor may replace the MTP with the Barcode Ticket Dispenser, or convert the MTP to a BTD, subsequent to Validating Farebox installation.

### 11.2.2 Passenger Display and Keypad

The Passenger Display shall be a backlit LCD display with sufficient size, resolution, brightness, and contrast to provide ADA-compliant readability under all lighting conditions present in the transit vehicle environment.

The display shall be of sufficient ruggedness to withstand the rigors of the transit vehicle environment.

The Passenger Display shall at minimum:

- Prompt the passenger in the use of the Validating Farebox
- Display the operating status of the Validating Farebox
- Display the transaction type and value that will occur upon presentation of a valid fare instrument
- Display the results of the transaction, and in sufficient detail to inform the passenger of the validity of the presented fare media and the new status and value of the presented smart card (as applicable)

The Passenger Keypad shall provide at least two physical pushbuttons with which the passenger may make selections or respond to prompts. Each button shall be:

- Made of suitably rugged material
- Backlit or otherwise illuminated for visibility in low ambient light conditions
- Approximately 1 square inch in surface area
- Labeled by appropriate ADA-compliant raised lettering and Braille
- Accompanied by an audio tone whenever pressed
- Easy to press, even when used by passengers wearing gloves

### 11.2.3 Transaction Status Lamps

The Validating Farebox shall include three LED lamps in red, yellow, and green, which shall be visible in all ambient lighting conditions. The operation of the LEDs shall match the operation of the OCM. After each transaction, the appropriate LED shall remain illuminated.

Alternatively, the Validating Farebox may utilize comparably-colored messages shown on the Passenger Display in lieu of discrete transaction status lamps.



#### **11.2.4 Audio Transducer**

The Validating Farebox shall be capable of emitting at least 8 distinct sounds or sound patterns, which shall match those emitted by the OCM. All sounds emitted by the Validating Farebox shall be of sufficient volume to be heard by the passenger while the vehicle is in operation.

For each transaction result and operating condition, the Contractor shall submit samples of the tones emitted by the Validating Farebox audio transducer in .mp3, .wav, or other standard format for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 11-3**

### **11.3 Operator Control Module**

Each Validating Farebox shall interface with an Operator Control Module (OCM) to provide suitable display and input for operators to control and monitor the Validating Farebox. The Operator Control Module and the Validating Farebox shall convey identical transaction feedback information.

### **11.4 Validating Farebox Enclosure**

#### **11.4.1 General**

The Validating Farebox enclosure shall:

- Be sufficiently robust to withstand the public transit vehicle environment, resist vandalism, and maintain integrity for the expected life of the NFTS
- Satisfy all environmental requirements
- Have no sharp edges or corners
- Have no paint or other coatings on external surfaces that may scratch or wear off
- Accommodate CTDOT-approved graphics applied to identify the coin slot and return cup, bill slot, CSCP antenna, barcode reader, and other human interfaces as necessary

#### **11.4.2 Dimensions**

As measured from the vehicle floor to the highest point of the Validating Farebox, including any mounting base plate, the Validating Farebox shall measure no more than 41 inches high. The Validating Farebox shall be no more than eleven inches (11") square in cross section, excluding any mounting base plate.

#### **11.4.3 Materials and Finish**

The Validating Farebox shall be constructed of heavy-gauge stainless steel and engineered high-impact thermoplastics or other corrosion-resistant materials, designed to withstand the rigors of the CTDOT public transit bus environment and to resist attempts at vandalism and theft.

External surfaces shall be made of stainless steel with a random orbital finish and other revenue service-proven materials. The Validating Farebox external surfaces shall be clean, with no projections, sharp edges or corners that can cause any person injury or any damage to property. Exterior finishes shall resist corrosion, abrasion and scratching and shall be clean with all corners rounded. External surfaces shall not contain cracks, weld marks, burrs, discolorations, or distortions resulting from fabrication, shipment or installation.



Internal surfaces not of stainless steel, aluminum, engineered plastics, or plated, shall be painted with a corrosion resistant paint. The Contractor shall ensure that all painted surfaces are finished to a hard enamel finish. All paint shall be uniformly applied over the intended surfaces, and shall be free from runs, sags, dirt or other application defects.

Paint or permanent coloring applied to any surface shall be designed to last for the life of the component to which it is applied.

#### **11.4.4 Validating Farebox Mounting**

The Validating Farebox mounting system shall satisfy the following requirements:

- A. The Contractor shall securely install the Validating Farebox using stainless steel hardware in a manner and location that is safe to passengers and operators, ergonomic, compliant with ADA, and suitably robust for the transit vehicle environment.
- B. When installed, the Validating Farebox shall not obstruct operator views nor cause excessive glare on the windshield during all ambient lighting conditions.
- C. Validating Farebox mounting shall facilitate easy and rapid exchange of defective modules without the use of tools or manipulation (disconnection and reconnection) of power or data cables.

#### **11.4.5 Locks and Security**

Maintenance and revenue service access doors for the Validating Farebox shall be secured.

#### **11.4.6 Cashbox Access Door**

The Validating Farebox shall have a single cashbox access door integral to the Validating Farebox cabinet, which shall securely protect and conceal the cashbox within the Validating Farebox. Access door design shall have no pry points.

The cashbox door shall be fitted with internal devices, which shall only release and open the door as a consequence of a successful data transfer sequence including transmission of the data from the Validating Farebox and release the cashbox access door.

The cashbox access door shall be secured by an electronic lock system. The electronic lock shall deter unauthorized access to the cashbox.

#### **11.4.7 Maintenance Access**

The Validating Farebox shall have one or more access doors or panels to facilitate maintenance tasks. An open maintenance access panel shall not provide immediate access to cash in the cashbox.

#### **11.4.8 Validating Farebox Enclosure Design Submittals**

Contractor shall provide dimensioned drawings of the Validating Farebox showing each side and with the doors and covers both opened and closed. **CDRL 11-4**

Contractor shall provide drawings of the proposed Validating Farebox installed on each type of vehicle, including modification or replacement of the handrails or equipment within the installation area for final approval by CTDOT. **CDRL 11-5**

The physical design of the Validating Farebox to meet all of the requirements defined within these specifications shall be submitted for review and approval of CTDOT. **CDRL 11-6**



## 11.5 Bill Processor

The Validating Farebox shall include a Bill Processor module that satisfies the following requirements.

- A. The bill mechanism shall accept and process all bills properly presented to the insertion slot.
- B. The Validating Farebox shall accept and count \$1, \$5, \$10 and \$20 bills, including new and old versions of these bills. The Bill Processor shall accept no less than 12 different bill types (where a bill "type" is a distinct design or series of any denomination, regardless of insertion orientation).
- C. The Bill Processor shall be reprogrammable to add and delete bill types to be accepted. Such reprogramming shall not require the exchange of hardware components within the module, but shall be accomplished by software download to the Bill Processor's static memory.
- D. The bill acceptance slot shall be positioned in the general proximity of the coin insertion area, and shall accept unfolded bills inserted lengthwise. The dimensions of the currency slot shall hinder the accidental insertion of coins. The currency slot shall be illuminated to permit ease of bill entry in diminished lighting conditions. The mechanism employed to transport the inserted bills shall be positive and not require precise insertion by the passenger. The bill validator shall be programmable to accept bills inserted in either both orientations face-up or all four orientations.
- E. A guide plate shall be provided to assist in the entry of the bill into the Validating Farebox. The guide plate shall not have any height variation with any other component in the bill throat that may cause jamming or other insertion difficulties for the passenger or slow throughput. The paper currency shall be inserted approximately one inch before the mechanism shall become operational and advance the bill into the Bill Processor. The Bill Processor shall employ a roller mechanism to positively engage an unfolded bill, regardless of condition. It shall require no force to cause the mechanism to start.
- F. The inserted bill shall be verified based on optical, magnetic or other means to positively identify the denomination of the inserted bill and to reject foreign and counterfeit currency as well as other items which are not valid US currency. The counting logic of the Validating Farebox shall increment the appropriate non-resettable counter for each denomination of bill validated and accepted.
- G. Validated bills shall be advanced to the cashbox after validation.
- H. Bills shall be processed at a rate of not less than one bill in two seconds. This time shall be measured from the time that the bill is sensed in bill insertion slot to the time that the bill is validated by the Validating Farebox and the appropriate value displayed.
- I. The Bill Processor shall have the capability of handling, without jamming, bills which are deformed, that is, bills which are subject to the conditions of daily "street" use, including wrinkled, torn, folded, or damp bills. The Bill Processor shall accept and validate bills that are:
  - Not uniformly flat or in "new condition"
  - Torn to a depth of one-half inch from the edge of the bill
  - Damp but not saturated



- J. The Bill Processor shall meet the following performance criteria:
- 97% of valid bills shall be accepted upon initial insertion.
  - 98.5% of valid bills shall be accepted within two insertions.
  - All known counterfeit bills, color photocopies of valid bills, duplicates made by other known means, foreign bills, and bills of denominations not valid shall be rejected upon every insertion.
  - Validation accuracy of accepted bills shall be at least 99.95%
- K. Each Bill Processor shall be permanently inscribed with a unique serial number, clearly visible when the maintenance apertures of the Validating Farebox are opened.

## 11.6 Coin Processor

The Validating Farebox shall include a Coin Processor module that satisfies the following requirements.

### 11.6.1 Coin Acceptance

- A. The Validating Farebox Coin Processor shall accept, validate and count US pennies, nickels, dimes, quarters, half dollars, and post-1978 dollar coins. Validation of the coins shall be by weight, density, magnetic properties, size and/or other means which shall guarantee that only valid US coins are accepted, validated and deposited in the cashbox.
- B. Acceptance and validation of coins shall be at an insertion rate of not less than 5 coins per second.
- C. The Coin Processor and associated logic shall be programmable to identify other coins, including existing coins issued with new metallic content, without necessity of replacement or remanufacture of the coin validator or other hardware change.
- D. Subsequent to insertion and registration, coins shall be directed to the cashbox.
- E. The counting logic of the Validating Farebox shall increment the appropriate non-resettable counter for each denomination of coin and each token type validated and accepted.
- F. The Coin Processor shall meet the following criteria:
- 99.5% of valid coins shall be accepted upon initial insertion
  - 99.8% of valid coins shall be accepted upon one reinsertion
  - All known counterfeit coins, common slugs, foreign coins, and coins of denominations not valid shall be rejected upon every insertion
  - Validation accuracy of accepted coins shall be at least 99.95%
- G. Each Coin Processor shall be permanently inscribed with a unique serial number, clearly visible when the maintenance apertures of the Validating Farebox are opened.

### 11.6.2 Coin Return

- A. The Validating Farebox shall include a coin return cup, located within easy reach of a passenger and conforming to all ADA requirements.
- B. The coin return cup contents shall be illuminated at all times while the Validating Farebox is in operation.



- C. The coin return cup shall have a pivoting door to retain returned coins in the cup.
- D. Any coin which is inserted into the Validating Farebox and cannot be automatically validated by the Coin Processor shall be returned to the passenger via the coin return cup. This shall include deformed coins and coins otherwise not meeting the specified valid coin criteria.
- E. The coin return cup shall have the capacity to retain no less than 20 US quarters.
- F. The Validating Farebox shall note in its memory and retain for data transmission, the instances of coin returns. This information shall be forwarded to the CDS to assist in performance and failure diagnosis.

### **11.6.3 Coin Unjamming**

The Validating Farebox shall include a mechanism to release coins that jam in the Coin Processor, including insertion of materials other than valid coins such as from the insertion of non-coin foreign material and/or the failure of the electronic logic. The released coins and material shall be routed to the coin return cup. An event record shall be created in Validating Farebox memory, for subsequent data upload, each time the unjam mechanism is used.

The Contractor shall provide full details on the mechanism utilized to clear a coin jam for CTDOT approval. **CDRL 11-7**

### **11.6.4 Coin Bypass**

In the event the Validating Farebox Coin Processor is inoperable and the coin jam release cannot remedy the condition, the operator shall be able to engage a coin bypass mechanism that routes coins directly to the cashbox without going through the Coin Processor. When the Validating Farebox is in this degraded mode the following shall apply:

- Coins routed through the bypass need not be counted but shall fall directly to the cashbox.
- Security of the Validating Farebox and the retention of the revenues shall not be diminished by the activation of any coin jam or coin bypass.
- Once placed into coin bypass operation, the coin bypass mechanism shall remain in place until reset by authorized maintenance personnel.
- Use and operation of the Bill Processor or any other fare payment modules shall not be affected by the coin bypass operation.
- Use of an employee fare media may be part of the reset process, but shall not be accepted in lieu of the use of a Portable Data Unit.
- The operator shall still have the means of controlling and recording each transaction while the coin system is in bypass status, via the Operator Control Module.
- Cash transactions recorded while in this bypass status shall be coded, so there is clear identification of the transactions, which occurred while the Validating Farebox was in coin bypass status.

## **11.7 Contactless Smart Card Processor**

The Validating Farebox shall contain a Contactless Smart Card Processor (CSCP), which shall provide contactless smart card read and write functionality that is fully compliant with the ISO/IEC-14443 standard, able to process media defined as Type A and B, certified for use with EMV®-compliant bankcard media, and satisfies all other requirements stated herein.



The CSCP antenna shall be sized and operate at a power that satisfies the ISO/IEC-14443 read/write distance range requirements, and the read/write distance range requirements for the media being supplied under this Contract.

## 11.8 Magnetic Ticket Processor

### 11.8.1 General

As delivered, the Validating Farebox shall include a Magnetic Ticket Processor (MTP) that shall process existing CTDOT magnetic media, consistent with CTDOT fare policies and practices. The Contractor shall supply new MTPs. **CDRL 11-8**

The MTP shall:

- Issue paper-based, thermal-coated, magnetic media that is physically compatible with existing CTDOT magnetic media for dimensions, printing, and encoding
- Print and encode magnetic media upon issue, including Day Passes and transfers
- Accept, read, re-encode (as necessary) and print (as necessary) inserted magnetic media, including existing CTDOT magnetic media
- Reliably and accurately process existing CTDOT magnetic media, which is paper and plastic, nominally 7 to 10 mils thick
- Provide validation information to operator and passenger
- Conduct ticket dispense transactions in no more than 2 seconds from the time the dispense command is issued to when the magnetic ticket is available for retrieval
- Conduct read/write and print transactions for inserted media in no more than 3 seconds from when the ticket is inserted to when the processed magnetic ticket is available for retrieval
- Conduct read-only transactions for inserted media in no more than 2 seconds from when the ticket is inserted to when the processed magnetic ticket is available for retrieval

### 11.8.2 Read/Write Magnetic Fare Media Characteristics

CTDOT's existing read/write magnetic media is used as floating period passes, stored ride tickets, and transfers.

The MTP shall reliably and properly process existing CTDOT read/write magnetic media. Processing of existing read/write magnetic media requires the MTP to read the encoded data, re-encode the data as necessary, and in some cases, print text on the thermally-sensitive side of the document.

In addition, the MTPs shall issue (encode and print) tickets for use as transfers and Day Passes. All MTP-issued transfers and Day Passes shall be dimensioned and magnetically encoded to be fully compatible with CTDOT's existing bus fare collection system.

As necessary, the MTP shall print onto read/write magnetic media using direct thermal technology.

Within 30 days of the Contractor executing a non-disclosure agreement, the CTDOT Contract Manager shall provide magnetic ticket stock specifications **CTDOT 11-1** and existing encoding and data interpretation information **CTDOT 11-2** to the Contractor.





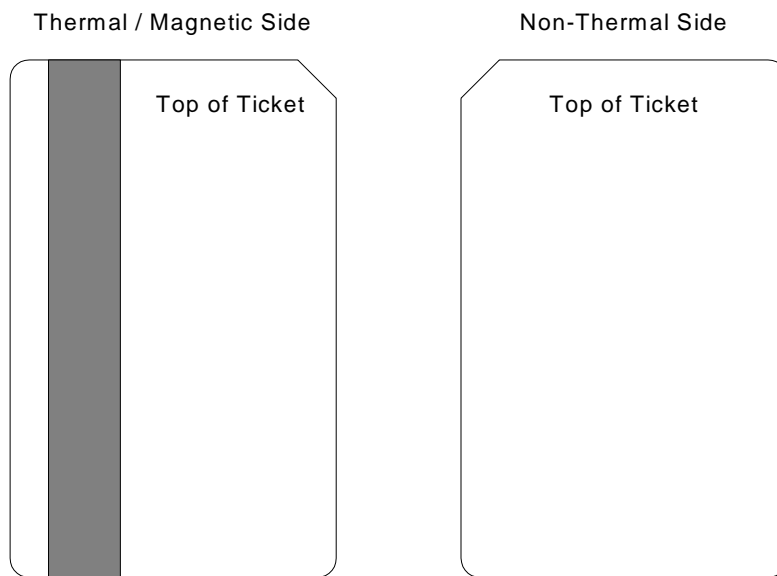
### 11.8.2.1 *Dimensions*

CTDOT's existing read/write magnetic media is nominally 2.125 inches by 3.275 inches, with tolerances of  $\pm 0.005$  inches in each dimension. Existing read/write magnetic media is between 0.007 and 0.008 inches thick.

As viewed from the thermal/magnetic side of the ticket, the upper right corner of the ticket shall be "notched" at a 45° angle approximately 0.25 to 0.35 inches from the top and adjacent side, resulting in an edge approximately 0.5 inches long. See diagram below (diagram not to scale.)

Figure 11.8.2.1

Current CTDOT Read/Write Magnetic Media



### 11.8.2.2 *Base Material*

All tickets to be issued by the MTP shall utilize plain paper 0.007" to 0.008" thick as the base material.

Existing ticket media, which the MTP shall process, includes paper and plastic media, nominally 0.007" to 0.010 inches thick.

### 11.8.2.3 *Magnetic Stripe*

All ticket stock shall employ high-coercivity magnetic material suitable for encoding at 2750 Oersteds. The magnetic material shall be securely attached to the ticket stock and shall resist peeling, abrading, and cracking in normal patron use. The stripe shall be approximately 0.5" wide and be located so as to accommodate two tracks of magnetic encoding located in standard ANSI/ISO tracks 2 and 3.



#### 11.8.2.4 *Encoding*

CTDOT's existing fare collection system employs a dual-track magnetic read head (positioned at tracks 2 and 3) and a single-track write head (positioned at track 2). When used, data on track 3 is said to be "fixed," that is, data encoded in track 3 is never altered. Data in track 2 is said to be "variable," and may be written and/or altered upon each use.

CTDOT's existing bus transfers use only the variable data track. All variable data is written when the transfer is issued and may be rewritten upon each use by the Validating Farebox. Hence, blank MTP ticket stock (used for transfers) shall be delivered with no encoding.

Magnetic encoding on tickets issued by the MTPs shall be at a nominal 121 bits per inch, and shall be in ANSI/ISO track 2 only.

#### 11.8.2.5 *Thermal Coating*

CTDOT's existing ticket stock is coated with thermally sensitive material on the same side as the magnetic stripe.

### 11.8.3 **Ticket Printing**

The Magnetic Ticket Processor shall be able to print all alphanumeric characters in both upper and lower case. Printed characters shall be produced with a minimum height of 0.12 inches and a height up to 1.0 inch. The approximate height to width ratio of the characters shall be 5:3. The printer(s) shall be of the direct thermal type, with the flexibility of being programmed to print the following configurations.

- CTDOT-specified graphics
- Various print sizes on the same ticket
- Reverse printing (white characters on black background)
- Composite type over several lines
- Vertical and horizontal character orientation

The thermal printer shall utilize print heads that provide no less than 100 dots per inch of resolution. Thermal print heads shall be easily replaceable, and shall produce no fewer than 250,000 CTDOT tickets without the loss of a single pixel due to wear or electronic failure.

Text printed on the read/write magnetic media shall match the information printed on the existing media.

Ticket print data shall be clearly legible to patrons. It shall be printed in characters as large and clear as possible, consistent with generally accepted ticket printing formats. Printing shall not degrade the physical condition of the ticket. There shall be no extraneous marks placed on the ticket as a result of the printing operation.

### 11.8.4 **Ticket Encoding**

For all magnetic tickets issued by the MTP, magnetic information shall be verified prior to issuing tickets to the patron. Tickets that fail to verify after a CTDOT-adjustable number of retries shall be voided and captured by the MTP. Upon capture of a ticket, the MTP shall then attempt to issue the ticket again. If the MTP fails to issue a ticket after two attempts, the transaction shall be canceled and the MTP shall be declared inoperable.

### 11.8.5 **Ticket Dispensing**

The dispensed ticket shall be fully separated from the supply stock before any portion of the dispensed ticket is visible to the patron.



The MTP ticket dispensing slot shall be dimensioned to eliminate potential for insertion of coins and bills.

The MTP shall issue transfers either manually upon command of the operator (subsequent to payment of fare), or automatically (without operator intervention) upon payment of each fare. The transfer dispensing operation shall be a configurable service parameter.

## 11.9 Magnetic Swipe Reader

The Validating Farebox shall include an integrally mounted read only magnetic swipe reader (MSR) located on the top surface of the Validating Farebox. The reader shall be of the "swipe" type, which provides a longitudinal slot in which a magnetic card is manually traversed past a read head.

- A. The MSR shall be able to accept magnetically encoded cards which have been previously encoded with data in a format that is compatible with CTDOT's existing magnetic fare media.
- B. The MSR shall automatically process a correctly inserted, valid magnetic card in one-half second or less. The operation and usage of the MSR shall not impede passenger boarding or flow in any manner. Magnetic card insertion, swipe through and removal by the patron shall be in the general flow of patron boarding on the coach.
- C. Passes shall be read on first proper insertion with an accuracy of not less than 99.9%, assuming each pass is valid, is fully inserted such that all coded information passes across the read head, and the pass is not damaged sufficient to destroy the ability of the MSR to correctly read the coded data.
- D. If a pass is not valid for the current class of service, the Validating Farebox shall display the amount to be inserted by the passenger. Additionally, the Validating Farebox shall accept and separately register additional cash fare payments in accordance with the fare structure. Registration of additional cash fares shall cause the pass to be accepted without requiring the operator to push a button. This cash data shall be accumulated in a separate register.
- E. The card read head assembly shall be held in place by not more than two readily accessible fasteners. Electrical connections shall be plug-in and screw type connectors, or equivalent, approved by CTDOT. A trained maintenance person shall be able to replace the read head assembly within five minutes.

## 11.10 Barcode Ticket Dispenser

### 11.10.1 General

When fully deployed, the NFTS shall use no magnetic media. After the transition from magnetic media, the Validating Farebox shall dispense transfers as paper-based barcode media. To do so, the Contractor shall either replace the Magnetic Ticket Processor (MTP) with a Barcode Ticket Dispenser (BTD), or shall convert the MTP to function as strictly a Barcode Ticket Dispenser.

The Contractor shall provide a comprehensive MTP-to-BTD conversion plan and schedule for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 11-9**



After installation or conversion, the Barcode Ticket Dispenser shall:

- Dispense transfers from roll or fan-fold stock
- Print human-readable transfer validity information in CTDOT-configurable content and format
- Print machine-readable transfer validity information utilizing a secure (encrypted) two-dimensional barcode employing an industry standard format

#### **11.10.2 Ticket Stock**

The Barcode Ticket Dispenser shall provide capacity of no less than 800 tickets per roll or fan-fold stack; ticket stock paper shall be no less than 0.007 inches (7 mils) thick, and each ticket shall be no less than 3 inches long.

The BTP shall include a ticket stock sensor to detect low and empty stock conditions. When low and empty ticket stock conditions are sensed, the BTP shall activate a ticket stock status indicator that is clearly visible by from passenger side of farebox. Alternatively, the ticket stock itself shall be visible from the passenger side of the farebox such that service personnel can easily and quickly ascertain the stock level through visual inspection, without having to open the farebox.

#### **11.10.3 Ticket Printing**

The Barcode Ticket Dispenser shall be able to print all alphanumeric characters in both upper and lower case. Printed characters shall be produced with a minimum height of 0.12 inches and a height up to 1.0 inch. The approximate height to width ratio of the characters shall be 5:3. The printer shall be of the direct thermal type, with the flexibility of being programmed to print the following configurations.

- CTDOT-specified graphics
- Various print sizes on the same ticket
- Reverse printing (white characters on black background)
- Composite type over several lines
- Vertical and horizontal character orientation

The thermal printer shall utilize print heads that provide no less than 100 dots per inch of resolution. Thermal print heads shall be easily replaceable, and shall produce no fewer than 250,000 CTDOT tickets without the loss of a single pixel due to wear or electronic failure.

Ticket print data shall be clearly legible to passengers and fare inspectors. It shall be printed in characters as large and clear as possible, consistent with generally accepted ticket printing formats. Printing shall not degrade the physical condition of the ticket. There shall be no extraneous marks placed on the ticket as a result of the printing operation.

#### **11.10.4 Barcode Encoding**

All machine-readable information shall be printed using a secure two-dimensional barcode in an industry-standard format. All barcode data shall be encrypted using a standard encryption algorithm such as AES or 3DES, and shall use an encryption key that is CTDOT configurable.

#### **11.10.5 Ticket Dispensing**

- A. The BTD shall dispense barcode tickets in no more than 2 seconds as measured from the time the command is issued (when operating in manual mode) to when the ticket is available for retrieval.



- B. The dispensed ticket shall be fully separated from the supply stock before any portion of the dispensed ticket is visible to the patron.
- C. The BTD ticket dispensing slot shall be dimensioned to discourage insertion of coins and bills.
- D. The BTD shall sense the progress of ticket stock throughout the printing, cutting, and dispensing process and shall notify the Validating Farebox Electronic Control Unit whenever a jam or failure to dispense is detected.
- E. The BTD shall issue transfers (which shall act as a receipt for proof of payment operations) either manually upon command of the operator (subsequent to payment of fare), or automatically (without operator intervention) upon payment of each fare. The transfer dispensing operation shall be a configurable service parameter.

### 11.11 Barcode Ticket Module

The Validating Farebox shall incorporate a barcode module that is capable of reading and processing barcodes on printed tickets, and barcodes created by a future Mobile Ticketing Application (provided by others). The barcode module incorporated into the Validating Farebox shall:

- Be housed completely within the Validating Farebox such that installation of the Validating Farebox shall provide ease of use by the customer when scanning their barcode and provide quick and easy presentation and removal of a ticket or smart phone
- Provide no hazard from the barcode reading laser or other components
- Be commercially available
- Have firmware upgradeable via the CDS data communication system
- Be high resolution (greater than 0.8 megapixels)
- Interface with the Validating Farebox via USB cable or other standard interface for power and data communications
- Be capable of reading 2D barcodes no less than 2 inches square while the media is in direct contact with the barcode reader outer lens
- Be capable of reading 2D barcodes no greater than 1 inch square from a distance of no less than 6 inches.
- Read standard 1D barcode
- Read secure 2D barcodes (including but not limited to: QR code, Data Matrix, Aztec, PDF417, or other CTDOT-approved format)
- Utilize an encryption key, configurable by CTDOT, and AES encryption algorithms to process secure 2D barcodes
- Forward validity information to the Validating Farebox logic for processing and determination of validity using standard data communications protocols
- Have a first read accuracy of not less than 99.5%

### 11.12 Cashbox

The cashbox shall be securely constructed of suitable materials for continuous use and shall be secured in the Validating Farebox enclosure by high-security locks. The Validating Farebox shall not enter service unless a cashbox is properly inserted and fully secured.

The cashbox shall securely hold all cash fares accepted by the Validating Farebox in the course of its operation. Coins and bills shall be stored in separate compartments within the cashbox



such that separation of coins and bills is maintained at all times. The cashbox shall be designed to be secure against all attempts to gain access to the cashbox other than those that are authorized.

#### **11.12.1 Cashbox Configuration**

The operation of the cashbox shall be such that the cashbox is in a closed and locked condition whenever the cashbox is removed from the Validating Farebox. When the cashbox is out of the Validating Farebox, it shall be secure and shall be able to be opened only with the proper key. The materials and construction techniques shall be such that a fully loaded cashbox, if dropped in the upright position to a hard floor and landing on its bottom or bottom corner from a height of 48 inches, shall suffer no operational impediment, revenue exposed or security breach.

The mechanism and operation of the cashbox shall be positive and at no time shall the interior of the cashbox or any of its contents be exposed, during any portion of the fare collection process or revenue transfer cycle. The cashbox shall not have removable lids, covers or other elements, which may be detached from the cashbox. The cashbox shall be designed to fit into the Validating Farebox in a single orientation. The Validating Farebox shall remain inoperable until a cashbox is properly inserted and the cashbox access door is closed and successfully locked.

The interior of the cashbox shall afford complete gravity discharge of coins and bills/tickets during the revenue transfer cycle, while maintaining the separation of bills/tickets and coins. No ledge or other areas shall be present where coins, bills or tickets may lodge and impede the operation of the cashbox.

The Validating Farebox and cashbox shall not be distorted when the cashbox is carrying a full revenue load. Metal parts not constructed of stainless steel shall be painted, plated or constructed of corrosion resistant material. The cashbox shall be designed and fabricated to prevent extensive tolerance buildup and resultant vibration.

#### **11.12.2 Capacity Requirements**

The Validating Farebox shall include a cashbox capable of storing no less than 1,000 "street-condition" bills after validation by the Bill Processor.

Each cashbox shall provide coin storage volume equivalent to no less than 50% of the volume dedicated to bill storage.

If upon entering range of a CTDOT facility wireless data network, the farebox cashbox is at or above a CTDOT-configurable percentage of capacity, the farebox and OCM shall emit a distinctive audio alert, accompanied by appropriate messages on the OCM and Patron Displays. As delivered, the "cashbox capacity alert" shall occur when the cashbox is at or above 60% of rated capacity for either coins or bills.

#### **11.12.3 Physical Characteristics**

The cashbox shall be securely constructed of suitable materials for continuous use as approved by CTDOT. It shall have no external fasteners exposed which affect security. The exterior of the cashbox shall be abrasion resistant. Neither insertion nor removal of the cashbox from the Validating Farebox, nor vibration or shock experienced while the cashbox is in revenue service, shall cause any distortion of the cashbox material.

The cashbox, when empty, shall weigh no more than 20 pounds. It shall be provided with a handle to permit its being carried by a person with a gloved hand.



A permanent serial number shall be securely affixed to the cashbox. The cashbox shall also have an electronic method of identification. The permanent serial number affixed to the cashbox shall match the electronic identification number. Reading of the electronic identification number shall be automatic and the information relative to the serial number shall be stored in Validating Farebox memory for subsequent data transmission to the Garage Communication Server. Only one serial number record shall be stored for each cashbox insertion or removal from the Validating Farebox and receiver.

The cashbox and Validating Farebox shall be fitted with devices to determine and report that the cashbox has been properly inserted into the Validating Farebox and that the cashbox has been properly opened (in place) and is ready to receive revenue. All security devices shall be tamper resistant, solid state and not subject to malfunction due to vehicle vibration or other environmental situations encountered during operation.

The Validating Farebox shall be fitted with such devices to determine and report that the cashbox has been properly inserted into the Validating Farebox to allow the revenue access door to be fully closed and locked. When a cashbox is inserted, the electronic identification number shall be incorporated in all transaction data.

#### **11.12.4 Cashbox Identification**

The Validating Farebox shall have the ability to automatically read the electronic identification number of the inserted cashbox. The means and methods employed for electronic identification shall require neither batteries nor electrical contacts, plugs or other physical connections between the Validating Farebox and the cashbox.

The Validating Farebox shall not accept payment unless the cashbox electronic identification number is detected; the farebox shall monitor the cashbox identification with sufficient frequency to detect the removal of the cashbox or the failure of the cashbox identification circuitry within no less than two seconds of the event.

### **11.13 Validating Farebox Electronic Control Unit**

The Validating Farebox shall incorporate an Electronic Control Unit (ECU), which shall control all aspects of the Validating Farebox. The ECU shall be a microprocessor-based system with an industrial grade, commercially available processor specifically designed for continuous operation in the specified environment.

The ECU shall permit plug-in upgradeability to double the amount of memory initially supplied, including memory for both primary and redundant data storage.

The ECU shall contain electronic clock functionality. The clock shall be used to generate time signals to maintain accurate records. The clock shall also contain calendar data to determine, year, month, and day including leap year without manual intervention. Automatic correction for time changes between standard and daylight savings time shall be provided. The clock shall be able to have daylight savings time start and end dates and times modified to reflect changes made by the Federal and State governments. The clock shall reset with the correct time each time communication is successful with the GCS.

The ECU shall also control the functions of data collection and storage, and communications both within the Validating Farebox and with external sources. Data capacity shall exceed initial storage needs by at least 100%. All data contained in electronic non-volatile data storage modules in the Validating Farebox shall be protected from loss for a minimum of 30 days.



Full detailed information on all data and information stored by the Validating Farebox shall be provided as a data dictionary at the Preliminary Design Review and updated at the Final Design Review. The Data Dictionary shall also be updated as needed through the implementation and acceptance period. **CDRL 11-10**

The ECU shall support an internally secured, removable recording apparatus having sufficient, expandable, non-volatile storage medium (i.e., flash disk, USB drive), to store a minimum of the data and information defined plus all files and applications required for proper operation of the Validating Farebox.

Full detailed information on the ECU modules, including dimensioned drawings and exploded drawings, shall be provided. **CDRL 11-11**

## 11.14 Validating Farebox Functional Requirements

### 11.14.1 Fare Tables

The Validating Farebox shall store a minimum of ten complete fare tables. One fare table shall be designated the active table; all other stored tables shall include a date and time at which the table is to become active.

Fare tables shall be highly configurable and shall include support all fare policies and pricing structures defined herein and necessary to support CTDOT operations.

### 11.14.2 Downloaded Lists

The Validating Farebox shall receive one or more lists of data from the CDS. These lists shall be updated regularly and as needed. The Contractor may provide alternate designs and content for these lists, but total capacity and functionality shall remain as specified herein.

The Contractor shall submit a complete description of the downloaded lists (including content and format, capacity, and the procedures employed to update the lists on the Validating Farebox) for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 11-12**

#### 11.14.2.1 *Master Status List*

The Validating Farebox shall store and regularly update the Master Status List (MSL).

The CDS shall transmit MSL updates in two forms: incremental changes and complete MSL updates. Upon receipt of an incremental MSL update, the Validating Farebox shall integrate all changes into the farebox's Master Status List. Upon receipt of a complete MSL update, the Validating Farebox shall replace its MSL with the new version.

The Validating Farebox shall complete all MSL updates within 60 seconds of receipt. Updating the MSL shall not interfere with the Validating Farebox's ability to conduct transactions.

#### 11.14.2.2 *Third Party-Issued Valid List*

The Validating Farebox shall store and regularly update the Third Party-Issued Valid Card List (VCL).

The CDS shall transmit VCL updates in two forms: incremental changes and complete VCL updates. Upon receipt of an incremental VCL update, the Validating Farebox shall integrate all changes into the farebox's VCL. Upon receipt of a complete VCL update, the Validating Farebox shall replace its VCL with the new version.





The Validating Farebox shall complete all VCL updates within 60 seconds of receipt. Updating the VCL shall not interfere with the Validating Farebox's ability to conduct transactions.

#### 11.14.2.3 **Valid Operator ID List**

As part of the operator login process, the Validating Farebox shall confirm the operator's ID and PIN are valid, based on a list received from the CDS. At minimum, each entry shall include:

- The sequential serial number of the operator's CTDOT Employee card
- The operator's Personal Identification Number
- Login type ("Operator" or "Maintenance")

Operator PINs shall be no less than 4 digits; the login process shall support operator PINs in the range of 0000 through 99999.

The Valid Operator ID List shall support no less than 5,000 operator and 1,000 maintenance entries.

Alternatively, valid operator and maintenance IDs may be maintained in separate lists; if valid IDs are stored in separate lists, the total capacity of each list shall be no less than as specified above.

#### 11.14.2.4 **Valid Block Number List**

The Validating Farebox shall store a list, received from the CDS of valid block numbers and associated routes and service levels. The Valid Block Number List shall support no less than 2,000 entries. Each entry on the Valid Block Number List shall include at minimum:

- Block Number
- Route Numbers assigned to the block (up to 10 route numbers per block)
- Default Service Level (which shall establish the default fare)

### 11.14.3 **Configurability**

As described herein, the Validating Farebox shall support configurability through numerous adjustable parameters, centrally controlled and transmitted via the CDS.

The Contractor shall submit a comprehensive document describing the configurability of the Validating Farebox, including a listing of all configurable parameters and their value range, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 11-13**

### 11.14.4 **Software and Configuration Updates**

The Garage Communications Servers (GCSs) shall manage and conduct all software and configuration updates to the Validating Fareboxes. Each update shall have a unique version number and include a date and time upon which the update shall be effective.

The Validating Farebox shall activate updates to downloaded lists as soon as possible, and without interfering with a transaction in progress or requiring the operator to login or reset Service Parameters.

Updates (received from the GCS) to Fare Tables, configuration settings, and Validating Farebox software shall become effective upon the first Validating Farebox power-up or operator login after the effective date and time.



Under no circumstances shall interrupted communication with the GCS cause file or data corruption on the Validating Farebox or GCS.

The Contractor shall submit a description of the process used to update Validating Farebox software and configurations for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 11-14**

#### **11.14.5 EMV Certification**

As delivered, the Validating Farebox shall be Level 1 certified as compliant with the EMV standards in effect at the time of contract award. The Validating Farebox shall, via software upgrades, be capable of being certified to newer versions of the EMV standard as they are published.

#### **11.14.6 PCI Compliance**

As delivered, the Validating Farebox shall be certified compliant with the Payment Card Industry's Data Security Standard in effect at the time of contract award.

### **11.15 Validating Farebox Operations**

At minimum, the Validating Farebox shall provide all of the operational functions described below. The Contractor shall provide a complete description of all operational functions and a flow chart depicting Validating Farebox operation for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 11-15**

#### **11.15.1 Power-up**

The Validating Farebox shall have no external power switch. When the vehicle engine starts (*i.e.*, the ignition is turned to "on"), if powered off, the Validating Farebox modules shall commence power-up sequence. While the vehicle engine is running, the Validating Farebox shall remain powered.

#### **11.15.2 Power-on Self Test**

Internal diagnostic programs shall check the Validating Farebox for proper performance of each module each time it is turned on. When a failure is detected of sufficient severity to cause the Validating Farebox to cease functioning or cause transactions to fail, the Validating Farebox shall go out of service and provide visual indication. The detected deficiency shall be recorded in the Validating Farebox's memory for later extraction.

While no login is active, pressing a button on the OCM shall cause the Validating Farebox to perform the Power-on Self Test.

#### **11.15.3 Login**

The Validating Farebox shall require a valid operator login to function. Logging in shall require the following:

1. The Validating Farebox shall be operational but with no valid login active.
2. If the Validating Farebox is in communication with the GCS, all data exchange shall be complete prior to prompting the operator to login. During the period of communication, the OCM shall display a message indicating that data exchange is in progress, and a button or touch region shall be available to enable the operator to commence login prior



to completion of data exchange. The Validating Farebox shall generate an event record whenever the login override button is pressed.

3. Upon completion of data exchange with the GCS (or the operator pressing the login override button), or if the Validating Farebox is not in communication with the GCS, the OCM shall activate the Contactless Smart Card Processor (CSCP) and 2D barcode reader on the Validating Farebox and display a login prompt on the OCM.
4. The operator shall present his/her Operator ID Card to the smart card reader on the Passenger Interface Module. If the operator's smart card is defective (*i.e.*, cannot be read), the barcode reader on the Validating Farebox shall provide an alternate, backup method of reading the card's sequential serial number. If both methods fail, the OCM shall provide the operator the ability to manually enter the card's sequential serial number.
5. Using the Valid Operator ID List received from the CDS, the Validating Farebox shall confirm that the card is a valid CTDOT Operator ID Card. (If the list of valid cards is older than a CTDOT-definable age, the Validating Farebox shall reject all attempts at logging in until it has communicated with the CDS and received an updated list.) If the card is invalid, the login process shall fail.
6. If the card is valid, the Validating Farebox shall prompt the operator to enter his/her PIN on the OCM. If the PIN is valid for the presented Operator ID, the login shall be successful. If the PIN is incorrect, the Validating Farebox shall prompt the operator to re-enter the PIN. After a CTDOT-definable number of failed attempts to enter a valid PIN, the login process shall fail and generate an event record.
7. Upon successful login, the Validating Farebox shall display a suitable message on the Validating Farebox and OCM displays, but shall not enter service until the operator enters all required service parameters

The method and operator interface design used to log into the Validating Farebox shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 11-16**



**11.15.4 Service Parameters**

If the successful login is an ID with operator permissions (as defined in the Valid Operator ID List), the OCM shall prompt the operator to enter various parameters prior to the Validating Farebox entering service. At minimum, these parameters shall include those shown in Table 11.15.4:

Table 11.15.4: Validating Farebox Service Parameters

Parameter	Format	Entry Method	Minimum Range	Verification
Block Number	Numeric	Keyed Entry	0 – 99999	Compared with Valid Block List
Route Number	Numeric	Menu	0 – 9999	Restricted to Menu Selections
Direction	Text	Menu	As per Section <del>11.18.141.18.1</del>	Restricted to Menu Selections
Service Level Default Fare	Alphanumeric	Menu	As per Section 3.10	Restricted to Menu Selections Default Retrieved from Valid Block List
Transfer/Receipt Operation	Alphanumeric	Menu	Manual / Automatic	Restricted to Menu Selections

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Menu selectable parameters shall be constrained to valid values, based on lists constructed from data stored in the fare table or from data contained in an associated downloaded list. Changes in the fare table and the contents of associated downloaded lists shall have corresponding effects on the available menu selections. (The menu selections shall not be hard-coded, but shall be CTDOT-configurable, based on entries in the fare table or the contents of an associated downloaded list.)

The Validating Farebox shall require the operator to re-enter any keyed-entry values that fail verification. Upon successful input of the service parameters, the Validating Farebox shall enter service and be ready to process fare media.

Unless overridden by temporary actions, all transaction records shall include the values of the service parameters in effect at the time of the transaction.

While the Validating Farebox is in service, the operator shall be able to modify any of the service parameters without having to logoff.

The method and operator interface design used to enter service parameters shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 11-17**

**11.15.5 Maintenance Functions**

If the successful login is an ID with maintenance permissions (as defined in the Valid Operator ID List), the OCM shall display one or more pages for maintenance and configuration purposes.

The method and operator interface design used to perform maintenance functions shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 11-18**



11.15.5.1 **Maintenance Parameters**

While a valid maintenance login is in effect, the OCM shall display one or more screens of parameters used to configure the Validating Farebox. At minimum, these parameters shall include those shown in Table 11.15.5.1:

Table 11.15.5.1: Validating Farebox Maintenance Parameters

Parameter	Format	Entry Method	Minimum Range
Validating Farebox Serial Number	Numeric	Factory Setting	NA
Validating Farebox Device Number	Numeric	Keyed Entry	0 – 9999
Vehicle Number	Numeric	Keyed Entry	0 – 9999
Cashbox Configuration	Text	Menu	Full Height / Reduced Height
Default Transfer/Receipt Operation	Text	Menu	Manual / Automatic (Proof of Payment)
IP Address	Numeric IP Address	Keyed Entry	0 – 255 (each field)
Subnet Mask	Numeric IP Address	Keyed Entry	0 – 255 (each field)
Wi-Fi Settings	As Necessary		
Cellular Broadband Modem Settings	As Necessary		
Validating Farebox / Patron Volume	Numeric	Keyed Entry	0 – 9
Validating Farebox / Patron Brightness	Numeric	Keyed Entry	0 – 9
OCM Serial Number	Numeric	Factory Setting	NA
OCM Device Number	Numeric	Keyed Entry	0 - 9999
OCM Volume	Numeric	Keyed Entry	0 – 9

As indicated in Table 11.15.5.1, the Validating Farebox and OCM Serial Numbers shall be a factory setting that cannot be altered by use of the OCM. The Contractor shall ensure that all Validating Fareboxes and OCMs have unique Serial Numbers.

Menu selectable parameters shall be constrained to valid values, based on lists constructed from data stored in the fare table or from data contained in an associated downloaded list. Changes in the fare table and the contents of associated downloaded lists shall have corresponding effects on the available menu selections. (The menu selections shall not be hard-coded, but shall be CTDOT-configurable, based on entries in the fare table or the contents of an associated downloaded list.)

The Maintenance Parameter screen(s) shall include a touch region that when selected shall save all maintenance parameter settings in the Validating Farebox’s non-volatile memory, where they shall remain unchanged unless altered by later use of the Maintenance Parameter screen(s).

All subsequent transaction records shall include the values of the Device Number and Vehicle Number in effect at the time of the transaction.

Upon exiting the Maintenance Parameter screen(s), the Validating Farebox shall return to the login prompt screen.



#### 11.15.5.2 *Maintenance Commands*

While a valid maintenance login is in effect, the OCM shall provide the technician the ability to test the Validating Farebox using a variety of maintenance commands. At minimum, the following maintenance commands shall be available:

- Initiate the Validating Farebox Power On Self Test and return to maintenance command screen when complete
- Activate the CSCP and display the sequential serial number of a presented CTDOT-issued card
- Activate the Validating Farebox barcode reader and display the sequential serial number of a presented CTDOT employee ID card's barcode, CTDOT-printed barcode ticket, or Mobile Ticket
- Activate the Validating Farebox audio transducer at the volume specified
- Activate the OCM audio transducer at the volume specified
- Dispense a test ticket from the Barcode Ticket Dispenser or the Magnetic Ticket Processor (as applicable)
- Display the cashbox ID and status for coins and bills (OK, near full, full)
- Display the transfer ticket stock status (OK, near empty, empty)
- Display the operating status of all modules
- Display the current power status (ignition on, ignition off and remaining time to power down)
- Display the date and time of most recent communication with CDS and GCS
- Display all current and pending version numbers for software, downloaded lists, configuration settings, etc.
- Display the current memory usage
- Display the current Wi-Fi communications status
- Display the current GPS status and location coordinates
- Display the current cellular broadband modem status
- Operator reboot of the farebox and/or magnetic ticket processor



### 11.15.6 In-Service Operator Commands and Functions

At minimum, the Validating Farebox shall provide the following operator functions and commands while in service with a valid operator login in effect:

- A. Temporarily Override Default Fare: Using as few buttons as practical, the operator shall be able to override the default fare set for the next transaction. Ideally, the available alternate fares shall be shown on the OCM display in such a way that only a single button or touch region is required to activate any temporary override and set the fare for the next transaction. The available choices for the temporary fare set shall be CTDOT-configurable and constructed from values in the fare table, similar to the menu-driven choices in the Service Parameters selection screen.

The Validating Farebox shall restore the default fare set upon completion of the transaction, upon the driver cancelling the override, or after a CTDOT-configurable time of inactivity, initially set to 20 seconds.

- B. Change Service Parameters: A button or touch region on the OCM shall enable the operator to return to the Service Parameters screen and change any parameter. Upon completion, the new parameters shall be in effect for all subsequent transactions, unless changed or temporarily overridden.
- C. Review Prior Transactions: The operator shall have the ability to review no less than the previous 5 transactions. When the transaction review function is selected, the OCM shall display a brief summary of each transaction and indicate in simple color-coded fashion (green / yellow / red) the results of each transaction. By selecting one of the prior transactions, the OCM shall then display additional detail about the transaction.
- D. Undo Last Transaction: Under strictly controlled conditions, the Validating Farebox shall support operator-initiated reversal of a prior transaction to CTDOT-issued smart cards. Transactions shall be reversed (that is, a transaction record shall be created instructing the CDS to reverse the prior transaction) when all of the following conditions are in effect:
- The operator initiates the transaction reversal
  - The presented card is a CTDOT-issued smart card
  - The previous transaction was on the same vehicle and within a CTDOT-configurable time, initially set to 120 seconds

Upon successful completion of the transaction, the Validating Farebox shall display an appropriate message to the operator and the passenger.

Failure to satisfy any of the above conditions shall cause the reversal transaction to fail and an appropriate message displayed to the operator and passenger.

The Validating Farebox shall resume normal operations upon completion of the reversal transaction, upon operator cancellation of the transaction, or upon a CTDOT-configurable time of inactivity, initially set to 20 seconds.

Availability of the Undo Last Transaction function shall be CTDOT configurable as a fleet-wide parameter.

- E. Logout: To avoid unintentional logout during normal service operations, the operator logout function shall be available only on the Service Parameters and Maintenance Parameters data entry screens.



### **11.15.7 In-Service Operating Status Messages**

At minimum, the Validating Farebox shall provide the following operator status messages on the OCM while in service with a valid operator login in effect:

- Communications with GCS or CDS overdue (CTDOT configurable number of days since last GCS communication)
- Receiving update (from CDS or GCS)
- Power-down imminent (while ignition off, displaying minutes and seconds countdown to self-actuated power-down)
- Cashbox near capacity (CTDOT configurable percentage)
- Cashbox at capacity
- Transfer ticket stock near empty
- Transfer ticket stock empty
- Data memory near capacity (CTDOT configurable percentage)
- Any detectable self-diagnostic failures, with error condition

### **11.15.8 Data Exchange**

#### **11.15.8.1 *Broadband Cellular***

- A. Any time the Validating Farebox is active (regardless of whether an operator is logged in) and out of range of a Garage Communications Server, the Validating Farebox shall periodically receive incremental updates to the Master Status List (MSL) from the Central Data System, via the broadband cellular modem.
- B. The Validating Farebox shall integrate the incremental MSL updates with the MSL without adversely affecting the responsiveness of the Validating Farebox to patron and operator input; while updating the MSL, the Validating Farebox shall continue to satisfy all performance requirements stated herein.
- C. The frequency of MSL updates shall be CTDOT-configurable.
- D. While in range of a cellular transmission tower, the Validating Farebox shall transmit account-based transaction results records to the CDS for every transaction as soon as each transaction completes. When cellular service is disrupted, the Validating Farebox shall store account-based transaction results records and transmit them to the CDS as soon as cellular service is restored.
- E. While in range of a cellular transmission tower, the Validating Farebox shall transmit event records to the CDS as soon as events are recorded. When cellular service is disrupted, the Validating Farebox shall store event records and transmit them to the CDS as soon as cellular service is restored.





#### 11.15.8.2 *Garage Communications Server / Wi-Fi*

All Validating Fareboxes shall exchange (upload and download) data with the Garage Communications Server (GCS):

- At vehicle startup
- Upon entering the garage property
- Whenever the GCS initiates a request for data while the vehicle is in a CTDOT facility and the Validating Farebox is in operation

During GCS communications, data exchange functionality shall include the following as a minimum:

- Downloading to the Validating Farebox a complete Master Status List containing up-to-date status information for all accounts
- Uploading of all Validating Farebox stored transaction, event, and route/run data
- Downloading of all parameter and fare table information to the Validating Farebox
- Downloading of all data configuration modifications to the Validating Farebox
- Downloading of the Valid Operator ID List to the Validating Farebox
- Downloading of the Valid Block Number List to the Validating Farebox
- Clock synchronization
- Communication verification
- Downloading program/software updates to the Validating Farebox

If upon entering range of a CTDOT facility wireless data network, the farebox cashbox is at or above a CTDOT-configurable percentage of capacity, the farebox and OCM shall emit a distinctive audio alert, accompanied by appropriate messages on the OCM and Patron Displays. As delivered, the cashbox near-full alert shall occur when the cashbox is at or above 60% of rated capacity for either coins or bills.

While the Validating Farebox is communicating with the GCS, the OCM and farebox Patron Display shall display a suitable message.

#### **11.15.9      Diagnostics**

To the extent possible, internal diagnostic programs shall check the Validating Farebox for proper performance while the device is operating. The malfunction detection shall cover at least failure of power or control circuitry, and any failure of a fare media read/write module (CSCP and barcode reader) that could result in a false, incomplete, or corrupted reading or encoding of a fare product.

The Validating Farebox and its electronic logic shall be designed to provide operational self-testing, diagnostic checking (detecting basic internal malfunctions), reporting, and indication.



Validating Farebox malfunction detection shall cover at least

- Failure of power or control circuitry, including the number of times the primary power source has gone to zero (0) volts and back to normal.
- Opening of an access panel, including the length of time that the cashbox access door is open. If the cashbox access door is opened longer than a CTDOT configurable time period, initially set to three (3) minutes, an event record shall be stored within the Validating Farebox memory for transmission to the GCS. This confidential process shall be described and submitted to CTDOT for review and approval. **CDRL 11-19**
- Out-of-service conditions including cashbox full, and memory full indicators,

When a failure is detected of sufficient severity to cause the Validating Farebox to cease functioning or cause transactions to fail, the Validating Farebox shall go out of service and provide visual indication on the OCM and Validating Farebox patron displays. The information displayed shall indicate the type of failure that caused the Validating Farebox to go out of service.

The detected deficiency shall be recorded as an event record in the Validating Farebox's memory for later extraction.

A description of the maintenance and service indicators for the Validating Farebox shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 11-20**

#### **11.15.10 Logout**

Operator logout of the Validating Farebox shall occur:

1. When the operator selects the logout command on the OCM.
2. Automatically within a CTDOT-configurable time after the vehicle ignition is shut off.
3. Automatically upon commencement of communication with a GCS.

Upon logout, the Validating Farebox shall generate and store an event record and go out of service; the OCM shall then revert to the login prompt state or power down, as appropriate.

#### **11.15.11 Power-down**

When the vehicle engine is turned off, the Validating Farebox and OCM shall remain powered, fully operational, and able to exchange data via the wireless data and broadband cellular interfaces, for CTDOT-configurable duration, initially set to 30 minutes. After this configurable time has elapsed, the Validating Farebox and OCM shall commence automatic self-activated power-down, unless communications with the CDS or GCS are in progress. If communications with the CDS or GCS cause a delay in automated power-down, upon completion of the communications session, the Validating Farebox and OCM shall automatically power down. Prior to shutting down, the Validating Farebox shall generate and store an event record and perform all necessary steps to retain integrity of all stored data.

### **11.16 Transaction Processing**

While a valid operator login is in effect, the Validating Farebox shall be ready to accept fares in all forms (cash, contactless smart card, barcode, and magnetic media). While ready to accept fares, the Validating Farebox shall have an active fareset that shall define the cash fare in effect for the next transaction. The fareset shall either be the default fare or the temporary fare (override fare) selected by the operator.



While the Validating Farebox is in “Ready” mode and prior to fare payment, the OCM and passenger displays shall indicate the amount due, according to the fareset in effect.

#### **11.16.1 Timeouts**

In addition to the intra- and inter-transaction timeouts, the Contractor shall identify all Validating Farebox timeouts in the review of the transaction process that shall occur at the Preliminary Design Review, and shall be subject to CTDOT approval at the Final Design Review. **CDRL 11-21**

#### **11.16.2 Cash Payments**

As the passenger inserts cash fares, the OCM display and the passenger display shall indicate the total amount inserted and the total amount due.

##### **11.16.2.1 Exact Fare Payment**

When exact fare is paid and the fareset is reached, the OCM and passenger displays shall indicate that no additional funds are required, and both the OCM and the Validating Farebox shall emit a distinct “fare paid” tone.

##### **11.16.2.2 Fare Overpayment**

When an overpayment is made by a customer, a “fare paid” tone shall sound on reaching the preset fare and the amount overpaid shall be displayed to the passenger and operator. The operator shall be able to assign the overpaid amount as a full or partial payment of a fare other than the preset fare by selection of one of the fare category push buttons.

If an overpayment is not registered by the actuation of one of the push buttons, the revenue shall be dumped when intra-transaction timeout expires and the amount on the displays shall be cleared.

The operator shall also be able to press a “Dump” button on the Operator Control Unit to clear the displays. A separate count shall be accumulated for all cash that is displayed on the operator display and dumped. All such revenue shall be counted by an Extra Revenue register. The Validating Farebox shall store a transaction record of the amount each time this situation occurs.

##### **11.16.2.3 Partial Fare Payment**

Partial fares occur when a patron either:

- Makes an incomplete payment for the current fare set
- Overpays for the current fare set by an amount less than the current fare set

When a partial payment is in effect, the transaction shall end when either the transaction times out or the operator terminates the transaction by depressing the “Dump” button on the Operator Control Unit. In either case, the Validating Farebox shall assign the partial fare payment to an Extra Revenue register.

If a subsequent passenger commences payment while a partial payment is in effect, the Validating Farebox shall treat the partial payment as part of the subsequent passenger’s fare payment.



#### 11.16.2.4 **Upgrade Fare Payment**

Upgrade fares are required when a passenger uses a legitimate pass or stored ride product that is not valid for the current fare set. For example, use of an unexpired 31-Day Regular pass on an Express bus requires the incremental fare to be paid, either by deduction from the associated account's stored value, or via cash deposited into the Validating Farebox.

If a presented fare instrument requires payment of an upgraded fare and the associated account includes sufficient stored value, the Validating Farebox shall accept the pass and indicate that the account's stored value has been used to pay the incremental fare. If appropriate, the Validating Farebox shall inform the CDS that the card's account has transfer privileges valid for the upgraded fare per CTDOT's fare policies. (The CDS shall update the Master Status List accordingly, and broadcast the update to all other NFTS devices.)

If a presented fare instrument requires payment of an upgraded fare and the associated account has insufficient stored value, the Validating Farebox shall alert the operator and the passenger that additional cash payment is required. The Validating Farebox shall automatically adjust the current fare set to the incremental fare owed. If the incremental fare is paid, the transaction shall complete and the Validating Farebox shall inform the CDS that the card's account has transfer privileges valid for the upgraded fare per CTDOT's fare policies. If the incremental fare is not paid, the Validating Farebox shall only record the usage of the fare instrument and shall not inform the CDS that the account has transfer privileges valid for the upgraded fare.

#### 11.16.3 **Contactless Smart Cards**

While a valid operator login is in effect, the Validating Farebox shall energize the smart card read/write antenna and be ready to perform smart card transactions. The Validating Farebox shall conduct all smart card transactions according to the procedures and requirements defined. The Validating Farebox shall store a transaction record for each smart card presented.

#### 11.16.4 **Barcode Media**

While a valid operator login is in effect, the Validating Farebox shall activate the barcode reader and be ready to perform barcode media transactions. The Validating Farebox shall conduct all barcode transactions according to the procedures and requirements set forth herein.

#### 11.16.5 **Magnetic Media**

As delivered, using the Magnetic Ticket Processor, the Validating Farebox shall process read/write magnetic media as necessary to support CTDOT's existing fare policies. In addition, the Validating farebox shall process read/write magnetic media transactions that require no re-encoding (such as validating a previously activated floating period pass) in the Magnetic Swipe Reader.

When read/write magnetic media are discontinued, the Validating Farebox shall continue to support the use of the Magnetic Swipe Reader, although at present, once read/write magnetic media are discontinued, CTDOT has no plans to distribute or use read-only magnetic media.

### 11.17 **Transaction Speed**

- A. All contactless smart card and barcode media use transactions shall complete in no more than 500 milliseconds, as measured by when the fare media is within the defined read distance and orientation to the antenna or barcode reader and the transaction



results are displayed. The transaction time allowed shall include processing of all media when all lists described in Section 6 are at maximum capacity.

- B. The Validating Farebox shall accept valid inserted bills at rates no less than specified.
- C. The Validating Farebox shall accept valid inserted coins at rates no less than specified.
- D. The Validating Farebox shall dispense barcode tickets (transfers and receipts) at speeds specified.

## 11.18 Data Records

### 11.18.1 Transaction Records

The Validating Farebox shall generate and store a discrete data record for each transaction performed. Each transaction record shall be unique within the NFTS. All Validating Farebox transaction records shall include the following information as a minimum:

- Date and time of transaction
- Validating Farebox (Device) number
- Cashbox serial number
- Vehicle number
- Operator ID
- Route number
- Block number
- Fareset in effect
- Fare/Transaction type (e.g., Full Fare / Reduced Fare / Partial Fare / Upgrade Fare)
- Direction (no less than 8 values, including North, South, East, West, Inbound, Outbound)
- Vehicle location (latitude/longitude – most recently received GPS coordinates)
- Transaction sequence number (which shall be unique per day per Validating Farebox)
- Passenger Count

The Validating Farebox shall have capacity to store no less than 20,000 transaction records.



#### 11.18.1.1 *Cash Transactions*

In addition to the data fields defined, cash transaction records shall also include, at minimum:

- Transaction value
- Value of bills inserted
- Value of coins inserted
- Coin bypass status (normal / active)
- Transfer issued, including sequence number (if applicable)

#### 11.18.1.2 *Contactless Smart Card Transactions*

In addition to the data fields defined, contactless smart card transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number if CTDOT-issued, chip Unique ID (UID) if third party-issued)
- Action performed (if applicable)
- Transaction value (if applicable)

#### 11.18.1.3 *Barcode Media Processing Transactions*

In addition to the data fields defined, barcode media transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number)
- Action performed (if applicable)
- Transaction value (if applicable)

#### 11.18.1.4 *Magnetic Media Transactions*

In addition to the data fields, barcode media transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number, if applicable)
- Action performed (if applicable, e.g., activated pass)
- Transaction type (e.g., pass type, stored value, transfer)
- Transaction value (if applicable)

#### 11.18.1.5 *Tally Transactions*

When transactions require manual tallies, upon operator selection of a tally key on the OCM, the Validating Farebox shall create a tally transaction record that in addition to the data fields shall also include, at minimum:

- Tally ID or OCM tally key identifier
- Associated tally data (such as deposited cash to be assigned to tally)



### 11.18.2 Event Records

At minimum, the Validating Farebox shall generate and store an event record for each of the following actions or incidents:

- Power on
- Power On Self Test complete
- Power On Self Test failure, including failure mode
- Power off
- Operator login, including ID and login method (smart card, barcode, keyed entry)
- Failed login attempt (excessive PIN entries), including ID
- Operator logout
- Maintenance parameter changed, including parameter and new value
- Route changed, including new route number
- Default fare (service level) changed, including new fare set
- End of transit business day (CTDOT programmable, default is 3:00 AM)
- Communication between the OCM and Validating Farebox failed
- Communication between the OCM and Validating Farebox is restored
- Communication with Garage Communications Server (GCS) initiated
- Communication with GCS completed
- Communication with GCS terminated before complete (*i.e.*, Wi-Fi signal lost)
- Communication with GCS terminated by operator (during login)
- GPS reception lost
- GPS reception restored
- New downloaded list received, including list type and version number
- New downloaded list activated, including list type and version number
- New fare table received, including version number
- New fare table version activated, including version number
- New Validating Farebox software version received, including version number
- New Validating Farebox software activated, including version number
- New Validating Farebox configuration data received, including version number
- New Validating Farebox configuration data activated, including version number
- Validating Farebox internal clock reset for a time discrepancy greater than 3 minutes
- Coin Processor in bypass
- Coin Process bypass restored
- Cashbox near full
- Cashbox full
- Cashbox access door opened (including method of authorization)
- Cashbox access door closed
- Cashbox removed (with serial number)
- Cashbox inserted (with serial number)
- Cashbox security alarms
- Data memory nearing capacity (CTDOT configurable threshold)
- Data memory full
- Validating Farebox reset (when action occurs while operator is logged in)
- Successful data transfer (including destination – GCS or PDU)
- Unsuccessful data transfer (including destination – GCS or PDU)
- Other Validating Farebox errors and failures



Each event record shall include, at minimum:

- Date and time of event
- Validating Farebox (Device) number
- Cashbox serial number
- Vehicle number
- Operator ID (if available)
- Route number (if available)
- Block number (if available)
- Direction (if available)
- Vehicle location (latitude/longitude – most recently received GPS coordinates, if available)
- Associated event parameters (as required)

The Validating Farebox shall have capacity to store a minimum of 2,000 event records.

### **11.18.3 Module Cycle Counters**

The Validating Farebox shall include cycle counters that maintain the number of operational cycles for at least the coin processor, bill processor, and Barcode Dispenser. These individual cycle counters shall be reset whenever the corresponding module is exchanged. This information shall be stored within the Validating Farebox and transferred to the GCS upon data transfer. **CDRL 11-22**

### **11.18.4 Data Integrity**

All Validating Farebox transaction, event, fare table, downloaded lists, configuration, cycle counters, and software application data memory shall be non-volatile (*i.e.*, retained without power).

The Validating Farebox shall retain transaction and event records in its nonvolatile memory until notified that the CDS has successfully received and stored the records in the CDS database.

In the event a Validating Farebox cannot communicate with the GCS and in cases where the Validating Farebox is non-functional, the Validating Farebox shall provide authorized maintenance technicians access to a removable non-volatile memory module that shall contain a duplicate of all transaction and event records. The Contractor shall provide means to upload the records in the removable memory module to the CDS, a description of which shall be submitted for CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 11-23**

The Validating Farebox shall not enter service without a properly installed and functional removable backup memory module.





## 11.19 Additional Design Submittals

The Contractor shall submit descriptions of the Validating Farebox for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. Validating Farebox design submittals shall include:

- Validating Farebox passenger interfaces **CDRL 11-24**
- Validating Farebox Contactless Smart Card Processor **CDRL 11-25**
- Validating Farebox 2D barcode reader **CDRL 11-26**
- **Validating Farebox mounting system CDRL 11-27**



## 12 Stand Alone Processors

### 12.1 General

#### 12.1.1 Description

Certain vehicles operated by CTDOT or its contractors shall be equipped with Stand Alone Processors (SAPs) in lieu of Validating Fareboxes.

The SAP shall contain the ISO/IEC 14443-compliant read/write antenna and support circuitry, a 2D barcode reader and support circuitry, a suitable display screen, simple multi-colored lamps to convey transaction results, audio transducers, and other required user interfaces.

- A. The Stand Alone Processor shall support CTDOT fare policies. To do so, the SAP shall:
  - Accept and process contactless smart card media, both CTDOT-issued and third party-issued
  - Accept and process 2-dimensional barcode media, including paper tickets issued by the Multi-Function Vending Machines (MVMs), CTDOT Ticket Vending Machines (supplied by others), and tickets and transfers dispensed by the Validating Farebox
  - Accept and process 2-dimensional barcodes displayed by a future mobile phone ticketing application (supplied by others)
- B. The SAP shall provide reliable, accurate, and maintainable service for a time period.
- C. The Contractor shall furnish CTDOT with all hardware, software and supporting equipment capable of processing all CTDOT present fares based on CTDOT's business rules.
- D. This SAP shall include flexibility to ensure that CTDOT's future fare structure, fare policy, and tariff requirements can be satisfied without Contractor-developed software modifications; all fare structure, fare policy, and tariff modifications shall be through parameter modifications and the modification of the fare structure via the Central Data System (CDS).
- E. Equipment design shall be customer-friendly, and shall include the use of sculptured buttons, tinted latent panels, high intensity lights, surface grain depth and direction and other similar elements to:
  - Enable ease of operation by the customers
  - Minimize the time for a transaction
  - Provide for high reliability
- F. Once installed, the SAP shall meet all local, State and Federal ADA requirements in force at the date of Final Design Review.
- G. Subject to CTDOT approval at the Preliminary Design Review, the SAP may incorporate components into one or more additional modules to optimize the size of the SAP and OCM. The design and location of any such additional modules shall be subject to CTDOT review at the Preliminary Design Review, and approval at the Final Design Review. **CDRL 12-1**
- H. The SAP shall support at minimum the smart cards identified in these specifications.

The Contractor shall provide a complete description of the design and functionality of the Stand Alone Processor for CTDOT review and approval at each stage of the design review with the



final document fully describing the operation, capabilities, and functionality of the SAP as described within this section. Sufficient detail shall be provided to permit verification that all required functions are satisfactorily included. **CDRL 12-2**

### **12.1.2 Operating Environment**

The SAPs shall operate reliably in the environment of CTDOT's bus fleet, including elevated temperatures due to solar loading, shock, vibration, dust, and moisture from wind-driven precipitation and interior bus cleaning.

### **12.1.3 Installation Design**

The SAP design shall support flexible, ergonomic, safe, and rugged installation methods that accommodate a wide variety of vehicle configurations, within the limited space available.

### **12.1.4 Power Requirements and Wiring**

For power input, the SAP modules shall be wired to the bus battery, which may be a nominal 12 VDC or 24 VDC, depending on vehicle model. The SAP modules shall also sense the ignition state of the vehicle engine and respond as specified herein.

## **12.2 SAP Functional Requirements**

### **12.2.1 Configurability**

Stand Alone Processors (**SAP**) shall be installed in specified CTDOT fixed-route vehicles. As described herein, the SAP shall also support configurability through numerous adjustable parameters, centrally controlled and transmitted via the CDS.

The Contractor shall submit a comprehensive document describing the configurability of the SAP, including a listing of all configurable parameters and their value range, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 12-3**

### **12.2.2 Fare Tables**

The SAP shall store a minimum of three complete fare tables. One fare table shall be designated the active table; all other stored tables shall include a date and time at which the table is to become active.

Fare tables shall be highly configurable and shall include support all fare policies and pricing structures defined herein and necessary to support CTDOT operations.

### **12.2.3 Transaction Records**

The SAP shall generate and store a discrete data record for each transaction performed. Each transaction record shall be unique within the New Fare Collection system and shall include the following information as a minimum:

- Date and time of transaction
- SAP (Device) number
- Vehicle number
- Operator ID
- Route number



- Block number
- Direction (no less than 8 values, including North, South, East, West, Inbound, Outbound)
- Vehicle location (latitude/longitude – most recently received GPS coordinates)
- Fare/Transaction type
- Transaction sequence number (which shall be unique per day per SAP)

The SAP shall have capacity to store no less than 20,000 transaction records.

#### 12.2.3.1 *Contactless Smart Card Transactions*

In addition to the data fields defined, contactless smart card transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number if CTDOT-issued, chip Unique ID (UID) if third party-issued)
- Action performed (if applicable)
- Transaction value (if applicable)

#### 12.2.3.2 *Barcode Media Processing Transactions*

In addition to the data fields defined, barcode media transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number)
- Action performed (if applicable)
- Transaction value (if applicable)

#### 12.2.3.3 *Tally Transactions*

When transactions require manual tallies, upon operator selection of a tally key on the OCM, the SAP shall create a tally transaction record that in addition to the data fields defined shall also include, at minimum:

- Tally ID or OCM tally key identifier
- Associated tally data

#### 12.2.4 **Event Records**

At minimum, the SAP shall generate and store an event record for each of the following actions or incidents:

- Power on
- Power On Self Test complete
- Power On Self Test failure, including failure mode
- Power off
- Operator login, including ID and login method (smart card, barcode, keyed entry)
- Failed login attempt (excessive PIN entries), including ID
- Operator logout
- Maintenance parameter changed, including parameter and new value
- Route changed, including new route number
- Default fare (service level) changed, including new fare set
- End of transit business day (CTDOT programmable, default is 3:00 AM)
- Communication between the OCM and SAP failed
- Communication between the OCM and SAP is restored



- Communication with Central Data System (CDS) initiated
- Communication with CDS completed
- Communication with CDS terminated before complete (*i.e.*, Wi-Fi signal lost)
- Communication with CDS terminated by operator (during login)
- GPS reception lost
- GPS reception restored
- New downloaded list received, including list type and version number
- New downloaded list activated, including list type and version number
- New fare table received, including version number
- New fare table version activated, including version number
- New SAP software version received, including version number
- New SAP software installed, including version number
- New SAP configuration data received, including version number
- New SAP configuration data activated, including version number
- SAP internal clock reset for a time discrepancy greater than 3 minutes
- Data memory nearing capacity (CTDOT configurable threshold)
- Data memory full
- SAP reset (when action occurs while operator is logged in)
- Unsuccessful data transfer
- SAP errors and failures

Each event record shall include, at minimum:

- Date and time of event
- SAP (Device) number
- Vehicle number
- Operator ID (if available)
- Route number (if available)
- Block number (if available)
- Direction (if available)
- Vehicle location (latitude/longitude – most recently received GPS coordinates, if available)
- Associated event parameters (as required)

The SAP shall have capacity to store a minimum of 2,000 event records.

### **12.2.5 Downloaded Lists**

The SAP shall receive several lists of data from the CDS. These lists shall be updated regularly and as needed. The Contractor may provide alternate designs and content for these lists, but total capacity and functionality shall remain as specified herein.

The Contractor shall submit a complete description of the downloaded lists (including content and format, capacity, and the procedures employed to update the lists on the SAP) for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review.

#### **CDRL 12-4**

##### **12.2.5.1 Master Status List**

The ~~Validating Farebox~~SAP shall store and regularly update the Master Status List (MSL)



#### 12.2.5.2 *Third Party-Issued Valid List*

The ~~Validating Farebox~~SAP shall store and regularly update the Third Party-Issued Valid Card List.

#### 12.2.5.3 *Valid Operator ID List*

As part of the operator login process, the SAP shall confirm the operator's ID and PIN are valid, based on a list received from the CDS. At minimum, each entry shall include:

- The sequential serial number of the operator's CTDOT Employee card
- The operator's Personal Identification Number
- Login type ("Operator" or "Maintenance")

Operator PINs shall be no less than 4 digits; the login process shall support operator PINs in the range of 0000 through 99999.

The Valid Operator ID List shall support no less than 2,000 operator and 1,000 maintenance entries.

Alternatively, valid operator and maintenance IDs may be maintained in separate lists; if valid IDs are stored in separate lists, the total capacity of each list shall be no less than as specified above.

#### 12.2.5.4 *Valid Block Number List*

The SAP shall store a list of valid block numbers and associated routes and service levels. The Valid Block Number List shall support no less than 2,000 entries. Each entry on the Valid Block Number List shall include at minimum:

- Block Number
- Route Numbers assigned to the block (up to 10 route numbers per block)
- Default Service Level (which shall establish the default fare)

#### 12.2.6 *Software and Configuration Updates*

The Garage Communications Servers shall manage and conduct all software and configuration updates to the SAPs. Each update shall have a unique version number and include a date and time upon which the update shall be effective.

The SAP shall activate updates to downloaded lists as soon as possible, and without interfering with a transaction in progress or requiring the operator to login or reset Service Parameters.

Updates to Fare Tables, configuration settings, and SAP software shall become effective upon the first SAP power-up or operator login after the effective date and time.

Under no circumstances shall interrupted communication cause file or data corruption on the SAP.

The Contractor shall submit a description of the process used to update SAP software and configurations for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 12-5**



### **12.2.7 Data Integrity**

All SAP transaction, event, fare table, downloaded lists, configuration, and software application data memory shall be non-volatile (*i.e.*, retained without power).

The SAP shall retain transaction and event records in its nonvolatile memory until notified that the CDS has successfully received and stored the records in the CDS database.

In the event a SAP cannot communicate, and in cases where the SAP is non-functional, the SAP shall provide authorized maintenance technicians access to a removable non-volatile memory module that shall contain a duplicate of all transaction and event records. The Contractor shall provide means to upload the records in the removable memory module to the CDS, a description of which shall be submitted for CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 12-6**

The SAP shall not enter service without a properly installed and functional removable backup memory module.

### **12.2.8 Performance Requirements**

All SAP use transactions shall complete in no more than 500 milliseconds, as measured by when the fare media is within the defined read distance and orientation to the antenna or barcode reader and the transaction results are displayed.

The transaction time allowed shall include processing of the Master Status List, including while updating the Master Status List with incremental updates when all lists are at maximum capacity.

### **12.2.9 EMV Certification**

As delivered, the SAP shall be Level 2 certified as compliant with the EMV standards in effect at the time of contract award. The SAP shall, via software upgrades, be capable of being certified to newer versions of the EMV standard as they are published.

### **12.2.10 PCI Compliance**

As delivered, the SAP shall be certified compliant with the Payment Card Industry's Data Security Standard (PCI DSS) in effect at the time of contract award.

## **12.3 Passenger Interfaces**

The Stand Alone Processor shall contain the following elements:

### **12.3.1 Passenger Display**

The Passenger Display shall be a backlit LCD display with sufficient size, resolution, brightness, and contrast to provide ADA-compliant readability under all lighting conditions present in the transit vehicle environment.

The display shall be of sufficient ruggedness to withstand the rigors of the transit vehicle environment.



The Passenger Display shall at minimum:

- Prompt the passenger in the use of the Stand Alone Processor
- Display the operating status of the SAP
- Display the transaction type and value that will occur upon presentation of a valid fare instrument
- Display the results of the transaction in sufficient detail to inform the passenger of the validity of the presented fare media and the new status and value of the presented smart card (as applicable)

### **12.3.2 Contactless Smart Card Processor**

The SAP shall contain a Contactless Smart Card Processor (CSCP), which shall provide contactless smart card read and write functionality that is fully compliant with the ISO/IEC-14443 standard, able to process media defined as Type A and B, certified for use with EMV<sup>®</sup>-compliant bankcard media, and satisfies all other requirements stated herein.

The CSCP antenna shall be sized and operate at a power that satisfies the ISO/IEC-14443 read/write distance range requirements, and the read/write distance range requirements for the media being supplied under this Contract.

### **12.3.3 2D Barcode Reader**

The SAP shall incorporate a barcode reader that is capable of reading and processing barcodes on CTDOT-printed tickets and barcodes created by a future Mobile Ticketing Application. The barcode reader module incorporated into the SAP shall:

- Be housed completely within the SAP such that installation of the SAP shall provide ease of use by the customer when scanning their barcode and provide quick and easy presentation and removal of a ticket or smart phone
- Provide no hazard from the barcode reading laser or other components
- Be commercially available
- Have firmware upgradeable via the CDS data communication system
- Be high resolution (greater than 0.8 megapixels)
- Interface with the Standalone Processor via USB cable or other standard interface for power and data communications
- Be capable of reading 2D barcodes no less than 2 inches square while the media is in direct contact with the barcode reader outer lens
- Be capable of reading 2D barcodes no greater than 1 inch square from a distance of no less than 6 inches
- Read standard 1D barcode
- Read secure 2D barcodes (including but not limited to: QR code, Data Matrix, Aztec, PDF417, or other CTDOT-approved format)
- Utilize an encryption key, configurable by CTDOT, and AES encryption algorithms to process secure 2D barcodes
- Forward validity information to the SAP logic for processing and determination of validity using standard data communications protocols
- Have a first read accuracy of not less than 99.5%





#### **12.3.4 Transaction Status Lamps**

The Stand Alone Processor shall include three LED lamps in red, yellow, and green, which shall be visible in all ambient lighting conditions. The operation of the LEDs shall match the operation of the OCM.

After each transaction, the appropriate LED shall remain illuminated for a defined period of time. Alternatively, the SAP may utilize comparably-colored messages shown on the Passenger Display in lieu of discrete transaction status lamps.

#### **12.3.5 Audio Transducer**

The Stand Alone Processor shall be capable of emitting at least 8 distinct sounds or sound patterns, which shall match those emitted by the OCM. All sounds emitted by the SAP shall be of sufficient volume to be heard by the passenger while the vehicle is in operation.

For each transaction result and operating condition, the Contractor shall submit samples of the tones emitted by the SAP audio transducer in .mp3, .wav, or other standard format for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review.

**CDRL 12-7**

### **12.4 SAP Enclosure**

The SAP enclosure shall:

- Be sufficiently robust to withstand the public transit vehicle environment, resist vandalism, and maintain integrity for the expected life of the NFTS
- Satisfy all environmental requirements
- Be made of engineered high-impact thermoplastics or other corrosion-resistant materials
- Have no sharp edges or corners
- Have no paint or other coatings that may scratch or wear off
- Be sealed against moisture ingress
- Accommodate CTDOT-approved graphics applied to identify the CSCP antenna and other interfaces as necessary
- Be of a CTDOT-approved color
- Be latched or secured closed in such a way that it can be opened only when properly removed from the mounting bracket

### **12.5 Mounting**

The SAP mounting system shall satisfy the following requirements:

- A. The Contractor shall securely install the SAP using stainless steel hardware in a manner and location that is safe to passengers and operators, ergonomic, compliant with ADA, and suitably robust for the transit vehicle environment.
- B. When installed, the SAP shall not obstruct operator views nor cause excessive glare on the windshield during high ambient lighting conditions.



- C. SAP mounting shall facilitate easy and rapid exchange of defective modules without the use of tools or manipulation (disconnection and reconnection) of power or data cables.
- D. Exchange of a SAP shall require the use of a key or other physical security method to ensure that only authorized CTDOT personnel are performing the exchange.
- E. The SAP mounting system shall provide a sufficient degree of flexibility to support installation in the range of vehicle types in CTDOT's current fleet.
- F. Placement and mounting of the SAP shall not interfere with maintenance or revenue servicing of the nearby Non-Registering Farebox; it shall not be necessary to move or remove the SAP to service or exchange the Non-Registering Farebox.
- G. When installed, the SAP displays shall be easily readable and all other passenger interfaces easily employed.

## 12.6 SAP Design Submittals

The Contractor shall submit descriptions of the SAP for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. SAP design submittals shall include:

- SAP passenger interfaces **CDRL 12-8**
- SAP Contactless Smart Card Processor **CDRL 12-9**
- SAP 2D barcode reader **CDRL 12-10**
- SAP mounting system **CDRL 12-11**

## 12.7 Operator Control Module

Each Stand Alone Processor shall interface with an Operator Control Module (OCM) as defined in Section 10 to provide suitable display and input for operators to control and monitor the SAP. The Operator Control Module and the SAP shall convey identical transaction feedback information; the operator and the passenger shall see and hear the same information as a result of the transaction.

## 12.8 Operations

At minimum, the SAP shall provide all of the operational functions described below. The Contractor shall provide a complete description of all operational functions and a flow chart depicting SAP operation for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 12-12**

### 12.8.1 Power-up

The SAP shall have no external power switch. When the vehicle engine starts (*i.e.*, the ignition is turned to "on"), if powered off, the SAP modules shall commence power-up sequence. While the vehicle engine is running, the SAP shall remain powered.

### 12.8.2 Power-on Self Test

Internal diagnostic programs shall check each module of the SAP for proper performance each time it is turned on. When a failure is detected of sufficient severity to cause the SAP to cease



functioning or cause transactions to fail, the SAP shall go out of service and provide visual indication. The detected deficiency shall be recorded in the SAP's memory for later extraction.

While no login is active, pressing a button on the OCM shall cause the SAP to perform the Power-on Self Test.

### 12.8.3 Login

The SAP shall require a valid operator login to function. Logging in shall require the following:

1. The SAP shall be operational but with no valid login active.
2. If the SAP is in communication with the CDS, all data exchange shall be complete prior to prompting the operator to login. During the period of communication, the OCM shall display a message indicating that data exchange is in progress, and a button or touch region shall be available to enable the operator to commence login prior to completion of data exchange. The SAP shall generate an event record whenever the login override button is pressed.
3. Upon completion of data exchange with the CDS (or the operator pressing the login override button), or if the SAP is not in communication with the CDS, the OCM shall activate the Contactless Smart Card Processor (CSCP) and 2D barcode reader on the SAP, and display a login prompt on the OCM.
4. The operator shall present his/her Operator ID Card to the smart card reader on the Stand Alone Processor. If the operator's smart card is defective (*i.e.*, cannot be read), the barcode reader on the SAP shall provide an alternate, backup method of reading the card's sequential serial number. If both methods fail, the OCM shall provide the operator the ability to manually enter the card's sequential serial number.
5. Using the Valid Operator ID List received from the CDS, the SAP shall confirm that the card is a valid CTDOT Operator ID Card. (If the list of valid cards is older than a CTDOT-definable age, the SAP shall reject all attempts at logging in until it has communicated with the CDS and received an updated list.) If the card is invalid, the login process shall fail.
6. If the card is valid, the SAP shall prompt the operator to enter his/her PIN on the OCM. If the PIN is valid for the presented Operator ID, the login shall be successful. If the PIN is incorrect, the SAP shall prompt the operator to re-enter the PIN. After a CTDOT-definable number of failed attempts to enter a valid PIN, the login process shall fail and generate an event record.
7. Upon successful login, the SAP shall display a suitable message on the SAP and OCM displays, but shall not enter service until the operator enters all required service parameters.

The method and operator interface design used to log into the SAP shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review.

#### CDRL 12-13



#### 12.8.4 Service Parameters

If the successful login is an ID with operator permissions (as defined in the Valid Operator ID List), the OCM shall prompt the operator to enter various parameters prior to the SAP entering service. At minimum, these parameters shall include those shown in Table 12.8.4:

Table 12.8.4: SAP Service Parameters

Parameter	Format	Entry Method	Minimum Range	Verification
Block Number	Numeric	Keyed Entry	0 – 99999	Compared with Valid Block List
Route Number	Numeric	Menu	0 – 9999	Restricted to Menu Selections
Direction	Text	Menu	As per Section 11.18.1	Restricted to Menu Selections
Service Level Default Fare	Alphanumeric	Menu	As per Section 3.10	Restricted to Menu Selections Default Retrieved from Valid Block List

Menu selectable parameters shall be constrained to valid values, based on lists constructed from data stored in the fare table or from data contained in an associated downloaded list. Changes in the fare table and the contents of associated downloaded lists shall have corresponding effects on the available menu selections. (The menu selections shall not be hard-coded, but shall be CTDOT-configurable, based on entries in the fare table or the contents of an associated downloaded list.)

The SAP shall require the operator to re-enter any keyed-entry values that fail verification. Upon successful input of the service parameters, the SAP shall enter service and be ready to process fare media.

Unless overridden by temporary actions, all transaction records shall include the values of the service parameters in effect at the time of the transaction.

While the SAP is in service, the operator shall be able to modify any of the service parameters without having to logoff.

The method and operator interface design used to enter service parameters shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 12-14**

#### 12.8.5 Maintenance Functions

If the successful login is an ID with maintenance permissions (as defined in the Valid Operator ID List), the OCM shall display one or more pages for maintenance and configuration purposes.

The method and operator interface design used to perform maintenance functions shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 12-15**



12.8.5.1 **Maintenance Parameters**

While a valid maintenance login is in effect, the OCM shall display one or more screens of parameters used to configure the SAP. At minimum, these parameters shall include those shown in Table 12.8.5.1:

Table 12.8.5.1: SAP Maintenance Parameters

Parameter	Format	Entry Method	Minimum Range
SAP Serial Number	Numeric	Factory Setting	NA
SAP Device Number	Numeric	Keyed Entry	0 – 9999
Vehicle Number	Numeric	Keyed Entry	0 – 9999
SAP Configuration	Text	Menu	(if applicable)
IP Address	Numeric IP Address	Keyed Entry	0 – 255 (each field)
Subnet Mask	Numeric IP Address	Keyed Entry	0 – 255 (each field)
Wi-Fi Settings	As Necessary		
Cellular Broadband Modem Settings	As Necessary		
SAP Volume	Numeric	Keyed Entry	0 – 9
SAP Brightness	Numeric	Keyed Entry	0 – 9
OCM Serial Number	Numeric	Factory Setting	NA
OCM Device Number	Numeric	Keyed Entry	0 - 9999
OCM Volume	Numeric	Keyed Entry	0 – 9

As indicated in Table 12.8.5.1, the SAP and OCM Serial Numbers shall be a factory setting that cannot be altered by use of the OCM. The Contractor shall ensure that all SAPs and OCMs have unique Serial Numbers.

Menu selectable parameters shall be constrained to valid values, based on lists constructed from data stored in the fare table or from data contained in an associated downloaded list. Changes in the fare table and the contents of associated downloaded lists shall have corresponding effects on the available menu selections. (The menu selections shall not be hard-coded, but shall be CTDOT-configurable, based on entries in the fare table or the contents of an associated downloaded list.)

The Maintenance Parameter screen(s) shall include a touch region that when selected shall save all maintenance parameter settings in the SAP's non-volatile memory, where they shall remain unchanged unless altered by later use of the Maintenance Parameter screen(s).

All subsequent transaction records shall include the values of the SAP Device Number and Vehicle Number in effect at the time of the transaction.

Upon exiting the Maintenance Parameter screen(s), the SAP shall return to the login prompt screen.



#### 12.8.5.2 *Maintenance Commands*

While a valid maintenance login is in effect, the OCM shall provide the technician the ability to test the SAP using a variety of maintenance commands. At minimum, the following maintenance commands shall be available:

- Initiate the SAP Power On Self Test and return to maintenance command screen when complete
- Activate the SAP's CSCP and display the sequential serial number of a presented CTDOT-issued card
- Activate the SAP's barcode reader and display the sequential serial number of a presented CTDOT employee ID card's barcode, CTDOT-printed barcode ticket, or Mobile Ticket
- Activate the SAP audio transducer at the volume specified
- Activate the OCM audio transducer at the volume specified
- Display the current power status (ignition on, ignition off and remaining time to power down)
- Display the date and time of most recent communication with CDS
- Display all current and pending version numbers for software, downloaded lists, configuration settings, etc.
- Display the current memory usage
- Display the current Wi-Fi communications status
- Display the current GPS status and location coordinates
- Display the current cellular broadband modem status

#### 12.8.6 Smart Card Transaction Processing

While a valid operator login is in effect, the SAP shall energize the smart card read/write antenna and be ready to perform smart card transactions. The SAP shall conduct all smart card transactions according to the procedures and requirements set forth herein.

The SAP shall process all CTDOT-issued smart cards, and ISO 14443-compliant smart cards which are on the Third Party-Issued Valid List.

#### 12.8.7 Barcode Transaction Processing

While a valid operator login is in effect, the SAP shall activate the barcode reader and be ready to perform barcode media transactions. The SAP shall conduct all barcode transactions according to the procedures and requirements set forth herein.

#### 12.8.8 In-Service Operator Commands and Functions

At minimum, the SAP shall provide the following operator functions and commands while in service with a valid operator login in effect:

- A. Temporarily Override Default Fare: Using as few buttons as practical, the operator shall be able to override the default fare set for the next transaction. Ideally, the available alternate fares shall be shown on the OCM display in such a way that only a single



button or touch region is required to activate any temporary override and set the fare for the next transaction. The available choices for the temporary fare set shall be CTDOT-configurable and constructed from values in the fare table, similar to the menu-driven choices in the Service Parameters selection screen.

The SAP shall restore the default fare set upon completion of the transaction, upon the driver cancelling the override, or after a CTDOT-configurable time of inactivity, initially set to 20 seconds.

- B. Change Service Parameters A button or touch region on the OCM shall enable the operator to return to the Service Parameters screen and change any parameter. Upon completion, the new parameters shall be in effect for all subsequent transactions, unless changed or temporarily overridden.
- C. Review Prior Transactions: The operator shall have the ability to review no less than the previous 5 transactions. When the transaction review function is selected, the OCM shall display a brief summary of each transaction and indicate in simple color-coded fashion (green / yellow / red) the results of each transaction. By selecting one of the prior transactions, the OCM shall then display additional detail about the transaction.
- D. Undo Last Transaction: Under strictly controlled conditions, the SAP shall support operator-initiated reversal of a prior transaction to CTDOT-issued smart cards. Transactions shall be reversed (that is, the value of the prior transaction shall be restored to the card) when all of the following conditions are in effect:
  - The operator initiates the transaction reversal
  - The presented card is a CTDOT-issued smart card
  - The previous transaction was on the same vehicle and within a CTDOT-configurable time, initially set to 120 seconds

Upon successful completion of the transaction, the SAP shall display an appropriate message to the operator and the passenger.

Failure to satisfy any of the above conditions shall cause the reversal transaction to fail and an appropriate message displayed to the operator and passenger.

The SAP shall resume normal operations upon completion of the reversal transaction, upon operator cancellation of the transaction, or upon a CTDOT-configurable time of inactivity, initially set to 20 seconds.

Availability of the Undo Last Transaction function shall be CTDOT configurable as a fleet-wide parameter.

- E. Logout: To avoid unintentional logout during normal service operations, the operator logout function shall be available only on the Service Parameters and Maintenance Parameters data entry screens.



### 12.8.9 In-Service Operating Status Messages

At minimum, the SAP shall provide the following operator status messages on the OCM while in service with a valid operator login in effect:

- Communications with CDS or CDS overdue (CTDOT configurable number of days since last communication)
- Receiving update (from remote access point)
- Power-down imminent (while ignition off, displaying minutes and seconds countdown to self-actuated power-down)
- Data memory nearing capacity (CTDOT configurable percentage)
- Any detectable self-diagnostic failures, with error condition

### 12.8.10 Data Exchange

#### 12.8.10.1 *Broadband Cellular*

- A. Any time the Stand Alone Processor is active (regardless of whether an operator is logged in) and out of range of a Garage Communications Server, the SAP shall periodically receive incremental updates to the Master Status List (MSL) from the Central Data System, via the broadband cellular modem.
- B. The SAP shall integrate the incremental MSL updates with the MSL without adversely affecting the responsiveness of the SAP to patron and operator input; while updating the MSL, the SAP shall continue to satisfy all performance requirements stated herein.
- C. The frequency of MSL updates shall be CTDOT-configurable.
- D. While in range of a cellular transmission tower, the SAP shall transmit account-based transaction results records to the CDS for every transaction as soon as each transaction completes. When cellular service is disrupted, the SAP shall store account-based transaction results records and transmit them to the CDS as soon as cellular service is restored.
- E. While in range of a cellular transmission tower, the SAP shall transmit event records to the CDS as soon as events are recorded. When cellular service is disrupted, the SAP shall store event records and transmit them to the CDS as soon as cellular service is restored.

#### 12.8.10.2 *Communications*

All Stand Alone Processors shall exchange (upload and download) data with the CDS:

- At vehicle startup
- Upon entering the garage property
- Whenever the CDS initiates a request for data while the vehicle is in a CTDOT facility and the SAP is in operation





During CDS communications, data exchange functionality shall include the following as a minimum:

- Downloading to the Stand Alone Processor a complete Master Status List containing up-to-date status information for all accounts
- Uploading of all SAP stored transaction, event, and route/run data
- Downloading of all parameter and fare table information to the SAP
- Downloading of all data configuration modifications to the SAP
- Downloading of the Valid Operator ID List to the SAP
- Downloading of the Valid Block Number List to the SAP
- Clock synchronization
- Communication verification
- Downloading program/software updates to the SAP

While the SAP is communicating with the CDS, the OCM and SAP Patron Display shall display a suitable message.

#### **12.8.11 Diagnostics**

To the extent possible, internal diagnostic programs shall check the SAP for proper performance while the device is operating. The malfunction detection shall cover at least failure of power or control circuitry, and any failure of a fare media read/write module (CSCP and barcode reader) that could result in a false, incomplete, or corrupted reading or encoding of a fare product.

When a failure is detected of sufficient severity to cause the SAP to cease functioning or cause transactions to fail, the SAP shall go out of service and provide visual indication on the OCM and SAP displays. The information displayed shall indicate the type of failure that caused the SAP to go out of service.

The detected deficiency shall be recorded as an event record in the SAP's memory for later extraction.

A description of the maintenance and service indicators for the SAP shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 12-16**

#### **12.8.12 Logout**

Operator logout of the SAP shall occur:

1. When the operator selects the logout command on the OCM.
2. Automatically within a CTDOT-configurable time after the vehicle ignition is shut off.

Upon logout, the SAP shall generate and store an event record and go out of service; the OCM shall then revert to the login prompt state or power down, as appropriate.

#### **12.8.13 Power-down**

When the vehicle engine is turned off, the SAP and OCM shall remain powered, fully operational, and able to exchange data via the wireless data interface, for CTDOT-configurable duration, initially set to 30 minutes. After this configurable time has elapsed, the SAP and OCM shall commence automatic self-activated power-down, unless communications with the CDS are in progress. If communications with the CDS cause a delay in automated power-down, upon completion of the communications session, the SAP and OCM shall automatically power down.



Prior to shutting down, the SAP shall generate and store an event record and perform all necessary steps to retain integrity of all stored data.



## 13 Vehicle Data Communications

### 13.1 Communications Interfaces

The Contractor shall provide and install communications interfaces for all CTDOT vehicles equipped with Validating Fareboxes or Stand Alone Processors. These interfaces may be installed in the Operator Control Module, the fare processing devices (Validating Farebox and SAP), or a separate secure enclosure.

#### 13.1.1 Wi-Fi

Power output of the Wi-Fi network interface shall be 24dBm minimum.

The IEEE 802.11n Wi-Fi, or the prevailing equivalent standard at the time of contract award, interface shall support Multi-Input, Multi-Output (MIMO) and dome type low profile antennas.

#### 13.1.2 Cellular Broadband Modem

The cellular broadband modem shall support 3G and 4G/LTE communications from common carriers such as AT&T®, Verizon®, Sprint®, T-Mobile®, and others. The cellular broadband modem shall support MIMO antennas.

#### 13.1.3 Global Positioning System

NFTS interfaces shall include an integrated 12-channel GPS receiver and interface to connect to an external GPS antenna via appropriate cabling and connectors, which shall be used to provide GPS coordinates stored as part of every transaction record. All components of the GPS system, including software, receiver, antenna, cabling and connectors shall be supplied by the Contractor.

The NFTS devices shall retrieve current GPS coordinates no less than once every 5 seconds.

#### 13.1.4 Ethernet

The Validating Farebox and Stand Alone Processor shall provide at least one spare Ethernet interface, operating at switchable data rates of no less than 10/100 Mbps. The Ethernet interface shall support future integration with other on-vehicle systems, including but not limited to: CAD/AVL for real-time stop ID information, other systems as necessary to support single-point login, and consolidated operator controls (to replace the OCM).

### 13.2 Roof-Mounted Antennas

All roof-mounted antennas shall:

- Not require external ground plane outside of antenna enclosure
- Be white in color
- Be UV and corrosion resistant
- Provide a watertight seal (rated IP7) against water ingress into the vehicle
- Not interfere with the operation of other existing and Contractor-installed antennas

Separate antenna enclosures are acceptable, but CTDOT prefers all antennas to be in a single radome, such as the LTM Surface Mount series provided by Mobile Mark, Incorporated:

[www.mobilemark.com](http://www.mobilemark.com)



The Contractor shall submit the design, make, model, operating characteristics (including both azimuth and elevation patterns), and installation details for all roof-mount antennas for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review.

**CDRL 13-1**

**13.2.1 Wi-Fi**

Roof-mounted Wi-Fi antennas shall:

- Be low profile, surface-mount, omni-directional
- Include two MIMO antennas with a minimum gain of 5 dBi
- Operate at 2.4 and 5 Ghz bands

**13.2.2 GPS**

The GPS antenna shall support the installation and use of a CTDOT-installed splitter (at some future time if needed) so the antenna may be shared by devices that need their own GPS antenna source.

**13.2.3 Cellular Broadband**

The cellular broadband modem antennas shall include two Long Term Evolution (LTE) MIMO antennas for the 700 MHz band, with the following minimum frequency response characteristics:

- 694 – 960 MHz band, minimum gain of 3 dBi
- 1710 – 2170 MHz band, minimum gain 4 dBi

## 13.3 Communications Equipment Enclosure

If additional communications components are required to support NFTS devices (such as external communications or power control components), the Contractor shall mount all such components into a secure and sturdy enclosure. Each such enclosure shall include keyed access and externally visible status indicators as necessary to enable CTDOT maintenance personnel to quickly ascertain the functional status of all devices inside the enclosure.

The design and installation methods and locations for any auxiliary enclosures shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 13-2**



## 14 Non-Registering Fareboxes

Some CTDOT routes are served by contracted service providers using vehicles used for many non-CTDOT activities. These contractors and their vehicles require minimal cash handling devices, and the ability to quickly equip and de-equip a vehicle for CTDOT service.

To satisfy these requirements, the Contractor shall provide and install secure, Non-Registering Fareboxes (NRFs) that can be easily and quickly installed and removed. The NRFs shall:

- A. Have an enclosure made of stainless steel and other vandal-resistant material
- B. Be a compact device, with no more than a 6-inch square cross-section in plan (top) view
- C. Securely latch to a mounting bracket installed on a handrail, bulkhead, or dashboard
- D. Be locked to the mounting bracket with a high-security lock
- E. Permit passengers to insert coins and bills into single, common slot
- F. Display deposited cash to the operator for inspection
- G. When installed, be located within easy (ergonomic) reach of the operator
- H. Be easily relocated to other vehicles with pre-installed mounting bracket
- I. Include a cashbox with volume no less than 200 cubic inches
- J. If separate, have a cashbox secured to farebox with a high-security lock
- K. Provide access to deposited cash contents via a separate high-security lock
- L. If a separate cashbox is used, maintain security of all deposited cash when the cashbox is removed from the farebox
- M. Include separate, unique, permanently etched serial numbers for the farebox and the cashbox (if separate)
- N. Include an "anti-fishing" mechanism to prevent unauthorized access to inserted cash
- O. Provide a manual dump mechanism to allow the operator to transfer inserted cash from inspection area to cashbox



## 15 Garage Equipment

### 15.1 General

Each Garage shall be equipped with the necessary hardware, software and communications to successfully transfer collected revenue and data from the Validating Farebox, or data from the Stand Alone Processor, on each vehicle. The hardware and software shall support and provide for strict accounting of the revenues. This equipment shall also provide for secure and expedient data transfer between the Validating Farebox and SAP equipment and the Central Data System (CDS), via the Garage Communications Server (GCS).

The Contractor shall provide equipment to permit CTDOT to securely collect and transfer revenues from Validating Fareboxes in such ways that are secure and that permit assessing and auditing the accuracy of collected revenues, when compared with reported revenues.

The transfer of transaction and event records and download of data files from the Validating Farebox or SAP shall occur on at least a daily basis via the data interfaces installed at each garage facility.

The Contractor shall equip each garage with a Garage Communications Server (GCS) for centralized monitoring of revenue collection activity (as applicable) and data communications with Validating Fareboxes, Stand Alone Processors, and cashbox receivers (where necessary). In garages serving vehicles with Validating Fareboxes, the Contractor shall provide:

- A Cashbox Revenue Collection System at service islands for data and revenue transfer
- One or more Portable Data Unit(s) for data exchange and cashbox removal while Validating Fareboxes are not at the service islands

With the exception of when the Portable Data Unit is used, the System shall be designed to ensure that the cashbox door cannot be opened permitting the cashbox to be removed anywhere other than at the service islands or any other location at which a CTDOT cashbox revenue collection system has been installed.

### 15.2 Vaulting System

At each revenue service location within a garage facility serving Validating Fareboxes, the Contractor shall provide and install vaulting system(s) as required herein. The vaulting system(s) for each facility shall include all hardware to permit the secure removal of all revenues from cashboxes, and permit transfer of these monies for processing.

The revenue service equipment shall be installed in a convenient location, similar to the present location for Bus equipment service islands. This installation shall be performed in a phased manner to suit the operational needs of CTDOT. At no time shall CTDOT be unable to provide the required revenue servicing for the vehicles.

The Contractor shall perform all site and facility modifications required for installation of the vaulting systems, including all physical modifications required. The Contractor shall reposition existing revenue service and vaulting system equipment in a manner to allow the installation of the NFTS systems - while maintaining the operation of the old system. The old and new systems shall be able to operate concurrently.



All security and interlocks shall be maintained except when the vault is accessed for maintenance by properly authorized personnel. All vault housing maintenance access locks and revenue retrieval locks shall be Cyber™ Lock or CTDOT-approved equal.

The Contractor shall provide two varieties of vaulting systems: stationary and through-wall.

Each stationary vault system shall be comprised of the following elements:

- Stationary Vault Housing
- Cashbox Receiver
- Mobile Safe
- Vaulting Authorization Tool

Each through-wall vault system shall be comprised of the following elements:

- Through-Wall Vault Housing
- Cashbox Receiver
- Vaulting Authorization Tool

#### 15.2.1 Stationary Vault Housing

- A. The stationary vault housing shall be a sturdy enclosure located at each revenue island. It shall house the Mobile Safe and include a cashbox receiver on its upper surface. Hardware and software interlocks shall be incorporated to prohibit unauthorized access to any monies stored in the cashbox or in the Mobile Safe. Hardware interlocks shall prevent the processing of cashboxes unless a Mobile Safe is properly installed and secured.
- B. The Stationary Vault Housing shall read and immediately forward the serial number of the Mobile Safe as soon as the safe is properly installed into the vault housing. Likewise, the Stationary Vault shall immediately report the removal of a Mobile Safe to the GCS.
- C. The When one or more Mobile Safe compartments are deemed to be full (based on separate CTDOT-adjustable limits for coins and currency), the GCS shall activate the "Mobile Safe full" visual indicator on the receiver housing.

Contractor shall provide dimensioned drawings of the stationary vault with the doors and covers both opened and closed. **CDRL 15-1**

#### 15.2.2 Through-Wall Vault Housing

- A. The through-wall vault housing shall be a sturdy enclosure to be located at facilities where CTDOT requires no mobile safes to transport vaulted cash. It shall house secure revenue storage bins and include a cashbox receiver on its upper surface. Hardware and software interlocks shall be incorporated to prohibit unauthorized access to any monies stored in the cashbox or in the secure revenue storage bins.
- B. The through-wall vault shall receive cash that is emptied from the cashboxes removed at a Garage service island. The through-wall vault shall:
  - Contain two (2) independent compartments - one to store coins and another to store bills
  - Have capacity of not less than \$20,000 in mixed coins and 20,000 currency notes



- C. As the contents of each cashbox are transferred to a through-wall vault, the GCS shall monitor the total amount of coins and currency in the through-wall vault by coin and currency denomination.
- D. When one or more through-wall vault compartments are deemed to be full (based on separate CTDOT-adjustable limits for coins and currency), the GCS shall activate the “vault full” visual indicator on the receiver housing.
- E. Coins shall be retrieved by manually opening a “sluice gate.” The gate shall be constructed of a sturdy steel plate that slides vertically when unlocked. When the gate is opened, coins shall slide down a sloped ramp. Internal baffles shall direct all coins to the sluice gate opening such that no coins are left inside the vault, or such that any remaining coins can be easily seen and retrieved by hand.
- F. Currency and tickets deposited into the through-wall vault shall be collected in a separate lightweight, removable bin secured inside the vault. Access to the currency bin shall be through a locked door on the vault housing.

Contractor shall provide dimensioned drawings of the through-wall vault with the doors and covers both opened and closed. **CDRL 15-2**

Design details of the through-wall vault shall be provided at FDR and shall be subject to approval by CTDOT. **CDRL 15-3**

### 15.2.3 Cashbox Receiver

- A. The cashbox receiver shall be incorporated into the vault housing. The cashbox receiver shall
  - Be capable of receiving and emptying cashboxes with and without commercial electric power, and in a secure manner.
  - Not permit the cashbox emptying cycle to commence unless a Mobile Safe is properly installed in the vault housing (if applicable)
  - Not permit the cashbox emptying cycle, once started, to be manually halted or reversed
  - Incorporate indicators to visually identify the current status of the cashbox receiver:
    - One indicating that the emptying cycle is in progress
    - One indicating that the cycle is completed
  - Incorporate a visual indicator to identify when the Mobile Safe or vault has reached its capacity for coins or bills. (The number of coins and bills that will trigger this indicator shall be CTDOT-configurable at the CDS.)
  - Complete the cashbox emptying cycle in not more than fifteen (15) seconds, but with sufficient delay to ensure that all coins and bills are transferred from the cashbox to the safe
  - Read and immediately forward the cashbox serial number to the GCS upon commencement of the emptying cycle
  - Ensure that when the receiver door is open, access to the interior of the cashbox or to the Mobile Safe or secure cash bins is prohibited
  - Locate all connectors for external cables under the secure maintenance shroud
- B. The cashbox receiver mechanism shall operate reliably, without the use of pneumatics or other such timing mechanisms that are subject to wear or may require frequent adjustment.





- C. The cashbox receiver shall be protected by a door to deny access to the receiver opening and shall provide manual locking means for security purposes when the receiver is not being employed for revenue servicing.
- D. The cashbox receiver shall be designed so that the cashbox must be properly and securely inserted into the receiver for the receiver door to close properly and for the interlocks to engage and permit the cashbox to be emptied. If the cashbox is not properly in place, the door shall not close and the emptying cycle shall not commence.
- E. The cashbox receiver shall be of heavy-duty stainless steel construction. All openings and high wear areas shall be constructed to be durable and shall be able to accommodate rough handling.
- F. The cashbox receivers shall be able to be manually unlocked by a supervisor or other authorized personnel at the commencement of the revenue servicing period and manually locked at the end of the servicing period. It shall contain secure lock releases that enable the cashbox door to the cash compartments to open and the cash to drop into the Mobile Safe or secure bins positioned below the cashbox receiver during the revenue service process.
- G. Interlocks shall prohibit access to the interior of any revenue collection vault area or cashbox located within the cashbox receiver when the cashbox receiver door is opened.

Design details to meet the above requirements shall be provided and shall be subject to approval by CTDOT at Preliminary Design Review. **CDRL 15-4**

#### **15.2.4 Mobile Safe**

- A. The Mobile Safe shall receive cash that is emptied from the cashboxes removed at a Garage service island. The Mobile Safe shall:
  - Contain two independent compartments – one to store coins and another to store bills and other paper documents
  - Have capacity of not less than \$10,000 in mixed coins and 10,000 currency notes
- B. As the contents of each cashbox are transferred to a Mobile Safe, the GCS shall monitor the total amount of coins and currency in the safe by coin and currency denomination.
- C. The Mobile Safe shall be constructed of heavy gauge steel plate, be secured against unauthorized access by electronic high-security locks, and have wheels suitable to withstand the weight of a full Mobile Safe. At no time shall money be exposed.
- D. All security and interlocks shall be maintained except when the Mobile Safe is accessed for maintenance by properly authorized personnel
- E. Coins shall be retrieved by manually opening a “sluice gate.” The gate shall be constructed of a sturdy steel plate that slides vertically when unlocked. When the gate is opened, coins shall slide down a sloped ramp. Internal baffles shall direct all coins to the sluice gate opening such that no coins are left inside the Mobile Safe, or such that any remaining coins can be easily seen and retrieved by hand.
- F. Currency and tickets deposited into the Mobile Safe shall be collected in a separate lightweight, removable bin secured inside the safe. Access to the currency bin shall be through a locked door on the safe housing.
- G. The Mobile Safe shall be designed to easily transport revenues from the islands to the revenue counting facility once removed from the vault housing. The Mobile Safe shall



be mounted on four wheels - two fixed and two with a 360° swivel to facilitate maneuvering.

- H. A braking system shall be provided to engage the two fixed wheels so that the Mobile Safe shall be held in a stationary position both during cashbox emptying and during emptying for money processing.

Design details of the Mobile Safe shall be provided at FDR and shall be subject to approval by CTDOT. **CDRL 15-5**

**15.2.5 Vaulting Authorization Tool**

The ability to open a Validating Farebox cashbox access door shall be possible only using a secure Vaulting Authorization Tool located at the service island and also incorporated into a portable data unit. The revenue collection equipment at the service island shall include a location for secure (lockable), convenient, and weather-protective storage of the Vaulting Authorization Tool when not in use.

The Contractor shall demonstrate before acceptance of either method that the Vaulting Authorization Tool after being completely submerged in water. An immediate attempt to use the Vaulting Authorization Tool shall be made after complete submerging for a minimum of sixty (60) seconds.

The Vaulting Authorization Tool shall be designed so that:

- It cannot be removed from its location and will not function if it is removed
- It shall not require the manual entry of any data to initiate or complete communication with the Validating Farebox or the cashbox
- It is convenient in size and shape
- Is durable to withstand the extreme rigors of continuous depot operations
- Is impervious to diesel fuels, gasoline, oils, transmission fluids and road salts
- Is useable in inclement weather, including demonstrating that near-lightning strikes have no effect on the operation of the key
- When dropped from a height of 36 inches to a concrete floor, it shall not suffer loss of operation in any way

**15.2.6 Vault System Locations**

The following table identifies the CTDOT bus garages and the number of vaulting system equipment to be installed for each facility.

Table 15.2.6: Vault System Requirements

CTDOT Garage	Revenue Service Lanes	Stationary Vault Systems	Through-Wall Vault Systems	Vaulting Authorization Tools
Hartford	4	4	0	4
New Haven	4	4	0	4
Stamford	2	0	2	2
<u>Waterbury (Northeast)</u>	<u>1</u>		<u>2</u>	<u>2</u>
<u>DATTCO</u>	<u>1</u>		<u>1</u>	<u>1</u>
<u>NB Transit</u>	<u>1</u>		<u>1</u>	<u>1</u>
<b>TOTAL</b>		8	<del>6</del> <u>2</u>	<del>14</del> <u>10</u>



### 15.3 Cashbox Processing

The GCS shall monitor and record all servicing and event transactions, including at minimum the following:

- Time the Validating Farebox cashbox door is opened, and the cashbox removed (a CTDOT-settable parameter)
- Time the data transfer commences
- Elapsed time between cashbox removal from a Validating Farebox, and its insertion into the cashbox receiver
- Time that the cashbox receiver door is open
- Time the cashbox is removed from the receiver

CTDOT shall be capable to enter timing parameters for all cashbox removal and emptying events; events that exceed these timing parameters shall be considered revenue alarms, to be tracked by the CDS. Data included and format provided for the detailed transaction data records shall be provided to CTDOT for review at the Preliminary Design Review and for approval at the Final Design Review. **CDRL 15-6**

### 15.4 Operation

When a vehicle enters the Garage and pulls into service lane adjacent to the service island, a CTDOT employee will use the Contractor-provided probe to initiate communications with the Validating Farebox. Transfer of data on cashbox contents, however, is required to occur prior to the cashbox vaulting. With communication successfully established, the following data shall be transferred from the Validating Farebox to commence the vaulting operation:

- Identification information, including Validating Farebox ID and cashbox ID
- Alarms stored by the Validating Farebox
- Transaction records
- Summary information on cash revenue in the cashbox, including coin totals and bill totals by coin and bill denomination and fare media usage
- Date and time synchronization data
- Time and location of last data transfer and cashbox vaulting operation

During this data exchange, a coded number (design to be approved by CTDOT) shall be transmitted to the Validating Farebox from the GCS for verification of valid data transfer. If this number matches the coded number, that has been previously downloaded from the GCS and stored in Validating Farebox memory, the Validating Farebox shall unlock the cashbox door, permitting the cashbox to be removed. The system shall be designed such that knowledge and use of the code shall not provide access to the cashbox by any means other than at the service island or using the portable data unit. It shall be possible to change the code in the Validating Farebox by means of the GCS both on a pre-programmed automatic basis and on an elected basis by authorized personnel at either GCS or CDS workstations.

Transmission of data shall include appropriate security as well as error detection and recovery functions. If an error occurs in transmission, a retry shall be initiated by the GCS immediately and automatically. If three attempts to extract data automatically result in no success, means shall be provided to alarm this condition audibly and visually locally on the Validating Farebox and at the GCS display, to register the error condition to the GCS and terminate the attempted transmission. An alarm message shall be stored and transferred to the appropriate workstation to notify the appropriate personnel. No data transfer shall occur if the Validating Farebox has not been vaulted in the proper manner.



## 15.5 Audit Unit

The audit unit shall contain two compartments - one for coins and one for bills. The audit unit shall have capacity of not less than 1,000 bills and \$1,000 in mixed coins.

A crank mechanism similar to the one provided for the cashbox receiver shall be furnished for the emptying of the cashboxes.

The audit unit shall be a stand-alone unit and shall not communicate with the GCS or CDS or store any data.

## 15.6 Portable Data Unit

A Portable Data Unit (PDU) shall be provided to collect data from Validating Fareboxes and manually transfer the data to the GCS. The PDU shall be a battery-operated hand-held device and shall utilize the same data transfer and security methods as provided for the rest of the Validating Farebox System. The PDU batteries shall be rechargeable and provide no less than 6 hours of operating time between charges. Alternatively, the PDU shall be based on a solid state device, such as a USB flash drive, with appropriate security measures incorporated.

The PDU shall extract all stored data, including transactional and event data, from a single Validating Farebox in not more than 25 seconds and store the information in non-volatile memory. As a CTDOT-settable default, each time the PDU is used to access Validating Farebox data, the Validating Farebox data shall be reset.

The PDU shall cause the Validating Farebox to increment the non-resettable PDU counter to be incremented each time the PDU is used to download the Validating Farebox data. An event record, which includes the serial number of the PDU, plus date and time, shall also be stored in the Validating Farebox each time the PDU is used to download Validating Farebox data.

By default, the PDU shall cause the Validating Farebox to open the cashbox door. Using a downloadable parameter from the CDS, CTDOT shall be able to configure any PDU to leave the cashbox door unopened.

The PDU shall be designed to store data in a secure manner, and shall have capacity to store data from at least 20 Validating Fareboxes.

Each PDU shall include a docking station that charges the batteries and exchanges data with the GCS or CDS. The data transfer method shall be reviewed by CTDOT at the Preliminary Design Review and approved by CTDOT at the Final Design Review. **CDRL 15-7**

Contractor shall provide a complete description of the functionality of the PDU and dimensioned drawings of the PDU showing all displays, controls, interfaces, and peripherals for CTDOT review and approval. **CDRL 15-8**



## 16 Platform Validators

### 16.1 General

Platform Validators (PVs) shall be deployed at CT*fastrak* stations to enable patrons to process contactless smart cards prior to boarding a vehicle. PVs shall be compact, ergonomically designed, simple to use, and sufficiently robust to withstand the operational environment encountered in unsheltered BRT stations and to deter acts of vandalism. Each PV shall contain:

- A user interface that is:
  - Flexible, easy to understand by the patron
  - Configurable by CTDOT without the intervention of the Contractor
- A Passenger Display
- A Passenger Selection Keypad
- A three-color status lamp array (or equivalent)
- An audio feedback and voice message system
- A Contactless Smart Card Processor and associated Read/Write Antenna
- An Electronic Control Unit that has
- An industrial grade processor
- Static memory for transaction data, fare tables and software application(s)
- An internal clock
- An Ethernet Network Connection
- A USB connection
- Other internal modules as necessary

The PVs shall:

- Process contactless smart cards
- Respond to patron selections
- Display the presented card's validity, value (if applicable), instructions, notices, and other information to the patron
- Register and store transaction data
- Annunciate transaction results using
- Distinct audible tones
- Three-color light display
- Synthesized text to speech voice messages
- At locations suitably equipped, use standard Ethernet and TCP/IP networking technology to communicate with the CDS to receive commands, transmit, and receive data regarding transaction status, and action list information.
- Support the optional installation and use of modules and antennas necessary to communicate with the CDS via wireless technology, including secure Wi-Fi (IEEE 802.11i and IEEE 802.11n) and cellular 3G/4G broadband
- Be upgradeable by simply adding or replacing modules
- Employ a design that permits mounting on a pedestal, or a wall

A complete description of the PV functionality shall be provided for CTDOT review and approval at each stage of the design review process. Sufficient detail shall be provided to permit verification that all required functions are satisfactorily included. **CDRL 16-1**



## 16.2 PV Enclosure

The Platform Validator shall be a self-contained machine complete with mounting pedestal. Additionally, the PV design shall accommodate installation of the PV to a wall, column, or other vertical surface, without the use of a pedestal.

The PV enclosure shall be constructed using a service proven commercially available material such as non-rusting stainless steel (Grade 316). When installed, the PV enclosure shall satisfy all defined requirements. The Contractor shall provide separate dimensioned drawings of the PV showing all displays, controls and openings/interfaces with doors/covers both open and closed for review at the Preliminary Design Review and for approval at the Final Design Review.

### **CDRL 16-2**

The Contractor shall provide drawings and supplier specifications of all major PV enclosure components, and a sample of the finished PV cabinet outer surface, for review at the Preliminary Design Review and for approval at the Final Design Review. **CDRL 16-3**

## 16.3 User Interface

The PV user interface shall consist of no less than the following:

- Passenger Display
- Passenger Selection Keypad
- Contactless Smart Card Processor
- Transaction Status Lamps
- Audio Transducer
- Voice Messaging System
- Graphics and Braille

### **16.3.1 Passenger Display**

The Passenger Display shall consist of a color, trans-reflective back-lighted Liquid Crystal Display (LCD) screen that:

- Provides resolution of at least 800 by 600 pixels
- Is backlit and produces a minimum of 1,000 nits brightness
- Has at least a 750:1 contrast ratio
- Is capable of displaying the complete VGA Color Palette
- Is fully dot addressable and capable of displaying graphic bit-mapped icons and images
- Incorporates a CTDOT-configurable "screen saver" function in a standard movie format
- Provides a level of visibility sufficient to allow all displayed instructions to be easily read by the patron under operational ambient light conditions, including direct sunlight
- Is suitable for installation in unsheltered outdoor environments
- Is unaffected by heat loading from exposure to the sun
- Displays characters and symbols compliant with ADA requirements and at least 0.375 inches tall

The PV Passenger Display shall convey instructions to guide the patron through each selection and validation process, and shall convey transaction results.

The PV Passenger Display shall be located so that the display remains fully visible while passengers tag smart cards to the antenna, regardless of which hand the patron uses.



In concert with the Passenger Selection Keypad, the PV Passenger Display shall form a user interface similar to an Automated Teller Machine. Displayed messages shall be easily modifiable by CTDOT once the system is in operation. All message formats and contents shall be subject to CTDOT review and approval at the Preliminary and Final Design Reviews. **CDRL 16-4**

### 16.3.2 Passenger Selection Keypad

The PV shall include a Passenger Selection Keypad containing a minimum of six (6) programmable passenger-operated selection keys. The selection keys shall:

- Be made of stainless steel or revenue service-proven materials
- Have a flat front surface of approximately 1 square inch to provide proper finger contact
- Not rotate
- Provide an audible tone upon being depressed
- Protrude no more than 0.25 inches from the surface of the PV enclosure
- Be protected against vandalism, including impact resistance from pounding, such as by a person's foot or fist
- Be liquid proof to provide sealed contacts for all switches
- Not be removable from the outside
- Be non-fading and easily replaceable from the inside
- Be spaced to accommodate labeling in conformance with ADA requirements

The selection buttons shall be capable of being variably defined by CTDOT without Contractor intervention, with each button's active function shall be defined by text displayed on the area of the Passenger Display adjacent to the button.

Functions to be available via the Passenger Selection Keypad shall include:

- Cancel a transaction in progress and resume default "Ready" condition
- Activate / deactivate voice message system
- Adjust volume of voice message system (volume adjustment may be combined with the "activate / deactivate voice message" button)
- Conduct a read-only transaction that leaves limited use smart cards unaltered (does not validate the smart card) or only verifies the status of the account associated with the smart card (does not conduct a transaction)
- Reverses the patron's previous validation if it is conducted at the same PV within a CTDOT-adjustable period, initially set to 3 minutes
- Select destination zone other than default zone (when zone fares are in effect). The default zone shall be independently configurable for each PV. The transaction shall be based on the last zone button pressed prior to validation; patrons shall be able to repeatedly select another zone prior to tagging their smart media to the PV.

### 16.3.3 Contactless Smart Card Processor

The PV shall have a commercially available ISO/IEC-14443 compliant Type A and B Contactless Smart Card Processor as identified within these specifications. The CSCP shall be located such that patrons can easily tag their smart cards.

The PV antenna shall be energized and ready to conduct a transaction whenever the PV is in service.



#### **16.3.4 Transaction Status Lamps**

The PV shall also include three LED lamps in red, yellow, and green, which shall be visible in all ambient lighting conditions.

After each transaction, the appropriate LED shall remain illuminated for a CTDOT-configurable time defined herein as the Inter-transaction time-out, or until another smart card transaction is initiated.

The operation of the Status Lamps shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 16-5**

#### **16.3.5 Audio Transducer**

The PV shall be capable of emitting at least 8 distinct sounds or sound patterns. All sounds emitted by the PV shall be of sufficient volume to be heard by the patron in a public transit environment. Each illumination of LEDs shall have one or more distinct sound or sound pattern assigned. For example, it shall be possible to assign a sound for a successful transaction that also requires the operator to inspect the passenger's fare media which is distinct from the sound emitted for a successful transaction that requires no inspection. (In both such cases, the green light shall illuminate.)

The sounds and sound patterns shall be demonstrated for CTDOT review and approval at the Preliminary Design Review. **CDRL 16-6**

#### **16.3.6 Voice Messaging System**

The PV shall incorporate a Passenger Selection button to activate the audio function for the PV. The activation of this function shall cause the information displayed to be "read" to the patron. The patron shall be provided with a method to increase and decrease the volume of the voice annunciation.

The information displayed shall continue to be annunciated until the audio function is deactivated or the transaction sequence is complete.

In addition, when this function is activated, full details on the hardware, software, and settings for this functionality shall be provided for CTDOT review at the Preliminary Design Review and for approval at the Final Design Review. **CDRL 16-7**

#### **16.3.7 Graphics and Braille**

The PV enclosure shall include suitable space for decals and labels to convey any branding or other CTDOT-specific graphics. The size and location available for graphic decals, and the location and content of raised-letter and Braille labels, shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 16-8**





## 16.4 Data Storage

### 16.4.1 Transaction Records

The Platform Validator shall generate and store a discrete data record for each transaction performed. Each transaction record shall be unique within the NFTS. All Platform Validator transaction records shall include the following information as a minimum:

- Date and time of transaction
- Platform Validator (Device) number
- Station name
- Station number
- Fareset in effect
- Fare/Transaction type (e.g., Full Fare / Reduced Fare / Partial Fare / Upgrade Fare)
- Direction (no less than 8 values, including North, South, East, West, Inbound, Outbound)
- Transaction sequence number (which shall be unique per day per Platform Validator)

The Platform Validator shall have capacity to store no less than 20,000 transaction records.

#### 16.4.1.1 *Contactless Smart Card Transactions*

In addition to the data fields defined, contactless smart card transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number if CTDOT-issued, chip Unique ID (UID) if third party-issued)
- Action performed (if applicable)
- Transaction value (if applicable)

### 16.4.2 Event Records

At minimum, the Platform Validator shall generate and store an event record for each of the following actions or incidents:

- Power on
- Power On Self Test complete
- Power On Self Test failure, including failure mode
- Power off
- Maintenance parameter changed, including parameter and new value
- Route changed, including new route number
- Default fare (service level) changed, including new fare set
- End of transit business day (CTDOT programmable, default is 3:00 AM)
- Communication with CDS initiated
- Communication with CDS completed
- Communication with CDS terminated before complete (i.e., Wi-Fi signal lost)
- Communication with CDS terminated by maintainer
- New downloaded list received, including list type and version number
- New downloaded list activated, including list type and version number
- New fare table received, including version number
- New fare table version activated, including version number
- New Platform Validator software version received, including version number
- New Platform Validator software activated, including version number
- New Platform Validator configuration data received, including version number



- New Platform Validator configuration data activated, including version number
- Platform Validator internal clock reset for a time discrepancy greater than 3 minutes
- Data memory nearing capacity (CTDOT configurable threshold)
- Data memory full
- Platform Validator reset (when action occurs while operator is logged in)
- Successful data transfer (including destination – GCS or PDU)
- Unsuccessful data transfer (including destination – GCS or PDU)
- Other Platform Validator errors and failures

Each event record shall include, at minimum:

- Date and time of transaction
- Platform Validator (Device) number
- Station name
- Station number
- Fareset in effect
- Fare/Transaction type (e.g., Full Fare / Reduced Fare / Partial Fare / Upgrade Fare)
- Direction (no less than 8 values, including North, South, East, West, Inbound, Outbound)
- Transaction sequence number (which shall be unique per day per Platform Validator)
- Associated event parameters (as required)

The Platform Validator shall have capacity to store a minimum of 2,000 event records.

#### **16.4.3 Fare Tables**

The Platform Validator shall store a minimum of three complete fare tables. One fare table shall be designated the active table; all other stored tables shall include a date and time at which the table is to become active.

Fare tables shall be highly configurable and shall include support all fare policies and pricing structures defined herein and necessary to support CTDOT operations.

#### **16.4.4 Lists**

The Platform Validator shall receive and update one or more lists of data from the CDS as identified in Section 7.

### **16.5 Transaction Processing**

The PV shall process fare media as appropriate to the type of validity information stored, by the SMT System or fare media itself. The PV shall process presented Smart Media according to the CTDOT fare policies in effect and as programmed. The patron may override the default transaction by selecting an alternate destination zone, fare, or transaction type using the Passenger Selection Keypad. Upon completion or cancellation of a non-default transaction, the PV shall resume its default transaction mode.

A flow chart of the PV transaction process shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 16-9**

#### **16.5.1 Timeouts**

In addition to the intra- and inter-transaction timeouts the Contractor shall identify all Platform Validator timeouts in the review of the transaction process that shall occur at the Preliminary



Design Review, and shall be subject to CTDOT approval at the Final Design Review. **CDRL 16-10**

#### **16.5.2 Fare Payment**

Only exact fares are accepted at the PV. When exact fare is paid the Platform Validator shall emit a distinct "fare paid" tone indicating full payment of fare. All other non-valid fare payments or presentation of invalid fares shall emit a distinct "invalid" transaction tone.

#### **16.5.3 Transaction Speed**

All contactless smart card transactions shall complete in no more than 500 milliseconds, as measured by when the fare media is within the defined read distance and orientation to the antenna and the transaction results are displayed. The transaction time allowed shall include processing of all media when all lists described in Section 6 are at maximum capacity.

#### **16.5.4 Passback Control**

It is possible that patrons may repeatedly tag their Smart Media to a PV. While such actions may technically constitute a passback situation, the PV shall not cause the patron undue alarm by indicating an invalid transaction. If a passback situation is detected, the PV shall display a message that indicates that the patron's Smart Media has already been validated, and that it is valid for one ride on the BRT.

The PV "passback" time period, shall be a parameter set by CTDOT. All aspects of the passback controls and settings shall be provided for CTDOT review at the Preliminary Design Review and approval at the Final Design Review. **CDRL 16-11**

### **16.6 Installation**

The PVs shall be installed on station platforms and at other exterior locations, which may be unsheltered from the environment. Once installed, the PV shall meet all ADA requirements.



## 17 Multi-Function Vending Machine

### 17.1 General

The Multi-Function Vending Machines (MVMs) shall be designed to sell tickets and passes and to reload smart cards with cash (any combination of coins and bills) and bank cards. MVMs shall be capable of issuing different tickets, passes or combinations thereof from within the same housing.

The Multi-Function Vending Machines shall be compatible with the smart card fare media. Subsequent to processing by the MVMs, all smart cards shall remain compatible with CTDOT'S existing fare collection system.

In general, each MVM shall:

- Accept U.S. coins and bills
- Accept authorized bank cards
- Respond to patron's choice of action
- Display the current amount due based on patron selections and payments
- Print and issue short-duration fare products on plain paper-based barcode tickets
- Print, encode, and issue medium-duration fare products on Limited Use Media (disposable smart cards)
- Print and issue receipts and audit tickets
- Dispense new CTDOT-issued Long-Term Smart Cards
- Add stored value to accounts associated with CTDOT-issued Long-Term Smart Cards
- Add floating period passes to accounts associated with CTDOT-issued Long-Term Smart Cards
- Display instructions and notices
- Issue change if excess payment is made and change is available
- Return monies deposited if a transaction is canceled or aborted
- Register and store accounting data
- Provide audio output of messages and instructions
- Contain a security and alarm system
- Communicate over a network to send and receive data and commands with the Central Data System (CDS)

The MVM shall be fully compliant with the relevant Payment Card Industry Data Security Standards (PCI DSS) in effect at the time of contract award, and shall be easily upgraded to be compliant with any updates to the PCI DSS that are pending within 5 years after commencement of revenue service.

Preliminary design drawings of the interior and exterior of the MVM and all major assemblies identified shall be submitted for CTDOT approval at the Preliminary Design Review. **CDRL 17-1**



## 17.2 Supported Transactions and Products

The MVM shall support a wide variety of transactions, including but not limited to:

- Selling short-term fare products (with barcodes) on plain paper tickets
- Selling medium-term fare products encoded onto Limited Use Smart Card Media
- Dispensing new CTDOT-issued Long-Term Use Smart Cards
- Adding value to a Long-Term Use Smart Card's associated account
- Adding a pending pass to a Long-Term Use Smart Card's associated account

### 17.2.1 Short- and Medium-Term Fare Products

The MVM shall, at minimum, issue the short- and medium-term fare products listed in Table 17.2.1, which reflects CTDOT's fare policies and prices as of September, 2013 and anticipated future policies. CTDOT shall provide final short- and medium-term fare products and prices for implementation on the MVM no less than 30 days prior to commencement of Factory Acceptance Testing. **CTDOT 17-1**

Table 17.2.1: Short- and Medium-Term Fare Products

Type	Ticket Stock	Regular Fare	Youth Fare	Senior / Disabled Fare
Single Trip	Plain Paper	X	X	X
2-Hour Pass	Plain Paper	X		
10-Ride Ticket	Limited Use Smart Card	X	X	X
Day Pass	Plain Paper	X		
3-Day Pass	Limited Use Smart Card	X		
5-Day Pass	Limited Use Smart Card	X		
7-Day Pass	Limited Use Smart Card	X		

### 17.2.2 Long-Term Use Smart Card Transactions

The MVM shall, at minimum, support the smart card transactions listed in Table 17.2.2, which reflects CTDOT's fare policies and prices as of September, 2013 and other anticipated policies. CTDOT shall provide final smart card transaction types and prices for implementation on the MVM no less than 30 days prior to commencement of Factory Acceptance Testing. **CTDOT 17-2**



Table 17.2.2: Supported Long-Term Use Smart Card Transactions

Type	Regular Fare	Youth Fare	Senior / Disabled Fare
Sell New Long-Term Use Smart Card	X		
Add Stored Value	Per Menu Selections		
10-Ride Ticket	X	X	X
Day Pass	X		
3-Day Pass	X		
5-Day Pass	X		
7-Day Pass	X		
31-Day Pass	X		X
Express Zone 2 10-Ride Ticket	X		
Express Zone 3 10-Ride Ticket	X		
Express Zone 4 10-Ride Ticket	X		
Express Zone 5 10-Ride Ticket	X		
Express Zone 2 31-Day Pass	X		
Express Zone 3 31-Day Pass	X		
Express Zone 4 31-Day Pass	X		
Express Zone 5 31-Day Pass	X		
I-Bus Express 10-Ride Ticket	X		
I-Bus Express Day Pass	X		
I-Bus Express 31-Day Pass	X		

## 17.3 MVM Cabinet Construction

### 17.3.1 Equipment Enclosure

All MVM modules shall be enclosed in a sturdy cabinet that shall conform to the following specifications:

- A. The overall dimensions of an installed MVM shall not exceed 80 inches high, 36 inches wide, and 25 inches deep. (Depth limitations exclude exterior light fixture housing and bill slot rain shield.)
- B. The exterior of the MVM shall be unpainted stainless steel, and shall be finished with a random orbital pattern or other CTDOT-approved finish. Contractor shall submit a sample of the finished stainless steel of the MVM cabinet for the CTDOT's review and approval prior to or as part of the Preliminary Design Review. **CDRL 17-2** This sample shall clearly indicate the gauge or thickness of the material, and specify the grade of stainless steel.
- C. The MVM cabinet shall be sufficiently robust to withstand long-term use by the public. When properly installed according to the Contractor's installation procedures, the MVM cabinet shall withstand, without permanent deformation, a force of 400 pounds applied horizontally in any direction at the top of the machine cabinet. The open MVM door shall be able to withstand a concentrated vertical force of 250 pounds applied at the extreme



open edge of the door without causing damage or deformation of any part of the door or MVM cabinet.

- D. All internal carbon steel framing and equipment supports shall be protected with plating or paint. Interior surfaces of stainless steel need not be painted.
- E. The design of the MVMs shall permit installation as stand-alone units, side-by-side units (accommodating installation with 12 inches or less between cabinets), back-to-back units (with units abutted to each other), and in recessed areas.
- F. Any external accouterments (such as button panels, rain shields, and light fixtures) shall be robust and vandal-resistant.
- G. Access to the equipment shall be provided by a hinged front door having a minimum of 110 degrees of opening and be equipped with a latch to hold the door at approximately 90 and 110 degrees of opening while servicing. When closed, the door shall seat in a manner that prevents insertion of a pry bar or other burglary tools to force open the door.
- H. The door hinges and/or pivoting mechanism shall be tamperproof and adjustable to allow for proper alignment of the door and locking devices, to prevent any wear or binding between the enclosure and the door when opening or closing the door. All hinge and latch hardware and metal surfaces subject to sliding contact shall be stainless steel.
- I. The MVM access door shall be locked with at least a three-point latching device with a bascule bolt and hook bar, or equivalent construction.
- J. The MVM interior shall be illuminated by a service lamp that shall operate by a manual switch and only while the outer door is open. The interior fixture shall use a standard, commercially-available compact fluorescent light bulb and provide sufficient illumination for service activities.
- K. With the outer door latched, it shall not be possible to view any internal components or insert any foreign objects into the cabinet through the gaps between door and cabinet.
- L. If an internal heater is required to maintain sufficient internal cabinet temperatures for reliable MVM operation, the heater shall be thermostatically controlled. The heater shall incorporate a fan to distribute evenly heat throughout the cabinet, and the thermostat shall be adjustable and clearly marked to indicate proper operating position. It shall be possible to operate the fan independently of the heating elements to facilitate cooling during warm weather. With the heater operating at full power, peak MVM operating current demands shall be within the limits.
- M. If a cooling system is required to maintain internal cabinet temperatures for reliable MVM operation, the cooling system shall be thermostatically controlled. Any air filters necessary to maintain proper operation of the cooling equipment shall be easily replaceable disposable type filter sized for replacement no more frequently than annually. Any condensate resulting from cooling shall drain to the exterior of the MVM. With the cooling system operating at full power, peak MVM operating current demands shall be within the limits defined in these specifications. If a cooling system is required, the Contractor shall submit a detailed description of the cooling system design for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 17-3**
- N. The top of the MVM shall slope at least five degrees downward and to the rear of the MVM to prevent any accumulation of precipitation.



Conceptual plan and elevation drawings of MVM showing outer door open and closed, and drawings of MVM interior showing all module locations, including those mounted to inside of exterior door, shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-4**

The Contractor shall present drawings showing MVM modules in service positions, indicating servicing and maintenance clearances, for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-5**

### **17.3.2 Mounting Pedestal**

The cabinet shall have a mounting pedestal constructed of Grade 316 stainless steel, which shall accommodate variations in the concrete base at the station platform. As delivered, pedestals for all MVMs shall be sized to position the highest operable patron control at 48 inches above the finished platform.

At CTDOT's option, the Contractor shall provide one or more pedestals to position the highest operable patron control at 54 inches above the finished platform. Pedestals shall be interchangeable between MVMs; CTDOT shall be able to exchange pedestals between standard and optional heights without having to modify the remainder of the MVM cabinet.

The Contractor shall submit the design of the standard and optional pedestals for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-6**

### **17.3.3 Exterior Light Fixture**

The MVM shall be equipped with an exterior light fixture to achieve the following:

- A. Illuminate the front face of the MVM.
- B. Consume less than 15 watts and use nominally white Light Emitting Diode (LED) lighting.
- C. Protrude no more than four inches from the front face of the MVM and not create a bumping hazard.
- D. Be weatherproof.
- E. Be fully operable in the complete range of temperatures specified.
- F. Under all ambient lighting conditions, provide a level of lighting sufficient to allow patrons to read easily all instructions and other items on the front of the MVM without the need for any additional peripheral light source. Lighting intensity shall be suitable for vision-impaired patrons under the most adverse lighting conditions.
- G. Meet the vandal-resistant strength requirements. The material, thickness, and finish of the fixture enclosure shall be the same as those for the MVM housing.
- H. Keep dirt, moisture, and insects out.
- I. Contain a commercially available lamp or lamps and circuits, and be constructed to allow easy replacement of the lamp with access obtained by use of a key.
- J. Provide an ambient light sensor to automatically turn on the light fixture when ambient light conditions on the reading surface of the MVM fall below 25 foot-candles. A bypass switch inside the enclosure shall permit the light fixture to be switched on and off manually.





#### 17.3.4 Security

The design of the Multi-Function Vending Machine shall:

- Discourage and minimize the effects of vandalism and theft
- Prevent unauthorized access to the interior of the MVM
- Prevent unauthorized removal of the equipment from its installed location
- Provide controlled levels of access to the interior of the equipment for maintenance personnel, revenue servicing personnel, and money processing personnel at CTDOT's revenue-counting facility
- Provide without undue delay, access to the equipment by authorized personnel equipped with proper keys and individual access code(s)

#### 17.3.5 Protection against Vandalism and Burglary

For protecting against vandalism and burglary for each MVM, the following requirements shall be met:

- All latches shall be secure and robust.
- All external screws shall be tamperproof.
- All fasteners used to secure equipment shall be concealed and tamperproof.
- All hinges for the front door and external access panels shall be concealed.
- Security locks with profile catches shall be used. All security locks shall capture and hold the key whenever the lock is open.
- Locks and keepers shall be drill-resistant stainless steel, and be mounted flush with the outside surface of the access door.
- The cabinet designs shall hinder any use of burglary tools.
- All gaps between doors/access panels and the cabinet shall be consistent along each edge and shall not exceed 0.05 inches when the door/access panel is latched.
- Reinforcement shall be provided at the positions where there is the possibility of burglary.
- Each MVM shall be equipped with an alarm system for indicating unauthorized intrusion, burglaries, and faults.
- While the outer doors are secured, the MVM shall remain operational and undamaged after experiencing a kick, punch, or other impact resulting in a concentrated load of 400 pounds to one square inch to any part of the enclosure.

The Contractor shall submit conceptual security provisions, including lock(s) and door latching schemes for the MVM, for CTDOT review and approval at the Preliminary Design Review.

**CDRL 17-7**



## 17.4 MVM Locks and Access Control

### 17.4.1 MVM Keys and Locks

All MVMs shall have controlled key locks to implement no less than three levels of security as outlined in the following table:

Table 17.4.1: MVM Keys and Locks

Type of Access	Personnel Allowed Access
Equipment Access, Front Door	A, B
Equipment Access, Pedestal (if separate)	A
Exterior Light Fixture Enclosure (if separate)	A
Bill Vault, Replacement	B
Recirculating Coin Tube, Replacement	B
Coin Vault, Replacement	B
Supplemental Change Supply Module, Replacement	B
Alarm Disable Key (if applicable)	A, B
Recirculating Coin Tube, Opening	C
Coin Vault, Opening	C
Supplemental Change Supply Module, Opening	C
Bill Vault, Opening	C
Key: A = Maintenance Crew and Administrative Personnel B = Revenue Service Crew C = Money Processing Crew at Revenue Facility	

The outer door lock shall utilize an electronic high-security lock such as Cyber® Lock or CTDOT-approved equivalent.

The keyways for all high security keys shall be registered to CTDOT, and replacements shall be available only to CTDOT-authorized personnel directly from the lock manufacturer, or their authorized representative. Excluding Cyber® Lock keys (or equivalent), the Contractor shall provide ten sets of keys (A, B, & C, each uniquely numbered). These keys shall be securely shipped under separate cover directly to CTDOT'S Director of Finance. **CDRL 17-8**

Sensors shall detect the status of the outer door lock; the MVM door shall be considered open or unsecured whenever the outer door lock is not in the fully locked position. For the MVM door to be considered closed and secure, the door shall be fully closed and the outer door lock fully engaged in its locked position.

To avoid excessive strain on the lock and key, a device other than the key shall actuate the front door latching mechanism.

### 17.4.2 Access to MVM Interior

Access to the interior of the MVM for maintenance and servicing shall be by opening the front door with a key and strain-relief device described in 17.4.1. Under normal operating circumstances, the MVM shall require the following steps for an individual to gain access to the interior of an MVM for either servicing or maintenance. If the proper access method is not followed, the intrusion alarm shall be activated and the MVM shall notify the CDS of a security breach.



1. Proper opening of the front door of the MVM.
2. Within a prescribed time period (adjustable by CTDOT and initially set to 30 seconds), the individual must enter his or her individual code on the service keypad inside the MVM. The MVM shall allow a maximum of three attempts to enter a proper individual code; failure to enter a valid code within the time limit or three successive failed attempts shall be considered an intrusion. A display or other indication visible from the inside of the MVM shall indicate valid or invalid input.

The MVM shall relate the individual's identification code to an internally recorded name or employee number. Audit and maintenance receipts printed by the MVM shall never include sufficient printed information to allow unauthorized access or another employee's identity to be used to gain entry.

If the MVM includes other external access panels, opening the panel shall require that the MVM front door is opened first and all proper entry procedures are followed before the access panel may be opened. If the external access panel is opened without proper front door access authorization, the intrusion alarm shall be activated, and the MVM shall notify the CDS of a security breach.

Other access methods may be proposed by the Contractor prior to or as part of the Preliminary Design Review, and are subject to review and approval by the CTDOT. **CDRL 17-9**

#### **17.4.3 Internal Access Restrictions**

The MVM shall be programmed with individual codes and corresponding security codes, which shall restrict the actions available to the individual based on his or her authorized activities. A database of security codes, personnel codes, and maintenance and servicing functions shall be provided at the CDS and downloaded into each MVM. CTDOT shall have full access to modifying this database. A detailed description of the MVM access method, security codes, restrictions per security code, and security code database content and modification procedures shall be provided for Contracting Officer review and approval as part of the Preliminary Design Review. **CDRL 17-10**

Security codes and personnel codes shall contain a minimum of four and a maximum of twelve alphanumeric or numeric characters.

Personnel codes shall be assigned to one or more of three distinct categories for access permissions. Each function shall be individually assignable to any category. Activities permitted to each of these categories by default are defined in Table 17.4.3 below. Additional activities and functions shall be defined as necessary by the Contractor for CTDOT review and approval at the Preliminary and Final Design Reviews. **CDRL 17-11**

The arrangement of modular mechanical and electrical components and money containers shall be such that normal maintenance, including replacement of defective modules, shall neither require removal of nor provide access into the coin and bill storage containers.

Maintenance personnel shall not be permitted access to monies. Only personnel assigned revenue service permissions shall be permitted to handle (*i.e.*, remove and install) devices that store money. Vaults and other money storage devices (coin hoppers, bill cassettes, recirculating coin tubes) shall be capable of being opened by money processing crews only.

Removal of a cash storage device by any person not so authorized shall activate the local siren and result in a revenue security alarm being recorded by the MVM and transmitted to the CDS.



Table 17.4.3: Default Access Permissions by Personnel Category

Personnel Category	Permitted Functions
Maintenance	<ul style="list-style-type: none"> <li>- Open outer door</li> <li>- Diagnose modules</li> <li>- Print and review MVM status, events, and diagnostics data</li> <li>- Exchange modules (excluding cash storage modules)</li> <li>- Set date/time clock</li> <li>- Replenish ticket and receipt stock</li> <li>- Place recovered jammed money in coin or bill vault</li> </ul>
Revenue	<ul style="list-style-type: none"> <li>- Open outer door</li> <li>- Diagnose modules</li> <li>- Print and review revenue status, sales history, MVM status, events, and diagnostics data</li> <li>- Exchange coin/bill vaults and cash storage modules</li> <li>- Set date/time clock</li> <li>- Replenish ticket and receipt stock</li> <li>- Replenish recirculating coin supply (to clear Exact Fare Only mode)</li> <li>- Place recovered jammed money in coin or bill vault</li> </ul>
Administrative	<ul style="list-style-type: none"> <li>- Open outer door</li> <li>- Diagnose modules</li> <li>- Print and review revenue status, sales history, MVM status, events, and diagnostics data, cash storage module contents</li> <li>- Set date/time clock</li> <li>- Place recovered jammed money in coin or bill vault</li> <li>- Alter MVM configuration and operating parameters</li> <li>- Alter or load fare table</li> <li>- Alter personnel security code database</li> </ul>

## 17.5 Patron Interface

### 17.5.1 General Patron Interface Requirements

The MVM shall provide patron interface through a variety of devices, each of which shall be designed to satisfy its intended purpose in an ergonomic and safe manner. Together, the elements of the MVM patron interface shall provide patrons with an easy-to-use MVM that satisfies all functional and performance requirements stated herein.

It shall be possible for the patron to change any transaction selection up to the moment when the first coin or bill is deposited, when a smart card is presented with sufficient stored value to complete the purchase, or when a bank card has been inserted. Once payment media has been inserted, it shall no longer be possible for new patron selections to be made until the current transaction has been completed or canceled.

The MVM shall automatically detect what form of payment the patron has inserted. Patrons shall not have to declare whether the transaction will be by cash (coin or bill), smart card stored value, or a bank card. However, payment types shall be mutually exclusive; that is, each transaction shall only be by cash, stored value, or bank card. Once cash is inserted into the MVM, the card readers shall be disabled. Once a card is inserted into the bank card reader, the coin and bill slots shall close and the contactless bank reader shall be deactivated. Attempts at



simultaneous payment by more than one payment method shall result in the transaction being automatically canceled.

It shall be possible to deposit coins and bills in any sequence. Deposited coins and bills shall be verified for denomination and validity. If all verification conditions are not fulfilled, each unverified coin or bill shall be rejected and returned.

The MVM shall also include a module or modules to accept bank cards (credit and debit). These modules shall include a "push-pull" card reader that does not capture the patron's card, a contactless bank card reader, and an encrypting keypad for the entry of Personal Identification Numbers and ZIP codes. A contact smart card interface to accommodate EMV and process EMV certified cards shall be incorporated into the bank card reader.

A contactless smart card interface shall also be provided to read and encode existing CTDOT smart cards.

The patron interface with the MVM shall be at the front of the machine. All patron interface openings shall be designed to prevent unauthorized access to the MVM interior.

A conceptual description of the function, configuration, and arrangement of all devices on the front panel shall be submitted to the CTDOT for its review and approval as part of the Preliminary Design Review. **CDRL 17-12**

#### **17.5.2 Patron Selection Controls**

The MVM shall utilize one of two methods of patron selection controls:

1. The MVM shall provide buttons adjacent to the Patron Display that shall be variably defined as transactions progress. This interface is hereafter referred to as "variable buttons."
2. The patron display shall incorporate a touch sensitive surface to allow clearly delimited regions of the display to perform variably-defined functions as transactions progress. This interface is hereafter referred to as "touch screen."

Using the MVM's selection interface, patrons shall be able to select any available transaction type; the MVM shall present patrons only those selections that are currently available according to operating status, ticket stock availability, and so on.

Whenever pressing a selection button or touch screen region would result in commencing payment, each label corresponding to a variable button or touch screen region shall include the type of transaction or ticket being purchased and the price of a single (or default) purchase.



#### 17.5.2.1 **Required Pre-Defined Buttons**

Regardless of the method of patron selection controls employed, certain functions shall be implemented in pre-defined pushbuttons that are always functional while the MVM is operating:

1. One VOICE message pushbutton which, when depressed, shall cause message(s) to be announced to the patron in the currently selected language.
2. One CANCEL pushbutton which, if activated before fare payment has been completed or before completing a smart card encoding transaction, shall cancel transaction according to the procedures defined.

#### 17.5.2.2 **Push Button Requirements**

Pushbuttons used for the “variable button” interface, and the required pre-defined buttons, shall be provided for patrons to choose their transaction, cancel a transaction, and perform other operations as necessary. The pushbuttons shall:

- Be made of stainless steel or hardened aluminum or other material approved by the CM
- Have a flat front surface of approximately 1 square inch to provide proper finger contact
- Not rotate
- Provide an audible tone upon being depressed
- Provide less than 8 ounces of resistance to depressing
- Protrude no more than 0.25 inches from the face of the front panel
- Be protected against vandalism, including impact resistance from pounding, such as by a person’s foot or fist
- Be liquid-proof to provide sealed contacts for all switches
- Not be removable from the outside
- Be easily replaceable from the inside
- Be spaced to accommodate labeling directly adjacent to each button (such labeling shall be in conformance with ADA requirements)
- Be non-fading
- Comply with paragraph 707.6.3 of the Americans with Disabilities Act Accessibility Guidelines, version 2004. For example, the CANCEL button shall have a raised letter “X” tactile symbol.
- Function properly with the same amount of applied force irrespective of where the force is applied on the front surface of the button

#### 17.5.2.3 **Variable Button Interface**

If the MVM employs a variable button interface, in addition to the buttons, patron-operated controls shall provide for the following inputs:

- A minimum total of 10 fare selection buttons shall be provided on both sides of the display screen, arranged similarly to standard Automatic Teller Machines, and with an equal number of selection buttons on each side of the screen. (There shall be a minimum of 5 buttons per side of the Patron Display.) The dynamically-defined menus that can be constructed shall be at least three layers deep, and shall provide at least 256 entries in each fare table (current and future).
- One LANGUAGE pushbutton, which shall alternately toggle the displayed messages (and voice messages, if activated) between English, Spanish, and at least two other languages. This function may be provided by a pre-defined button or incorporated as a variably defined button selection.



When the same function appears in several screens, the use of the variable buttons shall be consistent between menu screens.

#### 17.5.2.4 *Touch Screen Interface*

If the MVM employs a touch screen interface, patron-operated controls shall provide for the following inputs:

- A. The touch screen shall provide for no less than 12 clearly delimited regions from which selections can be made. Each region shall be no less than 2 square inches. Suitable spacing between regions shall be provided to limit accidentally erroneous selections.
- B. The dynamically defined menus that can be constructed using these touch regions shall be capable of supporting the functions required, including a minimum of 256 entries in each fare table (current and future).
- C. At least three touch regions shall be dedicated to selecting the language of displayed messages (and voice messages, if activated) between English, Spanish, and two other languages. These regions shall be active throughout the transaction process.
- D. One region shall be dedicated to the CANCEL function, duplicating the function of the pre-defined CANCEL push button. This region shall be active whenever cancellation of the transaction is possible.
- E. When the same function appears in several screens, selection regions shall be consistently placed on the screen.
- F. A separate keypad shall be provided to assist the visually impaired in operating the MVM. This keypad shall be laid out as a telephone keypad and shall be fully ADA compliant. This keypad shall also function as the Personal Identification Number entry keypad when using bank cards.
- G. The technology used to detect patron selections shall be resistant to scratches and other normal wear. No coatings or other materials applied to the outer surface of the display's protective shield shall be required to detect the patron's selection.
- H. The sensitivity of the touch screen shall be unaffected by precipitation, temperature, sunlight, and other environmental conditions typical of the CTDOT operating region.
- I. The touch screen shall accommodate patrons wearing gloves and using prosthetic devices.
- J. When the MVM is equipped with a standard-height pedestal, the entire region used for touch selections shall be within the ADA height restrictions for selection buttons.
- K. The display screen shall be angled at least 15 degrees from vertical to permit ease of use by standing patrons as well as those seated in wheelchairs.

If employed, the touch screen interface technology, size, and orientation on the MVM front panel shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 17-13**



### 17.5.3 Patron Display Screen

A color, trans-reflective back-lighted Liquid Crystal Display (LCD) screen bearing simple, basic instructions shall sequentially instruct the patron as to what to do to perform any transaction available from the MVM. The display screen shall:

- Provide resolution of no less than 1024 by 768 pixels, and shall generally use dark characters on a light background.
- Utilize Light Emitting Diodes for backlighting.
- Be capable of displaying at least 256 distinct colors.
- Measure at least 15 inches diagonally.
- Display characters and symbols compliant with ADA requirements.
- Be of industrial or military grade.
- Have a maximum operating temperature rating of at least 50 °C.
- Produce a minimum of 1,000 nits brightness with at least a 750:1 contrast ratio, and provide a level of visibility sufficient to allow all displayed instructions to be read easily by the patron under all ambient light conditions and without the need for any additional peripheral light source or shading device.
- Within the entire viewing area defined, all portions of the Patron Display screen shall be visible and not obstructed by any portion of the MVM outer door, mounting bezels, or other elements of the MVM.

The MVM shall include an ambient light sensor to adjust automatically the intensity of the Patron Display backlight. The extent to which the backlight intensity is reduced during low ambient light conditions shall be CTDOT adjustable.

The Contractor shall submit to the CTDOT for approval information on type of display and patron messages to be displayed. Conceptual designs of the Patron Display unit, messages, and shield shall be submitted for CTDOT review and approval as part of the Preliminary Design Review. **CDRL 17-14**

All text messages and information that varies according to ticket type that is displayed on the Patron Display, as well as those designating reduced functionality of the MVM which shall be displayed on the screen, shall be capable of being easily modified by CTDOT. All such messages shall be configured on the CDS and shall be downloaded to the MVMs via the network or shall be transferable to the MVMs via a Solid State Memory Module (SSMM) or other removable storage media. The procedures to modify Patron Display message content and format shall be presented for review and approval at the Preliminary Design Review. **CDRL 17-15**

### 17.5.4 Audible Tones

The MVM shall emit distinctive tones to provide audio feedback to the patron each time a valid button or touch screen region is pressed, and during circumstances where additional patron action is required (including at minimum while prompting the patron to retrieve coins, bills, or tickets from their respective return locations). The volume of the tones shall be field-adjustable locally for each MVM, and shall be audible in all station environments.





The Contractor shall identify all audible tones and provide digitally recorded samples of each for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 17-16**

#### **17.5.5 Multi-Lingual Capabilities**

The MVM shall include one or more selection buttons or touch screen regions to toggle the display and the voice message system between English and Spanish. The MVM display and voice message system shall support at least two additional languages.

The alternate language button(s) or touch screen region(s) shall be active at all times while the MVM is in service. Pressing an alternate language button or touch screen region at any time while the MVM is in the idle condition, and at any time during a transaction, shall cause the MVM to switch displayed and audio messages to the selected language.

While in idle mode, the MVM shall default to English displays and voice messages.

Whenever a transaction is completed or canceled, the MVM shall return to English. Pressing the CANCEL button while the MVM is displaying the idle screen shall cause the MVM shall return to English.

#### **17.5.6 Voice Instructions**

On demand of the patron, the MVM shall provide audible voice instructions and shall function to meet all ADA requirements. The voice system shall utilize human recorded speech or digitally synthesized speech. If digitally synthesized speech is used, it shall approximate human speech. No additional moving parts shall be required to play back the recorded information.

The MVM shall contain a vandal resistant speaker mounted inside the MVM, and its output shall be clearly audible from outside and in front of the MVM at all places within the viewing envelope defined.

The MVM shall also provide a standard jack for headphone use. Whenever headphones are plugged into the jack, the external speaker shall be disabled and all audible tones and all voice messages shall be directed to the headphone jack.

Messages shall be provided for the languages identified.

The system shall function as follows:

- A. A VOICE button shall be provided on the front of the MVM. The VOICE button shall provide for the following functions:
  - **Message On:** If the MVM is in the idle state when the VOICE button is pressed, a brief introductory instruction message shall be output in the currently selected language, followed by the appropriate message for the idle screen. If the MVM is not in the idle state (a transaction is in progress), the message for the current screen shall be output in the currently selected language.
  - **Change Volume:** Depressing the VOICE button when the voice message system is activated shall cause the volume to be increased. Pressing the VOICE button repeatedly shall cause the volume to increase until it reaches a maximum volume. A total of 4 increments in volume shall be provided. Alternatively, separate pushbuttons to increase and decrease volume may be used.
  - **Message Off:** Depressing the VOICE button when the volume is at maximum volume shall turn off the voice messaging system. Alternatively, if separate pushbuttons are used to change the volume, depressing the VOICE button while the voice message system is on shall toggle the voice messages off.



- B. Context-sensitive voice messages shall provide, in audio form, the information shown on the MVM patron display or conveyed by the MVM. Other messages, such as the return of an inserted bill, which may not be accompanied by a visual message on the MVM display, shall also be provided as required. Audio messages shall also be provided to indicate the value remaining to be deposited for purchase of the selected ticket(s). Each variable message shall occur as close as possible to the event or change in transaction status as possible and be as brief as possible to convey the necessary information. Content of all voice messages shall be subject to CTDOT review and approval at the Final Design Review. **CDRL 17-17**
- C. If the variable button interface is employed, voice messages shall direct patrons to press associated buttons by their assigned numbers or symbols to make selections. If the touch screen interface is employed, voice messages shall direct patrons to press associated buttons on the separate telephone-style keypad to make selections.
- D. The intra-transaction time-out counter shall begin decrementing at the completion of the voice message for each step of the transaction.
- E. Upon cancellation of a transaction in progress, a "Transaction Canceled" message shall be played and the voice message system shall toggle to off. The next activation of the VOICE button shall cause the message associated with the then-current step of the transaction to be played in the currently selected language.
- F. When a transaction is completed and the MVM returns to the idle state, the voice message system shall toggle to off. The next activation of the VOICE button shall cause the message associated with the then-current step of the transaction to be played in the currently selected language.
- G. Pressing the CANCEL button while the MVM is displaying the idle screen shall cause the voice message system to toggle to off.
- H. A conceptual description of voice messaging system hardware and operation shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-18**

### 17.5.7 Instructional Graphics

Instructions shall be contained on the front panel of the MVM to clearly indicate each step a patron must follow to choose and purchase a ticket or tickets and perform smart card transactions. The sequence of steps shall be clearly indicated by the use of graphics and symbols.

Instructions and graphics shall be designed to minimize glare and other effects of sunlight and ambient lighting that could otherwise reduce the readability of the instructions on the MVM.

The following features shall be provided:

- Raised lettering and Braille instructions shall be in conformance with ADA requirements.
- If the MVM employs a variable button interface, the buttons shall be labeled with capital letters, (e.g., "A" through "J").

Instructional graphics shall include pictograms that clearly depict proper insertion orientation of bills and bank cards into their respective slots.

All instructions, Braille, and graphics directly applied to the front face of the MVM shall be presented in American English. Conceptual designs of the MVM instructions and related



graphics shall be submitted for CTDOT review and approval as part of the Preliminary Design Review. **CDRL 17-19**

#### **17.5.8 Coin Slot**

The coin entry slot shall be sized to limit the dimensions of inserted material to the largest coin accepted, the post-1978 dollar coin. To minimize jams, the coin slot shall also be sized to prevent the simultaneous insertion of two coins, especially two dimes.

The coin entry slot shall be robust and scratch resistant and be designed to withstand wear and abrasion for the life of the MVM.

The coin acceptor slot shall be equipped with a protective shutter to ensure that foreign matter cannot enter the unit while the MVM is not accepting coins.

#### **17.5.9 Bill Slots**

The bill entry slot shall be designed to guide the bills fed into the MVM and/or returned from the validation module without jamming. Rejected bills shall be securely gripped at the entry slot or a separate return slot if used.

The bill return slot shall be designed to present and securely grip bills returned from the bill escrow module.

The bill entry and return slots shall be robust and scratch resistant and be designed to withstand wear and abrasion for the life of the MVM.

A shutter or a similar feature to ensure that foreign matter cannot enter the MVM shall protect the bill entry slot while the MVM is not accepting bills.

The bill entry slot shall be protected with a rain shield. The rain shield shall not inhibit sight lines or the insertion or retrieval of bills. The bill entry slot rain shield shall be made of durable clear polycarbonate at least 0.25 inches thick, and shall be easily replaceable from inside the MVM only. The bill entry slot rain shield shall protect the top and both sides of the slot and protrude no more than 4 inches from the front surface of the MVM. The bill entry slot shield shall extend approximately 1 inch beyond the edge of the bill insertion slot/ramp. The design of the rain shield shall be subject to CTDOT approval at the Preliminary Design Review. **CDRL 17-20**

#### **17.5.10 Smart Card Reader**

The MVM shall incorporate an ISO/IEC 14443 contactless smart card reader, to be used exclusively for processing CTDOT-issued smart cards, and which shall meet the following requirements.

- A. The Smart Card Reader shall be clearly marked with a pictogram or other information, and shall be in a distinct location separate from the Bank Card Subsystem modules defined.
- B. The Smart Card Reader shall be identified with raised letter and Braille as defined.
- C. The Smart Card Reader module shall process CTDOT-issued smart cards (read only for Long-Term Use Cards, and read/write for Limited Use Smart Cards), and shall be capable of reading ISO IEC 14443-compliant cards from other sources.



### 17.5.11 Bank Card Subsystem Interfaces

MVMs shall be furnished with a bank card subsystem consisting of the following modules, located in close proximity to each other and with features and functions as follows:

#### 17.5.11.1 *Magnetic Stripe / Contact Bank Card Reader*

- A. The Bank Card Reader shall consist of a push/pull (insert/remove) card reader such that the bank card is not captured completely by MVM. The card slot shall be sealed so that no liquids introduced into the slot enter the interior of the MVM.
- B. Standard size cards (2.125" × 3.375" × .030" thick) shall be accepted and processed, with magnetic data stripes and EMV-compliant contact interfaces.
- C. The Bank Card Reader shall be capable of simultaneously reading ISO/IEC 7811 tracks 2 and 3.
- D. The Bank Card Reader shall be capable of reading contact smart cards that are compliant with ISO/IEC 7816 parts 1 through 3.
- E. The Bank Card Reader shall be certified compliant with relevant EMV standards in effect at the time of contract award, and shall be easily upgraded to be compliant with any updates to the EMV standards that are pending within 5 years after commencement of revenue service.
- F. The Bank Card Reader shall be fully compliant with the relevant PCI DSS standards in effect at the time of contract award, and shall be easily upgraded to be compliant with any updates to the PCI DSS standards that are pending within 5 years after commencement of revenue service.

#### 17.5.11.2 *Contactless Bank Card Reader*

- A. The Contactless Bank Card Reader antenna shall be flush mounted to the front of the MVM and be protected by a cover that is resistant to vandalism. This cover shall be subject to CTDOT approval at the Preliminary Design Review. **CDRL 17-21**
- B. The antenna shall be clearly marked with a pictogram or other information.
- C. The antenna shall be identified with raised letter and Braille as defined.
- D. The Contactless Bank Card Reader shall read EMV-compliant contactless bank cards and NFC-compatible devices operating EMV-compliant applications, such as Google<sup>®</sup> Wallet and Isis<sup>®</sup> Mobile Wallet.
- E. The Contactless Bank Card Reader shall be certified compliant with relevant EMV standards in effect at the time of contract award, and shall be easily upgraded to be compliant with any updates to the EMV standards that are pending within 5 years after commencement of revenue service.
- F. The Contactless Bank Card Reader shall be fully compliant with the relevant PCI DSS standards in effect at the time of contract award, and shall be easily upgraded to be compliant with any updates to the PCI DSS standards that are pending within 5 years after commencement of revenue service.

#### 17.5.11.3 *Bank Card Personal Identification Number (PIN) Keypad*

- A. Each MVM shall include a secure keypad for PIN entry when debit cards are used, and whenever EMV transaction procedures so dictate. The PIN keypad shall also be used to enter ZIP codes to satisfy address verification requirements.



- B. The PIN keypad shall be distinct from the selection pushbuttons, and shall be mounted adjacent to the bank card reader. The PIN keypad shall be made of steel, resist vandalism, and shall be suitable for outdoor installation. The layout of the keys shall be similar to those of touchtone telephones, and the central "5" key shall have a raised dot or other identifying tactile feature to aid the visually impaired, in compliance with the Americans with Disabilities Act. The PIN keypad shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 17-22**
- C. The PIN keypad shall be capable of operating in both an encrypting and non-encrypting or "clear" mode so that it can be used for data entry and patron selection by the visually impaired.
- D. In concert with the voice messaging system:
  - Patrons shall be directed to press a button on the PIN keypad that is associated with each selection button or touch screen region. Where possible, selection buttons or regions shall be consistent with the keys on the PIN keypad.
  - When bank cards are used to add value to smart cards, the PIN keypad shall be used to enter the transaction amount. Alternatively, using the variable buttons or touch screen regions, the patron may be provided a menu of transaction values from which to select. These values shall be settable and changeable by CTDOT without Contractor assistance.
  - While voice messaging is active, entry of encrypted data (i.e., a patron's PIN) shall result in only an audio tone to be played as each key is pressed.
- E. The PIN keypad shall be certified compliant with relevant EMV standards in effect at the time of contract award, and shall be easily upgraded to be compliant with any updates to the EMV standards that are pending within 5 years after commencement of revenue service.
- F. The PIN keypad shall be fully compliant with the relevant PCI DSS standards in effect at the time of contract award, and shall be easily upgraded to be compliant with any updates to the PCI DSS standards that are pending within 5 years after commencement of revenue service.
- G. The PIN keypad shall employ encryption as required in accordance with banking requirements. The Contractor shall supply all PIN keypads with production encryption keys injected in a secure, PCI DSS-compliant manner.

#### **17.5.12 Ticket/Coin Return Bin**

The opening for the Ticket/Coin Return Bin shall be recessed and covered with a clear polycarbonate spring-loaded or weighted door that opens inward, and which does not present a pinching hazard when opened and closed by patrons. The door shall be at least 0.25 inches thick and completely cover the opening when closed. The bin and its door shall be robust, scratch-resistant, and visually prominent. The geometry of the bin and its door shall minimize intrusion into the machine while the Ticket/Coin Return Bin door is open. The bin shall be designed to drain any liquids placed in the bin to the outside of the MVM. The preferred minimum height of the centerline of the Ticket/Coin Return Bin is at least 24 inches from the finished floor.

As soon as a patron has completed payment for a transaction, or a transaction is canceled, and which results in coins or tickets being deposited in the Ticket/Coin Return Bin, a light in the Ticket/Coin Return Bin shall begin flashing. The Ticket/Coin Return Bin light shall continue



flashing for five seconds after all tickets and coins have been deposited there by the MVM, or until the inter-transaction time-out expires, whichever is longer.

#### **17.5.13 In Service/Out of Service Indicator**

Under normal operations, the displays shall indicate that the MVM is functional and is in service by instructing the patron to make a selection. Limited operation of the MVM in the event of a component failure, or when possible, complete loss of operation, shall be indicated on the Patron Display. If the MVM is taken out of service by disconnection, loss of power, or by failure of the internal power supply or modules, a blank Patron Display or some other visible means shall indicate that the MVM is inoperative.

#### **17.5.14 Information Signage Holder**

An information signage holder shall be provided for the front of the MVM to allow suitable printed information explaining the operation of the MVM and fares, CTDOT information, and service announcements or newsletters. The information signage holder shall be glazed with a polycarbonate panel, which shall be provided with a weather seal and suitably vented to prevent condensation. Information signage size, type, and characteristics shall be determined at the Preliminary Design Review, and shall in general utilize the maximum space available on the front of the MVM. **CDRL 17-23**

The information signage holder shall be accessible from inside the MVM, and shall be secured to the front of the MVM from within.

CTDOT shall be responsible for the design and production of the signage to be placed in the information signage holder. Completed information signage shall be provided by the CTDOT at least 30 days prior to MVM shipment, and shall be installed by the Contractor prior to shipping MVMs. **CTDOT 17-3**

### **17.6 Service Interface**

Inside the MVM, located within easy reach and viewing while the outer door is open, shall be a keypad and display for use by maintenance and revenue service personnel. (The Patron Display may be used for maintenance purposes.)

The service keypad shall be used to enter access codes and maintenance commands; all routine service interaction with the MVM shall be via this keypad.

The service display shall be used to indicate MVM error codes, and shall have the capability of displaying multiple error codes, such that one error code shall not need to be cleared to display other error codes.

The conceptual design of the service keyboard and display, and a preliminary listing of service commands, error displays, diagnostic messages, etc. that are available with the service interface shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-24**

### **17.7 Coin Processing Unit**

The MVMs shall accept, dispense for change, and store the following U.S. coins: nickels, dimes, quarters, and post-1978 dollar coins. The Coin Processing Unit shall also be capable (without hardware modification) of accepting a future token, and be capable of accepting at least one other denomination of coins for future use.



Each MVM shall be equipped with a Coin Processing Unit consisting of the following coin handling modules: a coin acceptor/verifier, coin recirculating system, a coin vault, and a chassis and its associated wiring and electronic devices. Each coin storage module (*i.e.*, recirculating module, vault) shall be key-locked into the MVM and shall be removable from the MVM without tools. Any module containing coins shall remain secure when removed from the MVM; access to money stored in such modules shall be granted only with keys available in the cash counting facility as defined.

The Coin Processing Unit shall automatically switch to an out-of-service condition if any one coin processing module is not installed or not operating properly.

The Coin Processing Unit shall be electrically and mechanically constructed to fulfill the requirements of this specification. Complete performance and status information shall be available locally and remotely at the CDS.

Documentation describing design and operation of the coin processing system including verification, rejection, recirculation, change dispensing, and vaulting processes shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-25**

#### **17.7.1 Coin Acceptor/Verifier**

The coin acceptor/verifier shall include a coin insertion mechanism and a verifier to accept only the specified U.S. coins. The verifier shall reject and return to the Ticket/Coin Return Bin rejected, counterfeit, excessively bent, and foreign coins, as well as slugs, and other foreign objects. The coin acceptor/verifier shall be capable of accepting and discriminating at least six types and denominations of coins.

The coin acceptance and verification process shall take less than two seconds per deposited coin, measured from the instant the coin is inserted into the coin slot until the coin acceptor is ready to process another coin.

The coin insertion mechanism shall be designed so that liquids entering through the slot flow out of the MVM to avoid damage to the MVM and its components. The coin acceptor slot shutter shall remain closed until a transaction is selected. The shutter shall automatically open once a transaction has been selected and the fare has been displayed. The shutter shall close automatically whenever one of the following situations occurs:

- Fare amount due has been inserted into the MVM.
- Bank card is processed for payment before any cash is accepted.
- Cancel button has been pressed or the transaction is automatically canceled.
- Coin vault is full.
- Coin is jammed.
- MVM or Coin Processing Unit switches to an out-of-service condition.
- The patron changes transaction selection to a type not available due to stock depletion or other malfunction.
- The patron changes transaction selection to a type that cannot be purchased with cash.

The geometry of the coin path and other provisions of the coin acceptor shall prevent the retrieval of coins by fishing such as with wire or attached thread.

#### **17.7.2 Coin Acceptance/Rejection Criteria**

Coins shall be electronically verified based upon their metallic content. Coin verification shall be consistent and repeatable. The criteria for verifying coins shall be CTDOT-adjustable for each coin value.



Documentation describing adjustments, revisions, and calibration procedures for the coin processing system and the procedure for reconfiguring the Coin Processing Unit to accept other coins shall be submitted for CTDOT review and approval at the Preliminary Design Review.

**CDRL 17-26**

The Contractor shall furnish any equipment necessary to adjust the Coin Processing Unit and to reconfigure the Coin Processing Unit for other coins at the completion of the Factory Acceptance Testing as defined. **CDRL 17-27**

**17.7.2.1 Coin Acceptance Rate**

The coin acceptor/verifier shall meet the following acceptance rates:

- 98% of valid coins shall be accepted upon initial insertion.
- 99% of valid coins shall be accepted upon one reinsertion.
- All known counterfeit coins, common slugs, foreign coins, and coins of denominations not accepted by the MVM shall be rejected upon every insertion.

The acceptance rate (AR) is defined as follows:

$$AR = \frac{I - R}{I}$$

where: I = Total number of valid coin insertions  
R = Total number of valid coin rejections

**17.7.2.2 Coin Accuracy**

The coin acceptor/verifier shall identify valid acceptable coins with at least 99.99% accuracy. Accuracy (A) is defined as follows:

$$A = \frac{V - M}{V}$$

where: V = Total number of coins accepted  
M = Total number of incorrectly identified coins





### 17.7.3 Coin Recirculating System

The coin recirculating system shall include a minimum of five self-filling coin recirculating modules. A recirculating module shall be assigned to each of the accepted US coin types (nickel, dime, quarter, dollar). The fifth recirculating module shall be reserved for future use, or shall be configurable to supply additional recirculating capacity for a CTDOT-selected coin type. Each coin recirculating module shall have a capacity of at least 55 coins. Any future accepted coin types shall either be assigned to a future tube or shall be directed to the coin vault.

The coin recirculating system shall:

- A. Together with the supplemental change supply modules, provide correct change with the fewest number of coins when excess payment is made and change is available
- B. Return the value of the inserted coins if a transaction is canceled or aborted
- C. Provide self-replenishing (*i.e.*, recirculating) coin storage
- D. Deposit coins into the coin vault when the recirculating module for that particular coin is full, and when a coin type has no recirculating coin module assigned

The coin recirculating system shall be capable of recycling and returning all specified coin values for making change resulting from MVM transactions. The dispensing of all coins shall be monitored and verified by sensors.

If the cancel button is activated before completion of the transaction, or the transaction is otherwise aborted, coins equal to the value of inserted coins shall be returned to the Ticket/Coin Return Bin.

The MVM shall automatically detect the location of each recirculating coin module, continuously monitor the contents of each, and adjust its operation accordingly.

Coins jams shall be minimized under all operating conditions.

Coin recirculating modules shall provide for the safe deposit and secure storage of coins. At no time shall a removed recirculating module provide unauthorized access to coins. If a removed recirculating module would expose coins to unauthorized access, the design of the coin system shall require the module to be emptied into the coin vault prior to being removed from the MVM. The MVM shall record the value and denominations of any coins transferred to the coin vault; all necessary MVM data registers shall be updated to reflect the transferred coins and an audit ticket shall be automatically printed to reflect the quantity and denominations of coins transferred to the vault.

The MVM shall provide authorized revenue service personnel a distinct command to manually initiate the addition of coins to the coin recirculation system. With the MVM outer door open, it shall be possible to randomly insert coins into the coin validator, allowing the MVM to monitor the denominations of inserted coins. The coin recirculating system shall then deposit the coins into the appropriate recirculating modules. At the initiation of recirculating coin replenishment, an audit receipt shall be printed showing the number of coins in each tube; at the conclusion of replenishment, another audit receipt shall be printed showing the new quantities in each recirculating module and the total value of coins added. All necessary MVM data registers shall be updated to reflect the additional coins.

### 17.7.4 Coin Vault

Each MVM shall be equipped with a removable coin vault having a capacity of at least 300 cubic inches. The coin vault shall function as an end collection container for coins. Coins shall enter the coin vault through an opening in the coin vault. Using sensors or other means, the MVM



shall confirm the passage of all coins to the coin vault; failure to detect a coin being deposited into the coin vault shall be considered a jam and shall cause the MVM to cease accepting coins.

It shall not be possible to open the coin vault while it is installed in the MVM, nor shall it be possible to install an open or unlocked coin vault into the MVM.

When properly installed in the MVM, it shall be impossible to access coins in the coin vault without damaging the vault in an obvious manner.

The coin vault shall be designed and constructed as a safe box of sturdy construction, manufactured from hardened steel or steel alloy of similar strength or other CTDOT approved material, and shall withstand regular removal, replacement and normal handling without deformation or in any way interfering with the insertion and removal process.

When a full coin vault (containing no less than 250 cubic inches of mixed US coins) is dropped from a height of three feet onto a concrete floor on any corner or side, the vault shall remain fully operational, shall suffer no more than cosmetic damage, shall not open, nor shall its locking mechanism be impaired.

The coin vault shall have a handle or handles placed to avoid injury, which provides adequate gloved-hand clearance for easy insertion, removal and carrying. The maximum weight when full shall not exceed 40 pounds.

Provision shall be made to detect a full coin vault and a nearly full vault, which shall cause an event to be recorded and transmitted to the CDS. The determinations of full and nearly full conditions shall be independently software controllable and adjustable by CTDOT. The MVM shall cease to accept coins (*i.e.*, enter "No Coins Accepted" mode) when the coin vault becomes full, but change shall continue to be dispensed as necessary from the coin recirculating and supplemental change storage systems.

#### **17.7.5 Coin System Security Interlocks**

The recirculating coin modules and coin vault shall be locked into the MVM and shall be provided with security interlocks to restrict access to monies on a "need to gain access" basis. A security interlock in the MVM shall ensure that revenue shall leave the recirculating coin modules for transfer into the coin vault only when a bona fide coin vault is inserted fully in its operating position. The coin vault shall be installable in one unique position, and concealed, tamperproof sensors shall detect when a coin vault has been properly installed. The coin vault and storage units shall be locked into the MVM in such a manner that they do not interfere with maintenance of the coin acceptor mechanism.

The coin vault shall be self-locking and self-sealing, so that when it is removed from the MVM, it cannot be opened locally or re-inserted in an MVM without emptying the contents of the vault through authorized means. Access to coins shall not be possible at any time during maintenance or revenue transfer operations, but shall only be accessible by controlled-key lock.

Each coin vault and recirculating module shall have a visually and electronically readable component code and serial number. The MVM shall automatically read and verify as valid the component code and serial number of each inserted coin storage module. This information shall be made available both locally at the MVM and remotely at the CDS. The MVM shall read the electronically readable component code at a frequency fast enough to ensure that the component cannot be exchanged without the MVM detecting the removal of the unit. The electronically readable component code and serial number shall not require the connection or disconnection of cables when replacing the coin storage module.



Each component code and serial number shall also be provided on a securely attached but replaceable tag. This tag shall be made of etched or stamped metal or other CTDOT approved material, and shall be oriented upright and visually readable when the coin handling module is installed in the MVM.

If a coin storage module is removed or replaced while the MVM is out of service, when the MVM is restored to service, the MVM shall automatically adjust all appropriate money counters to reflect that a module has been exchanged or removed.

### **17.7.6 Change Dispensing**

The MVM shall dispense change using the fewest number of coins possible. When a coin required for change is available in both the recirculating coin system and a supplemental coin hopper, change shall be dispensed from the recirculating coin system first.

A series of programmable parameters shall allow the MVM to limit the amount of change dispensed in the event that surplus cash is deposited for the selected fare.

#### **17.7.6.1 Per-Denomination Change Limits**

For each denomination of coin issued as change, a separately programmable maximum quantity to be dispensed for any single transaction shall be provided. These parameters shall be adjustable by CTDOT at the CDS, and shall be initially set to:

- 20 nickels
- 10 dimes
- 12 quarters
- 19 dollar coins

As initially configured, no transaction shall result in more than 20 nickels, 10 dimes, 12 quarters, or 19 dollar coins being issued as change.

#### **17.7.6.2 Maximum Change Payout**

A separate adjustable parameter shall determine the maximum value of change that can be dispensed for any given transaction. (This value must be set so that it is not more than the sum of the denomination quantity limits, or less than the largest denomination of accepted bill, whichever is smaller.) The maximum change parameter shall be individually adjustable locally at each MVM and at the CDS. If a pending surplus payment would result in change that exceeds this value, the transaction shall be automatically canceled, an explanatory message shall be shown on the Patron Display, and all deposited monies returned. For example, if the maximum change parameter is set to \$8.00, and the transaction is for a \$2 fare, by inference, \$10 bills are permitted for this transaction. If the patron then inserts a \$1 bill followed by a \$10 bill, the MVM shall cancel the transaction and display a message such as "Maximum change value exceeded."



## **17.7.7 Exact Fare Only Mode**

### **17.7.7.1 Conditions for Exact Fare Only Mode**

The MVM shall enter "Exact Fare Only" mode under any of the following conditions:

- A. The coin recirculating system and the supplemental change storage system together have insufficient change to dispense the maximum amount of change as defined by the maximum change parameter and as limited by the per-denomination quantities defined.
- B. The coin recirculating system and the supplemental change storage system together have less than 19 nickels.

### **17.7.7.2 Exact Fare Overpayment Limit**

The MVM shall have a maximum overpayment limit as a parameter adjustable by CTDOT. This parameter shall limit the amount a patron could forfeit if a surplus payment is made while the MVM is in Exact Fare Only Mode, and which the MVM cannot supply as change. This parameter shall be individually adjustable for each MVM remotely via the CDS, and shall initially be set to \$1.00 for all MVMs. If a pending overpayment (a surplus payment for which the MVM cannot make change) exceeds this value, the transaction shall be automatically canceled, an explanatory message shall be shown on the Patron Display, and all deposited monies returned. Note that if this parameter is set to zero, all overpayments that would result in forfeiture of change shall result in canceled transactions.

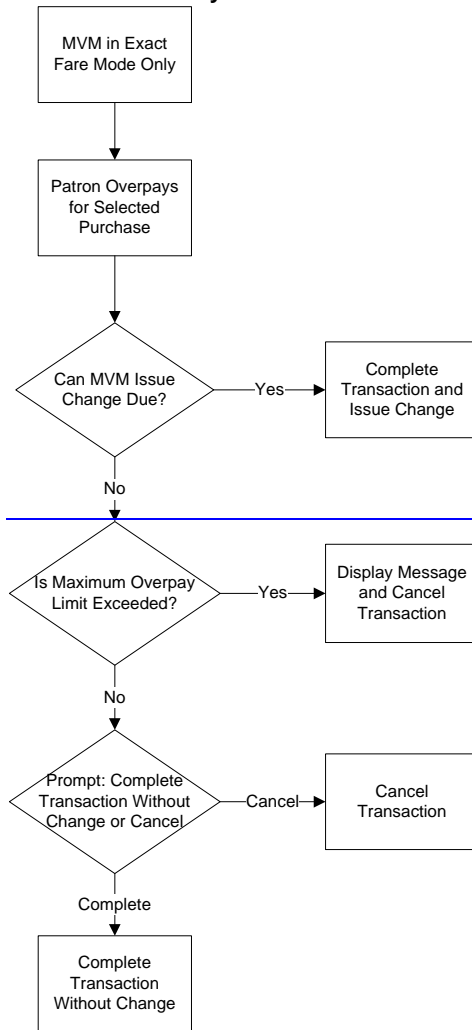
### **17.7.7.3 Exact Fare Only Mode Operations**

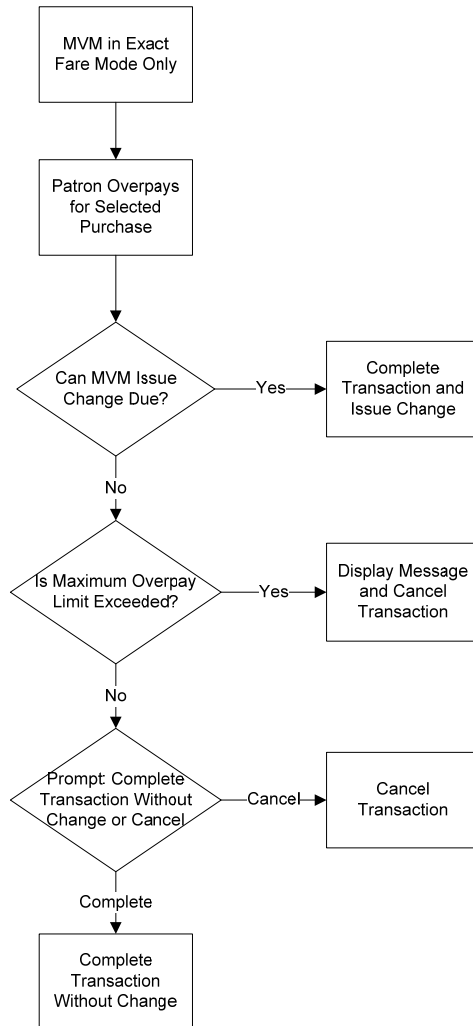
While in "Exact Fare Only" mode, the Coin Processing Unit shall continue to accept inserted coins. If sufficient coins are inserted to restore change-making capabilities, the MVM shall resume normal operations.

While in "Exact Fare Only" mode, the MVM shall always determine if correct change can be dispensed for a given surplus payment within the quantity limits defined. Whenever possible, correct change shall be dispensed, even if the MVM is in "Exact Fare Only" mode. While the MVM is in "Exact Fare Only" mode, transactions shall proceed according to the following chart:



Figure 17.7.7.3  
Exact Fare Only Mode Transactions





Field Code Changed

The supplemental change storage system need not be fully functional to avoid “Exact Fare Only” mode; if the coin recirculating system on its own has sufficient coin stock to make change (i.e., it can provide maximum change, and has at least 19 nickels), the MVM shall remain in normal operating mode.

### 17.7.8 Coin Jams

In the event a foreign object or coin, slug, bent coin, or a coin having a sticky substance on it becomes jammed inside the coin acceptor, a coin release mechanism shall cause the jammed coin(s) to be released into the Ticket/Coin Return Bin. While the MVM is in service, activation of



the cancel push button shall cause the coin release mechanism to activate (either directly via mechanical means or indirectly via electronic means).

When the coin system detects a jam in the coin acceptor, the coin release mechanism shall be automatically activated. At no time shall the coin entry slot open to accept an additional coin if another coin is already jammed in the coin system.

It shall be possible for maintenance and revenue service personnel to gain quick access to the jam to remove any jammed object if activation of the cancel push button does not clear the jam.

## 17.8 Supplemental Change Dispensing System

Multi-Function Vending Machines shall provide flexible change-making capabilities to address current and future fare structures. The ability of the MVM to dispense change shall not be limited to change that may be available from inserted coins. In addition to using coins inserted by patrons, the MVM shall include a supply of supplemental change that is replenished in bulk by CTDOT revenue service personnel.

The MVM shall be capable of dispensing supplemental change in at least three denominations of coins. As delivered, the MVM shall contain three separate supplemental change-dispensing modules, one each for nickels, quarters, and dollar coins.

The Supplemental Change Dispensing System shall issue change in response to commands from the Electronic Control Unit. Each change dispensing module (also referred herein as a "coin hopper") shall be able to sense that the correct change has been given to the patron and that no jam has occurred, and shall signal each action made to the Electronic Control Unit. The ECU shall retain a record of the value of monies dispensed.

The Supplemental Change Dispensing System shall function as follows:

- A. Coin hoppers shall be used as a supplemental stock of coins for automatic change making purposes, and shall operate independently of the recirculating coin system.
- B. The MVM shall use the supplemental coin hoppers as a source of change whenever doing so would result in fewer coins being returned as change, or if the recirculating coin system is unable to dispense proper change. However, for any given denomination of coin, coins in the recirculating tubes shall be used before those in a corresponding coin hopper.
- C. If an incorrect amount is dispensed or a jam occurs, the MVM Electronic Control Unit shall generate and store an appropriate event record, and the affected dispensing module shall be automatically shut down. If such a failure results in a patron being short-changed, the MVM shall make all necessary attempts to dispense correct change from other sources.
- D. Provisions shall be made to detect a repetitive cycle failure, which would dispense excess change, and to invoke a positive electrical shutdown to prevent a "jackpot."
- E. Because the supplemental change modules will be replenished in bulk by CTDOT revenue service personnel, the modules shall secure the change in sturdy containers equipped with high security locks. When removed from the MVM, the change storage containers shall remain secure and not allow insertion or removal of cash without proper, keyed access.
- F. The supplemental change storage containers shall be of sturdy construction, manufactured from stainless steel or other material approved by the CTDOT at the Preliminary Design Review, and shall withstand normal handling and regular removal



and replacement without deformation that would in any way interfere with the insertion and removal process. **CDRL 17-28**

- G. Rails, shelving, or tracks that guide the containers in and out of position shall also be constructed of stainless steel or other material approved by the CTDOT at the Preliminary Design Review. **CDRL 17-29**
- H. When dropped from a height of three feet on a concrete floor on any corner or side, a full supplemental change storage container shall retain its contents, shall not open, nor shall its locking mechanism be impaired or compromised.
- I. The supplemental change storage containers shall have a handle or handles placed to avoid injury, which provides adequate gloved-hand clearance for easy insertion, removal and carrying.
- J. Provision shall be made to detect when each supplemental change storage container is near-empty and empty, which shall cause an event to be recorded by the ECU and transmitted to the CDS. The determination of a nearly empty condition shall be software controllable and adjustable by CTDOT.
- K. Coins dispensed from the hoppers shall be deposited into the Ticket/Coin Return Bin.
- L. Each supplemental coin hopper shall have a capacity of at least 1,000 coins of any denomination chosen by CTDOT.
- M. When full, a supplemental coin hopper shall not exceed 40 pounds.
- N. The MVM shall automatically detect the presence or absence of each coin hopper and the type of coins contained in each unit; the MVM shall automatically adjust its operation accordingly. The MVM shall continue to function without a full complement of coin hoppers, and it shall not be necessary for all MVMs to be equipped with identical coin hopper configurations.

## 17.9 Bill Processing Unit

Each MVM shall be equipped with a Bill Processing Unit, which shall accept at least 30 different types of bills. The bill processing system shall accept documents inserted in any of the four possible length-wise orientations. The Bill Processing Unit shall be capable of accepting multiple varieties of \$1, \$2, \$5, \$10, \$20, \$50, and \$100.

The Bill Processing Unit shall include a bill validator, bill escrow module, bill vault, and a chassis and its associated wiring and electronic devices.

The Bill Processing Unit shall be a Mars Electronics Incorporated (MEI) model BNA 571-5 or CTDOT approved alternate.

The bill validator, bill escrow module, bill vault, and any other modules that store bills shall be electrically and mechanically constructed to fulfill the requirements of this specification. Complete performance and status information shall be available locally and remotely at the CDS.

Within an MVM, no Bill Processing Unit shall function unless all bill processing modules are properly installed and connected to the MVM. The Bill Processing Unit shall automatically switch to an out-of-service condition if any one bill processing module is not installed or operating properly.





### 17.9.1 Bill Validator

The bill validator shall accept one bill at a time and shall determine the denomination and validity of the document. If the document is acceptable, the bill validator shall forward it to the escrow module. If rejected, the document shall be returned and gripped so that the MVM retains a hold on it until the patron removes the document from the bill validator slot.

The bill validator shall be designed to reject or expel pieces of paper or other foreign material that can be introduced into the bill slot. A motorized conveyor shall pull the bill into the insertion slot once its leading edge is inserted in the slot. A mechanical blocking function shall be provided to prevent withdrawal of a bill after acceptance.

It shall be possible for maintenance and revenue service personnel to gain ready access to the bill path to clear jams.

The MVM shall be configurable by CTDOT to inhibit the acceptance of any denomination and insertion orientation; as delivered, the MVMs shall accept \$1, \$5, \$10, \$20, \$50 and \$100 bills. As the US Treasury releases new designs of bills, the Bill Processing Unit shall be capable of being programmed to accept the new designs while continuing to accept the current designs. The methods and procedures for adjusting the acceptance characteristics of the Bill Processing Unit shall be submitted as part of the Preliminary Design Review. **CDRL 17-30**

The MVM shall also be configurable by CTDOT to inhibit the acceptance of any document by transaction type. For example:

- High-denomination bills may be denied for single-ride ticket purchases. In such cases, whenever a valid bill is rejected due to transaction-specific criteria, the MVM shall not cancel the transaction, but present an explanatory message on the Patron Display, such as "Please use a smaller denomination." Note that this response is distinct from the maximum change payout message.

The bill slot shutter shall open or be activated once a transaction type has been selected and the MVM has displayed the fare. The shutter shall automatically close or be deactivated when one of the following situations occur:

- Fare amount due has been inserted into the MVM.
- Bank card is processed for payment before any cash is accepted.
- Cancel button has been pressed or the transaction is automatically canceled.
- Bill vault is full.
- Bill is jammed.
- Bill escrow is full.
- MVM or Bill Processing Unit switches to an out-of-service condition.
- The patron changes ticket selection to a type not available due to stock depletion or other malfunction.
- The patron changes transaction selection to a type that cannot be purchased with cash.

Except when bills are jammed, when the bill validator is removed from the MVM, it shall not be possible to retrieve or fish bills from the bill vault.

### 17.9.2 Bill Acceptance/Rejection Criteria

The bill validator shall determine the denomination and validity of both sides of a document by dimension checks and pattern and color recognition. The bill validator shall be able to detect counterfeit bills, including copies made in either single or double-sided printing on an electronic copier and those made with color printers.



Document verification shall be consistent and repeatable. The bill validator shall be adjustable to differences in bills in circulation due to bill production and printing variances. The bill validator shall be adaptable to reject fraudulent currency that may be introduced to circulation.

Valid bills to be accepted by the bill acceptor shall include currency in general circulation in the following conditions:

- New, old, and worn bills
- Bills that have been folded, then unfolded
- Bills that have been crumpled, then un-crumpled
- Bills of current and recent printing series in general circulation
- Clean and dirty bills
- Damp bills

The bill acceptor may reject bills with the following physical defects. Bills with these defects are not considered as valid for purposes of determining acceptance rate:

- Bills with torn corners with a side length exceeding 0.75 inch
- Bills with sticky substances, such as tape or food smears
- Bills with tears in them that exceed:
  - Longitudinally, one quarter of bill length
  - Transversely, one half of bill width
- Bill that are saturated or have been washed
- Bills with holes larger than 0.25 inch
- Bills with staples, or other items attached to the bill
- Bills with excessive pen, pencil, or marker lines

#### 17.9.2.1 **Bill Acceptance Rate**

The bill validator shall meet the following acceptance rates for bills:

- 95% of valid bills shall be accepted upon initial insertion.
- 97% of valid bills shall be accepted within two insertions.
- All known counterfeit bills, color photocopies of valid bills, duplicates made by other known means, foreign bills, and bills of denominations not accepted by the MVM shall be rejected upon every insertion.

The acceptance rate (AR) is defined as follows:

$$AR = \frac{I - R}{I}$$

where: I = Total number of valid bill insertions  
R = Total number of valid bill rejections



#### 17.9.2.2 **Bill Accuracy**

The bill validator shall identify valid acceptable bills with at least 99.999% accuracy. Accuracy (A) is defined as follows:

$$A = \frac{V - M}{V}$$

where: V = Total number of bills accepted  
M = Total number of incorrectly identified bills

#### 17.9.3 **Bill Escrow Module**

A bill escrow module shall be part of the Bill Processing Unit. Once the bills are verified and accepted, the bill acceptor shall forward the bills to the escrow module to put in reserve temporarily until completion or cancellation of the transaction. The escrow module shall have the capacity to store and return to the MVM patron as necessary a minimum of 15 bills in one stack. When the escrow is full or a CTDOT-adjustable limit of inserted bills per transaction is reached (whichever occurs first), the bill acceptor shall cease acceptance of bills.

In the event a transaction is canceled by the patron, is aborted by the MVM, or the MVM switches to an out-of-service condition, the exact same bills inserted for the transaction shall be returned through a return slot. The bill escrow return slot shall maintain a grip on the returned bills such that the bills do not fall or can be wind-blown from the MVM upon return.

When a transaction is completed, all bills in the escrow module shall be transported to and stored in the bill vault for retention.

#### 17.9.4 **Bill Vault**

The Bill Processing Unit shall be equipped with a removable bill vault. The bill processing system and the MVM shall support two varieties of bill vaults. The low-capacity bill vault shall have a minimum capacity of 1,000 stacked bills in street condition. The high-capacity bill vault shall have a minimum capacity of 2,000 stacked bills in street condition. All MVMs and bill processing systems shall readily accept either type of vault. As delivered, all MVMs shall be equipped with high-capacity bill vaults, which shall be Mars Electronics Incorporated model BNA 542-1 or CTDOT approved alternate.

- A. Bills shall be stored in a neat stack in the bill vault.
- B. It shall not be possible to open the bill vault while it is installed in the MVM, nor shall it be possible to install an open or unlocked bill vault into the MVM.
- C. When properly installed in the MVM, it shall be impossible to access bills in the bill vault without damaging the vault in an obvious manner.
- D. The bill vault shall be designed and constructed as a safe box of sturdy construction, manufactured from hardened steel or steel alloy of similar strength or other CTDOT approved material. The bill vault shall withstand regular removal, replacement and normal handling without deformation that in any way interferes with the insertion and removal process.
- E. When dropped from a height of three feet on a concrete floor on any corner or side, the full bill vault shall remain fully operational, shall suffer no more than cosmetic damage, shall not open, nor shall its locking mechanism be impaired.



- F. The bill vault shall have a handle or handles placed to avoid injury, and which provide adequate gloved-hand clearance for easy insertion, removal and carrying.
- G. When full, the bill vault weight shall not exceed 20 pounds.
- H. Provision shall be made to detect a full bill vault and a nearly full vault, which shall cause an event to be recorded and transmitted to the CDS. The determinations of full and nearly full conditions shall be independently software controllable and adjustable by CTDOT for each MVM. The MVM shall cease to accept bills (*i.e.*, enter "No Bills Accepted" mode) when the bill vault becomes full.

#### **17.9.5 Bill System Security Interlocks**

The bill vault shall be locked into the MVM and shall be provided with security interlocks to restrict access to monies on a "need to gain access" basis defined. A security interlock in the MVM shall ensure that bills shall leave the escrow module for transfer into the bill vault only when a bona fide bill vault and escrow module are inserted fully in their proper operating positions. The bill vault shall be installable only in their proper locations and orientations, and concealed, tamperproof sensors shall detect when each module has been properly installed. The bill vault shall be locked into the MVM in such a manner that it shall not interfere with fingertip maintenance of the bill validator.

The bill vault shall be self-locking and self-sealing, so that when it is removed from the MVM, it cannot be opened locally or re-inserted in the MVM without emptying the contents of the vault through authorized means. Access to bills shall not be possible at any time during maintenance or revenue transfer operations, but shall only be accessible by controlled-key lock.

Each bill vault shall have a visually and electronically readable component code and serial number. The MVM shall automatically read and identify as valid the component code and serial number of each inserted bill vault. This information shall be made available in both local and remote mode. The MVM shall read the electronically readable component code at a frequency fast enough to ensure that the bill vault cannot be exchanged without the MVM detecting its removal. The electronically readable component code and serial number shall not require the connection or disconnection of cables when replacing the bill storage module.

The component code and serial number of each bill vault shall also be provided on a securely attached but replaceable tag. This tag shall be made of etched or stamped metal or other CTDOT approved material and shall be oriented upright and visually readable when the bill vault is installed in the MVM.

All appropriate money counters shall reset automatically when the bill vault is removed.

If a bill vault is removed or replaced while the MVM is out of service, when the MVM is restored to service, the MVM shall automatically adjust all appropriate money counters to reflect that the bill vault has been exchanged or removed.

#### **17.9.6 Bill Jams**

In the event a bill becomes jammed inside the Bill Processing Unit, the Bill Processing Unit shall immediately cease accepting bills and make several attempts to automatically clear the jam. Upon failure to clear the jam, the MVM shall cancel the transaction, return all monies possible, and leave the Bill Processing Unit out of service.



At no time shall the bill entry slot open to accept an additional bill if another bill is already jammed in the Bill Processing Unit.

Except for those jams requiring removal of the bill vault to be cleared, it shall be possible for maintenance and revenue service personnel to gain quick access to remove any jammed bill.

## 17.10 Smart Card Processing System

The MVM shall incorporate an ISO/IEC 14443 standard contactless smart card read/write unit to process smart card transactions. The MVM Smart Card Processing System shall be compatible with the smart card fare media specified.

The Smart Card Processing System shall provide the following features:

- A. The smart card read/write unit shall be compliant with both the A and B variants of the ISO/IEC 14443 standard.
- B. The smart card read/write unit shall be activated (*i.e.*, the antenna energized) only when necessary as a part of transactions involving smart cards.
- C. All smart card transactions shall be individually recorded by the MVM.
- D. All transactions that dispense new or replenish accounts associated with existing Long-Term User Smart Cards shall require the MVM to communicate with the CDS to create or modify the accounts associated with the cards. If communication with the CDS is unavailable, the MVM shall not process Long-Term Use Smart Card transactions.
- E. All transactions that replenish accounts of existing Long-Term Use Smart Cards shall proceed only if the associated account is valid (*i.e.*, not hotlisted, suspended, dormant, etc.)

The Contractor shall submit a detailed description of the Smart Card Processing System for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 17-31**

## 17.11 Bank Card Processing System

The MVM shall include the necessary module(s) to process bank cards (credit and debit) for the purchase of tickets and smart card transactions. These modules shall provide for the following functionality:

- A. All attempts at using non-bank cards (*e.g.*, department store credit cards and gift cards) shall be rejected locally by the MVM or by the CDS (without requesting authorization from the clearing house).
- B. Each fare table entry (ticket type selection) shall have an associated CTDOT adjustable parameter that determines whether the selection can be purchased with a bank card. For those fare table entries that are not identified as being available for purchase with bank cards, the bank card reader shall not be enabled when the associated ticket type is selected. Such transactions shall be "Cash Only," and the MVM shall display an appropriate message whenever the patron selects such tickets.
- C. Prior to authorizing a bank card transaction, the patron shall be prompted to choose whether the transaction is to be a credit or debit transaction.
- D. Distinct bank card transaction time-outs, modifiable by CTDOT where possible, shall be provided for each required input.



- E. The patron shall have the ability to cancel the bank card transaction up until the time authorization is received by the MVM.
- F. All bank card transactions shall be screened by the CDS and the bank card authorization clearing house prior to issuing ticket(s) or encoding a patron's smart card. If the CDS is inoperative, or communications to the CDS are disabled, or communications with the bank card authorization clearing house are disabled, bank card transactions shall be unavailable, and all MVMs shall enter "Cash Only" mode.
- G. All bank card transactions shall be conducted in full compliance with all portions of the Payment Card Industry Data Security Standard (PCI DSS).

The Contractor shall submit a detailed description of the Bank Card Processing System for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 17-32**

## 17.12 Ticket Printer/Encoder System

Each MVM shall be equipped with a Ticket Printer/Encoder System to meet the requirements of this Scope of Work. A conceptual description of the MVM Ticket Printer/Encoder System shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-33**

### 17.12.1 Function

The Ticket Printer/Encoder System shall be able to select, cut, print, and dispense tickets and passes of different types, using at least two different ticket/pass rolls. One roll shall be plain thermally-sensitive paper, the other roll shall be thermally-sensitive, paper-based Limited Use smart card media.

The expected ticket types to be vended by the MVM are shown in Table 17.2.1.

In addition, the MVM shall be equipped to print and issue patron receipts and audit tickets for accounting and registration requirements of the Contract Documents. Receipts and audit tickets shall print on separate receipt stock. If a separate receipt printer is used, it shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 17-34**

### 17.12.2 Ticket and Receipt Printing

- A. The printer(s) shall be able to print all alphanumeric characters in both upper and lower case and the standard symbols of the ASCII character set. Printed characters shall be produced with a minimum height of 0.12 inches and a height up to 1.0 inch. The approximate height to width ratio of the characters shall be 5:3. The printer(s) shall be of the direct thermal type, with the flexibility of being programmed to print tickets with the following configurations.
  - CTDOT-specified graphics
  - Various print sizes on the same ticket
  - Reverse printing (white characters on black background)
  - Composite type over several lines
  - Vertical and horizontal character orientation
- B. The thermal printer(s) shall utilize print heads that provide no less than 100 dots per inch of resolution. Thermal print heads shall be easily replaceable, and shall produce no fewer than 250,000 CTDOT tickets without the loss of a single pixel due to wear or electronic failure.



- C. Depending upon ticket type, the Ticket Printer/Encoder shall be capable of printing the following information on each ticket:
- MVM Number – up to eight alphanumeric characters to be provided by the CTDOT within 60 days after the NTP is issued **CTDOT 17-4**
  - Expiry Date – month, day and the last two digits of the year, totaling nine characters (e.g., 02-MAR-14)
  - Expiry Time – four digits separated by a colon and followed by two letters “AM” or “PM,” using a 12-hour clock (e.g., 11:45AM, 1:20PM.)
  - Station name or zone where purchased – up to 32 characters
  - Fare type – up to 32 characters
  - Purchase price of the ticket – up to \$999.99
  - Secure (encrypted) 2-dimensional barcode representing the information above
  - Other information to be printed on the tickets shall be provided by the CTDOT within 60 days after the NTP is issued **CTDOT 17-5**
- D. All ticket encoding (for Limited Use smart card media) and printing, including any CTDOT-specified graphics, shall be completed and the ticket deposited in the Ticket/Coin Return Bin within three seconds from start of the print cycle. For the purposes of this requirement, the beginning of the print/encoding cycle shall be defined as when sufficient money has been inserted and verified or bank card authorization is received to purchase the selected ticket.
- E. Ticket print data shall be clearly legible to patrons and fare inspectors. Ticket text shall be printed in characters as large and clear as possible, consistent with generally accepted ticket printing formats. Printing shall not degrade the physical condition of the ticket. There shall be no extraneous marks placed on the ticket as a result of the printing operation.
- F. The printing shall not be erasable with chemicals without leaving any traces of erasure, shall be water and fade resistant, and shall not smear, blur, or transfer upon immediate handling by a patron. Character fonts shall not have any missing dots, and all dots shall be complete, closed, aligned, and filled. Contrast shall be uniform throughout the entire print. The Contractor shall submit printing samples on actual ticket stock samples for CTDOT approval as part of the Preliminary Design Review. **CDRL 17-35**
- G. CTDOT will require occasional ticket print format modifications, or additional ticket types for sale from the MVMs. Such changes shall be able to be performed by CTDOT employees. Ticket printing format, including information to be printed, print location, orientation, size and font, shall be controlled by programmable software.
- H. Ticket stocks shall be continuously gripped and positively fed through the ticket issuing mechanism from the storage area to the printing area, for subsequent cutting to separate the ticket from the remaining stock, and for issue.
- I. The ticket printing system shall sense the progress of the ticket through the printer and detect the completion of the ticket dispensing process. A sensor shall detect when the ticket has left the printer on its way to the coin return/ticket bin. Should the ticket fail to clear this sensor, the MVM shall go out of service and return all deposited funds.
- J. A CTDOT-adjustable sensor shall be provided to detect when each ticket stock is 10% to 25% of capacity. When this sensor is activated, the ECU shall record as an event and transmit to the CDS a ticket stock low condition. When any ticket stock is depleted, the ECU shall record as an event and transmit to the CDS a ticket stock empty condition. If



a patron subsequently selects a ticket requiring stock that the MVM cannot dispense (due to stock depletion or other malfunction), the MVM shall display "Selection Not Available." Alternatively, ticket selections that are unavailable may be omitted from the menu of selections available shown on the Patron Display.

- K. Whenever more than one bundle of identical stock is used for additional capacity, the MVM shall switch from one ticket stock bundle to another of identical stock, once the first bundle has been depleted.
- L. Replacement of stock shall require only rudimentary knowledge of the MVM. Clearly illustrated instructions showing proper ticket stock orientation and feeding procedures shall be placed inside the MVM adjacent to the ticket stock holders.

The Contractor shall submit type of printer, model, and manufacturer for the CTDOT's approval as part of the Preliminary Design Review. **CDRL 17-36**

### **17.12.3 Ticket Stock Description**

The MVM shall dispense tickets from roll stock that is commercially available in the United States. .

### **17.12.4 Tickets to be Vended**

MVMs shall vend all ticket types as specified in Table 17.2.1. At minimum, ticket types, prices, printed text, barcode format, and assigned ticket stock shall be CTDOT configurable from the CDS.

### **17.12.5 Audit Tickets**

On demand of an authorized technician and as required, the MVM shall produce audit tickets. Each audit ticket shall indicate the date, time, MVM number, technician name or number (not security code), and other specific information as required. The Contractor shall supply samples of all audit tickets for the CTDOT's review and approval as part of the Preliminary Design Review. **CDRL 17-37**

Where audit tickets provide information that is subject to modification, including coin and bill denominations and ticket types, means shall be provided that permit CTDOT to easily modify printed text. For example, should CTDOT decide to accept \$2 bills, add a new ticket type, or change the name of a ticket type, all affected audit tickets shall be easily reconfigured to accommodate the change.





At a minimum, the MVM shall provide the following audit tickets.

Table 17.12.5: Audit Tickets to be Produced

Audit Ticket	Reference Section
Recirculating Coin Replenishment	17.7.3
Coin Vault Removal / Insertion	17.7.5
Coin Hopper Removal / Insertion	17.7.5
Recirculating Coin Storage Removal / Insertion	17.7.3, 17.7.5
Bill Vault Removal / Insertion	17.9.5
MVM Configuration	17.21.9.3
MVM Revenue Status	17.21.9.4
MVM Current Status	17.21.9.5

### 17.12.6 Bank Card Transaction Receipts

Receipts shall be printed either by the Ticket Printer/Encoder System using audit stock or a separate printer for receipts and audit tickets.

Receipts shall clearly indicate that the document is a receipt and not a valid ticket, shall contain at least the following information, and all information as identified in Federal Regulations E and Z:

- MVM Number – up to eight alphanumeric characters to be provided by the CTDOT to the Contractor within 60 days after the NTP is issued **CTDOT 17-6**
- Date – month, day and the last two digits of the year, totaling nine characters (e.g., 03-MAR-14)
- Time – four digits separated by a colon and followed by two letters “AM” or “PM,” using a 12-hour clock (e.g., 11:45AM, 1:20PM.)
- Station name or zone where purchased – up to 16 characters
- Ticket purchased or smart card transaction type – up to 16 characters
- Truncated card number (last four digits) and type (Visa, MasterCard, etc.)
- Transaction amount
- Authorization number
- Other information to comply with banking standards, Federal Reserve regulations, and to be provided by the CTDOT within 90 days after the NTP is issued **CTDOT 17-7**

### 17.12.7 Receipt Stock Description

The MVM shall dispense audit tickets and receipts from roll stock that is commercially available in the United States. All receipt stock shall be paper-based and shall meet the requirements outlined in these specifications.



### 17.12.8 Ticket Cutter Mechanism(s)

Each printer in the Ticket Printer/Encoder System shall be equipped with a self-sharpening cutting mechanism to cut individual tickets and receipts from the roll supply. Each cutter shall perform at least 1,000,000 cuts without requiring replacement or sharpening.

## 17.13 Smart Card Dispenser

Each MVM shall be equipped with a Smart Card Dispenser to meet the requirements of this Scope of Work. A conceptual description of the MVM Smart Card Dispenser shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-38**

The Smart Card Dispenser shall:

- Under command of the MVM Electronic Control Unit (ECU), dispense CTDOT-issued Long-Term User Smart Card media from an internal stack that shall have a capacity of no less than 200 cards
- Monitor the contents of the card stock stack and transmit an event to the MVM ECU whenever available stock is below a CTDOT-configurable low threshold and whenever the stack is empty
- Read the sequential serial number of each card prior to dispensing the card and report the number to the ECU upon dispensing the card
- Secure the contents of the card stack with a high-security lock and key
- Deposit dispensed cards into the MVM Ticket / Coin Return Cup no more than 2 seconds after commencing the vending process

## 17.14 Electronic Control Unit

Each MVM shall be equipped with an Electronic Control Unit (ECU) to control, store, coordinate, supervise, and respond as appropriate to the status, operation, security, and accounting of all MVM functions.

The ECU shall cause the display screen to display instantaneously, with minimal perceptible delay to the patron, information that is to be displayed in response to patron input. For example, upon selection of a fare by pressing a push button, the display screen shall react instantaneously by displaying the ticket type selected and amount of fare due.

The ECU shall be equipped with a Central Processing Unit, Random Access Memory, Input and Output (I/O), Non-Volatile Memory, removable Solid State Memory Module, and Software capable of performing all control and data processing functions of the MVM. The ECU shall be suitable for operation in a transit system trackside environment.

Whenever the MVM shuts down due to loss of commercial power, upon restoration of power, the MVM shall automatically resume operations within 4 minutes.

A conceptual description of the MVM ECU shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-39**



### 17.14.1 ECU Hardware

The ECU shall be based on an embedded microprocessor or an IBM PC-compatible industrial microcomputer system. The ECU at a minimum shall be equipped with:

- A. A microprocessor with adequate processing speed for the type of service for which it is intended.
- B. Adequate random access memory for operating program(s) and other temporary needs. The ECU shall have sufficient RAM to avoid the use of virtual memory as a means of temporarily supplementing RAM during normal MVM activities. Provision shall be furnished to permit plug-in upgradeability to double the amount of memory initially supplied.
- C. Solid-state non-volatile memory device(s) for operating system and application software. (Hard disk drives shall not be used for this purpose.) The primary copy of dynamic data registers, status flags, ticket/pass text, fare tables, event records, etc. shall be stored on the non-volatile memory device(s). Capacity shall exceed current storage needs by at least 200%.
- D. An interface for removable read/write storage media as required for software upgrades and data transfers.
- E. A removable solid-state memory module (SSMM) for backup of dynamic data stored in the primary non-volatile memory device(s).
- F. Additional (unused) communication ports, minimum of two, or the ability to communicate with at least two additional internal modules without requiring additional ECU hardware.
- G. Keypad and display for entry of commands to retrieve, display, and print diagnostic, status, accounting, and registration data locally at the MVM.
- H. An internal clock.
- I. Ethernet (minimum 100 Mbps) and other communications interfaces as required to support external communications.
- J. A "watchdog" timer circuit that automatically initiates an orderly operating system restart (i.e., a system shutdown and reboot) in the event of a software-induced failure such as a total suspension of all activities.
- K. Components as necessary to support the Voice Messaging System.

The ECU hardware shall be subject to CTDOT review and approval as part of the Preliminary Design Review. **CDRL 17-40**

### 17.14.2 Data Memory

A programmable memory shall be provided to contain all station names and designated zones, all types of tickets and passes, and a minimum of two sets of fare tables (one current, one future).

All data corresponding to ticket/pass sales, smart card transactions, MVM status, and/or diagnostics shall be stored in the data memory for accounting and registration, and shall be processed to accommodate the requirements of this Scope of Work. Non-volatile data storage shall be provided for accounting, registration, and event data; the contents of these registers shall be updated with each transaction or event. A second copy of the contents of the non-volatile data registers shall be stored on the removable solid-state memory module as defined.



All MVM sales, status, and event data shall be successively and safely registered, even if a power failure occurs.

The ECU shall also store in memory a list of invalid smart card serial numbers.

### **17.14.3 Removable Solid State Memory Module**

All dynamic data that is unique to each MVM, including configuration, register, status, and event data recorded in the ECU non-volatile memory, shall be duplicated in a removable Solid State Memory Module (SSMM). As the name implies, the SSMM shall incorporate no moving parts. The SSMM shall be subject to CTDOT review and approval at the Preliminary Design Review.

#### **CDRL 17-41**

In the event that the ECU or the primary non-volatile memory device becomes inoperative and must be replaced, data from the SSMM shall be copied to the new primary memory device before the MVM returns to service.

In addition:

- A. The SSMM shall use non-volatile memory and store required data to reactivate an MVM to its previous working state without further data entry. Configuration and other information that is generic to all MVMs, such as fare tables, ticket/pass text, display text, and the CTDOT-issued Long Term Smart Card hotlist, may be stored on the SSMM or may be retrieved by the MVM from the CDS upon re-initialization. If restoration of an MVM requires data to be retrieved from the CDS, alternate methods of retrieving this data shall be provided for times when the CDS or data network are inoperable.
- B. The SSMM shall be readily accessible and easily exchanged without the use of tools.
- C. When an ECU (or primary non-volatile memory) is replaced, the removable Solid State Memory Module from the faulty ECU will be installed in the new ECU. When the new ECU is activated, it shall retrieve all data from the SSMM and copy the data to the primary non-volatile memory before resuming service. The Contractor shall submit a description of the ECU replacement process for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-42**
- D. The SSMM shall be capable of storing all MVM dynamic data, and its capacity shall exceed current storage needs by at least 200%.
- E. The SSMM shall use flash memory or other similar non-volatile RAM technology requiring no battery.
- F. Data in the SSMM shall be updated concurrently with the non-volatile memory internal to the ECU; no queuing of updates to the SSMM is permitted. Data in the SSMM shall at all times (to the extent possible due to hardware limitations) be identical to the ECU's primary non-volatile memory so that in the event of ECU failure, no transaction or register data is lost.
- G. The contents of the ECU's primary non-volatile data shall be compared at least once per day to the contents in the SSMM. In addition, this comparison shall be made each time an MVM is placed into operation. Any discrepancies in this comparison shall result in an SSMM failure event being recorded by the MVM and reported to the CDS.
- H. The MVM shall require a properly installed and functioning SSMM to enter service.



#### **17.14.4 ECU Clock**

Each ECU shall contain its own real-time electronic clock, which shall be used to generate time signals and maintain an accurate record of year, month, day, date, and time and shall be properly set upon installation.

Means shall be provided to retain accuracy of the clock during periods when the MVM is shut down. This shall be sufficient to retain clock accuracy for a period of at least five years. An indication of the need to replace the battery shall be provided prior to the battery requiring replacement, or if not available, the MVM maintenance manuals shall clearly identify each battery and its recommended replacement interval.

The clock shall be synchronized and/or reset locally by numeric keypad input and shall also be synchronized and/or reset by remote communication from the CDS, no less than once per day. The MVM shall also request clock synchronization from the CDS each time the MVM is powered up and/or initialized. If the MVM's internal clock indicates a time more than 3 minutes different from the time as reported by the CDS, the MVM shall generate, record, and transmit to the CDS a clock warning event.

The Contractor shall provide information on local and remote clock reset/synchronization functions as part of the Preliminary Design Review. **CDRL 17-43**

#### **17.14.5 MVM Operating System Software**

The ECU shall employ commercially available operating system software. The operating system shall be of the latest version available from the supplier (minimum Microsoft Windows® 7 or CTDOT-approved equivalent) and be fully supported by the OEM supplier. The MVM operating system shall be capable of performing all tasks necessary to support the MVM and its application software, including the ability to perform multiple tasks concurrently and communicate with the CDS.

Upon issuing a command from the internal maintenance keyboard, the ECU operating system shall perform an orderly shutdown (preserving all file and data integrity) and restart. It shall not be necessary to cycle power to the ECU to restart the operating system.

The operating system shall be subject to the review and approval of the Contracting Officer at the Preliminary Design Review. **CDRL 17-44**

#### **17.14.6 MVM Application Software**

MVM application software shall consist of software code that operates on the ECU for control and supervision of MVM functions.

MVM application software shall also meet the following specifications.

- A. The software shall be designed, coded, and implemented consistent with generally accepted software design and coding practices. Software shall contain appropriate levels of security to prevent unauthorized access to software modules.
- B. The software shall be modular in design, user-friendly, and be configurable by CTDOT. The software modules shall be written in one industry standard high-level language (not microprocessor assembly language).
- C. Using standard inter-process communications or other similar methods, a master software application module shall monitor the health of all other executing application software modules. In the event that a malfunction is detected in any application software module (*i.e.*, the module fails to transmit a "heartbeat" message), the master software module shall reinitialize (*i.e.*, restart) the application module. Should the application



module fail to reinitialize, the master software application module shall cause the MVM to perform an orderly shutdown and reboot.

- D. Diagnostic software shall be furnished for testing and troubleshooting of all MVM functions. MVM application software shall include all software packages necessary for real-time MVM diagnostics and accounting and registration communications between the MVMs and the CDS.
- E. The MVM software shall permit CTDOT to control various aspects of the MVM operations by varying the values of parameters. The variable parameters shall be modifiable both locally and remotely by downloading information via the CDS. A complete preliminary listing of all variable operational parameters for the MVM shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-45**
- F. The CDS shall be capable of downloading updated application software to the MVM (individually, in groups, or system-wide). With new application software remotely loaded, a remote command from the CDS to reinitialize the MVM shall result in execution of the new application software.

The Contractor shall submit a description of the MVM application software, depicting all functions and transaction flows, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 17-46**

#### **17.14.7 Fare Tables**

The MVM and CDS shall be capable of supporting at least three fare tables (one current and two future), each with a capacity of at least 256 entries, where an entry in the fare table provides all configuration data corresponding to a transaction type selectable by passengers.

The MVM application software shall be designed to accommodate the existing fare structure as reflected in Tables 17.2.1 and 17.2.2.

#### **17.14.8 Anti-Virus and Anti-Malware Software**

Each MVM shall include commercially-available software to detect, prevent, and remove software virus programs and other malware. This software shall be operational at all times while the MVM is operating.

Definitions for virus and malware programs shall be updated regularly. All MVMs shall receive such updates no less than 48 hours after the OEM releases updated definitions. The CDS shall distribute updates for virus and malware program definitions to each MVM.

### **17.15 Power Supply and Switches**

The MVM shall have at least two power switches that are easily accessible from within the MVM enclosure:

1. A MAIN power switch that removes all power from all devices within the MVM cabinet
2. An MVM power switch that removes power from the MVM power supply only

The MVM may include additional power switches, but all other power switches shall be powered through the MAIN switch.

The MVM shall be equipped with a modular, filtered power supply which shall be connected to the incoming grounded electrical service. The power supply shall be connected to the incoming



electrical service and deliver all of the necessary operating voltages for the MVM. Voltages internal to the MVM shall not exceed 125 Volts.

The MVM power switch shall turn the MVM's power supply on or off; this switch shall be separate from the main circuit breaker that removes all power from the MVM. While the MVM power supply is off, integrity of the non-volatile memory and the internal clock shall be maintained. With the power supply switch off, it shall be possible to service the machine and make field repairs and/or module replacement without risking the safety of maintenance personnel.

Power to the MVM power supply shall also be remotely controllable by an IP-addressable power switch, such as the iBoot<sup>®</sup>-G2+ from Dataprobe Inc. (See <http://dataprobe.com/iboot-g2.php>.) The Contractor shall submit the proposed remote power switch for CTDOT review and approval at the Preliminary Design Review. **17-4**

A Ground Fault Circuit Interrupter (GFCI) duplex convenience outlet, plus a secondary duplex outlet wired as a load to the GFCI outlet, rated at 125 VAC, 15 amps shall be easily accessible within the interior of each MVM. These outlets shall be installed no less than 4 inches above the finished platform, shall be protected by a separate circuit breaker internal to the MVM enclosure, and be grounded.

While the MVM power supply switch is off and the MAIN power switch is on, the following devices shall remain powered:

- The internal service light.
- The auxiliary GFCI power outlets
- All internal fans, heaters, and cooling devices
- The external LED light fixture
- The Ethernet Switch (powered by an auxiliary GFCI outlet)

Appropriate warning labels shall be provided on or near any components or cables that may have hazardous voltages present while the MVM power supply switch is off.

Indicator lamps shall identify when each of the various aspects of the power supply are functional.

A conceptual description of the MVM power wiring, switches, and supply shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-47**



## 17.16 Supplemental Battery Power

The MVM shall be equipped with a battery operated supplemental power supply integral to the MVM and connected to the primary power supply. This battery power supply shall be used in the event the incoming voltage falls below the reliable MVM operating voltage and in the event of loss of AC power to the MVM. The supplemental power supply shall contain a battery, a trickle-charge circuit, and appropriate indicators. The ECU shall monitor the power supply's source of power and shall transmit a power alarm to the CDS as soon as it is informed that battery power is being utilized. The supplemental power supply shall be of sufficient capacity to permit the MVM to perform the following functions in the event of an AC power failure or fault, or other fault that would cause the MVM to shutdown without AC power:

- If the entire fare value has been collected prior to loss of AC power but after ticket printing or smart card encoding has commenced, the transaction shall be completed. This includes ticket printing or smart card encoding, issuance of all change due, and transfer of inserted money to associated vault(s) or coins/drums/carousels.
- If loss of AC power occurs before the entire amount has been collected or prior to ticket printing or smart card encoding, the transaction shall be canceled and the inserted money shall be returned to the patron.
- Transmit a power loss alarm message to the CDS.
- Record an event in the MVM's non-volatile memory indicating date and time of power loss.
- Provide for an orderly shutdown of the MVM such that no data loss occurs.

At no time shall a transaction be permitted to commence while the MVM is operating on battery power.

Batteries in the supplemental power supply shall have an expected life of no less than 5 years of normal use. An indication of the need to replace the battery shall be provided prior to the battery requiring replacement, or if not available, the MVM maintenance manuals shall clearly identify each battery and its recommended replacement interval.

The supplemental power supply shall be subject to Contracting Officer review and approval at the Preliminary Design Review. **CDRL 17-48**

## 17.17 Alarm Unit

Each MVM shall be equipped with an alarm unit that shall have the ability to monitor MVM security conditions and report them to the Electronic Control Unit (to be forwarded to the CDS). The alarm unit and its operation shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 17-49**

The alarm unit shall have the following features and perform the following functions.

- A. The alarm unit shall by switch, optical detector, or other means detect status of the outer door lock and the opening of the outer door. The MVM outer door shall be considered unsecured or "open" whenever the outer door lock is open or disengaged from its secure position. The alarm unit shall commence its countdown to declaring an intrusion as soon as the outer door lock is disengaged from its secure position. Similarly, the MVM shall not commence in-service activation until the outer door is closed and the outer door lock is returned to its fully secured position.
- B. The alarm unit shall detect and report pending and active security breaches to the ECU.





- C. The alarm unit shall be equipped with an electronic or mechanical siren that shall be capable of emitting a sound level of at least 110 dB (A) measured at a distance of three feet with the door open. Whenever the siren is sounding, the MVM shall go out of service. When the siren is silenced, the MVM shall perform self-diagnostics, and if possible, resume normal operations.
- D. When entry is authorized, the ECU shall cause the alarm unit to disarm. If not disarmed within the prescribed time period, the alarm unit shall activate the siren for a CTDOT-adjustable period of one to five minutes or until entry is authorized. Each time the MVM is secured, the alarm unit shall reset and resume monitoring MVM security.
- E. Each time a security breach or impact is detected, an event record of the activation with date and time shall be created and stored in the non-volatile register memory of the ECU and immediately forwarded to the CDS, if communications is available.
- F. The alarm unit shall monitor the security status of the MVM independent of the ECU; if the ECU is disabled for any reason, the alarm unit shall continue to operate and monitor the MVM for security breaches and impacts.
- G. A rechargeable battery that is trickle-charged while commercial power is available shall power the alarm unit. During power outages, the alarm unit shall utilize battery power to continue to monitor the security status of the MVM, and if an impact, unauthorized entry or other security breach is identified, the alarm unit shall utilize battery power to activate the local siren. The battery shall have sufficient capacity to operate the siren for at least 30 minutes and operate the alarm unit for a period of at least 24 hours.
- H. Each MVM shall have a secure local control switch or other secure means that permits the alarm system to be disarmed in the event entry must be gained while the ECU or maintenance keypad (where security codes are entered) is disabled. The alarm system shall inform the ECU as soon as possible whenever the secure local control switch has been used to disarm the unit. The ECU shall record the event in its non-volatile memory and immediately report the event to the CDS.
- I. If a security breach occurs while the ECU is disabled or the MVM is without power, upon restoration of power or ECU operation, the alarm unit shall transmit to the ECU that a breach occurred; the ECU shall record the event in its non-volatile register memory and immediately transmit the alarm to the CDS.
- J. An adjustable impact sensor shall be provided that can detect severe frontal blows to the MVM and attempts at unauthorized or forced entry. The alarm unit shall activate the siren as soon as the impact sensor is triggered. In such cases, the siren shall shut off and re-arm after a separate CTDOT-adjustable time period (default 60 seconds) unless continued impacts or attempts at intrusion are detected.
- K. The impact sensor shall detect severe blows induced by abusive patrons and vandals, and shall be most sensitive to blows applied to the front of the MVM. Impacts of lesser force applied elsewhere to the MVM enclosure shall not cause the siren to sound. At time of delivery, the impact sensor shall be adjusted so that blows that are caused by a 1 pound object moving at 25 feet per second, applying perpendicular force in an area of 1 square inch anywhere on the MVM door shall cause the MVM siren to sound. CTDOT shall be able to adjust this sensor for greater or lesser sensitivity. The operation of the impact sensor shall be demonstrated for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-50**



- L. A glass-breakage sensor shall be provided in the MVM to detect severe impacts and breakage of the glass cover of the Patron Display. When activated, this sensor shall trigger an Intrusion Alarm.
- M. The alarm unit and the ECU shall exchange "heartbeat" messages at least once every two seconds. If the ECU detects a failure of the alarm unit, it shall record the event in its non-volatile memory and transmit an alarm unit failure message to the CDS. If the alarm unit detects failure of the ECU, the alarm unit shall operate in its stand-alone mode until communication with the ECU is restored.

## 17.18 Service Indicator

Each MVM shall have a visible exterior indication that the equipment is in need of servicing. This shall be accomplished by use of one or more blinking lights, visible from a distance of 300 feet from the MVM. The service indicator shall be activated under any of the following conditions:

- MVM is out of service (except during power failure)
- MVM is in Exact Fare Only mode
- One or more MVM modules has failed
- Coin vault is near full or full
- Bill vault is near full or full
- One or more supplemental change storage modules is low or empty
- One or more ticket stocks is low or empty
- A security breach is in progress
- The alarm siren is activated due to impact detection
- Communication with the CDS has failed

CTDOT shall be able to select which of these conditions shall be enabled for the activation of the service indicator and which shall not, using the CDS. This shall be able to be performed at any time after the installation of the MVMs and CDS by CTDOT without any Contractor assistance through the setting of parameters. The indicator light(s) and location(s) shall be subject to CTDOT review approval as part of the Preliminary Design Review. **CDRL 17-51**

## 17.19 Security Camera

The MVM front panel shall include a convex "fish eye" mirror positioned so that MVM users may see if someone is behind them in close proximity. This mirror shall be a "two-way" mirror, behind which shall be a security camera (internal to the MVM) to view out the front of the MVM through a hole in the door that is covered by the mirror.

At pre-selected point in the maintenance and servicing process, as selected by CTDOT, and at specific steps during purchase of ticket by the passenger, the camera shall record the image and store it on the MVM hard drive. Each of these recorded images shall be stored on the MVM internal storage device and associated with the transaction. These recorded and stored images shall be retained within the MVM until removed locally by an authorized CTDOT technician or transferred to the CDS over the data communication system. CTDOT shall be able to select specific dates, times and specific intervals to have the image files automatically transferred to the CDS from the MVMs. The system shall also permit these stored images to be automatically removed at a specific date or after a specified number of days have passed. The AFC Central Data System shall be capable of modification of these associations and adding new associations, based on passenger fare selections or servicing steps. Alternatively, these



cameras shall remain in operation always recording and sending all images via the IT network to the proper storage location within CTDOT.

## 17.20 Ethernet Switch

Each MVM shall include an unmanaged Ethernet switch to consolidate network communications. The Ethernet switch shall:

- A. Provide a minimum of 8 Ethernet ports operating at a minimum 100 Mbps
- B. Be capable of supplying Power Over Ethernet to compatible devices
- C. Be suitable for the anticipated elevated operating temperatures present inside the MVM
- D. Accept cables with standard RJ-45 connectors
- E. Be securely mounted inside the MVM so that the operating condition of all ports is visible when the MVM outer door is open
- F. Utilize 125 VAC power, supplied by the auxiliary GFCI power outlet inside the MVM, as described in Section 17.15

The Contractor shall connect all internal Ethernet cables to the switch. These cables shall connect to:

- The station Local Area Network
- The Network Interface Card of the ECU
- The remote IP-addressable power switch described in Section 17.15
- The security camera described in Section 17.19

Spare ports on the Ethernet switch shall remain active so that CTDOT technicians can connect diagnostic tools and laptop computers to the station LAN.

The Contractor shall identify the make and model of the Ethernet Switch and submit technical documentation for the switch for CO review and approval at the Preliminary Design Review.

### **CDRL 17-52**

## 17.21 MVM Operation

### 17.21.1 Normal Operations

Each MVM shall normally be ready to respond to a patron selection when it is in the idle condition. If the MVM is not ready, all operating functions shall be disabled. A programmable display screen and selection buttons shall be provided for patrons to complete a transaction. The display screen shall direct the patron through the steps of the transaction with the patron's inputs being entered through push buttons or other means.

The operating status and fare table configuration of each MVM shall determine the availability of ticket and transaction types. Only ticket and transaction types that are available shall be shown on the Patron Display.

The Patron Display shall indicate amount due upon selection of ticket or transaction type by the patron. The remaining amount due from the patron shall be continuously updated by the amount of fare inserted and accepted by the MVM.

When failures occur during a transaction, the MVM shall make every attempt to complete the transaction or return all deposited funds. If necessary, the MVM shall err in favor of the patron, even if it means a possible loss of accounting accuracy.



**17.21.2 Limited Operation of MVM**

Operation of the MVM shall provide continued but limited operation of the MVM in the event of a failure of one or more components; assuming that the failure poses no risk of further damage to the MVM or its components, the MVM shall remain in service as long as it is capable of vending tickets or processing smart cards.

At a minimum, the MVM shall provide the following reduced level of operations:

Table 17.21.2: Limited Operations of MVM

Failure of:	Shall Result in Continued Operation as:
Bill System	Coin and/or bank card operated MVM with change making capabilities. Message on MVM to be displayed: "No Bills Accepted."
Coin System	Bill and/or bank card operated MVM with change making capabilities provided by the supplemental change storage system. Message on MVM to be displayed: "No Coins Accepted." If available change denominations warrant, also "Exact Fare Only."
Supplemental Change Storage System	If insufficient change is available in the recirculating coin system, exact fare bill and coin operated MVM; message on MVM to be displayed: "Exact Fare Only." If the recirculating coin system has an adequate coin supply to make change (within the per-denomination limits defined), an inoperative supplemental change storage system shall have no effect on MVM operation.
Bank Card Subsystem	Cash-only MVM. Message on MVM to be displayed: "Cash Only: No Bank Cards Accepted."
Smart Card Read/Write Module	New-product vending machine only. Message on MVM to be displayed: "No Smart Card Add-Value Transactions."
Ticket Printer/Encoder	Smart Card-only machine. Message on MVM to be displayed: "No Tickets Available."  NOTE: Operation of the MVM with an inoperable Ticket Printer/Encoder shall be CTDOT-configurable. Each MVM shall be individually configurable at the CDS to either remain in service (degraded mode) or go out of service in the event of an inoperable Ticket Printer/Encoder.
Receipt Printer	Fully functional MVM without receipts for bank card transactions only. Message on MVM to be displayed: "No Receipts Available."
Smart Card Dispenser	Message on MVM to be displayed: "No New Smart Cards Available for Sale"
Communications with CDS	Cash-only ticket vendor, and no sales or replenishments of Long-Term Use Smart Cards. Message on MVM to be displayed: "Cash Only: No Bank Cards Accepted. No Long-Term Use Smart Card Transactions."

Whenever possible, the MVM shall remain in service even if multiple failures occur; for example, it shall be possible for the MVM to simultaneously be in both "No Coins Accepted" mode and



“Exact Fare Only” mode. These limiting conditions that affect the passenger payments and selections shall be indicated on the passenger display in a manner to easily identify that the MVM is not in full service. The MVM shall go out of service only when one or more of the following occur:

- A component necessary to support all MVM operations fails, such as the Electronic Control Unit, power supply, patron keyboard, etc.
- All payment accepting modules fail (coin acceptor, bill acceptor, Bank Card Subsystem)
- Both the Ticket Printer and the Smart Card Read/Write Module fail
- Other operational conditions as defined herein occur
- Other conditions as approved by the CTDOT during the Final Design Review **CDRL 17-53**

Whenever possible, the MVM's Electronic Control Unit shall indicate the limited operating condition to the CDS.

**17.21.3 Transaction Speed**

The assumed speed of MVM transactions is a critical parameter in the calculations used to determine the number of MVMs required at each platform.

**17.21.3.1 Cash Transactions**

For ticket transactions purchased with cash, transaction time is defined as the time from completion of ticket selection to when all tickets are deposited in the Ticket/Coin Return Bin and all change is returned.

Assuming:

- All inserted coins and bills are inserted at maximum possible speed,
- All inserted coins and bills are accepted on the first insertion, and
- All transactions are for the purchase of a single ticket,

The time required to complete the sample transactions listed below shall not exceed the following.

Table 17.21.3.1: Maximum MVM Transaction Times

Sample Transaction Content	Maximum Time to Complete
One bill inserted Two coins returned	10 seconds
Four coins inserted Two coins returned	12 seconds
Two bills inserted Four coins returned	15 seconds
One bill inserted Four coins inserted Two coins returned	17 seconds
Five bills inserted Four coins returned	25 seconds

For all ticket purchase transactions, the time from acceptance of the last coin or bill to deposit of the first ticket in the Ticket/Coin Return Bin shall not exceed 3 seconds.



Where transactions produce multiple tickets, the time between successive tickets being deposited in the Ticket/Coin Return Bin shall not exceed 2 seconds each.

For all cash transactions, the time between the completion of the transaction (*i.e.*, when all tickets and all change are deposited in the Ticket/Coin Return Bin, and when any CTDOT-issued Long Term Smart Card re-encoding is complete) and the MVM's readiness to begin another transaction shall not exceed 5 seconds, or the inter-transaction time-out defined, whichever is longer.

If a transaction is canceled before cash payment is complete, all inserted money shall be returned and the MVM shall resume its idle condition within 7 seconds, or the inter-transaction time-out defined whichever is longer. This interval shall apply under normal operating conditions, when no more than 10 coins and 5 bills have been inserted.

Where possible, MVM speed shall be optimized by the use of concurrent activities. For example:

- Dispensing of change shall occur concurrently with the transfer of any inserted bills from the bill escrow into the bill vault.
- If change requirements call for dispensing change from multiple devices (the recirculating coin system and one or more modules of the supplemental change storage system), devices shall be activated simultaneously.
- If a canceled transaction requires the return of coins and bills, the MVM shall direct both the coin and bill systems to do so simultaneously.

#### 17.21.3.2 **Bank Card Transactions**

Transaction times for bank card transactions, measured from the time a bank card is read by the Bank Card Subsystem to the time a ticket is dispensed or CTDOT-issued Long Term Smart Card encoding is complete, shall not exceed the following times (excluding PIN entry time and clearing house processing time):

- A. When the CDS is on-line with the clearing house: 3 seconds;
- B. When the CDS is not on-line with the clearing house, with attempt to establish communications: 5 seconds.

For all bank card transactions, the time between the completion of the transaction (*i.e.*, when all tickets and receipts are deposited in the Ticket/Coin Return Bin, and when any CTDOT-issued Long Term Smart Card re-encoding is complete) and the MVM's readiness to begin another transaction shall not exceed 5 seconds, or the inter-transaction time-out defined whichever is longer.

For those transactions where the patron has requested a receipt, the receipt shall be deposited in the Ticket/Coin Return Bin within three seconds after all tickets are deposited in the Ticket/Coin Return Bin, or after successful encoding of the patron's CTDOT-issued Long Term Smart Card.

If a transaction is canceled before the patron's bank card is read, the MVM shall resume its idle condition within 5 seconds, or the duration of the inter-transaction time-out defined, whichever is longer.

#### 17.21.3.3 **Smart Card Transactions**

Smart card read actions, as measured by the time the patron presents a card to the MVM Smart Card Reader until all transaction information is shown on the MVM Patron Display, shall occur in no more than 500 milliseconds. The card processing shall include checking of all data,



including maximum-sized lists, performing the necessary computations, and displaying results as required.

For CTDOT-issued Long Term Smart Card account replenishment transactions, the time from acceptance of the last coin or bill, or the time from receipt of bank card authorization, to presentation of the Smart Card Transaction Results Display shall not exceed 1 second.

#### **17.21.4 Cancel Functions**

In the event that one of the following conditions occurs prior to commencement of ticket/pass issue or encoding a presented smart card, the ECU shall initiate a cancel signal, causing all deposited monies to be returned and the transaction canceled. Whenever a transaction in progress is canceled, an explanatory message shall be shown on the Patron Display for a period equal to the inter-transaction time-out.

- A. Cancel Button – Actuation of the cancel button shall cancel the transaction. Note that if the patron manually cancels a transaction before any payment has been made, the MVM shall immediately return to the idle screen. Once ticket issuing or smart card encoding has begun, the cancel button shall have no effect.
- B. Time Out – Time out shall occur if a transaction is not continued within CTDOT adjustable time spans.
- C. Change Payout Limit Exceeded – Deposit of an amount for a selected fare that would result in exceeding the maximum change payout shall cancel the transaction. The change payout limit shall be specified by the CTDOT within 60 days after the NTP is issued and shall be a programmable, adjustable parameter by CTDOT. **CTDOT 17-8**
- D. Overpayment Limit Exceeded – Deposit of an amount in excess of a permitted limit of overpayment while the MVM is in “Exact Fare Only” mode, and which the MVM cannot supply as change, shall cancel the transaction. The limit of overpayment shall be specified by the CTDOT within 60 days after the NTP is issued and shall be a programmable, adjustable parameter by CTDOT. **CTDOT 17-9**
- E. Excessive Coins or Bills Inserted – Insertion of quantities of coins or bills greater than programmable limits (initially set to 12 bills and 30 coins but adjustable by CTDOT) shall cause the MVM to cancel the transaction and return all deposited funds.
- F. Shutdown – Unless otherwise specified elsewhere in this Scope of Work, any shutdown condition, including AC power failure, shall result in cancellation of the transaction, the return of all deposited funds, and orderly shutdown of the MVM.

#### **17.21.5 Time-Out Operations**

As described below, the MVM shall provide CTDOT-adjustable time-out periods to return the MVM to the idle state in prescribed times between steps of a transaction and between transactions. Other time-out periods, as applicable to the transaction process, shall also be adjustable by CTDOT. All time-outs shall be identified in the review of the transaction process that shall occur at the Preliminary Design Review, and shall be subject to CTDOT approval at the Final Design Review. **CDRL 17-54**

##### **17.21.5.1 Intra-Transaction Time-Out**

An intra-transaction time-out function shall be provided which shall limit the time between successive steps of any transaction. These steps shall include inserting the required money, processing bank cards or smart cards, presenting a CTDOT-issued Long Term Smart Card, or any other patron input after initiating a ticket selection or transaction type. The timer shall start



after selection is commenced, and shall reset and re-start after each patron input, insertion of a coin or a bill, presentation of a smart card, or processing of a bank card. If the patron's input, including the insertion of money, is interrupted for more than a CTDOT-configurable number of seconds at any point before the full value of the fare has been collected and ticket issuing has been initiated, the transaction shall be automatically canceled. Upon cancellation, the MVM shall display a cancellation message for a separately defined interval (the inter-transaction time-out) described below.

While the voice message system is active, the intra-transaction time-out countdown shall commence only after the entire voice message is played for the current transaction step.

CTDOT shall be able to easily program different time spans ranging from 1 to 90 seconds for the intra-transaction time-out operation of the MVMs, and shall be initially set to 45 seconds.

Prior to cancelling a transaction due to intra-transaction time-out, the MVM shall emit a distinct tone once per second. The time prior to cancellation at which point the MVM begins to emit this tone shall be CTDOT-configurable, and shall be initially set to 10 seconds.

#### **17.21.5.2 Inter-Transaction Time-Out**

Similar to the intra-transaction time-out described above, MVM operation shall also provide for an inter-transaction time-out. This timer shall limit the amount of time the MVM waits after completion or cancellation of a transaction (except as noted below) before resuming the idle state. During the inter-transaction time-out, the MVM Patron Display shall indicate either that the transaction is complete (including reminders to retrieve any tickets, change, and inserted CTDOT-issued Long Term Smart Card), or that the transaction has been canceled (including reminders to retrieve returned cash and inserted CTDOT-issued Long Term Smart Card).

While the voice message system is active, the inter-transaction time-out countdown shall commence only after the entire voice message is played for the end-of-transaction screen.

The inter-transaction time-out shall be initially set to 5 seconds and shall be adjustable by CTDOT from 1 to 30 seconds in increments of 1 second.

During the inter-transaction time-out period, all patron selection inputs shall remain active. The MVM shall immediately display the idle screen as soon as any button is pressed or the screen is touched (if touch screen interface is used).

#### **17.21.5.3 Idle Screen Time-Outs**

Two distinct time-outs shall apply while the MVM is displaying the idle screen.

- Alternate Language Time-Out. If a patron selects an alternate language while the MVM is displaying the idle screen but takes no further action for a CTDOT-adjustable period, the MVM shall revert to English. This time-out shall be adjustable from 1 to at least 120 seconds in increments of 1 second, and shall be initially set to 30 seconds.
- Screen Saver Time-Out. After a CTDOT adjustable period displaying the idle screen, the MVM shall display a screen saver. The screen saver time-out shall be adjustable from 1 minute to at least 90 minutes in increments of 1 minute, and shall initially be set to 5 minutes.

#### **17.21.5.4 Bank Card Authorization Time-Out**

The MVM shall also include a separate time-out parameter to define the time allowed for a response from the CDS for bank card transaction authorization. This parameter shall be initially set to 20 seconds, and shall be adjustable by CTDOT in the range of 1 to at least 90 seconds.





If the MVM receives no response from the CDS for a bank card authorization within the allotted time, the MVM shall cancel the transaction.

#### **17.21.6 Screen Saver**

When the screen saver time-out elapses, the MVM shall automatically display a screen saver on the Patron Display. The screen saver shall be downloadable from the CDS and shall be CTDOT configurable for each individual MVM. The screen saver program shall support the following:

- A single static image in any common graphics format, including JPG, TIFF, BMP
- A repeating "slide show" of static images in common graphics format
- A video in any common format, including MPEG, WMV, MOV, AVI

The screen saver shall automatically terminate and the MVM shall display the idle screen as soon as any button is pressed or the screen is touched (if touch screen interface is used).

#### **17.21.7 Automatic Activation of Time-of-Day Fares**

The MVM shall retain a record of current and future fare structures. Whenever the current fare structure includes time-of-day (*i.e.*, rush hour / non-rush hour) fare pricing, the MVM shall automatically alter the price of fare products according to the fare structure in effect, and according to the date and time indicated by the MVM's internal clock.

Patrons shall not be permitted to select whether they wish to purchase a rush or non-rush fare; the MVM shall automatically determine the ticket types to be vended.

The MVM shall also include a CTDOT-adjustable "grace period" that extends the time period during which the non-rush hour fares are in effect. The "grace period" parameter shall be adjustable in one-minute increments, which shall be equally applied to the beginning and ending times for the non-rush fare.

#### **17.21.8 Automatic Activation of Day-of-Week and Holiday Fares**

The MVM shall retain a record of current and future fare structures. Whenever the current fare structure includes day-of-week (*i.e.*, weekday / weekend) or holiday (*i.e.*, specific dates identified as holidays) fare pricing, the MVM shall automatically alter the price of fare products according to the fare structure in effect, and according to the day and date indicated by the MVM's internal clock.

#### **17.21.9 Accounting, Registration, Diagnostics, and Events**

The Electronic Control Unit shall process and store all ticket/pass sales, smart card transaction data, MVM status, event, and diagnostics in the data memory unit and transmit this information upon demand to the CDS. Access to data records at the MVM shall be restricted to authorized personnel on a need to know basis. Data access to be granted depending on authorization codes used to gain internal MVM access.

All recorded data shall be accessible directly from the MVM. Service personnel shall be able to access and print out all data accessible by them on audit ticket stock. All accounting, registration, event, and diagnostic information shall be sent to the CDS and shall on demand be transferable to an SSMM within the MVM for later manual transfer to the CDS. All accounting and registration information stored by the MVM on the SSMM shall be protected against any unauthorized manipulation.



At a minimum, this data shall include the following:

#### 17.21.9.1 **Sales and Transaction Data**

Each ticket sale, pass sale, and smart card reload transaction shall be separately recorded by the MVM. Transaction records shall include at minimum:

- Unique transaction identification number
- MVM number
- Date and time
- Ticket or pass type, or smart card transaction type
- Number of tickets or passes in transaction (if applicable)
- Dollar value by payment method (cash, credit card, debit card, CTDOT-issued Long Term Smart Card stored value)
- Smart card serial number
- Bonus value added to smart card (if applicable)
- Overpayment amount (if applicable)

Sales and transaction data shall be stored in the ECU's primary non-volatile memory and in the SSMM. The MVM shall continuously retain sales and transaction data records for the current and seven (7) previous days in the primary and secondary non-volatile memory devices.

The MVM shall immediately transmit each transaction record to the CDS upon completion of the transaction, or when polled by the CDS.

When communications with the CDS are disabled, the MVM shall transmit transaction data as soon as communications with the CDS are restored.

#### 17.21.9.2 **Master Status List**

The MVM ECU shall receive from the CDS the Master Status List (MSL), which shall govern how the MVM responds when presented with a CTDOT-issued Long-Term Smart Card. The CDS shall periodically transmit incremental upgrades for the MSL, which the MVM shall integrate into its MSL.

At least once per day, the CDS shall transmit to the MVM the complete updated MSL, which the MVM shall use to replace its existing MSL.

#### 17.21.9.3 **MVM Configuration**

The MVM shall record and update configurations to reflect current status and all changes. Current configuration information shall be available to all personnel authorized to gain entry to the MVM. The MVM shall immediately report to the CDS any change in MVM configuration. On demand, the MVM shall print an audit ticket indicating the configuration and the date and time each configuration item was changed.



At minimum, the MVM shall record and report the following configurations:

- ECU Operating System release
- MVM application software release
- Versions of software / firmware embedded in secondary controllers
- MVM fare table
- Anti-virus and anti-malware definitions file
- Other MVM configuration parameters

#### 17.21.9.4 *MVM Revenue Status*

On demand, an audit ticket with MVM revenue status information shall be printed. This information shall be restricted to those personnel with administrative and revenue access privileges.

The complete list of MVM revenue status properties to be recorded and reported shall be subject to CTDOT review and approval at the Preliminary and Final Design Reviews. **CDRL 17-55**

At a minimum, each MVM shall record and transmit to the CDS the following information about current revenue status.

- Serial number of each cash storage device
- Number and type of coins stored in each coin tube
- Number and type of coins stored in each of the coin hoppers
- Contents of bill vault (total and by denomination)
- Contents of coin vault (total and by denomination)
- Total value of all money currently stored in all devices

#### 17.21.9.5 *Current MVM Status*

Status of the MVM shall be recorded and updated to reflect changes in the MVM's condition. Current status information shall be available to all personnel authorized to gain entry to the MVM. Any change in MVM status shall be immediately forwarded to the CDS. On demand, the MVM shall print an audit ticket indicating all status conditions and the date and time each condition occurred.



At a minimum, the MVM shall record and report (via the CDS and on-demand printed audit receipts) the status conditions as listed in Table 17.21.9.3. The complete list of MVM status properties to be recorded and reported shall be subject to CTDOT review and approval at the Preliminary and Final Design Reviews. **CDRL 17-56**

Table 17.21.9.3: Current MVM Status Conditions Recorded and Reported

Status Category	Conditions Reported
MVM Operating Status	OK / Out of Service
Coin Status	OK / No Coins Accepted
Change Status	OK / Exact Fare Only
Bill Status	OK / No Bills Accepted
Smart Card Status	OK / No Smart Cards Accepted
Bank Card Status	OK / No Bank Cards Accepted / No Debit Cards Accepted
Receipt Status	OK / No Receipts Available
Power Status	OK / Battery Power
Communications Status	On-line / Off-line
Module Operating Status (each module, including) <ul style="list-style-type: none"> <li>- Bill Processing Module</li> <li>- Coin Processing Module</li> <li>- Ticket Printer/Encoder</li> <li>- Smart Card Dispenser</li> <li>- Alarm Module</li> <li>- Receipt Printer (if applicable)</li> <li>- Bank Card Reader</li> <li>- PIN Pad</li> <li>- Contactless Bank Card Reader</li> </ul>	OK / Jammed / Out of Service / Fault / Not Communicating / etc.
Patron Selection Button Status	OK / Fault / Button Jammed (Specify Button)
Ticket Stock Status (for each roll)	OK / Low / Empty /
Receipt Stock Status	OK / Low / Empty
Smart Card Dispenser Stock Status	OK / Low / Empty
Coin Vault Status (with serial number)	OK / Not Present / Near Full / Full
Supplemental Change Storage Module Status (for each module, with serial number)	OK / Not Present / Jammed / Fault / Low / Empty
Recirculating Coin System Status (for each denomination)	OK / Not Present / Jammed / Fault / Low / Empty
Bill Vault Status (with serial number)	OK / Not Present / Near Full / Full
SSMM Status	OK / Not Present / Fault / Data Mismatch
Security Status	OK / Door Unlocked / Door Open / Authorized Entry / Intrusion
Intrusion Alarm Status	OK / Intrusion Alarm Active
Impact Alarm Status	OK / Impact Alarm Active
Patron Display Glass Breakage Sensor	OK / Glass Breakage Sensor Active



#### 17.21.9.6 *Events Data*

The MVM shall record an event and report to the CDS whenever one of the data elements in Table 17.21.9.3 changes state. In addition, at a minimum, the following events shall be recorded by the MVM and reported to the CDS:

- MVM initialized (*i.e.*, ECU boot)
- MVM polled by CDS
- Data downloaded from CDS
- Anti-virus definitions downloaded from CDS
- Entry authorized by security code
- Entry authorized by alarm keyswitch (if applicable)
- Coin vault removed / installed
- Bill vault removed / installed
- Recirculating coin supply replenished (manually)
- Recirculating coins emptied to vault (manually)
- SSMM data retrieved
- MVM clock error (*i.e.*, excessive time difference)
- Failed/interrupted bank card authorization request
- Bad smart card presented and invalidated
- Failed/interrupted smart card transaction
- Manual diagnostic test routine initiated
- Supplemental change module removed / installed

Each event record shall contain, as appropriate, the MVM number, date, time, event code, employee identification number, MVM status, component code of inserted or removed component, and cash contents by denomination.

The MVM shall record an event each time the MVM outer door is unlocked and each time the MVM door is opened. Upon successful login of a maintenance or service technician, the MVM shall record an event that shall include at minimum the individual accessing the interior of the MVM, date, and time.

Errors caused by communication line problems and any resulting errors shall be recorded.

Each event shall be capable of being classified into one of at least three priorities. Event priorities shall be adjustable by CTDOT at the CDS. Each event priority level shall also be CTDOT definable as either an on-line or off-line event. On-line events shall cause the MVM to initiate communications to the CDS and transmit information about the event. Off-line events shall be recorded locally by the MVM and transmitted to the CDS upon the next polling. As delivered to CTDOT, all event priorities shall be classified as on-line events.

Events shall also be classified into categories to simplify later reporting and analysis. Each event shall be assigned to one of the following categories: Maintenance, Revenue, Administrative, or Other.

The complete list of events to be recorded and the priority and category of each shall be submitted to the CTDOT for review at the Preliminary Design Review, and is subject to CTDOT approval at the Final Design Review. **CDRL 17-57**

#### 17.21.9.7 *Alarm Conditions*

Events shall be considered alarm conditions of varying severity. The assigned priority of all alarms shall be configurable by CTDOT. The MVM shall transmit alarm conditions to the CDS as soon as possible. At a minimum, the following events shall be categorized as alarms (priority



3 events shall be categorized as informational events), and as delivered, the alarm priorities shall be assigned as indicated:

Table 17.21.9.7: MVM Alarm Condition Priorities

Alarm Type	Priority
<b>MVM Revenue Service Alarms</b>	
- Bill vault full	3
- Coin vault full	3
- Exact fare mode	3
- Supplemental change module empty	3
- Ticket stock empty	3
- Receipt stock empty	3
- Smart card stock empty	3
- Bill vault nearly full	3
- Bill vault removed	3
- Coin vault nearly full	3
- Coin vault removed	3
- Recirculating coin storage device removed	3
- Supplemental change module low	3
- Supplemental change module removed	3
- Ticket stock low	3
- Receipt stock low	3
- Smart card stock low	3
<b>MVM Maintenance Alarms</b>	
- MVM out of service	2
- Alarm unit out-of-order	2
- Bill Processing Unit out-of-order	3
- Coin Processing Unit out-of-order	3
- Patron Display out-of-order	2
- Patron keyboard out-of-order	2
- Smart card read/write module out-of-order	3
- Bank card system out-of-order	3
- PIN keypad out-of-order	3
- Power loss	2
- Ticket Printer/Encoder System out-of-order	2
- Receipt printer out-of-order (if separate)	3
- Solid State Memory Module out-of-order	3
- MVM time-of-day clock error	3
<b>Security Alarms</b>	
- Intrusion (unauthorized entry)	1
- Intrusion attempt (impact sensor activated)	1
- Unauthorized removal of cash storage device	1
- Outer door unlocked or open	2
- Service entry (authorized entry)	3

For each alarm event, a corresponding event to clear the alarm shall be transmitted by the MVM as soon as the alarm condition is no longer present. For Revenue Service and Maintenance Alarms listed above in Table 17.21.9.7, the alarm condition shall be cleared either automatically by the MVM or by manual intervention, as is appropriate to the alarm. Security Alarms listed



above shall remain in effect until the following actions occur, at which time the MVM shall transmit a corresponding event to clear the alarm:

Table 17.21.9.7a: Actions Required to Clear Security and Impact Alarms

Priority 1 Alarm	Action(s) to Clear
Intrusion (unauthorized entry or activated Glass Breakage Sensor)	Valid login at MVM
Intrusion attempt (impact sensor activated)	Valid login entered at MVM or 60 seconds (adjustable) without further impact activity
Unauthorized removal of cash storage device	Valid login of administrative user at MVM

A description of alarm processing shall be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 17-58**

17.21.9.8 **MVM Test Routines**

The MVM shall be capable of conducting a variety of test routines.

**17.21.9.8.1 Self-Diagnostic Tests**

Each MVM shall automatically perform self-diagnostic tests at regular intervals (at least once per day) and each time the MVM is initialized. Self-diagnostic tests shall at a minimum confirm communications integrity with all major modules, and to the extent possible, exercise all electro-mechanical devices. Any failures identified during self-diagnostics shall be recorded in the MVM's internal status registers and shall result in corresponding events being recorded by the MVM and transmitted to the CDS. The MVM shall indicate status using a local display and printout from the MVM upon request by technician. Self-diagnostic test routines shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 17-59**

**17.21.9.8.2 Manual Tests**

Each MVM shall be capable of performing test routines under manual command while the MVM is out of service and the front door is open. These tests shall permit the technician to easily determine that a module is functioning properly, and shall operate as follows.

- A. Under no circumstances shall these test routines result in the production of a valid ticket, encoding smart card data, coins or bills being deposited in the vaults, or revenue totals being altered in any way.
- B. The MVM shall maintain accurate count of manually printed test tickets for those ticket stocks that are sequentially numbered.
- C. The results (pass/fail) of all tests shall be displayed using a device or display that is visible while the MVM door is open.



At a minimum, the following test routines shall be available:

- Print a voided test ticket (one from each stock)
- Exercise coin acceptor system (allow coins to be inserted, validated, and returned)
- Exercise bill acceptor system (allow bills to be inserted, validated, escrowed, and returned)
- Read and display the contents of a Smart Card
- Request a test credit card authorization from the CDS, either by use of a test credit card, or a card of a type that shall be rejected by the CDS.
- Send test message to the CDS and receive acknowledgment
- Exercise all display elements of the Patron Display
- Verify alarm unit and siren functionality
- Verify ECU and removable Solid State Memory Module (SSMM) contents match
- Test patron selection keypad, and verify functionality of all buttons and touch screen regions (if touch screen interface is used).

A descriptive listing of all manually initiated diagnostic routines shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 17-60**

#### **17.21.9.8.3 Remote Tests**

It shall also be possible to initiate test routines remotely from any Revenue and Maintenance Workstation connected to the CDS. All remote tests shall be conducted only while the MVM is out of service but in communication with the CDS. If the MVM is in service, remote testing shall be preceded by a remote command to remove the MVM from service. Remote diagnostic tests shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 17-61**

At a minimum, it shall be possible to remotely instruct the MVM to:

- Report current status of all modules
- Remove the MVM from service (and cancel any transaction in progress)
- Reset the bill acceptor system (cause the unit to initialize and return to idle state)
- Reset the coin acceptor system (cause the unit to initialize, exercise automatic jam clearing, and return to idle state)
- Reset the Ticket Printer/Encoder System (exercise all ticket stock controls and return the Ticket Printer/Encoder System to idle state)
- Send test message to the MVM and receive acknowledgment
- Restore the MVM to service.

Under no circumstances shall the remote exercising of these test routines result in tickets or coins being dispensed other than the release of previously jammed tickets, coins, or bills.

## **17.22 MVM Transaction Procedures**

### **17.22.1 Ticket Purchases**

The MVM shall support purchase of tickets using cash, bank card (credit and debit), and stored value from a CTDOT-issued Long Term Smart Card. The user interface design shall endeavor to minimize the number of keystrokes and steps required to complete the transaction.





#### 17.22.1.1 **Ticket Quantity Selection**

While the MVM is able to vend tickets, a “Quick Ticket” selection shall be available that enables patrons to purchase one full-fare Local / CTDOT ticket with a single button or touch screen selection.

The MVM shall default all ticket purchases to single quantities, and the maximum quantity of tickets purchased in any single transaction shall be adjustable by CTDOT. As delivered, the maximum quantity of tickets purchased in a single transaction shall be set to ten.

The MVM shall also support the purchase of a variable number of tickets in a single transaction. When the number of tickets selected is one (the default), pressing the “DECREASE QUANTITY” selection button or touch screen region shall have no effect. When the number of tickets selected is the maximum allowed, pressing the “INCREASE QUANTITY” selection button or touch screen region shall have no effect.

As the patron changes selected ticket quantities, the MVM Patron Display shall indicate the quantity selected and total amount due.

As soon as the patron inserts cash or processes a bank card, it shall not be possible to alter the number of tickets selected without cancelling the transaction.

#### 17.22.1.2 **Cash Payment**

In normal operating mode, issuing fare media paid by cash shall require the following sequence of actions:

- Step 1 Patron selects type and quantity of tickets desired.
- Step 2 MVM shall activate all payment modules and the Patron Display screen shall indicate amount due and instructions.
- Step 3 Patron inserts coins and/or bills. Upon acceptance for first coin or bill, the MVM shall disable the bank card and smart card readers. Display screen shall decrement displayed amount due based on money collected by MVM.
- Step 4 When payment up to or in excess of correct fare value has been collected by MVM, the MVM disable the coin and bill payment modules and shall issue selected ticket(s) and change as necessary. Ticket(s) and coins shall be deposited in the Ticket/Coin Return Bin. If the MVM dispenses bills for change, bills shall be returned as appropriate.
- Step 5 The MVM shall display an appropriate “Transaction Complete” message for a period equal to the inter-transaction time-out.
- Step 6 The MVM shall return to idle condition.

#### 17.22.1.3 **Bank Card Payment**

Purchasing fare media with a bank card shall require the following sequence of actions:

- Step 1 Patron selects type and quantity of tickets desired.
- Step 2 MVM shall activate all payment modules and the Patron Display screen shall indicate amount due and instructions.
- Step 3 Patron inserts and removes bank card, or tags a contactless bank card to the reader. Upon successful read of the bank card, the MVM shall disable all payment modules.



- Step 4 If receipts are available, MVM prompts patron to select whether a receipt is desired. If receipts are unavailable, MVM prompts patron whether to continue with no receipt or cancel transaction.
- Step 5 MVM prompts and patron selects payment type (CREDIT or DEBIT), then enters their Personal Identification Number – “PIN” – for debit cards (or when required for EMV-compliant transactions), or billing address ZIP code for credit cards (US customers only), and follows other instructions on the display screen. Upon entry of PIN or ZIP code, the MVM shall initiate transaction authorization request to the CDS.
- Step 6 If authorization for the bank card transaction is received, the MVM shall issue the selected ticket(s). In the event a patron’s card is not authorized, the MVM shall display an appropriate message and return to Step 2 (showing the ticket(s) selected and the amount due). The patron may then resume the transaction with cash, a CTDOT-issued Long Term Smart Card, a different bank card, or cancel the transaction.
- Step 7 If the patron opted to receive a receipt, it shall be printed and deposited in the Ticket/Coin Return Bin.
- Step 8 The MVM shall display an appropriate “Transaction Complete” message for a period equal to the inter-transaction time-out.
- Step 9 The MVM shall return to idle condition.

#### **17.22.2 Smart Card Transaction Types**

The MVM shall support the following smart card transactions:

- A. Dispense new smart card – Using any payment method, this transaction will enable patrons to purchase a new smart card, which shall automatically be associated to an anonymous account. As part of the transaction, patrons may also select to add value to the associated account. If so configured by CTDOT, the MVM shall require patrons to add value to the associated account at the time the new smart card is purchased.
- B. Add value to smart card account – This transaction shall recharge the cash value of a patron’s smart card account up to a CTDOT-adjustable maximum amount, using cash or a bank card. At no time shall the account’s stored value exceed the maximum allowed.
- C. Add floating period pass to smart card account – Using cash or a bank card for payment, this transaction shall add a pending floating period pass to the patron’s smart card account, if the account has no other pending floating period pass.
- D. Check status and remaining value of smart card account – This transaction shall display on the MVM’s Patron Display the status and value of the card’s associated account.

##### **17.22.2.1 Purchase New Smart Card**

To purchase a new CTDOT-issued Long-Term Use Smart Card:

- Step 1 Patron selects “Purchase New Smart Card” transaction.
- Step 2 The MVM shall prompt the patron to select from among a menu of stored values to add to the new card’s associated account. If the menu does not include a zero value (configurable by CTDOT), the MVM shall require the patron to add a product to the card’s account as part of the transaction.
- Step 3 The patron selects a transaction amount from among the choices available.



- Step 4 The MVM shall display the price of the transaction (including the price to purchase a new card and any stored value to be added to the account), open coin and bill slots, activate the bank card reader, and prompt the patron to insert money or process bank card.
- Step 5 Patron pays for selected transaction. (See Paragraphs 17.22.1.2 and 17.22.1.3 for descriptions of MVM functions for cash and bank card payments.)
- Step 6 When cash payment up to or in excess of the transaction value has been collected by MVM, or authorization is received (for bank card payment), the MVM shall:
- Dispense a new smart card and report the sequential serial number of the dispensed card to the CDS as part of the transaction record
  - If excess cash was deposited for the transaction, issue change as required.
  - If payment was made by bank card, the MVM shall issue a receipt if so requested by the patron.
- Step 7 The MVM Patron Display shall indicate the value and status of the new card's account and an appropriate "Transaction Complete" message for a period of time equal to the inter-transaction time-out.
- Step 8 The MVM shall return to idle condition.
- Note that the patron shall be able to cancel the transaction at any point up to and including Step 7.

#### 17.22.2.2 **Add Stored Value**

To add stored value to a smart card account:

- Step 1 Patron selects "Add Value to Smart Card" transaction.
- Step 2 The MVM shall activate the Smart Card Reader and prompt the patron to present a CTDOT-issued Long Term Smart Card.
- Step 3 The MVM shall read the card's serial number. If the card is a valid CTDOT-issued Long-Term Smart Card, the MVM shall display the current information for the card's associated account, and deactivate the Smart Card Reader.
- Step 4 The MVM shall display a selection of available transactions by which the patron may add stored value to the card's account. The available selection of values to be added shall be limited by the maximum value a card's account can attain (CTDOT adjustable), and shall be further constrained by any calculated bonus values.
- Step 5 The patron selects a transaction amount from among the choices available.
- Step 6 The MVM shall display the price of the transaction, open coin and bill slots, activate the bank card reader, and prompt the patron to insert money or process bank card.
- Step 7 Patron pays for selected transaction. (See Paragraphs 17.22.1.2 and 17.22.1.3 for descriptions of MVM functions for cash and bank card payments.)
- Step 8 When cash payment up to or in excess of the transaction value has been collected by MVM, or authorization is received (for bank card payment), the MVM shall:
- If excess cash was deposited for the transaction, issue change as required.
  - If payment was made by bank card, the MVM shall issue a receipt if so requested by the patron.



Step 9 The MVM Patron Display shall indicate the new value and status of the card's account and an appropriate "Transaction Complete" message for a period of time equal to the inter-transaction time-out.

Step 10 The MVM shall return to idle condition.

Note that the patron shall be able to cancel the transaction at any point up to and including Step 7.

#### 17.22.2.3 **Add Floating Period Pass**

To add a floating period pass to a smart card account:

Step 1 Patron selects "Add Floating Period Pass to Smart Card" transaction.

Step 2 The MVM shall activate the Smart Card Reader and prompt the patron to present a CTDOT-issued Long Term Smart Card.

Step 3 The MVM shall read the card's serial number. If the card is a valid CTDOT-issued Long-Term Smart Card, the MVM shall display the current information for the card's associated account, and deactivate the Smart Card Reader. If the card's account has an existing pending floating period pass, the transaction shall be cancelled with an appropriate error message conveyed on the Patron Display.

Step 4 The MVM shall display a selection of available transactions by which the patron may add a pending floating period pass to the card's account.

Step 5 The patron selects a transaction from among the choices available.

Step 6 The MVM shall display the price of the transaction, open coin and bill slots, activate the bank card reader, and prompt the patron to insert money or process bank card.

Step 7 Patron pays for selected transaction. (See Paragraphs 17.22.1.2 and 17.22.1.3 for descriptions of MVM functions for cash and bank card payments.)

Step 8 When cash payment up to or in excess of the transaction value has been collected by MVM, or authorization is received (for bank card payment), the MVM shall:

- If excess cash was deposited for the transaction, issue change as required.
- If payment was made by bank card, the MVM shall issue a receipt if so requested by the patron.

Step 9 The MVM Patron Display shall indicate the new status of the card's account and an appropriate "Transaction Complete" message for a period of time equal to the inter-transaction time-out.

Step 10 The MVM shall return to idle condition.

Note that the patron shall be able to cancel the transaction at any point up to and including Step 7.

#### 17.22.2.4 **Check Smart Card Status and Value**

To check the value and status of a Long-Term Use smart card's account or a Limited Use smart card, the MVM shall perform the following steps:

Step 1 Patron selects Check Smart Card Status.

Step 2 The MVM shall activate the Smart Card Reader and prompt the patron to present a CTDOT-issued Smart Card (Long-Term or Short-Term).



Step 3 For Long-Term Use smart cards, the MVM shall read the card's serial number. If the card is a valid CTDOT-issued Long-Term Smart Card, the MVM shall display the current information for the card's associated account, and deactivate the Smart Card Reader.

For Limited Use smart cards, the MVM shall read the card's contents and value and display the current information and deactivate the Smart Card Reader.

Step 4 The MVM shall return to idle condition (without displaying a "Transaction Complete" message).

### 17.22.3 Smart Card Transaction Results Display

Whenever the MVM's Smart Card Reader reads a smart card, the status of the associated account or the contents of the card shall be shown in a consistent manner on the Patron Display. Information shown on the display shall indicate the status and content of the card or associated accounts after the card is read, and reflect the results of any transactions conducted. Smart card or account information displayed shall consist of at least the following:

- Smart card serial number
- Default fare category (Adult, Reduced, Student, etc.)
- Account or Card status (Active, Dormant, Deactivated)
- Current stored value and pass status (if any, displayed only for active cards)
- Card expiration date (if applicable)

The content and format of the Smart Card Transaction Results Display shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 17-62**

## 17.23 MVM Screen Flow

The progression of screens presented to the patron during transactions shall be logical and straightforward. To the extent possible, the MVM screen flows shall follow the steps outlined above.

The Contractor shall provide detailed screen flows depicting "snapshots" of each screen layout arranged as a logical flow chart for CTDOT review at the Preliminary Design Review and approval at the Final Design Review. The flow charts shall depict the screen flows for the MVM as it will be configured for revenue service, and as configured to support all fare products (current and future). **CDRL 17-63**



## 18 Retail Point of Sale Network

### 18.1 General Requirements

An essential component of the NFTS, for an initial period concluding 5 years after the start of NFTS revenue service (and for any optional periods exercised by CTDOT), the Contractor shall provide systems and services to establish a Retail Point of Sales Network. In general, in cooperation with participating retailers, the Contractor shall:

- Implement interfaces with cash register systems at participating retailers to enable media purchase and account value replenishment transactions for CTDOT-Issued Long-Term Smart Cards
- Package, distribute, and sell new CTDOT-Issued Long-Term Smart Card media
- Add value to accounts for new and existing CTDOT-Issued Long-Term Smart Cards

### 18.2 Fare Media Design

In support of the retail cash register transactions, the Contractor shall define requirements for the CTDOT-issued Long-Term Smart Card media designs, including UPC barcodes, magnetic stripes, and other such features. The Contractor shall document all such required fare media design features in a submittal provided no later than the Final Design Review. **CDRL 18-1**

### 18.3 Fare Media Packaging

The Contractor shall package CTDOT-issued Long-Term Smart Card media onto holders or other devices suitable for displaying media for sale on in-store racks of comparable gift cards. The Contractor shall develop graphic designs and informational text on the packaging in coordination with CTDOT marketing staff.

All fare media packaging designs (excluding graphics and text) shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review.

**CDRL 18-2**

CTDOT shall approve fare media package graphics design and text content no later than 180 days prior to start of fare media distribution. **CTDOT 18-1**

### 18.4 Fare Media Distribution

The Contractor shall distribute media to participating retailers. The Contractor shall commence services to provide retail distribution (to CTDOT customers) of Long-Term Smart Card media no less than 60 days prior to the start of NFTS revenue service. The Contractor shall maintain distribution services such that all participating retailers have sufficient inventory to satisfy anticipated and ongoing customer demand

### 18.5 Fare Media Inventory

The Contractor shall maintain accurate records of all fare media inventory, including at the distribution points and at all retailers. The Central Data System shall include suitable reporting tools to enable CTDOT to monitor and track all inventory for the retail sales distribution channel.



## 18.6 Retailer Participation

The Contractor shall identify and select retailers to participate in the NFTS Retail Point of Sale Network. The Contractor shall select retailers in sufficient quantity and geographic diversity to ensure that CTDOT's fare media sales and replenishment services are convenient and compliant with all State and Federal regulations, including ADA and Title VI.

The Contractor shall provide the list and location (in listing and map forms) of participating retailers for CTDOT review and approval at the Final Design Review. **CDRL 18-3**

## 18.7 Retailer Coordination

The Contractor shall coordinate with participating retailers to ensure that retailer cash registers are able to conduct media sales and account replenishment transactions in time for commencement of media distribution and NFTS revenue service.

## 18.8 Retailer Compensation

The Contractor shall provide and manage all compensation for participating retailers.

## 18.9 Retailer Cash Register Interfaces

The Contractor shall develop the necessary interfaces to enable participating retailer cash registers to conduct sale and replenishment transactions.

For simplicity, all retail cash register transactions to replenish accounts shall be for stored value only.

The retail cash register applications shall enable CTDOT to establish at minimum:

- The price of a new CTDOT-issued Long-Term Use Smart Card
- The selections available for account replenishment transactions, including a minimum value

Upon completion of every sale and replenishment transaction, the cash register application shall indicate the value of the card's associated account.

Retail cash register transaction receipts shall also include a record of the CTDOT-issued card transaction, which shall include the card's sequential serial number, the transaction value, and the resulting account balance.

## 18.10 NFTS Central Data System Interface

The Contractor shall develop the interfaces to enable, at minimum:

- Retail sales and replenishment transactions to be reported to the NFTS Central Data System
- A card's account value to be reported to the cash register within 5 seconds after completion of a transaction
- CTDOT to configure the cash register application for the price of new fare media and the menu of replenishment transaction values



## 18.11 Transaction Records

All Retail Point of Sale Network fare media sale and replenishment transactions shall be reported to the NFTS Central Data System within 10 seconds of completion of the customer's retail transaction.

The transaction records shall include, at minimum:

- Date, time, and location of the transaction
- Transaction identification number (unique per location)
- Transaction type (e.g., new account / add value / both)
- Card sequential serial number
- Transaction value





## 19 Administrative Point of Sale Terminals

The Administrative Point of Sale Terminal (APOS Terminal) shall be a modular, PC-based device, and shall support multiple configurations, depending on the modular components included. The APOS Terminal hardware shall be optimized for its intended use and configuration. The Contractor shall supply two configurations of the APOS Terminal:

- Front Office Administrative POS Terminal
- Portable Administrative POS Terminal

### 19.1 Administrative POS Terminal Software

All OEM-supplied operating system and application software shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review.

#### 19.1.1 Operating System

The Administrative POS Terminal shall utilize a standard Microsoft Windows® operating system (minimum Windows® 7). **CDRL 19-1**

#### 19.1.2 Application Software

The Administrative POS Terminal shall use application software that is developed with a high-level language and that supports all functions described herein.

#### 19.1.3 Fare Tables

The Administrative POS Terminal shall retain in non-volatile memory the current and at least two future fare tables. Each future fare table shall include all entries to reflect the intended fare structure and the date and time at which the new fare structure is to take effect.

#### 19.1.4 Data Registers

Each APOS Terminal shall contain registers that track the following information:

- The unique serial number of the APOS Terminal
- The total number and value of all transactions completed by the APOS Terminal since data was last uploaded to the CDS. These registers shall be modified only by the Administrative POS Terminal itself and shall not be manually alterable.
- The date and time of the last successful data upload to the CDS. This register shall be modified only by the Administrative POS Terminal itself and shall not be manually alterable.
- The assigned IP address or secure web site to initiate data transfer to the CDS. This register shall be modifiable only by use of a maintenance password.
- Maximum number and value of transactions that can be conducted prior to uploading data to CDS. These registers shall be modifiable only by download from the CDS and by use of a maintenance password.

#### 19.1.5 Data Records

The Administrative POS Terminal shall store records of transactions, events, operator login and logout, and diagnostics. Each data record shall incorporate a unique identification number for



that APOS Terminal and day and shall be date/time stamped. Each data record shall be stored in the APOS Terminal memory for transfer to the CDS.

#### 19.1.5.1 **Transaction Records**

Each APOS Terminal patron transaction record shall, at minimum, consist of the following:

- Sequential transaction number (unique per APOS Terminal)
- APOS Terminal number
- Location (where available)
- User ID
- Serial number of card
- Time and date
- Transaction type (e.g., stored value, pass type)
- Transaction value
- Payment amount per payment method

#### 19.1.5.2 **Login / Logout Records**

When a user signs on to the APOS Terminal, the following data shall be stored in a data record:

- APOS Terminal number
- Location (where available)
- User ID
- Time and date
- Login attempts

When the user logs off the APOS Terminal, the device shall store a similar record and shall include summaries of the sales and transaction values and counts for each of the various transaction types.

#### 19.1.5.3 **Event Records**

The Administrative POS Terminal shall be capable of recording locally data representing no less than 1,000 events, including changes in status and communication problems. At a minimum, each event record shall include:

- APOS Terminal number
- Time and date
- Event code
- Any associated event data

#### 19.1.5.4 **Diagnostic Records**

The Administrative POS Terminal shall create data records each time a problem is detected during the automatic diagnostic testing. These records shall be a sub-set of the event records identified above and shall include the following additional information:

- Identifier of the failed test
- Iteration number of test
- Reason for test failure (unique code)
- Additional information to define the nature of the failure



#### 19.1.6 Action List

The Administrative POS Terminal shall receive from the CDS and store a list smart card serial numbers for which specific actions are required (*i.e.*, the Action List).

- A. All smart card transactions shall be confirmed against the Action List, which shall be internally recorded by the APOS Terminal. No smart card transaction shall be completed until the smart card serial number has been confirmed to be not on the list. Transaction times for smart cards shall include the time necessary to search the maximum-length action list.
- B. Whenever a smart card presented to the APOS Terminal is on the Action List, the APOS Terminal shall record the transaction and respond according to the action list category (*i.e.*, deactivate, suspend, reject, track, etc.) The "Action List Activity" transaction record shall include the APOS Terminal number, date, time, smart card serial number, and the card's current value and status.

#### 19.1.7 Authorized Transaction Limits

Each APOS Terminal shall have limits that control the number and value of transactions that the device may conduct before transaction data must be uploaded to the CDS. As each transaction is conducted, the APOS Terminal shall increment internal data registers that track the number and value of completed transactions. When either data register is within 75% of the defined limits for the device, the APOS Terminal shall initiate data communications with the CDS. Upon successful completion of data uploading, the data registers reflecting number and value of transactions since last data upload shall be zeroed. If the APOS Terminal cannot communicate with the CDS, the device shall make repeated attempts at communicating at a CTDOT-configurable interval, initially set to once every 5 minutes.

If an APOS Terminal reaches the permitted limit of the number or value of transactions without data uploading, the device shall discontinue all sales and replenishment transactions until all transaction data is successfully transmitted to the CDS.

#### 19.1.8 Configurability

In addition to the ability to configure the APOS Terminal hardware for the three versions, the APOS Terminal application software shall at minimum support configurability for:

- Operator interface
- Operating parameters
- Products Available for Sale and Upgrade
- Pricing
- Payment Method selection
- Receipt Content

As described herein, the APOS Terminal shall also support configurability through numerous adjustable parameters, centrally controlled and transmitted via the CDS.

The Contractor shall submit a comprehensive document describing the configurability of the APOS Terminal, including a listing of all configurable parameters and their value range, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 19-2**



### 19.1.9 Set-up and Administration

Before entering service, the APOS Terminal shall require initialization via maintenance activity. Maintenance users shall be able to set local configurable parameters and reset data registers as necessary. Once installed, the Administrative POS Terminal shall not enter service until it has communicated with the CDS to receive current fare table, application software, administrative and maintenance login IDs, Action List, and other configurable data.

Only APOS Terminals that are recognized by the CDS (as established in the CDS databases) shall receive initialization data.

### 19.1.10 Anti-Virus and Anti-Malware Software

On each APOS Terminal, the Contractor shall supply, install, and configure client versions of anti-virus and anti-malware software that is compatible with the enterprise software. This software shall be operational at all times while the APOS is operating.

The APOS Terminal shall automatically install updates to the anti-virus and anti-malware software upon receipt from the CDS.

Definitions for virus and malware programs shall be updated regularly. All APOS terminals shall receive such updates no less than 48 hours after the OEM releases updated definitions. The CDS shall distribute updates for virus and malware program definitions to each APOS terminal.

The Contractor shall identify the anti-virus and anti-malware software package for CTDOT review and approval at the Preliminary Design Review.

### 19.1.11 APOS Terminal Software Design Submittals

The Contractor shall submit descriptions of the APOS Terminal software design for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. APOS Terminal software design submittals shall include:

- APOS Terminal data registers **CDRL 19-3**
- APOS Terminal transaction, event, login, etc. records **CDRL 19-4**
- APOS Terminal operator interface **CDRL 19-5**
- APOS Terminal Action List storage, update, and processing **CDRL 19-6**
- APOS Terminal transaction limitation procedures **CDRL 19-7**
- APOS Terminal setup and administration procedures **CDRL 19-8**
- APOS Terminal anti-virus and anti-malware software and procedures **CDRL 19-9**

## 19.2 Functionality

The Contractor shall present a comprehensive summary of all Administrative POS Terminal functionality for CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. Also included in this summary shall be the layout of all Administrative POS Terminal screens, descriptions of all configurable parameters and tables, and the process flows for all transaction types. **CDRL 19-10**



### 19.2.1 General

The Administrative POS Terminal shall satisfy the following general requirements:

- A. When configured to do so, the APOS Terminal shall replace CTDOT's current cash registers and credit card devices with a single integrated system.
- B. The APOS Terminal shall be the primary user interface used by CTDOT clerks for selling products and fare media available at the CTDOT-operated retail sales locations.
- C. The APOS Terminal shall be the primary user interface used by CTDOT sales clerks for the issuing, loading value or products, reviewing, and updating smart cards.
- D. The APOS Terminal shall manage product menu selections, and payment collection and sources.
- E. The APOS Terminal shall interface to the CDS to download fare tables, configuration parameters, login authorizations, and other functions described herein, and to upload transaction records and other data as required. Communications with the CDS shall be via a wide area network supplied by CTDOT.
- F. Normally, the APOS Terminal shall be in communication with the CDS and report all transactions to the CDS as each transaction concludes. However, if the Terminal is not on-line with the CDS, all transaction records shall be stored locally and transferred once connected to the CDS is restored. In addition, all transaction data shall be stored on a secure USB drive and manually transferred to the CDS when necessary.
- G. The APOS Terminal shall track the issuance of new smart media and inform the CDS via transaction records when each smart media has been placed in circulation.
- H. The APOS Terminal software shall provide selection buttons by which multiple smart fare media with identical characteristics and products may be purchased or produced.
- I. The menu and price of all products presented for sale shall be customizable by downloading configuration data and tables from the CDS.
- J. The APOS Terminal shall provide the capability by which patrons are permitted to pay for their transactions using a combination of the payment methods, cash, credit, and check.
- K. The APOS Terminal shall fully comply with the Payment Card Industry's Data Security Standard (PCI DSS) in effect at the time of contract award and this shall be maintained throughout the warranty by the Contractor.

### 19.2.2 Smart Card Sales Transaction Types

The CTDOT clerk shall utilize the APOS Terminal to make the appropriate menu selections and collect payment. Upon collection of payment, the clerk shall present the smart media to the APOS Terminal's CSCP, which shall encode the media according to the selected transaction.

The APOS Terminal shall conduct the varieties of smart media transactions required to support CTDOT's fare policies in effect at the time of Contract award, and those defined herein. At minimum, these transactions shall include:

- Issue new fare cards (with and without fare product, and with and without deposit)
- Add stored value to an issued smart card
- Add a pending unlimited ride pass to an issued smart card
- Add a stored ride pass to an issued smart card
- Conduct a read-only transaction and display the card's current information



At time of issuance, all CTDOT-issued smart cards shall be encoded with user profile information.

At no time shall the Administrative POS Terminal add a pass to a smart card if doing so would result in the smart card having more than two passes (active or pending).

If a smart card has an existing pending pass and no active pass, the APOS Terminal shall restrict any second pending pass to be identical to the existing pending pass. If the patron wishes to add two pending passes in one transaction (provided no other pass exists on the patron's card), the Administrative POS Terminal shall restrict the pending passes to be identical.

All unlimited ride floating period passes shall be encoded in the pending state (without an expiration date associated with the pass product).

### **19.2.3 Integration with Cash Drawer and Payment Modules**

When configured to process cash transactions, the APOS Terminal shall control a cash drawer to securely store coins, currency, coupons, and other instruments of value. The cash drawer shall open only under command of the Administrative POS Terminal, which shall also monitor the status of the drawer at all times.

In addition, when configured, the APOS Terminal shall also include an integrated bankcard reader for conducting and authorizing credit and debit card payments.

### **19.2.4 Integration with Media Personalization Equipment**

The Administrative POS Terminal shall include the necessary software and peripherals to enable CTDOT to issue personalized cards to customers eligible for specialized fares, CTDOT employees, and in support of other fare programs (such as personalized cards for Corporate Partners). Personalized cards shall include the cardholder's name and photograph printed on one side of the card, accompanied by other CTDOT-defined graphics. In addition, the APOS Terminal shall encode personalized cards at the time of issuance with the relevant user profile information and other data as necessary to satisfy the transaction and CTDOT fare policies.

### **19.2.5 Payment Methods**

In recognition that CTDOT desires to provide convenient point-of-sales services, the APOS Terminal shall support a variety of payment methods. These shall include:

- A. Cash
- B. Bankcards: credit and debit, one or more per transaction , but only one bankcard type (credit or debit) per transaction
- C. Checks
- D. PayPal®
- E. Exchange of non-smart card fare media
- F. Any combination of the above

The APOS Terminal shall track, count and accumulate all transaction payments, by method of payment. CTDOT shall be able to enable or disable any of these payment methods to suit their operational needs, via the setting of parameters at the CDS.



## 19.2.6 Sales Procedures

When configured to conduct sales transactions:

- A. The APOS Terminal shall function as an “intelligent cash register,” allowing patrons and clerks to interact in a manner that is as similar as possible to normal retail sales transactions. To that end, the APOS Terminal shall structure each transaction around a patron’s desire to purchase smart cards, to add value to existing smart cards, and to purchase other non-fare products.
- B. The APOS Terminal shall present the clerk with selections that change as the transaction progresses, and prompt the clerk when certain tasks are required.
- C. When issuing a new smart card, the APOS Terminal shall permit the clerk to select whether a CTDOT-configurable deposit is to be collected.
- D. Via the Administrative POS Terminal software, the purchase of multiple fare products for a single smart card shall be possible with a single (total) amount due shown, and with payment collected once.
- E. When adding product to a previously issued smart card is required, the sales clerk shall tag the fare instrument to the APOS Terminal Contactless Smart Card Processor (CSCP) once at the beginning of the transaction to read the fare card’s current contents. After payment is collected, the sales clerk shall tag the fare card a second time to the CSCP to encode the fare card with the new fare product. Alternatively, and preferred, the CSCP shall be designed so that smart cards may be placed on the reader for the duration of the transaction.
- F. When multiple fare products are being purchased for addition to a single smart card, selections shall be editable at the APOS Terminal prior to collecting payment

### 19.2.6.1 Cash Transactions

Cash transactions shall provide total amount due, shall allow clerk to enter amount tendered, and shall display change due.

The APOS Terminal shall control and monitor the cash drawer, shall open the cash drawer when the clerk indicates that payment has been received, and upon calculation and display of the amount of change due.

The APOS Terminal shall require the operator to identify the initial funds bank (*i.e.*, starting cash drawer balance) at the start of each shift (main and relief). Upon logging out or otherwise indicating an end-of-shift condition, the APOS Terminal shall produce a report and receipt depicting the ending balance of the cash drawer.

The Terminal shall also support relief shifts, with the replacement of the cash drawer. The APOS Terminal shall also maintain statistics for the relief shift separately and shall not affect the main shift information.



#### 19.2.6.2 **Bankcard Transactions**

All credit and debit card transactions shall be authorized via the Administrative POS Terminal and its connection to the CTDOT bankcard authorization service. Communication with the bankcard authorization service shall be via the CTDOT wide area network.

For bankcard transactions, the APOS Terminal shall read the card using the bankcard reader.

If the credit card transaction is authorized by the processing center, the APOS Terminal shall activate the electronic signature capture device. The APOS Terminal shall record the patron's signature and display the captured signature on the APOS Terminal screen for the clerk's inspection.

Upon the clerk's confirmation, the patron shall be requested to authorize the transaction using a button or touch region on the bankcard processing module.

When credit card processing is complete, the clerk shall tag the patron's fare instrument to the CSCP, and upon successful encoding, the APOS Terminal shall issue a receipt for the transaction that complies with all Federal Reserve Board and relevant industry regulations. If the transaction is not authorized, the sales clerk shall be notified and the patron shall be allowed to make alternate payment.

Debit card transaction processing shall be similar to credit card transactions, except that in lieu of collecting the patron's signature, the patron shall be prompted to enter their Personal Identification Number (PIN) using the PIN pad on the bankcard module.

Similarly, for credit card transactions that require PIN entry, the APOS Terminal shall prompt the patron to enter their PIN using the PIN pad in lieu of activating the signature capture device.

#### 19.2.6.3 **Exchange of Old Fare Media**

The Administrative POS Terminal shall provide means by which patrons may exchange unused existing CTDOT fare products (non-smart card) for smart card-based fare products, pro-rated if necessary according to policies defined by CTDOT. Such exchange policies need not be programmed into the APOS Terminal, but may be based on manual entry of exchange value.

#### 19.2.6.4 **Non-Fare Media Sales Transactions**

The APOS Terminal shall support the sale of products that do not involve smart card fare media. All such products shall include entries in the CDS fare table that shall include description, price, and applicable sales taxes.

The APOS Terminal shall support transactions involving non-fare media products independently and in conjunction with fare media transactions.

#### 19.2.6.5 **Receipts**

The Administrative POS Terminal shall print a patron receipt for every completed sales transaction.

All receipts for credit and debit card transactions shall comply with all Federal Reserve Board regulations and other applicable standards.

Each receipt shall include a CTDOT-configurable header (in text form), the date, time, store location, clerk identification number, device number, and the total value of the transaction.

At minimum, the APOS Terminal shall, provide the same receipts and reports as the MVM





### 19.2.7 Issuance of Personalized Media

The Administrative POS Terminals shall provide CTDOT with the necessary features to produce personalized long-term use smart cards, encoded with the relevant fare privileges, for each user requiring personalized media.

The APOS Terminal shall support issuance of personalized cards in individual and multiple “bulk” production modes.

- A. For individual card personalization, a digital camera controlled by the APOS Terminal shall capture the customer’s image in .jpg or other standard graphics file format.
- B. For bulk card personalization production runs, the APOS Terminal shall use data files imported from an external source in a Contractor-specified format; the data files shall include the customer name, digital photograph, and other information as required.
- C. All transaction records for issuance of a personalized card shall include a record of the digital photograph printed on the card.
- D. The Contractor shall supply printing templates (also known as “masks”) using CTDOT-supplied graphic designs for all personalized card types. The APOS Terminal shall support no less than 10 pre-loaded templates from which the user shall select prior to printing. Where possible, template selection shall be automatic based on card type; for example, when selecting a Half Fare or CTDOT Employee ID card, the APOS Terminal shall automatically select the appropriate template.

CTDOT shall supply the graphics for printing templates within 90 days after the NTP is issued. **CTDOT 19-1**

The Contractor shall supply printing masks no later than 30 days before the commencement of APOS Terminal Factory Acceptance Testing. **CDRL 19-11**

The Contractor shall supply complete documentation describing the format and layout of printing templates for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 19-12**

- E. When printing a personalized card, the APOS Terminal shall scale the photo image to fit within the area defined by the printing template (*i.e.*, “mask”) without distorting the image or changing its native aspect ratio.

#### 19.2.7.1 *Media Personalization Process*

The APOS Terminal shall provide the operators with a structured process to produce personalized cards individually, for use in cases where the customer is present. In such cases, the APOS Terminal shall prompt the operator for the relevant input required for each step of the issuance process, including but not limited to:

- Step 1 Operator queries the customer for their CTDOT account information (login and a secret question). If the customer has an existing account, upon verification, the CDS shall transmit to the APOS Terminal the customer’s name and other data as necessary and populate the relevant data fields on the APOS Terminal screen. If the customer has no existing CTDOT account, the operator shall assist the customer in creating a new account.



Step 2 The APOS Terminal shall prompt the operator to enter additional information including:

- The customer's specialized fare authorization information (e.g., authorization case number, provided by CTDOT, Medicare Card information, retiree number, etc.), if applicable
- The fare category (Full Fare, Half Fare, CTDOT Employee, Concession Fare)
- If applicable, the specialized fare profile expiration date (default configurable by CTDOT; the Terminal shall provide the operator the ability to override the default expiration to a shorter validity period)

Step 3 The APOS Terminal shall prompt the operator to capture a digital photograph, using the Terminal's digital camera. If the customer has an existing account with a stored digital image, the APOS Terminal shall display that image for the operator. If the customer wishes to use the existing photograph (subject to approval and verification by the operator), the APOS Terminal shall use the existing image for production of the card.

Step 4 Upon entry of all necessary information and the transfer of the digital photograph to the APOS Terminal, the Terminal shall initiate the production of the personalized smart card, including all printing and data encoding.

Upon successful production of the personalized smart card, the APOS Terminal shall store a transaction record, including all personalization data, the sequential serial number of the issued card, the digital photograph image, and all other transaction data. The Terminal shall transfer the entire transaction record and all accompanying data to the CDS.

The Administrative POS Terminal shall use distinctive printing templates (or "masks") according to the fare category selected.

#### **19.2.7.2 Issuance of Half Fare Media**

CTDOT will issue customers with Half Fare privileges personalized smart cards for their individual use. These smart cards shall incorporate personalized information printed on one side of the card, including a digital photograph and the name of the cardholder.

Using the appropriate customized printing template customized for Half Fare media, the APOS Terminal shall print and issue (encode) personalized cards using the appropriate long-term smart card stock.

#### **19.2.7.3 Issuance of CTDOT Employee and Operator ID Cards**

Using a printing template customized for CTDOT employee ID cards, the APOS Terminal shall print and issue (encode) personalized CTDOT employee cards on the CTDOT Employee Combination Media.

During the issuance process, the APOS Terminal shall prompt the operator to enter personal information as required by CTDOT personnel policies, and whether the employee is an authorized bus operator or maintenance technician; the APOS Terminal shall incorporate all information into the issuance transaction record and transmit each record to the CDS.

CTDOT Employee ID cards with "Operator" or "Maintenance" permissions shall also have such permissions printed on the card as part of the personalization process.

If the issue record indicates that the CTDOT Employee ID is for an operator or maintenance technician, the CDS shall automatically add the card's sequential serial number, type



("Operator" or "Maintenance"), and PIN to the Valid Operator ID List. (Operator and Maintenance PINs shall be the CTDOT Employee Number, entered with other personnel information.)

#### **19.2.7.4 Issuance of CTDOT Concession Fare ID Cards**

Immediate CTDOT employee family members and CTDOT retirees are eligible for concession fares on all CTDOT services. Currently, the fares are free, but the NFTS shall support setting these concession fares independently of all other fare categories.

Using a printing template customized for CTDOT concession fare IDs, the APOS Terminal shall print and issue (encode) personalized CTDOT Concession Fare IDs onto long-term smart card stock.

#### **19.2.7.5 Bulk Card Personalization Production**

The Front Office APOS Terminal shall exclusively support production runs (using data imported from an external source) for bulk card personalization in quantities of 1 to no less than 100 cards per batch. The Front Office APOS Terminal shall support selection of custom printing templates for bulk personalization production, which may be used to support Corporate Partner, University, or other institutional programs.

Upon successful production of each card, the Front Office APOS Terminal shall store a transaction record similar to those created for individually personalized cards, and transmit all records to the CDS.

### **19.2.8 Non-Sales Transactions**

#### **19.2.8.1 Replacement of Lost or Stolen Registered Media**

The APOS Terminal shall support replacement smart cards with restoration of the remaining value from the lost or stolen media onto the replacement media.

If the patron registered their smart card with CTDOT, this action shall not require the presence of the patron's old fare instrument.

The APOS Terminal shall utilize the CDS database for information about the card to be replaced. The sales clerk shall access the CDS database to determine if the fare instrument is eligible for replacement (that is, it is not on the action list for deactivation) and the value and/or products to be encoded on the replacement card. If the smart card is eligible for replacement, the APOS Terminal shall automatically establish the transaction or transactions necessary to issue and encode the replacement card.

Upon placing the replacement card against the CSCP antenna, or upon initiation of the production of a replacement personalized card in the Smart Card Encoder/Printer, the APOS Terminal shall issue and encode the replacement card.

In conjunction with issuing and encoding the replacement card, the APOS Terminal shall notify the CDS to place the replaced card on the action list for deactivation.

Appropriate entries in the database shall indicate that the old card is deactivated and no longer in circulation, and that the new card has been issued as a replacement.

When replacing a previously issued personalized card, the APOS Terminal shall support use of the digital photograph, printing template, and other data from the original issue record to facilitate replacement without requiring the cardholder's presence, or the use of the digital camera to create and store a new digital image.



#### 19.2.8.2 **Replacement of Defective Media**

Replacing a malfunctioning smart medium shall be possible if the patron can present the malfunctioning fare instrument. Procedures to replace a defective card shall be similar to those used to replace a lost registered card, but replacement of a defective card shall not require the card to be registered.

#### 19.2.8.3 **Reactivation of Dormant Fare Media**

The APOS Terminal shall support reactivation of dormant smart cards. Smart cards that are dormant according to the definition and process shall be reactivated by the APOS Terminal in the following manner:

- Step 1 A patron with a dormant smart card shall present the fare instrument to the Administrative POS Terminal clerk.
- Step 2 The clerk shall cause the APOS Terminal to read the card to confirm that the card is functional but dormant.
- Step 3 The clerk shall initiate a reactivation procedure wherein the APOS Terminal shall query the CDS database to determine if the fare instrument was deactivated. (Note that after a smart card is declared dormant, it may be removed from the action list. The CDS shall retain a record of all smart cards that were ever deactivated.)
- Step 4 If the smart card was never deactivated, the APOS Terminal shall reactivate the smart card by encoding it with a new "last transaction date" record. At such time, any fare products that are not time-sensitive (*i.e.*, stored value, stored ride) shall be reinstated on the card. If the smart card was deactivated, the transaction shall abort.
- Step 5 The APOS Terminal shall record the reactivation transaction and transmit the record to the CDS.

#### 19.2.8.4 **Refund and Reversal Transactions**

The APOS Terminal shall provide operators the ability to reverse previous transactions for refund or error correction purposes. If necessary, multiple reversal transactions shall be used to reverse multiple fare products on a single fare card. Reversal transactions shall require the deletion of the relevant fare product from the patron's smart card, or deduction of the stored value or stored rides added during the replenishment transaction.

Reversal transactions shall require the operator to select the transaction for reversal from a list of eligible replenishment transactions generated by the APOS Terminal after reading the card.

The APOS Terminal shall also provide the ability for patrons to receive refunds for unused fare products, pro-rated if necessary by formulae defined by CTDOT, and downloaded to the APOS Terminal from the CDS.

The APOS Terminal shall fully record and transmit to the CDS all refund and reversal transactions.

#### 19.2.8.5 **Multiple Card Issuance Transactions**

The Front Office APOS Terminal shall exclusively support transactions that issue multiple (non-personalized) cards of the same type. These transactions shall be separately tracked and recorded, and shall enable authorized users to produce multiple cards (encoded manually, one at a time) for bulk production purposes.



The multi-card issuance function shall support transactions in the range of 2 to 1,000 cards. While conducting these transactions, the APOS Terminal shall display the number of cards completed and the number of cards remaining in the transaction. Cards that fail to encode properly shall be clearly identified to the operator for retry or replacement; the counters of cards completed and remaining shall not change unless a card is successfully encoded.

At the conclusion of the transaction, the Administrative POS Terminal shall generate and display a report showing the sequential serial numbers of all cards encoded in the transaction. The displayed report shall be user-configurable to be sorted by order of production or by sequential serial number. The user shall be able to easily direct the displayed report to a local printer.

A record of the multi-card transaction shall be transmitted to the CDS. Each card successfully encoded during the transaction shall be recorded in the CDS in the "issued" state.

#### **19.2.8.6 Barcode Ticket Printing**

Using a standard, commercial laser printer, the Front Office APOS Terminal shall support production and printing of barcode tickets to be used for special events and other time-specific, short-term use.

Barcode tickets shall be printed onto commercially-available, pre-perforated sheets containing 8 to 12 tickets per sheet.

Barcode tickets shall include printed information in human-readable form (no less than 14-point font) and in secure 2D barcode, using the same encryption key and algorithm. Printed human-readable and barcode data shall include, at minimum:

- Unique serial number
- Ticket type
- Validity start (date, time)
- Validity end (date, time)

Printed human-readable information shall also include CTDOT-configurable text, no less than 3 lines with no less than 12 characters each, in 18-point font or larger.

Tickets shall be produced in batches consisting of user-selectable quantities ranging from 1 to no less than 1,000 tickets. Ticket type, validity start and end parameters, text fields, and other data shall be user-selectable prior to commencing printing. Except for the serial numbers, all tickets produced for a batch shall be identical.

The Front Office APOS Terminal shall produce a variety of no less than 16 pre-defined ticket types (durations), configurable at the CDS in both Full Fare and Half Fare versions. These shall be identified by CTDOT at the Preliminary Design Review **CTDOT 18-1**

The APOS Terminal shall record the production of all barcode tickets and transmit relevant transaction records to CDS.

### **19.2.9 Customer Account Management**

#### **19.2.9.1 Customer Account Setup and Modification**

Via interaction with the CDS data entry forms, the APOS Terminal shall enable operators to setup and modify customer accounts.

For new accounts, the APOS Terminal shall sequentially prompt the operator to enter the customer's name, address, phone number, and other requisite information, including a requested login ID (which the APOS Terminal shall verify as being unique via a query to the



CDS). The CDS shall assign all new accounts a random 4-digit password, which the APOS Terminal shall print on a receipt and which the CDS shall require the customer to change upon first subsequent login.

#### **19.2.9.2 *Media Registration***

The APOS Terminal shall enable patrons to register their smart cards to enable replacement of the card with restoration of residual value in the event of theft or loss. Registration shall require the patron to present the smart card being registered. The clerk shall populate the requisite registration information by accessing the CDS database data entry form. To prevent manual data entry error, entry of the sequential serial number of the patron's smart card shall be by use of the Administrative POS Terminal's Contactless Smart Card Processor (CSCP).

#### **19.2.9.3 *Setup, Modification, and Cancellation of Autoload Subscriptions***

Via interaction with the CDS data entry forms, the APOS Terminal shall enable operators to establish, modify, and cancel patron subscriptions for autoload transactions. To prevent manual data entry error, entry of the sequential serial number of the patron's smart card shall be by use of the APOS Terminal's Contactless Smart Card Processor (CSCP), and the Terminal's Bankcard Processor module shall read any bankcard data required for the subscription.

If subscription autoload transactions require data encoded on the customer's card, upon successful entry of all requisite data, the APOS Terminal shall encode or modify the subscription data to the customer's card using the CSCP.

#### **19.2.9.4 *Reduced Fare User Profile Reauthorization***

Reduced fare privileges, encoded as part of the user profiles on Long-Term smart cards are subject to expiration. The APOS Terminal shall include a function to re-authorize reduced fare privileges (that is, encode a new profile expiration date) onto cards that are previously issued with reduced fare privileges. Reauthorization of such privileges shall not result in conversion of a card from full fare to any reduced fare privilege, nor from one non-full fare type to another.

### **19.2.10 Operations**

#### **19.2.10.1 *Clerk Login Procedures***

The APOS Terminal shall require all users to be authorized according to permissions assigned to each login and password. Authorized logins and passwords shall be managed by a CTDOT administrator and disseminated to all APOS Terminals via the CDS.

#### **19.2.10.2 *Access to CDS Database***

The Administrative POS Terminal shall provide authorized clerks the ability to query the CDS database to determine the last known status of any smart card. When querying the database for the status of a fare instrument, it shall be possible to use the CSCP to read the smart card's serial number for the query. If the patron's smart card is not functioning, the APOS Terminal shall permit the clerk to manually enter the serial number.

The APOS Terminal shall permit authorized users to conduct other queries of the CDS database as required herein, limited by permissions granted and configurable by CTDOT.



#### 19.2.10.3 *Web Browser Interface for Customer Service and CDS Database Queries*

Via standard web browser interface, the APOS Terminal shall provide authorized CTDOT clerks access to CTDOT's intranet site to answer questions from patrons, and to send and receive messages through CTDOT's email system. The APOS Terminal shall restrict browsing to only those sites in a configurable table; CTDOT shall identify the initial list of permitted sites at the Final Design Review. **CTDOT 19-2**

The Administrative POS Terminal shall provide authorized CTDOT clerks with the ability to query the CDS database to search transaction history of a presented smart medium and provide other customer service-related information.

#### 19.2.10.4 *Smart Media Inventory Control*

Upon issuance and/or initialization of a smart card, the APOS Terminal shall record in a special "issue record" the date, time, fare category, sequential serial number, and other pertinent information of the smart card. The APOS Terminal shall transmit this record to the CDS, where the existing central inventory database shall track the status of all smart cards in inventory and in circulation.

The CDS database shall track the smart cards distributed to each CTDOT sales location. Using the list of cards issued to each store and the issuance and/or initialization records previously transmitted to the CDS, it shall be possible for authorized APOS Terminal users to query the CDS database for the serial numbers and total quantity of smart media that remain in the sale location's inventory.

#### 19.2.10.5 *Integration with CDS*

The APOS Terminal shall connect to the CDS to upload all transactional information and receive downloaded configuration and fare tables, software updates, time of day, and so on.

#### 19.2.10.6 *Administrative POS Terminal Configuration Control*

Operating parameters shall be downloadable to the APOS Terminal from the CDS via the wide area network provided by CTDOT. Configurable parameters shall include:

- All sales selections (for smart card and non-smart card transactions)
- All text and touch screen region labels
- Value of deposit to be collected for new or replaced fare media
- Available intranet and other web sites
- Authorized users and passwords
- All other relevant fare table entries

When required, modification of the APOS Terminal application software and any OEM application or operating system software shall be performed by downloading new software from the CDS. The CDS database shall record and track the version number of all such software in each APOS Terminal, and the date that the software versions were downloaded and installed.

### 19.3 Administrative POS Terminal Modules

All Administrative POS Terminal hardware modules shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 19-13**



### **19.3.1 Computer Hardware**

All configurations of the APOS Terminal shall be based on Windows®-based personal computers.

### **19.3.2 Touch Screen**

All configurations of the APOS Terminal shall include an integrated Flat Panel Touch Screen Personal Computer. (That is, the touch screen user interface shall be integrated with the computer enclosure.)

The touch screen shall provide no less than XGA resolution and suitable touch sensitivity to satisfy operator selection and input requirements.

### **19.3.3 Keyboard and Pointing Device**

Fixed (non-portable) configurations of the APOS Terminal shall include separate full-sized keyboards and mouse pointing devices (with scrolling wheel).

Portable configurations shall include integrated keyboards and pointing devices.

### **19.3.4 Contactless Smart Card Processor**

The Contactless Smart Card Processor (CSCP) module shall be a separate module cabled to the POS terminal. Ideally, the CSCP shall allow the smart card to be placed atop the module throughout the transaction process.

### **19.3.5 Cash Drawer**

The cash drawer shall incorporate an insert with space for five bill denominations and five coin denominations. When the cash drawer opens, an alarm or bell shall sound indicating that the drawer has released and is open. Similarly, an alarm or bell shall sound when the drawer locks upon closing.

The cash drawer shall accommodate installation under a counter, be pry-resistant and shall be made of high quality, heavy gauge steel.

### **19.3.6 Bankcard Processor**

The Bankcard Processor module shall include:

- Magnetic stripe reader
- Contact bankcard reader (EMV certified)
- Contactless bankcard reader (EMV, payWave®, and PayPass® certified)
- Signature capture pad
- PCI-compliant PIN pad

### **19.3.7 Receipt Printer**

Where specified, APOS Terminals shall include a receipt printer. The printer shall print on a single roll of continuous thermal paper, nominally 2-1/4 inches wide and 150 feet in length. The unit shall provide for easy loading of a new paper roll when the current one is empty, and shall have a cutting edge to enable the operator to separate the receipt from the roll.





### **19.3.8 Customer Display**

Where specified, APOS Terminals shall include a Customer Display that satisfies the following requirements:

- Separately mounts on a pole or other support for optimum visibility for all customers, including those in wheelchairs
- Uses backlit LCD, LED, vacuum fluorescent, or other highly visible display technology suitable for the office environment
- Provides no less than 2 lines of text, with minimum 24 characters per line, with each character no less than 0.5 inches high

The Customer Display shall convey transaction price, status, and other pertinent information.

### **19.3.9 Digital Camera and Tripod**

APOS Terminals shall include a digital camera and tripod for capturing customer photos for printing on personalized cards. The camera shall include a built-in flash and an image sensor of no less than 2 Megapixels; the camera shall produce images of suitable resolution, clarity, and contrast to satisfy the requirements of photo ID cards.

The Contractor shall provide a tripod for each camera optimized for the specific APOS installation and photo capture location. For example, a compact, counter-top tripod may be well suited for permanent APOS Terminal installations, whereas a floor-standing tripod may be better suited for portable APOS Terminal application.

### **19.3.10 Smart Card Printer / Encoder**

The Smart Card Printer module shall utilize re-transfer printing technology, and shall encode smart cards with requisite data (such as the issue and user profile data) in coordination with the printing process.

The Smart Card Printer / Encoder shall print edge-to-edge (*i.e.*, "full bleed") on one side of the card in at least 4 colors (YMCK). As a re-transfer device, the Smart Card Printer / Encoder shall apply printed images to a laminate film, and then apply the laminate to the card. Each Smart Card Printer Encoder shall employ easily replaceable ribbons for the transfer printing and lamination films.

Print resolution shall be no less than 300 dots per inch.

The Smart Card Printer / Encoder shall provide a print speed of no less than 75 cards per hour.

Input and output card hoppers shall have a capacity of no less than 100 cards each, and shall be lockable for security.

Upon successful printing and encoding, the Smart Card Printer / Encoder shall inform the APOS Terminal of the successful issuance of each card, and the sequential serial number of each issued card. The APOS Terminal shall include the produced card's sequential serial number in the transaction record sent to the CDS.

### **19.3.11 Barcode Ticket Printer**

The barcode ticket printer shall be a standard, commercial monochrome (black & white) laser printer rated for monthly duty cycle of no less than 100,000 pages, and providing print resolution of no less than 600 dpi.



Toner cartridges sufficient to produce no less than 5,000 pages as rated by the manufacturer shall accompany each printer.

The barcode ticket printer shall use commercially available, standard-sized (A4 or Letter) pre-perforated paper, producing 8 to 12 tickets per page.

#### **19.3.12 Uninterruptible Power Supply**

Each Administrative POS Terminal shall receive power from a dedicated Uninterruptible Power Supply (UPS) with sufficient battery capacity to operate all components of the APOS Terminal for a minimum of 10 minutes. The UPS shall cause the APOS Terminal to shut down without loss of data integrity whenever the UPS determines that its remaining battery capacity is low.

The UPS shall also provide no less than 500 joules of overvoltage (surge) protection for all connected devices.

#### **19.3.13 Communication Interfaces**

As necessary, the APOS Terminal shall include integrated (10BaseT Ethernet or cellular broadband modem) or external communications interfaces (such as an external USB hub) to satisfy the requirements of the configuration.

### **19.4 Administrative POS Configurations**

The Contractor shall supply Administrative POS Terminals in three configurations, all of which shall utilize the same Contractor-supplied application and OEM software:

#### **19.4.1 Front Office Administrative POS Terminal**

The Front Office Administrative POS Terminal shall provide all functions available (except as noted herein), and shall be installed for walk-up customer transactions. The device shall include:

- A. Integrated touch-screen and computer enclosure
- B. Separate keyboard and mouse
- C. Contactless Smart Card Processor module
- D. Cash Drawer
- E. Bankcard Processor module
- F. Customer Display
- G. Receipt Printer
- H. Separate Digital Camera and Tripod
- I. Smart Card Printer / Encoder
- J. Barcode Ticket Printer
- K. Uninterruptible Power Supply
- L. Communications interfaces as necessary

The Front Office Administrative POS Terminal shall also be configured to support CTDOT internal needs and transactions where the customer is not present, including single and multiple card order fulfillments, CTDOT employee card issuance, and other transactions.

#### **19.4.2 Portable Administrative POS Terminal**

The Portable Administrative POS Terminal shall be based on a laptop computer with an integrated touch screen interface, keyboard and pointing device. The portable configuration



shall support remote sales and card personalization programs. In addition to the laptop computer, the device shall include the following modules, which shall be identical to those used for the Front Office APOS Terminal (except where noted herein):

- A. Contactless Smart Card Processor module
- B. Bankcard Processor module
- C. Receipt Printer
- D. Separate Digital Camera and Tripod
- E. Smart Card Printer / Encoder
- F. Cellular Broadband Data Modem and other communications interfaces as necessary (may be unique to the Portable APOS Terminal)



## 20 Handheld Fare Inspection Terminals

### 20.1 General

The new Bus Rapid Transit service, *CTfastrak*, will employ standard proof of payment fare policies and operations, which will subject all passenger fares to inspection while on board the BRT vehicles. To satisfy this need, the Contractor shall supply Handheld Fare Inspection Terminals (HFITs), which shall be based on commercially-available, consumer or industrial-grade devices, be as compact as practical, and be based on a “smart phone” platform with an integrated ISO 14443-compliant smart card reader.

Handheld Fare Inspection Terminals shall normally operate in a semi-protected bus environment; however, they shall also be capable of reliable operation in an outdoor environment and while experiencing rough handling.

The Handheld Fare Inspection Terminals shall be compatible with all CTDOT-issued smart cards and all other smart card fare media specified in Section 4 and processed by the Validating Fareboxes, Platform Validators, Multi-Function Vending Machines, and Point of Sale Terminals.

In general, the Handheld Fare Inspection Terminal shall:

- Read and write to CTDOT-issued contactless smart cards
- Read Third Party-issued smart cards
- Read 2D barcode fare media
- Automatically determine fare media validity for proof of payment services based on parameter and operational settings
- Respond to inputs of the operator
- Display account validity and value information upon request
- Register manually-entered counts of services provided to non-smart card users
- Register and store accounting and transaction data
- Provide different audible annunciations for valid and invalid transactions
- Communicate with the CDS to transmit and receive data regarding smart cards reviewed
- Issue and print citations for fare evasion

The Handheld Fare Inspection Terminals shall provide an expected useful life of no less than 2 years.

### 20.2 Handheld Fare Inspection Terminal Requirements

The Handheld Fare Inspection Terminal shall:

- A. Weigh no more than one pound, including rechargeable batteries.
- B. Be contained within a single enclosure and shall be easily and comfortably held and operated in one hand.
- C. Include at least 128 Mb of Random Access Memory and 2 Gb of non-volatile flash memory.
- D. Have a commercially available ISO/IEC-14443 compliant Type A and B contactless smart card read/write module that support the processing of smart cards compatible with the NFTS.
- E. Have the ability to read one- and two-dimensional barcodes.



- F. Utilize a display that measures at least 3.5 inches diagonally, displays in no less than full VGA resolution (640 x 480 pixels), and provides a touch screen user interface.
- G. Employ a data entry keypad to select functions, query stored databases, enter data, and to provide other functionality required to ensure proper operation. The entry interface shall be either a combination of fixed and variable function buttons or a combination of touch-screen display and pushbuttons.
- H. Process the CTDOT-issued smart card fare media as defined.
- I. Provide different audible and visual annunciations for each type of transaction.
- J. Be GPS or DGPS enabled to log the whereabouts of the HFIT user throughout the day.
- K. Include real-time integrated 3G/4G cellular broadband data communications to exchange data and transmit the current location of the HFIT to the CDS.
- L. Include a Bluetooth® Class II, v 2.0 on-board chip antenna to communicate with future peripherals.
- M. Operate under any of a minimum of two fare tables residing in its local memory, each that shall be programmable to become the active set at a particular time and date and to expire at a particular time and date.
- N. Communicate with the CDS while placed in a Recharging / Data Cradle or via 3G/4G cellular broadband to: transmit data, update the action and autoload lists, update the Third Party Valid Card List, and receive new fare tables, configuration and operations data, and new application software.
- O. In the event of communications loss or device failure, all transaction data records shall be retrieved from a removable memory module shall, which shall store duplicate records of all transactions.
- P. Incorporate a printer to permit the issuance of citations as needed.

The Contractor shall submit the make, model, and configuration of the HFIT for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 20-1**

## 20.3 Configurability

As described above, the HFITs shall support proof of payment fare inspections for both contactless smart card and barcode media. As described herein, the HFIT shall also support configurability through numerous adjustable parameters, centrally controlled and transmitted via the CDS.

The Contractor shall submit a comprehensive document describing the configurability of the HFIT, including a listing of all configurable parameters and their value range, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 20-2**



## 20.4 Handheld Fare Inspection Terminal Operations

The primary use of the Handheld Fare Inspection Terminal shall be for the reading and validation of smart cards and barcode tickets for proof of payment operations. The Handheld Fare Inspection Terminal shall:

- A. Not be operational until a proper log-on is successfully made by a valid user. Login shall require entry of a username, and password. CTDOT-issued smart card-based operator ID cards may also be used as part of the log-on process.
- B. Process all smart card fare media (CTDOT-issued and Third Party).
- C. Process all barcode fare media (CTDOT-printed tickets, third party-printed tickets, transfers, and mobile tickets as displayed on smart phones via an application provided by others) as described in Section 8.
- D. Review and display the information on a customer's smart card.
- E. Manually track (tally) the number of rides provided that were not paid with smart cards.
- F. Receive SMS text messages from CTDOT-authorized senders only. The ability of a Handheld Fare Inspection Terminal to send SMS text messages shall be restricted to users authorized to do so and CTDOT-specified recipients.
- G. Be restricted to performing only transaction processing and other functions defined herein; the HFIT shall not provide telephone, web browsing, SMS texting or other functions commonly found on smart phones unless approved by CTDOT at the Preliminary Design Review.
- H. Require no more than 60 seconds to resume operations from a full power-down condition, and no more than 10 seconds to resume operations from a "sleep" condition.

The Contractor shall submit a complete description of all HFIT operations, including but not limited to operator interface commands and displays, smart card read/write module functionality, and 2D barcode reader operations, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 20-3**

### 20.4.1 Functionality

The Handheld Fare Inspection Terminal shall:

- A. Read smart cards as appropriate to the type of card and transaction selected whenever a valid, genuine CTDOT smart card is presented within range of the card read unit. The HFIT shall verify that the smart card is valid for the patron's present trip.
- B. Upon request of the operator, conduct smart card transactions identically to the Validating Farebox.
- C. Utilize the same Master Status List and Third Party Valid Card List as the Validating Farebox.
- D. Require a valid login to commence operations; logins shall be validated against a list managed by the CDS.
- E. Contain non-volatile memory that shall record data for each transaction processed.
- F. Be capable of detecting basic internal malfunctions and shall annunciate failures to the display for the inspector to review. The malfunction detection shall cover at least failure of power circuitry and any failure of the smart card read unit that could result in a false, incomplete, or corrupted reading of a smart card.



- G. Incorporate an indicator to inform the operator off a low battery condition. This indicator shall activate when less than 2 hours of power remains.
- H. When inactive for a CTDOT-adjustable period (initially set to 5 minutes), revert to a sleep mode requiring depression of the "Enter" key or other designated key to activate the unit. During sleep mode, the smart card read antenna shall be deactivated and any backlight shall be extinguished. User log-on shall not be again required.
- I. After a CTDOT-adjustable period in sleep mode (initially set to 30 minutes), shut down completely, and shall require the user to log on after restoring power.

## 20.4.2 Operator Interface

### 20.4.2.1 *Display*

The Handheld Fare Inspection Terminal display shall provide operators with instructions, prompts and transactional information. The display shall meet the following minimum requirements:

- A. The display shall be easily read under all conditions of ambient light throughout the day and night. If necessary, a backlight shall be provided.
- B. Displayed messages shall be easily modifiable by CTDOT once the system is in operation.

### 20.4.2.2 *Keyboard and Touch Screen Input*

The HFIT shall provide operator input by touch screen and keyed input where appropriate. Touch regions shall be as large as practical, and sufficiently separated from each other to minimize accidental erroneous input.

Because the smart card read/write module will consume battery power when active, the HFIT shall activate the smart card read/write module only under operator command. Because this button will likely see repeated use, the button to activate the smart card read/write module shall be ergonomically located, preferably so that it can be pressed with the user's thumb. A suitably large and prominent touch region on the screen shall duplicate the function of the physical button.

### 20.4.2.3 *Validity Status Visual Indicators*

The HFIT shall include three indicators to indicate the validity of the smart card. The status indicators shall be located on the top of the Handheld Fare Inspection Terminal and shall be positioned so that they are visible in all ambient lighting conditions. Alternatively, dedicated regions of the Handheld Fare Inspection Terminal display may be used for these purposes, provided that the indications are unambiguous and are easily seen in all ambient light conditions. These indicators shall operate as follows.

- A. While the Handheld Fare Inspection Terminal is in the idle or sleep states, all of the displays and indicators shall be extinguished or blank.
- B. Upon processing a smart card or barcode fare instrument, the transaction status indicators shall function as shown for the Validating Farebox.
- C. The appropriate status indicator shall remain activated for a CTDOT-adjustable inter-transaction timeout period, or until the operator presses a button or tags another card to the Handheld Fare Inspection Terminal, whichever occurs first.



#### 20.4.2.4 **Audio Transducer**

Coincident with the activation of the visual validity status indicators, the HFIT shall emit a distinctive tone for each status indicator. In addition, the audio transducer shall emit a distinct short tone each time a push button is pressed. The tones shall be audible in the transit environments, and the volume of the tones shall be field-adjustable by the operator.

#### 20.4.3 **Smart Card Read/Write Module**

The HFIT shall include a smart card read/write module and an antenna located so that the operator has easy access to tag cards. The antenna shall not protrude from the exterior of the Handheld Fare Inspection Terminal and shall be made of materials that are impervious to weather conditions.

The HFIT smart card read/write module shall provide the following features:

- A. The smart card read/write module shall be compliant with both the A and B variants of the ISO/IEC 14443 standard, and provide contactless smart card read and write functionality that is fully compliant with the ISO/IEC-14443 standard.
- B. The smart card read/write module shall be activated (*i.e.*, the antenna energized) only while commanded to do so by the HFIT operator.
- C. The antenna shall remain energized while a card is in range of the antenna, and for a CTDOT-configurable period after a card is removed from the antenna field. As delivered, the HFIT smart card read/write antenna shall remain energized for 10 seconds after a card is removed from the antenna.

#### 20.4.4 **2D Barcode Reader**

The HFIT shall include a 2D barcode reader to process (validate) all CTDOT 2D barcode media. The 2D barcode reader shall:

- Be housed completely within the HFIT
- Provide no hazard from the barcode reading laser or other components
- Be high resolution (greater than 0.8 megapixels)
- Have a read range of not less than 4 inches and not more than 10 inches
- Read standard 1D barcode
- Read secure 2D barcodes (QR code, Aztec or other CTDOT-approved format)
- Utilize an encryption key, configurable by CTDOT, and AES decryption algorithms to process secure 2D barcodes
- Have a first read accuracy of not less than 99.0%

#### 20.4.5 **Fare Tables**

The HFIT shall store a minimum of two complete fare tables. One fare table shall be designated the active table; all other stored tables shall include a date and time at which the table is to become active.

Fare tables shall be highly configurable and shall include support all fare policies and pricing structures defined herein and necessary to support CTDOT operations.

#### 20.4.6 **Data Storage**

Each record shall be stored in memory for transfer to the CDS.





The Handheld Fare Inspection Terminal shall use solid-state memory with sufficient capacity to store a minimum of 10,000 transaction records.

The HFIT shall also include a removable memory module, which shall store duplicates of all transaction records. In the event the HFIT malfunctions, transaction records in the removable memory module shall be transferred to the CDS via a method subject to CTDOT approval at the Preliminary Design Review. **CDRL 20-4**

The HFIT shall record, at minimum, the following:

#### 20.4.6.1 *Transaction Records*

The HFIT shall generate and store a discrete data record for each transaction performed. Each transaction record shall be unique within the NFTS. All HFIT transaction records shall include the following information as a minimum:

- Date and time of transaction
- HFIT (Device) number
- Vehicle number
- Operator ID
- Route number
- Block number
- Fareset in effect
- Fare/Transaction type (e.g., Full Fare / Reduced Fare / Partial Fare / Upgrade Fare)
- Direction (no less than 8 values, including North, South, East, West, Inbound, Outbound)
- Vehicle location (latitude/longitude – most recently received GPS coordinates)
- Transaction sequence number (which shall be unique per day per HFIT)

##### 20.4.6.1.1 *Contactless Smart Card Transactions*

In addition to the data fields defined, contactless smart card transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number if CTDOT-issued, chip Unique ID (UID) if third party-issued)
- Action performed (if applicable)
- Transaction value (if applicable)

##### 20.4.6.1.2 *Barcode Media Transactions*

In addition to the data fields defined, barcode media transaction records shall also include, at minimum:

- Media ID number (CTDOT serial number)
- Action performed (if applicable)
- Transaction value (if applicable)



#### 20.4.6.2 **Event Records**

At minimum, the HFIT shall generate and store an event record for each of the following actions or incidents:

- Power on
- Power On Self Test complete
- Power On Self Test failure, including failure mode
- Power off
- Operator login, including ID and login method (smart card, barcode, keyed entry)
- Failed login attempt (excessive PIN entries), including ID
- Operator logout
- Maintenance parameter changed, including parameter and new value
- Route changed, including new route number
- Default fare (service level) changed, including new fare set
- End of transit business day (CTDOT programmable, default is 3:00 AM)
- Communication with CDS initiated
- Communication with CDS completed
- Communication with CDS terminated before complete (*i.e.*, Wi-Fi signal lost)
- Communication with CDS terminated by operator (during login)
- GPS reception lost
- GPS reception restored
- New downloaded list received, including list type and version number
- New downloaded list activated, including list type and version number
- New fare table received, including version number
- New fare table version activated, including version number
- New HFIT software version received, including version number
- New HFIT software activated, including version number
- New HFIT configuration data received, including version number
- New HFIT configuration data activated, including version number
- HFIT internal clock reset for a time discrepancy greater than 3 minutes
- Data memory nearing capacity (CTDOT configurable threshold)
- Data memory full
- HFIT reset (when action occurs while operator is logged in)
- Successful data transfer (including destination – GCS or PDU)
- Unsuccessful data transfer (including destination – GCS or PDU)
- Other HFIT errors and failures



Each event record shall include, at minimum:

- Date and time of event
- HFIT (Device) number
- Vehicle number
- Operator ID (if available)
- Route number (if available)
- Direction (if available)
- Vehicle location (latitude/longitude – most recently received GPS coordinates, if available)
- Associated event parameters (as required)

#### **20.4.7 Clock**

The Handheld Fare Inspection Terminal shall maintain date and time of day by an internal clock which shall have a battery, or equivalent, backup to keep the clock running for at least 150 hours without external power. The clock shall maintain time to an accuracy of less than 1-minute error within a 1-month period. Time shall be synchronized between the Handheld Fare Inspection Terminal and the CDS each time data is downloaded to the HFIT via the cradle. (To avoid potential time conflicts, the HFIT shall not synchronize its clock with the cellular network clock.)

### **20.5 Transaction Processing**

The Handheld Fare Inspection Terminal shall reliably read and write smart cards and read barcodes in no greater time and manner than defined for the Stand Alone Processor.

To the extent practical, the HFIT shall conduct all transactions (smart card and barcode) identically to the Validating Farebox.

The Contractor shall provide a comprehensive description of all HFIT transaction processes, including flow charts, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 20-5**

### **20.6 Handheld Fare Inspection Terminal Report Requirements**

The Handheld Fare Inspection Terminal shall be able to produce and display the following reports (generated by the device or queried from the CDS):

- A. Transaction summary report – A summary of all smart card transactions during the user's shift
- B. Transaction detail report – A list of all smart card transactions during the user's shift

The Contractor shall provide samples of all HFIT reports for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 20-6**

### **20.7 Power & Communications**

The Handheld Fare Inspection Terminal shall utilize rechargeable batteries for power. The batteries shall provide power to operate the device for not less than 12 continuous hours, with the smart card reader and any backlight activated not less than 50% of the time. Batteries shall



be Lithium-Ion technology, or CTDOT-approved equivalent. The use of nickel-cadmium batteries is prohibited.

Battery recharging shall take place in Recharging / Data Cradles or 120 VAC power adapters. One cradle or 120 VAC power adapter shall be provided for each device. In addition, for each HFIT, the Contractor shall provide a "cigarette lighter" power adapter for recharging the device while in use in a vehicle and while installed in the Dashboard Cradle.

Full recharging of a HFIT's batteries shall require no more than 4 hours.

The Recharging / Data Cradle shall sufficiently protect itself and all inserted devices against power surges.

If necessary, the Recharging / Data Cradle shall also be used to exchange information with the CDS. Any communications through the cradle shall be non-proprietary and shall use a TCP/IP protocol.



## 21 Central Data System

### 21.1 General

The NFTS Central Data System (CDS) is critical to CTDOT operations. As stipulated herein, the Contractor shall provide hosting services for a comprehensive Central Data System that gives CTDOT the ability to control, support, and monitor the NFTS equipment supplied under this contract and the functions they serve. The CDS shall provide transaction control, event and machine status reporting, a data repository for all event and transaction data, fare table implementation, system security and control of all communications between the devices, the host computer, and other internal and external systems.

All NFTS equipment shall communicate with the Central Data System for transfer of all stored data and transfer of equipment parameters. The CDS shall provide automatic monitoring and control of all devices connected to the network.

The CDS shall provide interface with a CTDOT-selected bank card clearing house, via a secure interface that is fully compliant with PCI DSS. The Contractor may suggest bank card clearing houses, although CTDOT will have sole discretion to select the bank card clearing house.

The CDS shall provide interface with the CTDOT Bus Operations Center to ensure that all data captured is stored in both locations immediately and to provide all control and monitoring functions at the Bus Operations Center, in addition to the CDS.

All data collected by the NFTS devices and web portals, and stored in the CDS, shall be the exclusive property of CTDOT, may only be used by its designees, and shall *not* be made available to others (including the Contractor) unless required by law.

The Contractor's CDS services and hosting facilities shall be certified compliant with the Payment Card Industry's Data Security Standard (PCI DSS) and the Payment Application Data Security Standards (PA DSS). The Contractor shall submit documentation verifying PCI DSS and PA DSS certification within 30 days of Notice to Proceed. **CDRL 21-1**

The Contractor's CDS shall be satisfactory to CTDOT and will, in all respects, be subject to CTDOT's review, comment, and approval. The Contractor shall have sole responsibility to address CTDOT's comments in accordance with the times specified in the contract, prior to NFTS start up and in accordance with CTDOT's on-going operating requirements after NFTS start up.

### 21.2 CDS Hosting Service Requirements

The Contractor shall supply all servers, including the relational database manager server and all other hardware and operating systems required for the CDS, at secure facilities with sufficient communications infrastructure to support the performance requirements stated herein. The Contractor shall provide CDS hosting services for 60 months, commencing with the start of NFTS revenue service (excluding any Pilot Tests), and for any optional periods exercised by CTDOT.

As part of the CDS hosting, the Contractor shall provide all System Administrator services including, but not limited to, backing up data and software, assigning and maintaining system access credentials, responding to user requests, applying software patches and other duties.

At the Preliminary Design Review, the Contractor shall submit for CTDOT review and approval, performance and configuration requirements for all CDS application servers, as well as the



database capacity requirements necessary to satisfy all performance requirements in this Scope of Work. **CDRL 21-2**

CDS capacity and performance will meet the following criteria:

- A. The system will have adequate capacity to retain data until redundant copies have been made and verified elsewhere.
- B. System will have at least 100% excess storage and processing capacity, to be demonstrated by actual system operation.
- C. Support for a minimum of 200,000 daily data transactions.
- D. The hardware will support and be compatible with all proposed software, and effectively process all events and transactions from the devices that are being furnished and will provide sufficient capacity to accommodate a 50% increase in the number of devices and transactions.
- E. The Contractor shall provide redundant CDS installations at separate locations and provide immediate, automatic fail-over between sites to ensure the CDS remains available whenever unplanned and planned outages of the production CDS occur. The redundant operations will enable continued operation of critical security and transaction functions without degradation that is obvious to the user.
- F. In combination, the two (primary and backup/disaster recovery) CDS sites will achieve no less than 99.9% availability measured monthly, and 99.99% measured annually, including scheduled down time. The CDS will be considered available when at least one CDS site is operational and communicating with the NFTS devices.
- G. CDS hardware configuration will support the NFTS equipment supplied under the Contract as initially configured at start of revenue service, and additional locations and equipment as without requiring expansion of the CDS hardware.
- H. The CDS will perform data processing, report generation, system monitoring, data communications, database updates, and all other required functions at speeds and response times suitable for the required task. Users of NFTS devices will perceive no response or functional delays due to equipment interaction with the CDS, and CDS users will not experience unreasonable delays.

### 21.3 General CDS Software Requirements

The Contractor shall supply all necessary software applications and shall design and configure all application programs and the database for optimal system performance. The Contractor shall install all software necessary for system operation that successfully provides adherence to the specifications and performance requirements herein.

- A. The Contractor shall provide licenses for all third party software and core software in accordance with requirements stated herein without additional charge for the life of the equipment.
- B. CDS licenses and software will permit no less than 50 concurrent users.
- C. Any software specifically written for this project will become the property of CTDOT.
- D. All user access to the CDS will terminate, and users logged out, after a CTDOT-adjustable period of inactivity.



- E. The CDS will allow control of designated system operational functions from remote locations.
- F. The CDS software will control and monitor system logins, both for the system as a whole and its separate functions. All accesses will be controlled, recorded, and reported to specific locations as identified within these specifications. Access privileges for individual users will be settable by the system administrator. The CDS will provide high-level security to fare tables, media layout functions and associated files to ensure protection from unauthorized access, tampering, or transmission.
- G. As delivered and licensed to CTDOT, the software and database structures for the CDS will have the capacity to support at least:
  - 1,500 Validating Fareboxes
  - 20 Garage Communications Servers
  - 25 Farebox Vaulting Systems
  - 500 Stand Alone Processors
  - 100 Multi-Function Vending Machines
  - 200 Platform Validators
  - 50 passenger stations
  - 200 Handheld Fare Inspection Terminals
  - 25 Administrative Point of Sale Terminals
  - 1 Maintenance Test Station

## 21.4 User Interface

All user interactions with the CDS will utilize standard browser interfaces on any personal computer with authorized access to the CTDOT network and the CDS. The CDS will employ industry-standard and common user interfaces such as pull-down menus, context-sensitive selections, fill-in-the-blank input and query forms, and other such means typical of database systems.

## 21.5 Communications

The Contractor shall utilize open standard protocols for communication among NFTS components and between the NFTS and external users. No proprietary or custom-designed protocols will be applied.

External data communications will be web-based. The Contractor shall utilize the available CTDOT network for communications between CDS and other NFTS components. The Contractor shall be responsible for identifying and specifying any upgrades to CTDOT's network necessary to support communications between the CDS and other system components. The Contractor shall submit a document describing network requirements, including any upgrades that will be required for System operation, for CTDOT procurement and installation.

CDS communications with the Validating Fareboxes will be via the Garage Communications Servers, and directly via broadband cellular communications.

Communications between the CDS and the Handheld Fare Inspection Terminals will be by broadband cellular communications.

Communications between the CDS and other devices within the NFTS will be via the CTDOT network using Ethernet over a high speed data connection.



## 21.6 Relational Database Manager

The CDS will employ a centralized relational database manager based on Oracle® version 12 or higher or CTDOT-approved equivalent.

All data stored in all NFTS databases and results of all queries and reports will be property of CTDOT.

## 21.7 System Interfaces

The CDS will interface with systems, both internal and external to CTDOT, including external interfaces with Garage Communications Servers, CTDOT Legacy Systems, bankcard payment entities, Contractor-supplied web portals, and other aspects of the NFTS described herein.

Interface with the CDS will be limited through security and appropriate password authorization. Every interface with the CDS will contain safeguards (software and/or hardware) to prevent unauthorized access to modification of data.

## 21.8 Software and Configuration Update Propagation

The CDS will be able to designate what will be downloaded, and to which units: All units of a particular type, sets of fare devices (e.g., defined by garage, type of transit service, retailer, etc.), or individual devices.

The system will track failed transmissions and provide diagnostic messages that include the SNMP message(s), the number of times transmission was attempted, and the device(s) affected. The CDS will retain this information for reporting, statistical analysis, audit, problem resolution, unit, and network reliability calculations.

Based on password/user ID security, any authorized user will be able to download to any single device, any group of devices, and all devices:

- Fare tables (one active, two pending)
- New and updated application (executable) software files
- Security access codes
- Configuration files
- Operational parameters
- New and updated patron display screen text
- New and updated operator display text and selections
- Any other information necessary for the operation and maintenance of the NFTS devices

Authorized users will be able to select the date and time when any data download is to occur and to review and cancel any previously scheduled download.

## 21.9 Data Backup and Archiving

The CDS will be designed so that data is backed up to allow full recovery of the system (operating system, application software, database, utilities, and all data and transaction files) with no loss of data integrity. The system will provide for the automatic archiving at user programmable time periods of all transaction data and critical core software to secure media without user intervention.





The CDS will have a means for regular automated backup and archiving to separate secure storage media. The backup process will clearly define the appropriate verification, recovery, and restoration procedures, and clearly demonstrate a successful process without loss or duplication of data. There will also be defined processes for automated data archiving. This process will include both onsite backups for fast restoration and off-site backups for disaster recovery.

The Contractor shall be responsible for defining the backup and archive media as well as the associated procedures for both backup and archiving. The Contractor shall provide details and information on the data backup and archiving schemes employed by the CDS for CTDOT's review at the Preliminary Design Review, and CTDOT's approval at the Final Design Review. **CDRL 21-3**

## 21.10 Data Redundancy

The CDS will redundantly store all configuration, event, and transaction data. Redundancy will be maintained throughout the system.

Redundant information will be stored so that no subsystem failure will compromise copies of the data.

The Contractor shall provide procedures, documentation, and training for restoration of data from any redundant sources in the event of failure in primary data storage. The Contractor shall provide details and information on the data redundancy scheme employed by the CDS for CTDOT's review at the Preliminary Design Review, and CTDOT's approval at the Final Design Review. **CDRL 21-4**

## 21.11 Disaster Recovery

The Contractor shall design the CDS to incorporate a production CDS hosting site and a second, identical CDS to be deployed at a separate Contractor hosting facility. Both installations of the CDS will be in periodic communications sufficient to support the recovery point objectives of system availability and zero data loss.

Through this synchronization, the production and backup copies of the CDS will be maintained as mirror images of each other.

No less than 90 days prior to commencement of NFTS revenue service, the Contractor shall provide a Disaster Recovery Plan that is specific to the CDS systems, applications, databases and interfaces. **CDRL 21-5**

## 21.12 Security

The CDS will conform to CTDOT information security policies. The CDS will implement appropriate security measures that are continuously active to prevent unauthorized intrusion to the operating system, applications, parameters, and other software modules, fully support PCI requirements, and support password protection to levels prescribed by CTDOT.

Additional security measures, including password protection to levels prescribed, will be included to prevent unauthorized access or modification to CDS software and associated tables. This will incorporate the use of a Microsoft® SQL or an Oracle® interface, which will utilize the current CTDOT employee as the User ID. When the user has logged out, the User ID will be cleared from the screen.



Reports for system security will be available through the security administration function. At a minimum, these reports will provide information on employee and technician access levels, access logs for logins, central functions, maintenance activities, and all security violations or attempts.

All components of the system will operate in a virus-free protected environment. The CDS will have sufficient measures (software, and /or hardware) in place and active at all times to ensure that all operating systems, applications and other software operate in a virus-free environment. The Contractor shall provide, install, and maintain a fully licensed, upgradeable commercially available anti-virus software application.

The CDS will also contain controls to prevent unauthorized access to the operating system, applications, and other software modules.

A functional description of all CDS security functions, including virus protection, will be provided at the Preliminary Design Review for review by CTDOT and for approval by CTDOT at the Final Design Review. This information will include the design or the operational flows, screens, functions and other similar information and will include increasing detail with each design review step. **CDRL 21-6**

#### **21.12.1 System Security**

The CDS security function will provide appropriate access to all CDS functions and system data. Functional access will, at a minimum, provide for such things as fare table and associated file maintenance, design and access of report queries, system polling, and network configuration.

CDS security functions will be separated into the following systems:

- Network security
- Data Security, which will, at a minimum, provide for four security levels: read only, update access, create, and delete
- Application Security, which will be incorporated into each application attached to the CDS and controlled at three levels:
  - Application access
  - Form access
  - Function access within form (inquire, add, change, delete)

#### **21.12.2 Security Administration**

The CDS will support maintenance of access level tables through a security administration function. These tables will be used to establish employee and employee group access to fare devices, Network, CDS, and data.

Reports will be available through the security administration function. At a minimum, these reports will provide information on employee and technician access levels, access logs for logins, critical CDS functions, maintenance activities, and all security violations or attempts.

A different password and user name will be required for access to system administrator functions.

A different password and user name would not be required to access system administration functions to restrict access by application, by form and by function within form. Only administrators will be able to get to forms that handle administration. With this, access will be capable of being further restricted to what administrative functions can be perform, including inquire, add, change, and delete.



## 21.13 PCI Compliance

From time of initial implementation through System Warranty completion, the NFTS will satisfy all requirements of the family of PCI standards (including PA-DSS) to ensure continuing PCI compliance. At the start of installation through the conclusion of the Software Warranty period as defined by the Contract, the Contractor shall utilize a PCI certification expert (*i.e.*, currently identified by the PCI Council as a “Qualified Security Assessor”) to certify the compliance with the standards in force at the time of Final Acceptance of the System.

Contractor shall assess the System’s compliance with PCI DSS and PA DSS. In conducting this PCI-compliance assessment, the Contractor shall also identify any existing CTDOT systems affected by the NFTS that are not PCI compliant. The Contractor shall notify CTDOT of these deficiencies not more than 30 days after becoming aware of them. Contractor shall furnish documentation at the Preliminary Design Review and Final Design Review to provide full details for the System’s compliance with all aspects of PCI. This document will include a plan to meet all applicable PCI requirements, including responsibilities of each party. **CDRL 21-7**

In addition, the NFTS will be compliant with all additional applicable PCI standards, Information Supplements and Guidelines in force at the time of Contract Award, unless written approval is provided by CTDOT at its sole discretion. Contractor shall identify these applicable PCI standards, Information Supplements and Guidelines not more than 90 days after the NTP is issued. **CDRL 21-8**

The Contractor shall design and implement the NFTS CDS so that the CDS is considered ‘out of scope’ for PCI assessment purposes, such as through the use of secured (*e.g.*, “tokenized”) bankcard data.

## 21.14 Anti-Virus and Anti-Malware Software and Definitions Management

A commercially available program will protect the CDS from software viruses and malware. All incoming files from all sources, including but not limited to CTDOT’s network communications, bankcard payment entity interface, removable data storage media readers, and all other external sources, will be scanned prior to transfer to any CDS data storage device and memory. The CDS will automatically apply updated definitions for the protection software within 48 hours of the OEM’s release of the update.

The CDS will provide centralized distribution of updated software and definitions for the anti-virus and anti-malware application installed on all Garage Communications Servers, all Administrative POS Terminals and all other networked NFTS devices running a compatible, commercial operating system. Within 48 hours of the OEM’s release of updated software and definition files, the CDS will distribute the updates to all requisite devices. The CDS will receive and distribute such updates automatically; no manual action will be required to distribute the updated definition files.

The Contractor shall purchase and convey to CTDOT subscription services for no less than 3 years of virus and malware definition updates from the OEM supplier. Subscription services will start no more than 30 days prior to commencement of revenue service. **CDRL 21-9**

The Contractor shall identify the anti-virus and anti-malware software package for CTDOT review and approval at the Preliminary Design Review. **CDRL 21-10**



## 21.15 Fare Tables

The fare tables are an extensive set of database relations/tables that define the policies and prices for each transaction type. The fare table entries will include all elements that are necessary to properly define the entry and other required sales information and functionality to meet the NFTS requirements.

Fare tables will support fare changes based on media types, as well as on an exception basis. Exception-based changes include fare changes for an entire service, line/route, or a branch and down to the individual location. Similarly, means will be provided to program special fares for designated special events such as sporting events for specific services, routes, line segments, and stations/stops. Fare tables will be identified by the date and time they become effective as well as with a unique version number.

The software will provide menu options to create, edit, display and/or print, and download the fare tables used to generate media and receipts, to collect cash fares, to validate machine-readable smart media, and all other fare transactions. The “create” and “edit” functionality will be coded so that it can be executed independently, if necessary. The fare table generation and manipulation software will be maintained by and operated via the CDS.

Automated processes will be established to copy any existing fare table effective-date to a new effective-date. This will reduce manual data entry by requiring the support staff to only key changes.

Records will be kept of all changes made to fare table components and associated files by user ID, date, time location, and modification made.

Current and future fare tables will be available for downloading to any or all equipment. This will include the ability to load fare tables to a device, prior to the table's effective date. In addition, the system will be able to retain no less than 10 fare tables, not including development and test instances, which are available for deployment. Each of these fare tables, at a minimum, will retain no less than 10 effective dates. In addition, the system will incorporate an automated process to copy any existing fare table effective-date to a new effective-date.

The ability to access fare table routines and files will be controlled through a separate layer of user security.

Records will be kept of all changes made to fare table components and associated files by user ID, date, time location, and modification made. At the device level, fare tables and associated files will be tamper proof.

### 21.15.1 Equipment Fare Tables

Each entry in the fare table (i.e., each ticket type selection) will be individually and dynamically configurable for availability for sale/use at each individual item of equipment. For example, an authorized CDS user will be able to configure MVMs in a specific station to vend 6-hour Round Trip Tickets, and then to subsequently disable such sales, without affecting other MVMs in the system. Such configurability will not require the creation and download of new fare tables.

The equipment will be capable of handling at least 24 other ticket types for each fare type (adult, senior, student, etc.). Additionally, the fare table will be able to accommodate new policies such as:

- Reduced fares for any ticket type
- Time-of-day (peak / off-peak) fares



- Holiday fares (up to 24 holidays per year)
- Weekend fares
- Rail-to-bus transfers as a surcharge to any fare
- Additional zone fares (up to ten zones)
- Additional smart card-based products, such as floating period passes, fixed-calendar (e.g., monthly, annual) passes, stored rides, etc. (for displaying card value and status)

Once new fare tables are created on the CDS, it will be possible to download the new fare table(s) from the CDS to the equipment via the data communications link using a single software package. New fare tables will also be transferrable onto a solid-state memory module (SSMM) or other removable storage media, which can then be loaded into the equipment by a service technician. Once fare tables are downloaded, the new fare table will be activated automatically at the specified date/time as programmed by CTDOT.

Each entry in the fare table will at a minimum contain:

- The price of the selection
- Validity information and rules
- Programmable text of the messages on the passenger display
- Information to be printed on the ticket (as applicable)
- A variable parameter to specify the validity period of the fare product (expressed in minutes from the current time and days from the current date) for all fare products that have variable expiry date and time
- Necessary information to identify the proper voice message to play when the transaction type is selected
- Associated variable text for those audit receipts that include a listing of ticket types

For ticket printing, it will be possible to program content (fixed and variable), location of all printed text on the ticket, character fonts and sizes, and print orientations as defined.

The Contractor shall provide the software utilities for adding, changing, and deleting text on tickets, passenger display messages, and accounting/registration printouts where ticket types are listed. The Contractor shall submit descriptions of these software utilities for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-11** These utilities will be demonstrated during the MVM Functional Tests conducted during the Factory Acceptance Tests.

The structure and layout of the fare table entries and the MVM's ability to accommodate existing and future fare policies will be subject to CTDOT review and approval at the Preliminary and Final Design Reviews. **CDRL 21-12**

## 21.16 Media Inventory Management

The CDS shall provide all functions necessary for inventory control and management of CTDOT's smart card and barcode fare media. This will include media ordering and return/replacement. In addition to the media status conditions, the CDS will provide for



complete inventory control of all fare media stocks, including stock transfers between CTDOT central storage and distribution units, as well as comprehensive accounting for media inventory. For each fare instrument in CTDOT's inventory, the CDS will at minimum track the following conditions:

- In CTDOT central inventory (including batch and bundle numbers)
- In secondary inventory (including location)
- In transit (including destination information)
- Stock provided to APOS Terminal operator
- Returned by operator
- Consigned to third-party organization for sale (including ID of third party)
- Returned unsold by third-party organization
- Returned unused by customer
- Reported lost, stolen, or destroyed

The CDS will also allow for accounting for all stock sold, spoiled, jammed, shipped, or missing, to provide a comprehensive system wide audit and control function.

All records will be identified by mode, equipment number, and/or location as appropriate.

All smart card deliveries from card manufacturers will include a data file that will list the sequential serial number and associated UID of each card in the delivery. The CDS will include a function to import these data files into the inventory control system and other requisite database tables.

## 21.17 Fare Media Accounts

Every account-based smart card in the NFTS system will be assigned a unique Fare Media Account Identification. Each Fare Media Account will be either Anonymous or Assigned to a Customer Account.

Fare Media Accounts will include, at minimum:

- Card Sequential Serial Number (which will be the Fare Media Account Number)
- Account Creation Date & Time
- Assigned Customer Account Number (if not Anonymous)
- Account Type (e.g., Regular, Half-Fare, Student, etc.)
- Account Value and Status (as required for the Master Status List)

The CDS will allow multiple Fare Media Accounts to share a single Customer Account for identification and payment purposes, but all Fare Media Accounts of a shared Customer Account will be restricted to a single Account Type. (For example, all Fare Media Accounts in a shared Customer Account must be either Regular, Half-Fare, or Student)



## 21.18 Customer Accounts

The CDS will be the central repository of all Customer Account information.

- A. The CDS will support classification of customer accounts into no less than 50 categories, such as:
  - General Public
  - Corporate Sponsor
  - University
  - Social Service Agency
  - CTDOT Employee
- B. Each entry in the customer account database will include at minimum:
  - Account Number (unique for each account)
  - Name
  - Address
  - Primary Phone
  - Secondary Phone
  - Mobile Phone (for SMS text messages)
  - Email Address
  - User Login ID (unique for each account)
  - User Password
  - Secret Question & Answer (no less than 3 per account)
  - Preferred Payment Method (i.e., tokenized payment card information)
  - Preferred Communication Method (primary / secondary phone, SMS, email)
  - Special Fare Permissions (none, Half, Employee, Concession)
  - Special Fare Authorization Information (e.g., case number, Medicare)
  - Account Category
- C. For each data field in the Customer Account, CTDOT shall be able to designate whether the field is required or optional and whether the field is restricted to CTDOT use only.
- D. The CDS shall allow account holders and authorized CTDOT users to create, modify, and delete customer accounts. All changes to Customer Account data, including the user making the change, will be recorded in the CDS database.
- E. Access to Customer Account data will be strictly password controlled and limited to authorized CTDOT users.
- F. The CDS will encrypt all Customer Account data stored in the CDS database.
- G. The CDS will store no payment method data (such as credit / debit card numbers) covered by PCI DSS requirements in the Customer Account database.

The Contractor shall submit a complete description of the CDS Customer Account database functions, data fields, and configurability for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-13**

CTDOT shall identify the account categories, data field characteristics, secret questions, and other configurable aspects of the Customer Account database for the Contractor's implementation no later than 90 days prior to the start of NFTS revenue service. **CTDOT 21-3**



## 21.19 Fare Media Registration

The CDS shall manage the fare media registration database and process for all CTDOT-issued fare media.

- A. The CDS will accept fare media registrations only from users with valid Customer Accounts.
- B. Customers may register more than one CTDOT-issued fare product in a single account; the CDS will support no less than 10 cards registered to a single account.
- C. Only customers authorized for special fares (Half Fare, Employee Fare, and Concession Fare) will be permitted to register cards with such fare profiles. For example, the CDS will permit only customers authorized to receive Half Fare media to register a Half Fare smart card.
- D. Customers authorized for special fares may register only one special fare card, but may also register one or more Full Fare cards.
- E. Registering a card will require the user to enter the card's sequential serial number and the 4-digit truncated UID, which will be printed on the face of the card. The CDS will reject all registrations for cards where the sequential serial number and the truncated UID do not match records in the CDS card inventory database.
- F. After a CTDOT-configurable number of failed attempts to register a card (initially set to 3), the CDS will reject all further attempts at registering the card; thereafter, only an Administrative POS Terminal will be able to register the card.

The Contractor shall submit designs of the Fare Media Registration function, data fields, and process for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-14**

## 21.20 Fare Media Processing Support

- A. All usage transactions will follow a strict processing algorithm that will include prioritized validation steps. The sequence of these steps may differ from the sequence described herein as long as the overall result is functionally compliant.
- B. When more than one fare product is active on a card's associated account, usage transactions will be governed by CTDOT-configurable priorities. As delivered, fare product priorities (the order in which fare products will be used when more than one product is active on a card's associated account) will be:
  1. Active, valid transfers
  2. All unlimited use passes (valid for the service level in effect) in order of highest value pass to lowest value pass. When no active unlimited ride pass is present, but the card's account has a pending pass, the pending pass will be activated and used for the current usage transaction.
  3. All stored ride passes (valid for the service level in effect), in order of highest value pass to lowest value pass.
  4. Stored value





The Contractor shall submit a complete description of all CDS functions in support of fare media processing for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-15**

#### **21.20.1 Stored Value**

When a transaction involves the use of stored value (either as complete payment of fare, to “upgrade” a pass to a higher level of service, or to reach a “capped fare” limit), the account’s stored value will be reduced by the amount required to satisfy CTDOT’s fare policies.

The value to deduct for each stored value transaction will be determined by CTDOT’s fare policies, including transfer privileges and “capped fares” as described herein. The CDS will calculate the result of each stored value transaction on the status of the associated account and update the Master Status List accordingly.

If the resulting stored value:

- Remains above the CTDOT-configurable low-value threshold, the CDS will update the Master Status List if necessary to reflect the account’s satisfactory stored value status.
- Is less than or equal to the CTDOT-configurable low-value threshold, the CDS will update the Master Status List if necessary to reflect the account’s low value.
- Is less than or equal to the minimum “floor” value for a stored value account (that is, the transaction has depleted all available funds and has caused the account to be reduced to the value of the deposit or less), the CDS will update the Master Status List to reflect the account’s zero value.

If the transaction’s value causes the account’s cumulative transaction value to meet or exceed a floating period pass over the respective prior period, the value of the transaction will be reduced, if necessary, to limit the cumulative value of the transactions to the price of the associated floating period pass. (The fare will be “capped.”) The CDS will then update the pass status of the associated account in the Master Status List to indicate that the pass privileges are in effect, and the expiration date of the “purchased” pass. (The CDS will calculate the expiration date based on the earliest usage for which the cumulative transaction values meet or exceed the price of the respective floating period pass.)

If the NFTS uses real-time transaction processing, in addition to modifying the Master Status List as necessary, the CDS will report the results of the transaction calculations to the requesting NFTS device.

#### **21.20.2 Stored Ride**

When applicable, stored ride transactions will result in the deduction of one trip from the associated account’s stored ride count. As necessary and available, and subject to CTDOT fare policies and pricing, stored ride transactions will include deduction of stored value to “upgrade” the trip to a higher service level (e.g., from a “local” to “express” service).

When a stored ride transaction requires an upgrade, but the card’s stored value has insufficient value to pay for the upgrade, the transaction will result in only the deduction of the trip from the card’s stored ride count; by inference, the CDS will assume that the incremental fare was paid in cash. If as a result of the stored value component of the transaction the account’s stored value falls below a CTDOT-configurable parameter, or falls to zero, the CDS will update the account’s entry in the Master Status List accordingly.

If as a result of the Stored Ride trip the Stored Ride counter falls below a CTDOT-configurable value, the CDS will update the Master Status List to indicate that the account’s Stored Ride



value is low. If as a result of the stored ride trip the account's Stored Ride counter falls to zero, the CDS will update the Master Status list to indicate that the account no longer has a valid stored ride pass.

If the NFTS uses real-time transaction processing, in addition to modifying the Master Status List as necessary, the CDS will report the results of the transaction calculations to the requesting NFTS device.

### **21.20.3 Activating a Pending Floating Period Pass**

When a card's account has no valid unlimited ride pass but has a pending floating period pass, subject to fare product priorities, the transaction will result in the activation of the account's pass (thereby commencing its validity period). The CDS will update the account's Master Status List to indicate that the card has pass privileges, including the pass type.

### **21.20.4 Using an Active Floating Period Pass**

When a card's account has an active floating period pass, subject to the fare product priorities, the transaction will be counted as a boarding by use of the pass.

As necessary and available, and subject to CTDOT fare policies and pricing, floating period pass transactions will include deduction of stored value from the card's associated account to "upgrade" the trip to a higher service level (e.g., from a "local" to "express" service).

When a floating period pass transaction requires an upgrade, but the card's stored value account has insufficient value to pay for the upgrade, the transaction will result in only the recording of the card's usage; by inference, the CDS will assume that the incremental fare was paid in cash.

As the active floating period pass ages and reaches a CTDOT-configurable remaining time (configurable per pass type), the CDS will update the account's entry in the Master Status List to reflect the status of the pass as "Nearing Expiration." When the pass expires, the CDS will update the account's entry in the Master Status List to indicate that no pass is active.

### **21.20.5 Fixed (Calendar) Passes**

Whenever a fixed (calendar-based) unlimited ride pass, such as a monthly pass, is used, subject to the fare product priorities, the transaction will be counted as a boarding by use of the pass.

As necessary and available, and subject to CTDOT fare policies and pricing, fixed (calendar-based) unlimited ride pass transactions will include deduction of stored value to "upgrade" the trip to a higher service level (e.g., from a "local" to "express" service).

When a fixed (calendar-based) unlimited ride pass transaction requires an upgrade, but the card's stored value account has insufficient value to pay for the upgrade, the transaction will result in only the recording of the card's usage; by inference, the CDS will assume that the incremental fare was paid in cash.

As the active fixed (calendar-based) pass ages and reaches a CTDOT-configurable remaining time (configurable per pass type), the CDS will update the account's entry in the Master Status List to reflect the status of the pass as "Nearing Expiration." When the pass expires, the CDS will update the account's entry in the Master Status List to indicate that no pass is active.



### 21.20.6 “Capped” Stored Value Fare

The NFTS will support the ability to limit a card's total stored value usage over one or more CTDOT-defined periods of time, effectively enabling customers to “purchase” floating period unlimited ride passes using several stored value transactions.

When a transaction results in the “purchase” of an unlimited ride pass due to “capped” stored value, the CDS will update the card's entry in the Master Status List to indicate that pass privileges are in effect, including the pass type.

### 21.20.7 Transfers

All transactions that result in deduction of stored value or stored ride quantity will be subject to CTDOT transfer policies. The NFTS will enable CTDOT-issued smart cards to provide transfer privileges in support of CTDOT policies, including when an unlimited ride pass or stored ride pass is used and upgraded by use of stored value.

When calculating the effect of boardings where stored value or stored ride would be used, the CDS will implement CTDOT's transfer policies and leave stored value or stored ride balances unchanged if the boarding fell within CTDOT's transfer policies. For example, if a passenger's smart card has only a stored value balance, the CDS will deduct the proper fare from the account's stored value for the first boarding of a trip. If the passenger subsequently boards another vehicle of the same or lesser service within CTDOT's transfer period (presently 90 minutes), the CDS will record the second boarding as a transfer and leave the passenger's stored value balance unchanged.

Transfers will be in effect based on the date and time of the initial boarding, and will be limited based on CTDOT-configurable parameters.

### 21.20.8 Reduced Fare Transactions

All elements of the NFTS will limit reduced fare transactions to CTDOT-issued cards associated with accounts with reduced fare profile information.

When a card associated with a reduced fare account is used, the CDS will process the transaction according to the reduced fare values associated with the service level in effect on the NFTS device at the time of the transaction.

## 21.21 Master Status List Processing

By reflecting the results of each reported transaction on each associated account's status, the CDS will maintain an accurate status of each card's associated account in the Master Status List. At a CTDOT-configurable interval, configurable in 1-minute increments from 1 minute to at least 6 hours, the CDS will accumulate all Master Status List changes (made since the last broadcast message) into an incremental update broadcast message and transmit the message to all NFTS devices that process smart cards. (The NFTS devices will process the MSL changes message to generate an updated consolidated MSL.)

At least once per day, each NFTS device that processes smart cards will receive the complete MSL from the CDS (via the GCS, if applicable) to ensure that all devices are synchronized daily with a known good MSL. (The NFTS devices will replace their MSL with the transmitted MSL.)

The Contractor will submit a complete description of all CDS functions in support of Master Status List processing for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-16**



## 21.22 Third Party Valid Card List Support and Processing

Participating Third Party organizations will be responsible for maintaining the lists of valid cards that are to be accepted for fare payment. The CDS will provide a secure means, such as a File Transfer Protocol (FTP) interface, to enable third parties to upload updated lists. At least once per day, the CDS will retrieve any updated lists, populate the requisite database tables with the updated information, and disseminate the updated Third Party Valid Card list(s) to the fare collection devices.

## 21.23 Action List

For all NFTS account-based media, the Master Status List and the Third Party-Issued Valid Card List will prohibit acceptance of invalid cards, including those reported lost or stolen. For card-based media, including all CTDOT-issued Limited Use Media and barcode media, the CDS and the NFTS devices will maintain a separate list of cards that are to be rejected if detected.

Any card-based CTDOT-issued smart card media and any barcode media may be placed on the Action List as a result of the media being reported as lost or stolen, for non-payment of account, for suspected fraudulent use, or other reasons defined by CTDOT. CTDOT shall have the ability to define the action to be taken by the fare collection device whenever a listed fare instrument is presented. These actions will include, at minimum:

- Deactivate – Fail the transaction and permanently deactivate the card (CTDOT-issued smart card media only)
- Reject – Fail the transaction (read-only media only)
- Track – Complete the transaction and track usage

Whenever a listed fare instrument is presented to a device, the device will store a transaction record indicating that a listed fare instrument was presented and the action taken.

A CTDOT-issued smart card that has been deactivated due to use after placement on the action list will be rejected as invalid for all subsequent attempted uses.

A CTDOT-issued smart card that has been suspended due to use after placement on the action list will be rejected as suspended for all subsequent attempted uses until and unless the card is reactivated.

Actions to modify the encoding of CTDOT-issued media will allow CTDOT to remotely modify cards as necessary to support functions described herein, and will include (if dictated by the Contractor's design) establishing, modifying, and deleting subscription autoload transactions.

## 21.24 Suspension and Reactivation

When a CTDOT-issued smart card is suspended, the CDS will update the associated account's status to indicate either a date upon which the card will automatically be reactivated, or an indefinite suspension. While a card is suspended, the CDS will maintain the card's entry in the Master Status List as "suspended."

If the suspension information includes a reactivation date, upon reaching that date, the CDS will update the card's entry in the Master Status List to indicate that it is no longer suspended, and restoring other relevant value and pass privileges as appropriate.



If the suspension is indefinite, or if CTDOT deems it necessary to reactivate a card before its predefined reactivation date, authorized CTDOT employees will be able to manually reactivate a card. At such time, the CDS will update the card's entry in the Master Status List to indicate that it is no longer suspended, and restoring other relevant value and pass privileges as appropriate.

## 21.25 Autoloading

Automatic loading ("autoloading") is the process which permits customers to remotely and automatically load and replenish fare accounts associated with one or more smart cards, without having to use a Point of Sale device to conduct the payment transaction.

The NFTS will provide customers three basic forms of autoloading:

- A. **Directed:** a one-time autoloading that is initiated by the customer, usually via a Web Portal, for a specified value, pass, or both to be added to the account. Directed autoloading will require the customer to identify their smart card (by sequential serial number and 4-digit truncated UID), payment method and product or value to add. Directed autoloading will be one-time transactions and will not be repeated unless the customer returns to the customer-specific Web Portal and instructs the system to do so.

The NFTS will collect payment for Directed Autoloads at the time of order, via the Web Portal. Upon collection of payment the CDS will update the associated account's entry in the Master Status List, according to the selected transaction. (If the transaction is for a floating period pass, the MSL will indicate that the pass is pending.)

- B. **Threshold:** a "subscribed" autoloading that adds value or a pass to a fare account based on a low-value threshold or an expiring or expired pass. The NFTS will allow customers to set up threshold autoloading via customer-specific Web Portals and the Administrative Point of Sale Terminal. Establishing a threshold autoloading will require the customer to identify their smart media (by serial number), payment method (such as a credit card number), and the value or product to add to their card's account once the threshold is reached. Threshold values will be CTDOT-configurable; CTDOT will also have the ability to enable customers to select threshold values, and to restrict threshold values to CTDOT-configurable levels only.

When the associated account for a customer's card falls below the selected threshold value, the CDS will initiate payment collection transactions automatically, based on the customer's selected payment method on file. Payment collection transaction processing for Threshold Autoloads as defined.

Upon successful completion of the autoloading payment transaction (triggered by the detected threshold condition), the CDS will update the associated account's entry in the Master Status List, according to the selected transaction. (If the transaction is for a floating period pass, the MSL will indicate that the pass is pending.)

- C. **Recurring:** another "subscribed" autoloading, but one that occurs on a regular calendar basis, usually monthly, and usually in support of employer-sponsored transit benefit programs or for calendar-based pass products.

The CDS will initiate payment collection transactions automatically for Recurring Autoloads, based on the customer's selected payment method on file. Payment collection transaction processing for Recurring Autoloads as defined.

Upon successful completion of the autoloading payment transaction (triggered by the calendar event), the CDS will update the associated account's entry in the Master Status



List, according to the selected transaction. (If the transaction is for a floating period pass, the MSL will indicate that the pass is pending.)

The NFTS autoloading processes will support use by registered and anonymous users.

The Contractor shall submit a complete description of all autoloading transactions and the processes to establish, modify, and cancel subscribed autoloading, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-17**

#### **21.25.1 Responses to Reported Autoload Activity**

The NFTS will strictly enforce exclusive execution of autoloading transactions; that is, each autoloading transaction will occur no more than once.

The CDS will automatically initiate payment transactions for all executed subscribed autoloading transactions, according to the transaction value and the customer's payment method on file.

Upon successful execution of a subscribed autoloading payment, the CDS will transmit a message and receipt to the customer via the customer's preferred method (email or SMS text), if provided.

#### **21.25.2 Failed Payment Transactions**

If subscribed autoloading require the CDS to initiate a payment transaction after a usage transaction (that is, the payment transaction was triggered by a threshold event), the CDS will provide the means for CTDOT to manage failed payment transactions.

Upon receiving denial for a CDS-initiated payment authorization, the CDS will make repeated, periodic attempts to collect payment. The number and periodicity of the repeated attempts will be CTDOT-configurable.

If payment for an executed autoloading transaction remains uncollectable after completing all attempts at collection, the CDS will include all pertinent information of the failure in a daily "Failed Autoloading Payment Transaction" report, which the CDS will email to a CTDOT-definable address.

#### **21.25.3 Automatic Autoload Cancellations**

The CDS will automatically cancel subscribed autoloading when any of the following occur:

- The subscription passes the customer-selected expiration date
- The associated payment method has expired (e.g., the credit card on file has expired)
- Payment for the previous executed subscribed autoloading transaction was denied

#### **21.25.4 Maintenance of Subscribed Autoloads**

The CDS will send periodic reminder messages to customers with subscribed autoloading when:

- The payment method will expire within a CTDOT-configurable number of days (initially set to 90).
- The customer's selected expiration date is within a CTDOT-configurable number of days (initially set to 60).

The CDS will send messages via the customer's preferred method, repeated on a CTDOT-configurable frequency, initially set to once every 10 days.



## 21.26 Dormancy

The CDS will monitor the use of all CTDOT-issued smart card media. Any CTDOT-issued account-based smart card that is unused for a CTDOT-adjustable period (initially set to 2 years) will be declared "dormant;" the CDS will alter the card's entry in the MSL accordingly. Account-based media with dormant status conditions in the MSL will be rejected upon use at any field device (except Administrative Point of Sale Terminals).

When a smart card account with stored cash value is declared dormant, CTDOT will comply with all Federal and State regulations regarding escheat; the CDS will supply all necessary data and reports to support CTDOT's compliance with Federal and CT and NY State escheat regulations.

## 21.27 Media Expiration

All CTDOT-issued long-term smart cards will include a media expiration date that is recorded in the associated account at the time of initial issuance. This date will be a CTDOT-configurable number of years beyond the date of issuance, and will be initially set to 5 years.

If a presented card is past its expiration date but is otherwise fully functional and valid for use, the NFTS device will accept the card and display a suitable warning message to the user that the card is old and should be replaced.

Attempts at replenishing (via POS device or autoload) an account associated with a card that is beyond its expiration date by a CTDOT-configurable period (initially set to 6 months), will be rejected.

## 21.28 Queries and Reports

The CDS will provide a suite of standard reports, which will provide all basic information necessary to operate, maintain, and analyze fare system performance and revenue and ridership data. CTDOT shall have the ability to generate reports using the CDS database in an ad-hoc manner using Crystal Reports® or other standard report generation tools.

It will be possible through the CDS to query any item of data stored within the systems, including transactional information, alarms, status changes, and all other elements stored as transaction records. This will include historical records as well as current information.

### 21.28.1 Standard Reporting

- A. The CDS will provide the capability to query the system database to produce reports for auditing, revenue, media control, planning, fare management information, maintenance, and other similar requirements.
- B. The CDS will provide one or more reports to indicate the software and fare table versions in effect on each device, including date of activation, based on events reported by the devices. Such reports will also indicate successful downloads of software and fare tables that are pending activation, and the date of their successful download.
- C. To the extent possible, the output format of all queries and reports will be of similar style. Each report and query will produce data in tabular format with each column clearly titled on each page. Each row of output data (excluding column titles) will be consecutively numbered.



- D. All reports will provide users with the ability to sort the report rows by any column, user-selectable in ascending or descending order.
- E. All reports will include a cover page that provides the following information:
- Title of the report
  - Date and time report was generated
  - Complete list of input parameters and sorting keys used to create the report
- F. Every page of all reports and queries will include a header that indicates the title of the report, a one-line synopsis of key input parameters, the beginning and ending date and time (where appropriate), and the page number of the report.
- G. It will also be possible for the user to select query and report output in a form that is exportable to other applications, such as spreadsheets and graphical report presentations programs.
- H. The Contractor shall provide several queries and reports at time of delivery. The prepared queries and reports will be presented in a menu form for selection at any time. Each query and report will have access permissions assigned to limit availability to those users authorized to view data presented by the query or report.
- I. Each prepared query and report will also be capable of being automatically processed at predetermined dates, times, and frequencies. It will be possible for CTDOT to identify reports to be run daily, weekly (*e.g.*, every Wednesday), monthly (*i.e.*, the first day, last day, or any specific day of each month), quarterly, and so on.
- J. Reports of general nature and those that include a wide variety of input fields will be configurable to narrow the scope of the report. For example, using the menu-driven input forms, it will be possible to limit a general query or report that provides total sales revenues to only sales associated with the mobile ticketing application.
- K. The queries and reports to be provided at time of delivery are grouped into five major categories:
- Summary Reports, which will provide an historical view of data within a date range. These reports will include detailed information and/or totals of related events or transactions.
  - Database Reports, which will provide printouts of configuration files, operational parameters, and other data used to determine operations of the equipment. Database reports will indicate the date and time the database table being shown was last modified.
  - Status Reports, which will provide “snapshots” of equipment and system conditions, usually for the most recent data available. For off-line equipment (such as Validating Fareboxes), status reports will list the date and time each device last communicated with the CDS.
  - Media Reports, which will provide information about fare media in circulation, in inventory, in various status conditions, etc.
  - Finance Reports, which will provide financial information and payment (credit/debit) reports.





A listing and conceptual description of all standard queries and reports will be submitted for CTDOT review and approval at the Preliminary Design Review. **CDRL 21-18**

Query and Report output format will be subject to CTDOT review and approval at the Final Design Review. **CDRL 21-19**

Standard reports may differ from the list below, but the general functionality and information conveyed will be as shown in the table below:

Table 21.28.121-28.1: Standard Reports

#	Type	Subsystem	Name	Description	Content
<del>14</del>	Summary	Sales & Revenue	General Sales Summary	Total value of sales and replenishments	Identifies sales source (POS, web, autoloader, mobile, etc.), and value
<del>22</del>			Product Sales Summary	Total sales and replenishments by product and media type	Identifies sales and replenishments for each product type by media type
<del>33</del>			Detailed Sales Summary	Total sales by each device and system	Identifies sales at each device and system by product type
<del>44</del>			General Revenue Summary	Total revenues by payment method	Identifies sales by source and payment method
<del>55</del>			Retail Sales Invoicing	Invoice reports for Retail Sales Outlets, by store and by retail chain	Provides invoicing information for Retailers coincident with CTDOT invoicing schedule
<del>66</del>		Ridership	General Ridership Summary	Total ridership by payment method	Identifies linked trips (excludes transfers) by media type, fare product, fare category
<del>77</del>			Detailed Ridership Summary	Total ridership by payment method, by route, etc.	Identifies linked trips by route, day of week, time of day, location, media type, fare product, fare category, etc.
<del>88</del>			General Boardings Summary	Same as General Ridership Summary, but includes transfers	
<del>99</del>			Detailed Boardings Summary	Same as Detailed Ridership Summary, but includes transfers	
<del>1040</del>			Transaction History	Detailed Transaction History Summary	Transaction history details for specified fare media
<del>1144</del>	General Usage History Summary	History of fare media usage by type and product		Provides historical usage (total transactions) of fare media in definable date ranges (days, weeks, months, quarters, years)	
<del>1242</del>	Fare Product Usage Summary	Usage (ridership) by fare product by media type		Provides number of rides per product type by media type for the given date range	

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#	Type	Subsystem	Name	Description	Content
1343		Cash Handling	Detailed Vault Contents Summary	Contents of each cash storage vault (farebox cashbox, MVM bill vault, coin vault, hopper) removed	Provides date, time, contents (by denomination) and ID of the vault when removed from the device, and the ID of the employee who removed the unit.
1444	Detailed Cash Replenishment Summary		Contents of each cash storage module (coin hopper, recirculating unit) when inserted into MVM, and contents of change replenishment transactions (to restore recirculating supply)	Provides date, time, contents (by denomination) and ID of coin storage module when inserted into MVM, the contents (by denomination) of change replenishment transactions, and the ID of the employee who performed the action	
1545	Consolidated Mobile Safe Contents Summary		Contents of one or more Mobile Safes when removed	Provides date, time, consolidated contents (by denomination), and ID of Mobile Safe when removed from the Farebox Vaulting System, and the ID of the employee who performed the action.	
1646	Detailed Mobile Safe Contents Summary		Contents of individual Mobile Safe when removed, listed by farebox	Provides date, time, individual contents (by farebox cashbox and denomination) and ID of Mobile Safe when removed from the Farebox Vaulting System, and the ID of the employee who performed the action	
1747		Vault Tracking	Detailed Vault Tracking Summary	List all vault insertion and removal activities.	Displays vault serial number, vault type, event, date and time, and employee removing or inserting the vault. If a vault serial number is not listed in the vault serial number database, the vault shall be considered a "rogue" and the vault type shall indicate that the vault is unknown.
1848	Vault Search Summary		Provides information about the last activity related to the specified vault(s) during the specified period	Lists date, time, vault ID, location, activity, and employee performing the action.	
1949		Events	Detailed Event Summary	Reported equipment & system events	Detailed event information for each reported event during the period
2020	Device Last Probed		Last date and time of communication with device	Provides device type, ID, location / vehicle, and date of last communication	
2124	Origin-Destination Analysis		Origin-Destination Analysis	See Section 3.16	
2222		Fraud Detection	Fraud Detection Queries	Identify the use/attempted use of duplicate card numbers, value increases without associated add value records and other similar common fraud methods	

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#	Type	Subsystem	Name	Description	Content
2323	Database	Fare Table	Active Fare Table	Contents of the current (active) fare table	
2424			Fare Table History	Contents of previous (saved) fare table versions	
2525			Pending Fare Table	Contents of any future table	Includes the activation date of the new table
2626		Equipment Configuration	Configuration Files	Contents of the configuration files for each device	Identifies all configurable operating parameters
2727		Network	Network Configuration	Configuration of the network, such as communications port assignments, IP addresses, etc.	
2828		NFTS User Administration	CDS Authorized Users	Lists each CDS user and permission levels	
2929			Web Portal Users	Lists web portal users	Provides contact information for web portal users by web portal
3030			Admin POS Users	Lists authorized users of CTDOT Administrative POS Terminals	
3134		Media Administration	Current Action List	Current action list	All smart cards and mobile tickets that are to be deactivated, suspended, rejected, reactivated, and tracked
3232			Deactivated & Suspended Cards	Cards that have been deactivated and suspended	Historical listing of all cards that have been deactivated, and all cards that have been suspended but not reactivated. (These cards may no longer be on the current action list.)
3333		Customer Administration	Current Customers	List of customer account information	Selected by category, ZIP code, fare permissions, and other characteristics
3434			Current Benefits Administrators	List of Corporate Partner, Institutional, Social Services, and other Sponsor coordinators	Selected by category, lists contact information, payment method, contract dates, etc.
3535		Autoload Administration	Pending Directed Autoloads	Directed autoloads which have not yet been completed	Includes card number, product, value awaiting autoload, expiration date
3636			Active Subscription Autoloads	Recurring autoloads which are currently active	Includes card number, product, threshold, value, and expiration date
3737			Failed Autoload Payment Transaction	Completed subscribed autoloads where attempts to collect payment failed	Includes smart card number, transaction value, transaction ID, payment type, authorization/denial ID

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#	Type	Subsystem	Name	Description	Content
3838	Status	System	Equipment Status	Last known reported status of equipment and systems	Provides operational status of each device and system (e.g., web portals, payment card processor, GCS, mobile ticketing interface, etc.) and date of last communication
3939			Current Software Configuration	Last reported versions of application software, configuration files, fare tables, etc.	Provides software and configuration version numbers for each device, and date of last modification
4040			Equipment Location	Installation location of each device	Vehicle number for Validating Fareboxes and Stand Alone Processors, BRT station platform for Platform Validators, assigned users for portable devices, locations for POS Terminals, etc.
4144			Current Vault Location	Current cash storage modules installed	Lists the type and ID of every cash storage module currently installed in all (or selected) fareboxes, Farebox Vaulting Systems, and MVMs
4242	Inventory	Media	Current Smart Card Status	Current status of smart cards (individual or range), products on card, current value, last transaction date	
4343			Smart Card Inventory Review	Number of smart cards in each status by fare category	
4444	Finance	Finance	Cash on Hand	Total cash stored in all modules of each selected MVM	Total value in each cash storage module and in each MVM
4545			Stored Value Liability	Total value of unused stored value, net of deactivated and dormant cards	
4646			Escheat Liability	Total value of unused stored value that is subject to escheat	Residual value of some or all dormant stored value, based on escheat regulations (dormancy period may differ from escheat requirements)
4747			Bankcard Reports	One or more reports to provide necessary oversight of credit, debit, and prepaid card transactions	Strictly limited to users authorized to view PCI-sensitive data

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### 21.28.2 Data Import from Ticket Vending Machine System

CTDOT's Ticket Vending Machine System (TVMS), supplied by others, includes a Central Management System (CMS) that monitors and tracks revenue and ridership statistics for the Ticket Vending Machines used for Proof of Payment purposes on the CTfastrak system. The NFTS Central Data System shall import data from the TVMS Central Management System to provide consolidated revenue and ridership data for all CTDOT services. This TVMS design information which will use an ODBC database, will be provided by CTDOT to the Contractor.

**CTDOT 25-4**

The Contractor shall coordinate the necessary design services, database queries, and Application Program Interfaces with the TVMS Contractor to enable the NFTS to import TVMS revenue and ridership data needed to satisfy the consolidated reporting requirements. Revenue and ridership reports defined in Table 21.28.1 shall include data from the TVMS.



### **21.28.3 Query and Report Design Services**

In addition to the reports listed in Table 21.28.1 (or their functional equivalent), the Contractor shall supply query and report design services for no less than 20 additional reports to be defined by CTDOT no less than 6 months before completion of the Software Warranty. The Contractor shall supply all such requested additional queries and reports before conclusion of the Software Warranty.

### **21.28.4 Ad Hoc Reporting and Queries**

The CDS shall provide a mechanism for authorized CTDOT users to extract information directly from the system through a Report Writer facility compatible with the CDS Relational Database Manager.

Menus and screens to support the generation of reports, as well as the timing and location of the resulting output shall be provided. Once a report is defined, the system shall have the ability to display the output before printing, and store the definition for reuse.

## **21.29 Applications**

### **21.29.1 Device Management**

The CDS shall be responsible for the management of all hardware and equipment included as a part of this System. This shall incorporate both Configuration Management and Equipment Monitoring.

#### **21.29.1.1 Configuration Management**

Configuration management shall be performed by the CDS to ensure the proper configuration of all field devices in the System. This shall be responsible for managing the addition, modification, and deletion of equipment functionality and equipment configurations utilizing a GUI menu-driven interface.

This shall allow CTDOT the ability to change, test configurations, and program tables before being updated throughout the system. This system shall allow the ability to roll back to a previous configuration that has not been manually purged from the system. Any difficulties with the rollback shall be automatically identified and reported to the user.

This shall have sufficient capacity to adequately support all hardware to be provided as part of this project, and shall have no maximum number of equipment to manage.

All configuration files and operational parameters of the NFTS equipment shall be managed by this application. All necessary parameters for the equipment and functionality shall be stored in the CDS database and distribute parameter and configuration changes across the System network as needed to ensure proper operation and security.

No change to these files or parameters shall be transmitted without a record of the change being stored on the CDS. The CDS shall store all changes made to files and parameters and allow for review of no less than the previous 100 changes made. Records of each change shall include the user, the date and time of change, the equipment to which change(s) was (were) transmitted and date and time of transmission. Contents of these files shall be protected by additional password privilege. Methods to alter configuration files and operational parameters shall utilize preformatted input forms supported by the relational database manager.



The NFTS Configuration Manager shall enable device-specific configurations as necessary. For example, only a subset of MVMs may have the ability to sell certain tickets in the fare table; such availability may be periodic, requiring the ability to routinely enable and disable ticket types.

The configuration files and operational parameters to be managed shall include at minimum the following information:

- Station names
- PV and MVM locations, identifiers and types
- Fare tables (one active, two inactive)
- Ticket and transaction types to be available for sale
- Ticket print format
- Patron Display screen configuration and messages
- Operational parameters including timeouts, vault full levels, accepted bill denominations.
- Event and alarm descriptions, categories and priorities
- Cash handling device serial numbers in system
- Digitally recorded voice message file assignments
- Technician identification and access codes

The Contractor shall submit a comprehensive listing of system parameters, downloadable information and descriptions of procedures to track information modifications for CTDOT review and approval at the Final Design Review. **CDRL 21-20**

#### 21.29.1.2 *Platform Equipment Status Monitor*

Status of all NFTS platform equipment shall be updated and automatically maintained by the system through the Platform Equipment Status Monitor application.

- A. The Platform Equipment Status Monitor application shall monitor the status of all on-line Multi-Function Vending Machines and Platform Validators, and all data transfers. The Contractor shall install, configure, and activate network monitoring software, such as HP® OpenView® or equivalent commercially available software.
- B. The Platform Equipment Status Monitor shall display status in three levels of detail:
  - All Platform Equipment
  - All Platform Equipment at a selected station
  - Individually selected device
- C. When displaying the status of all Platform Equipment, the Platform Equipment Status Monitor application shall provide a graphical representation of the system via a system map showing all stations where devices are installed under this contract. The icon for each station shall indicate (via color) a summary of the status of all Platform Equipment at the station. When a station has more than one alarm in effect, the station icon shall be shown in the color of the highest priority alarm.
- D. When displaying the status of all Platform Equipment at a selected station, the Platform Equipment Status Monitor shall display a station map, showing the status of each device at the selected station. The icon for each device shall indicate (via color) a summary of the status of all alarms for that device. When a device has more than one alarm in effect, the device icon shall be shown in the color of the highest priority alarm.
- E. When displaying the status of an individually selected device, the Platform Equipment Status Monitor shall display a graphical or picture representation of the device, indicating



via color icons or text, the status of all major modules within the device. When a module has more than one alarm in effect, the module icon shall be shown in the color of the highest priority alarm.

- F. Those alarms that CTDOT designates as high priority shall require CTDOT interaction at a CDS workstation to clear. All other alarm conditions shall clear automatically when the alarm condition is resolved.
- G. The Platform Equipment Status Monitor application shall incorporate menu options to facilitate monitoring of each of the following:
  - Device operational status
  - Device revenue status
  - Device software status
  - Effective date of fare tables and associated files
  - System and unit security
  - Network status
  - Polling status (i.e., last date and time of data upload and download)
  - External system interface status (i.e., clearinghouse link, links to other CTDOT computer systems, etc.)
- H. The Platform Equipment Status Monitor shall incorporate menus and screens supporting both the manual and automatic polling of transaction, status and event log information. The system shall be able to designate the polling for all devices, devices at a specified station, and any individual device. Authorized users of the Platform Equipment Status Monitor shall be able to request the CDS to query any single device, station of devices, or all devices for status update.
- I. The Platform Equipment Status Monitor shall automatically declare a security breach at an MVM is in effect when the following occurs:
  - An MVM “door open” event is recorded
  - The CDS receives no corresponding “authorized login” event within a CTDOT-adjustable interval, initially set to 60 seconds
- J. In addition, the Platform Equipment Status Monitor shall be able to monitor connections to external telecommunications networks, and shall incorporate menus and screens to support this function.

The Contractor shall submit a complete description of the Platform Equipment Status Monitor, including sample screen images, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-21**

#### 21.29.1.3 *Equipment Monitoring*

The CDS shall receive and store all event records transmitted by NFTS devices. When the CDS receives CTDOT-selected event records, the CDS shall transmit an email message with relevant content, to one or more CTDOT-specified addresses.

The CDS shall reject all external communication requests from devices and systems not in the CDS database; all such events shall cause the CDS to generate an entry in an error log for review by CTDOT.



#### 21.29.1.4 *System Monitoring*

The CDS shall be able to monitor the activity of the NFTS devices and the communications networks that connects and supports these devices.

System Devices perform a variety of self-diagnostic functions. The CDS shall provide real time access to such status and diagnostic information. When devices register events, in both volatile and non-volatile memory, such information shall be made available to the CDS on a real-time basis. Such information shall include, but not be limited to, the devices internal software version number, fare table (effective date) in use, event description/code, etc.

This information either shall be transmitted to the CDS as part of the unit's start up procedure, or as it becomes available. Should the network connection to a device become inoperable, the information shall be transmitted to the CDS when the connection is restored. The Contractor shall provide complete technical information on the recovery from an off-line status to an on-line status.

The CDS shall retain this event data for reporting and statistical analysis. It will be used to generate historical usage patterns, unit and network "mean time between failures" rates, and reliability statistics for machine operations and network availability.

Given that most of this information will be repetitive and non-critical, the CDS shall be able to determine when active operator intervention is required. The following conditions require special handling:

- At start up or start of any tour/start of day, the unit's internal clock setting shall be synchronized with the CDS host's internal clock based on time received from the CTDOT network clock. Any significant deviation shall be addressed.
- At start up, the unit's, software version number, the effective dates of the fare table, associated files, and media layouts shall be compared to internal CDS table(s). Any discrepancies shall generate an automatic upload of the correct information.
- When a security breach or failure occurs, a message is sent to the appropriate CTDOT department.
- When any component in an assembly fails, the associated diagnostic messages shall be captured, stored, and transmitted to the CDS to be made available to the CTDOT maintenance department.

A functional description of all monitoring functions shall be provided at the Preliminary Design Review for review by CTDOT and for approval by CTDOT at the Final Design Review. This information shall include the design or the operational flows, screens, functions and other similar information and shall include increasing detail with each design review step. **CDRL 21-22**

#### **21.29.2 Vehicle-Installed Equipment Management**

The Vehicle-Installed Equipment Manager shall control and manage all electronic NFTS equipment installed in any vehicle, including Validating Fareboxes and SAPs. Through this application, authorized users shall be able to define and change configuration and other operating parameters. The Vehicle-Installed Equipment Manager shall also interact with the CTDOT's existing equipment maintenance and inventory control applications to support tracking of devices at a location.

From the Vehicle-Installed Equipment Manager, authorized users shall have the capability to remotely control any on-line equipment. Functions that can be remotely performed by an authorized user shall include:





- Place equipment in service
- Place the device in Coin Bypass
- Place a module out of service
- Perform diagnostics at both the device and component levels
- Enable any payment mode or module
- Force an update of the valid card list to the device(s) - this can also be tied together with the Station-Installed Equipment Manager to force a system wide update
- Transfer any information or data
- Reset the equipment (*i.e.*, cause the equipment to restart all programs without affecting data registers)

All modifications to the equipment functionality shall be recorded in the CDS database and reported immediately to CTDOT's equipment maintenance and inventory control application.

### **21.29.3 Station-Installed Equipment Management**

The Station-Installed Equipment Manager shall control and manage all electronic NFTS equipment installed at any station location, including MVMs and platform validators. Through this application, authorized users shall be able to define and change configuration and other operating parameters. The Station-Installed Equipment Manager shall also interact with the CTDOT's existing equipment maintenance and inventory control applications to support tracking of devices at a location.

From the Station-Installed Equipment Manager, authorized users shall have the capability to remotely control any on-line equipment. Functions that can be remotely performed by an authorized user shall include:

- Place a module out of service
- Place an item of equipment in service or out of service
- Perform diagnostics at both the device and component levels
- Enable and disable any payment mode or module
- Force an update of the valid card list to the device(s) - this can also be tied together with the Vehicle-Installed Equipment Manager to force a system wide update
- Transfer any information or data
- Reset the equipment (*i.e.*, cause the equipment to restart all programs without affecting data registers)

All modifications to the equipment functionality shall be recorded in the CDS database and reported immediately to CTDOT's equipment maintenance and inventory control application.

### **21.29.4 Farebox Vaulting System Management**

The Farebox Vaulting System Manager shall control and manage the farebox vaulting systems at all of the CTDOT garages, including their associated data systems. Through this application, authorized users shall be able to define and change configuration and other operating



parameters. The Farebox Vaulting System Manager shall also interact with the CTDOT's existing equipment maintenance and inventory control applications to support tracking of devices at a location.

From the Farebox Vaulting System Manager, authorized users shall have the capability to remotely control any on-line equipment. Functions that can be remotely performed by an authorized user shall include:

- Place a module out of service
- Place an item of equipment in service or out of service
- Perform diagnostics at both the device and component levels
- Enable and disable any payment mode or module
- Force an update of the valid card list to the device(s) - this can also be tied together with the Vehicle-Installed Equipment Manager to force a system wide update
- Transfer any information or data
- Reset the equipment (i.e., cause the equipment to restart all programs without affecting data registers)
- Obtain revenue collected information, based on user access privileges

All modifications to the equipment functionality shall be recorded in the CDS database and reported immediately to CTDOT's equipment maintenance and inventory control application.

#### **21.29.5 Retail Sales Network Management**

The CDS shall receive and store all transaction data from the Retail Sales Network. The CDS shall also transmit to the Retail Sales Network configurable parameters, including at minimum the sales price of new CTDOT-issued smart card media, and the menu selections for account replenishment transactions.

In addition, the CDS shall manage and monitor all CTDOT-operated Point of Sale Terminals, and shall receive and store all transaction and event records produced by those devices.

#### **21.29.6 Handheld Fare Inspection Terminal Management**

As the Handheld Fare Inspection Terminals are not installed on CTDOT property and are out of the direct control of the CTDOT, these are being managed by a web portal as identified. The lists, configuration items and all other data and information required for the operation and setup of the devices shall be obtained from and stored on the CDS and retrieved for use by the authorized personnel for the management of the web portals.

All transaction data from those devices managed shall also be stored on the CDS when communicated from the devices.

#### **21.29.7 Voice Message Manager**

The CDS shall provide software tools to manage the assignment of all voice messages to each step of all MVM and PV transactions. Management of voice messages shall permit modifying existing voice messages, assigning new voice messages to additional transaction steps and ticket types created by CTDOT, and deletion of voice message assignments for transaction steps and ticket types that are discontinued by CTDOT.



If digitally-recorded audio files are employed, each voice message file shall be individually tracked, managed, modified and downloaded.

If text-to-speech synthesis is used, each message shall be configurable independently of the text displayed on the device Patron Display. For example, text messages may be phonetically spelled, or additional text converted into speech to clarify the displayed message.

The Contractor shall submit a description of procedures to track, modify and download voice messages for CTDOT review and approval at the Final Design Review. **CDRL 21-23**

#### **21.29.8 Solid State Memory Module Interface**

The CDS shall provide authorized users the ability to exchange data with off-line MVMs and PVs using removable Solid State Memory Modules (SSMMs). The process used to exchange data with off-line devices shall ensure that no data is erased from an SSMM unless the data is first stored and verified on the CDS.

### **21.30 Bankcard Processing**

Valid bankcards (*i.e.*, credit, debit, and prepaid cards) issued by financial institutions shall be accepted for NFTS purchases of smart cards and fare products.

- A. Bankcard payments for NFTS transactions shall occur via sales channels that include Multi-Function Vending Machines, Administrative POS Terminals and NFTS websites, including the General Public Web Portal.
- B. Payment for bankcard purchases shall be processed directly by CTDOT's selected third-party merchant services provider or payment gateway ("payment entities").
- C. If supported by the payment entities, bankcards shall be compared to the negative / "hot" lists stored by the payment entities to limit CTDOT exposure to fraud; the NFTS shall store the results of such denied authorization requests. CTDOT's third party payment entities shall process authorization of each bankcard purchase transaction and provide CTDOT with funds via a standard funds transfer process.
- D. With the possible exception of initial data capture at MVM and Administrative POS Terminal Bankcard Processor Module, at no point shall any element of the NFTS transmit or process full, unsecured bankcard Primary Account Numbers (PANs) and other related cardholder-sensitive data. In addition, at no point shall full bankcard PANs and other related cardholder-sensitive data (secure or unsecure) be stored by the NFTS. All bankcard PANs shall be secured (*e.g.*, "tokenized") by CTDOT's payment entities so that all NFTS records of bankcard transactions, and all records of NFTS authorized payment methods, shall be devoid of true bankcard PANs.
- E. Assignment of the Merchant Identification shall be CTDOT-configurable. The CDS shall support assignment of a single Merchant ID for all bank card-accepting NFTS devices (MVMs, and Administrative POS Terminals), and the assignment of an individual Merchant ID to each device.
- F. The NFTS shall provide a means, without the use of true bankcard PANs, to "link" purchases to applicable fare media to enable various customer service functions such as fare media deactivation, and shall provide for a seamless process for various customer service functions, including but not limited to researching transactions and processing refunds.



- G. Autoload transactions generated by the NFTS shall be transmitted to the payment entities for authorization. CTDOT's payment entities will transmit the result of autoload payment processing back to the NFTS in real time.
- H. Where allowed or required by card brand operating regulations, the NFTS shall incorporate Address Verification Service (AVS), partial approvals, real-time reversals, and split-payments when processing bankcard purchases.
- I. The Contractor shall introduce no technical or design features that prevent forward compatibility with standards of the financial services and payment industries. CTDOT requires that all aspects of the NFTS comply with generally accepted operating procedures and practices for processing electronic funds transfers of the financial services and payments industries.
- J. All software resident on the system to accommodate electronic payments shall conform to applicable ABA requirements, ISO/IEC standards, Federal Reserve Regulations (including "E" and "Z"), card brand operating regulations, and other regulations, laws and standards for electronic payment processing. The NFTS shall be fully compliant with all applicable data security standards in effect at the time the first element or function of the NFTS enters revenue service.

The Contractor shall submit a comprehensive document describing all procedures and processes in support of bankcard transaction processing. Because of its sensitive nature, the Contractor shall submit this document under secure cover or in encrypted form only, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review.

#### **CDRL 21-24**

#### **21.30.1 Bank Cards to be Accepted**

The NFTS shall accept the following credit cards: VISA, MasterCard, American Express, and Discover. Acceptance of other types of credit cards shall require modification of a CTDOT-adjustable table, resident on the CDS, containing ranges of Bank Identification Numbers (BINs) corresponding to the accepted credit card types.

All debit cards with ABA-compliant encoding shall be accepted by the MVM and Administrative POS Terminal and forwarded to the CDS for further processing. The clearing house will determine if the card is to be accepted for the transaction.

#### **21.30.2 Bank Card Usage Limits (Velocity Controls)**

For purposes of controlling potential losses through bank card fraud, the CDS shall maintain a database of all bank card sales. This database and the CDS usage of the data stored there shall be in full compliance with PCI DSS requirements. The database shall impose checks of transactions requests; if such checks are not passed, the transaction shall be denied:

- A. The database shall be updated automatically for each completed bank card sale.
- B. The database shall limit the number and value of transactions in total and by type for individual credit cards for given durations. Such limits shall be software definable and modifiable by CTDOT. For example, it shall be possible to deny a bank card transaction request for the same card when a third transaction is requested within a 10-day period and when the total value of card transactions exceeds a specified dollar amount in a given week.



The Contractor shall submit a description of the bank card usage limits process, including all configurable parameters, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 21-25**

### **21.30.3 Local Bank Card Hotlist**

The CDS shall include a CTDOT-maintained list of bank cards that are known to be unacceptable (*i.e.*, the Local Bank Card Hotlist). CTDOT will use this list to prevent unscrupulous patrons from repeatedly claiming false transactions and receiving multiple reversal refunds.

- A. The CDS shall reject all requests for authorizations for bank cards that reside on the Local Bank Card Hotlist and inform the requesting device or system of the rejection.
- B. When a bank card is on the Local Bank Card Hotlist, the CDS shall not request authorization from the bank card clearing house.
- C. Only authorized users, under strict compliance with PCI DSS requirements, shall have the ability to add, delete, modify, and review entries on the Local Bank Card Hotlist.
- D. The CDS shall record subsequent attempts to use cards that are on the Local Bank Card Hotlist.
- E. The Local Bank Card Hotlist shall have a capacity of no less than 1,000 cards.
- F. Each entry on the Local Bank Card Hotlist shall contain at minimum:
  - The complete bank card number
  - The date and time the entry was made or modified
  - The authorized user who made or modified the entry
  - The reason for the entry
  - The most recent date, time, and location (e.g., MVM number) of attempted use

### **21.30.4 Verify Billing Address for Credit Card Payments**

As part of the authorization process for bank card transaction, the system shall have the ability to perform address verification, which shall cause the device to prompt the patron to enter the ZIP code of the card's billing address

Authorized CDS users shall be able to configure the system to prompt for a zip code by the following criteria, at a minimum:

- Card brand
- Card type (e.g. credit, prepaid, signature debit, pre-tax transit benefit)
- Bank card country of issuance (e.g. US or non-US)
- Transaction purchase amount.

### **21.30.5 Reversals**

The CDS shall automatically reverse credit and debit card authorizations whenever necessary as a result of a timeout, failure to issue a ticket, or other transaction failure. When the CDS receives an authorization for a transaction but does not receive confirmation from the requesting device that the transaction completed successfully within a CTDOT-adjustable time period, the CDS shall assume that the transaction failed and reverse the authorization.



### **21.30.6 Funds Settlement**

The CDS shall generate an electronic settlement report and transmission with the appropriate financial institution. Once the settlement report has been successfully transmitted, a hard copy report shall be scheduled for printing. The settlement report shall be incremental in nature, containing transactions that have successfully occurred since the most previous transmittal of a settlement report.

### **21.30.7 Interface and Communications Requirements**

The Contractor shall be responsible for execution of all technical and procedural steps to comply with processing requirements identified by CTDOT's payment entities for bankcard payment processing.

The Contractor shall be responsible for development, testing, certification, and implementation of the interface and communications links to the payment entities. The Contractor shall also provide any associated software and hardware for purposes of securely processing the required data for bankcard transactions by NFTS components.

### **21.30.8 CDS Processing**

The NFTS shall, at a minimum, provide as part of the local software configurations defined in the CDS, the following regarding bankcard payment acceptance:

- Minimum sale amount
- Maximum sale amount
- Maximum credit card surcharge as a percentage of sale amount, by card brand
- Card brands accepted (e.g., Visa, MasterCard, Discover, American Express)
- Type of cards accepted (e.g., credit, debit, prepaid)

As needed to meet the requirements of the NFTS and/or the payment entities, Contractor shall implement either batch settlement (*i.e.*, end of day settlement files sent to the payment entities) or host-capture settlement (*i.e.*, no settlement files sent to the payment entities). As required, transmissions shall be sent in a format to be specified by the payment entities and using an Application Programming Interface (API). The API shall be constructed using technologies typical of banking APIs such as web services and XML.

The CDS shall accept from the payment entities, all settlement information for bankcard settlement to allow for full reconciliation of all purchase transactions.

As mutually agreed by CTDOT and the payment entities, the CDS shall automatically receive, and provide for reporting on, the necessary authorization, settlement and other log data files in a secure, electronic file.

## **21.31 NFTS Legacy Systems Interface**

The Contractor shall develop interfaces between the CDS and several existing ("legacy") CTDOT information systems used by each of its operating entities. The various types of legacy system examples are listed below and interfaces shall be provided for each operating entity. In addition, the CDS shall provide the data collected and stored by the CDS in a CSV format for import by legacy and other systems to provide the necessary operating information typically used at present.



The Contractor shall submit documentation describing each Legacy System Interface, including the communication protocols, file formats, and other design details, for CTDOT review at the Preliminary Design Review and approval at the Final Design Review. **CDRL 21-26**

**21.31.1 Finance (GFI Software)**

**21.31.2 Operations/Scheduling (Trapeze; Midas)**

**21.31.3 Maintenance Management (Assetworks)**

**21.31.4 Inventory (Assetworks)**



## 22 Garage Communications Servers

### 22.1 General

The Contractor shall supply, install, and configure Garage Communications Servers (GCSs) and wireless data networks at each of the garage facilities where CTDOT vehicles are parked and serviced. Via Wi-Fi communications, the Garage Communications Servers shall manage the secure and expedient transfer of all data transfers between the Central Data System (CDS) and the Validating Fareboxes and Stand Alone Processors (SAPs)

At minimum, the GCS shall transfer the following data to and from the Validating Fareboxes and SAPs:

- A. Uploads from Validating Fareboxes and SAPs – stored and then forwarded to CDS on a scheduled basis, at a minimum of once per day:
  - Previously unreported transaction records, including
    - Smart card usage transactions
    - Barcode media usage transactions
    - Third Party-Issued Media usage transactions
  - Previously unreported event records
- B. Downloads to Validating Fareboxes and SAPs – received from CDS, stored and then downloaded to Validating Fareboxes when communications is established:
  - Current date and time (from a master clock)
  - Complete Master Status List
  - New fare tables (when required)
  - Updated device software (when required)
  - Updated device configuration settings (when required)
  - Valid Operator ID List
  - Valid Block List

The GCS shall also provide all interfaces with the Farebox Vaulting Systems, including monitoring and reporting of:

- The operating status of all cashbox receivers
- The cashbox vaulting process
- The contents of each vaulted cashbox
- The Mobile Safe exchange process
- The contents of all Mobile Safes

The Contractor shall submit a detailed description of the GCS, including functionality, installation and installation requirements. This document shall be delivered for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 22-1**

### 22.2 GCS and Networking Hardware

The Contractor shall submit descriptions, specifications, and OEM literature for all GCS hardware for CTDOT's review at the Preliminary Design Review, and CTDOT's approval at the Final Design Review. **CDRL 22-2**





### **22.2.1 Computer Hardware**

The Contractor shall supply, install, and configure computer hardware with sufficient processing, memory, expandability, and data storage capacities to support successful operation of the GCS. GCS capacity and performance shall meet the following criteria:

- A. Sufficient memory capacity to retain data until redundant copies have been made and verified
- B. At least twice the storage and processing capacity that is required to support the number of daily customer transactions projected by CTDOT for full system deployment (base contract)
- C. Sufficient capacity to accommodate at least four times the number of devices of the full system deployment (base contract quantities).
- D. Redundancy to enable continued operation of critical security functions or of transaction functions without degradation that is obvious to the user.

Transfer of data between CDS and a GCS shall be possible using secure removable backup storage media, for use in the event a failure prevents the transfer of data via the communications network. These storage media shall also serve as backup data storage to protect data against loss in the event of GCS computer hardware failure or corruption.

All GCS hardware to be installed in an office environment shall be commercial grade. Hardware installed in a non-office environment shall be industrial grade. The Contractor shall supply and install a compact rack with locking doors for the GCS, and install all GCS hardware in the rack.

### **22.2.2 Uninterruptible Power Supply**

For each Garage Communications Server, the Contractor shall supply and install a dedicated Uninterruptible Power Supply (UPS), which shall power the GCS. The UPS shall supply sufficient battery capacity to operate all components of the GCS for a minimum of 30 minutes, and shall cause the GCS to shut down without loss of data integrity whenever the UPS determines that its remaining battery capacity is low.

The UPS shall also provide no less than 500 joules of overvoltage (surge) protection for all connected devices.

### **22.2.3 Garage Facilities Wireless Networks**

The Contractor shall design and install the wireless communication system for all CTDOT and contracted-service facilities. Contractor-installed wireless networks at all facilities shall provide coverage for all areas where CTDOT services, fuels, and washes vehicles equipped with NFTS equipment. Contractor-supplied wireless communication systems shall utilize access points that:

- Employ MIMO antennas
- Are fully compliant with IEEE 802.11n standards
- Are fully compliant with IEEE 802.11i standards for security and encryption
- Are suited to the installation environment (some indoor, some outdoor)
- Are managed by a Contractor-supplied dedicated Access Point Controller
- Use Power over Ethernet

The Contractor shall also supply, install, and configure one or more dedicated Access Point Controllers for each facility, such as a Cisco 2500 Series Wireless Controller or CTDOT-approved equal.



Subsequent to installation at each facility, the Contractor shall perform a Wi-Fi coverage analysis; within 5 days of completing installation at each facility, the Contractor shall submit documentation demonstrating satisfactory Wi-Fi coverage at each facility to CTDOT for review and approval. **CDRL 22-3**

## 22.3 GCS Software

### 22.3.1 GCS Operating System

The Contractor shall supply, install, and configure OEM operating system software for each GCS suitable for its role as an unattended “store and forward” service. The GCS shall automatically install updates to the OEM operating system upon receipt from the CDS.

### 22.3.2 GCS Application Software

The Contractor shall supply, install, and configure application software as necessary for the GCS to perform as required herein. The GCS shall automatically install updates to the application software upon receipt from the CDS.

Whenever the GCS reboots, it shall automatically initiate all programs necessary to conduct Validating Farebox and SAP data transfer and cashbox vaulting operations. A “watchdog” process shall monitor the status of all critical functions and restart a process or the entire GCS (only when necessary) whenever such processes are absent or malfunctioning.

Software controls shall be in place to limit access to the GCS and its functions. These controls shall require the user to input a personal password and access code denoting their privileges for the system function. Each system function accessible shall be assignable to each individual user. After a user-settable time (from one minute to a minimum of 60 minutes) with no activity, initially 2 minutes, the GCS shall revert to the log-on screen.

The matching of the Validating Farebox electronic code and GCS electronic code shall require positive identification. The CDS shall permit CTDOT to change the electronic code, which shall be downloaded to the GCS.

The end-of-transit-day shall be settable by CTDOT via the CDS and shall be initially set to 3 AM.

The Farebox Vaulting System shall communicate with the GCS and transfer the cashbox and Mobile Safe numbers to the GCS during the emptying process. In addition, the cashbox receiver shall also transmit the security status (open or closed) of the receiver and indicate when a Mobile Safe is removed and inserted into the receiver.

All data shall be transferable via removable backup media between GCS and CDS in event of a communications failure.

The Contractor shall submit design documentation providing complete descriptions of the GCS application software, its function, administration, configuration, operation, and other salient characteristics, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 22-4**

### 22.3.3 Anti-Virus and Anti-Malware Software

The Contractor shall supply, install, and configure client versions of anti-virus and anti-malware software that is compatible with the enterprise software. The GCS shall automatically install



updates to the anti-virus and anti-malware software upon receipt from the CDS. Upon receipt of new definitions files from the CDS, the GCS shall immediately activate the new definitions.

## 22.4 GCS Communications

- A. The Validating Farebox and SAP shall initiate and then maintain a wireless connection with the GCS while the device is powered on and is within range of the GCS Wi-Fi.
- B. The system shall provide for data transfer at least once per day. No bus or vehicle shall be required to stop for any length of time at a service island or other queue location prior to pull-out or following pull-in.
- C. The GCS shall maintain a log of each successful and unsuccessful data transfer with a Validating Farebox and SAP. Records of successful transfers shall include the version numbers of all software and data files sent to the Validating Farebox or SAP.
- D. The wireless communication system shall include appropriate security and authentication as well as error detection and recovery capabilities. If an error occurs in transmission, a retry shall be initiated by the system immediately and automatically. If three attempts to extract data automatically result in no success, an alarm message shall be generated and sent via the CDS to appropriate CTDOT personnel.
- E. The Farebox Vaulting System shall be securely connected and in constant communication with the GCS. Any attempt to terminate, alter or modify this connection in any form shall immediately result in the GCS transmitting an alarm to the CDS.
- F. The GCS shall ensure that all data stored is transferred in a secure, reliable, and efficient manner. Data transmission protocols shall identify all corrupted data and require retransmission until the data is properly received. Each time communication between the Validating Farebox or SAP and the GCS is initiated, the current date and time shall be authenticated and, if required, updated for each device.
- G. Upon proper operation of the Vaulting Authorization Tool and receipt of the security information from the Validating Farebox, the GCS shall instruct the Validating Farebox to open its cashbox access door, and the cashbox shall be easily extracted. Each time a Validating Farebox is instructed to open its cashbox access door, a record shall be transmitted to the GCS that contains at least the date, time, Validating Farebox number, cashbox serial number, contents (totals by coin, bill, ticket, token), vaulting location, and vaulting operator identification.
- H. Each time the Validating Farebox and SAP communicates with the GCS, new fare table (as needed), new electronic code (as needed), transaction records, parameters, and all other data and parameters required for proper NFTS operation shall be transferred between the Validating Farebox or SAP and the GCS.
- I. Whenever communications with the CDS are available, the GCS shall immediately forward uploaded transactions from Validating Fareboxes and SAP to the CDS. If communications with the CDS are unavailable, the GCS shall store transaction records and forward them as soon as communications with the CDS are restored.
- J. The NFTS architecture (Validating Farebox, SAP, GCS, and CDS) shall ensure that transaction records are stored in two places before they are deleted. In this regard, the GCS shall inform each Validating Farebox and SAP when uploaded transaction records have been successfully transferred to the CDS, thereby permitting the device to delete those records from internal memory.



## 23 Web Portals

The Contractor shall develop and provide hosting services for several web portals that shall enable internet users to access and manage information on the CDS, and to conduct a variety of transactions as defined below.

### 23.1 Web Design Services

The Contractor shall develop a series of websites for the NFTS that shall share a common design theme with CTDOT's existing web site pages and shall be in compliance with CTDOT's existing standards for web development. Security for this website shall be designed in concert with CTDOT security standards and technical IT staff input.

Currently, CTDOT's website experiences a 60/40% split between desktop to mobile users. As mobile usage continues to grow, and with the introduction of a future NFTS mobile ticketing application, mobile usage of web portals is expected to further increase.

To save time, money, and long-term maintenance costs, the Contractor shall design and develop the Web Portals using a responsive web design approach, which shall result in context-sensitive websites that respond to the needs and technology of the users.

The Contractor shall design the Web Portals to satisfy the operational needs and procedures of CTDOT and the constituent users of the Web Portals. To do so, the Contractor shall develop process flows for all activities to be supported by the portals; these process flows shall be submitted to CTDOT for review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 23-1**

### 23.2 Hosting Services

For a period defined in the Web Services Hosting Agreement, the Contractor shall provide secure hosting services for all NFTS Web Portals described herein. In addition to the hosting service, the Contractor shall also provide the necessary access to reports and other tools to fulfill purchase and other transaction requests from individuals as well as from groups (such as Employers, Retail Sales Locations and other venues) to CTDOT. CTDOT shall have access to administrative pages and functions to facilitate operations and management of the Web Portals.

#### 23.2.1 Web Servers

The Contractor shall provide web site hosting services for all Contractor-developed pages for the CTDOT web portals, and all associated Application Program Interfaces (APIs).

All hosted servers utilized to support NFTS web portals shall be dedicated to CTDOT. The use of shared virtual servers (supporting other customers) to support the web portals is not allowed.

If any server utilized for NFTS web portals is implemented as a Linux Server, an enterprise version of Linux, such as SUSE® or RedHat Enterprise Linux shall be utilized. Any implementation of a Linux server shall have the SE Linux security functions enabled. Furthermore, the server shall have the Tripwire intrusion detection software installed. Daily Tripwire reports shall be emailed to CTDOT IT Department's network administrator.



### **23.2.2 Availability of Service**

CTDOT considers web portal services to be mission-critical. As such, the Contractor shall provide web site hosting services that are highly reliable and provide best-of-industry availability to CTDOT's on-line Customers. The hosted web portals shall achieve the availability levels.

### **23.2.3 Server and Networking Equipment Location**

All equipment on which customer credit / debit card data is stored shall be installed in a secure location that complies with the PCI Data Security Standard.

### **23.2.4 Secure Transactions / Encryption**

All purchase transactions shall be secured, and shall utilize no less than 128-bit Secure Socket Layer (SSL) encryption. Similarly, all web pages utilized by administrators and work order clerks shall be secure sites utilizing 128-bit SSL encryption.

### **23.2.5 Credit Cards and Payment Processing**

The Contractor shall provide all interfaces to the credit card clearing and all other payment service providers required to process the variety of payment methods identified in this Scope of Work. (CTDOT will identify their payment service providers by Design Review) All applicable payment process shall comply with ISO/IEC 8583 and PCI DSS. All bankcard transactions shall include address verification and Credit Card ID (CCID) verification.

The web portals shall include subscription records as described herein. These records shall be used to automatically generate purchase transactions according to the product, frequency, and payment information contained in the records. While the web portals shall be a method for establishing and maintaining Automated Transactions (*i.e.*, "autoloads"), the CDS shall be responsible for processing all recurring transactions.

### **23.2.6 Transaction Volume to be Supported**

The Contractor shall provide web-hosting services that can process all sales volume, including maximum peak sales volumes experienced by the site, without unduly slowing the transaction speed as perceived by the end user. During the duration of the contract, the Contractor shall also expand the capacity of the web site as necessary to support sales volume increases without limitation.

## **23.3 General Web Portal Requirements**

The web portals shall be consistent in design and use with CTDOT's existing public web site, contain links to CTDOT's existing public web site, and be customized as necessary to satisfy the requirements of each user community.

All web portals shall incorporate security measures such as passwords, card identification by use of card serial number and truncated UID, secure web protocols (*i.e.*, https), and others, to ensure that user privacy is protected and to minimize fraudulent transactions.

Web portals shall fully comply with CTDOT web site and information security policies and design standards, PCI Data Security Standards, and requirements for web site access set forth in the Americans with Disabilities Act.

All web portals shall interface with the CDS database as necessary to query and modify stored information. In addition, the web portals shall communicate with the CDS to convey transaction



and configuration changes so that action lists, autoload lists, configuration files, and other data may be properly updated and propagated to the relevant field devices.

## 23.4 Web Portal Design Criteria

### 23.4.1 Compatibility with CTDOT's Web Site

The Contractor-developed web pages shall be connected with CTDOT's existing web pages. Users shall have the ability to switch between pages hosted by the Contractor and those hosted by the current CTDOT website host, where appropriate. Each website shall have one or more links to the other website, where appropriate.

All design aspects of the Contractor-developed web pages shall be subject to CTDOT review at the Preliminary Design Review and approval at the Final Design Review. **CDRL 23-2**

### 23.4.2 Access to Web Portals

CTDOT's current web designer shall add one or more links on its current web pages to direct users to the General Public web portal. The Contractor-designed General Public pages shall include one or more links back to relevant pages on CTDOT's web site. Every Contractor-designed General Public web page shall include at minimum a link back to CTDOT's home page and a link to CTDOT's Sales and Customer Support Start page.

All other Contractor-developed web portals shall be accessible only to authorized users using login and password protection. The address of each web portal's Home page shall not be visible by link from any other CTDOT web page, but shall require the user to enter the address directly.

Both the Contractor and CTDOT shall identify additional links to CTDOT web pages or other web pages at the Preliminary and Final Design Reviews. **CDRL 23-3, CTDOT 23-1**

### 23.4.3 Supported Browsers and Platforms

The Contractor's responsive web design approach shall employ a set of Web Standards-based technologies that are combined to create fluid, grid-based layouts that are device-aware and dynamically resized to suit the context in which they are viewed. The Contractor-designed web pages shall utilize standard design languages, and shall support the latest versions of Safari®, Opera®, Explorer®, Firefox® and Chrome® browsers available at the time of Contractor Notice to Proceed. The Contractor-designed pages shall support use by personal computers, as well as hand-held devices such as tablet computers and smart phones.

### 23.4.4 Security

All web pages designed by the Contractor that include e-commerce transaction data shall be certified secure to Verisign® or other similar standards. All transaction processing shall be compliant with the Payment Card Industry (PCI) Data Security Standard. Transaction data and all administrative and work order processing web pages shall be secured with no less than 128-bit Secure Sockets Layer (SSL) encryption.

### 23.4.5 Cookies

Users of the E-Commerce web pages who enable their browser to store "cookies," shall be able to opt to have the web page store on their computer or browser device information that will



facilitate subsequent revisits to the web site. The cookie shall include login and password information only.

#### **23.4.6 Administration**

The Contractor-designed web pages shall be fully configurable, and offer authorized CTDOT personnel the ability to modify the selection, price, descriptions, and images of products available for sale. The Contractor shall provide change management procedures to support modifications to the web portals. All such changes to the web portals shall be largely driven by changes to the product records in the CDS database. As necessary, other data tables or easily configurable files shall be used to configure the product selection web pages. The order in which products for sale appear on the selection page shall also be easily configurable by authorized CTDOT personnel.

Other transaction choices, such as payment methods (*i.e.*, credit media types accepted), shipping methods, shipping costs, and so on shall be easily configurable by authorized CTDOT personnel by modifying files or data tables.

Access to the configuration parameters and the product database shall be strictly controlled via password protection schemes and secure web pages.

As appropriate, special database queries, maintenance tools and reports shall be provided to assist authorized CTDOT personnel in monitoring, administering, and managing the web portals. These reports and queries shall be available only to authorized personnel through the password-protected secure administrative web pages.

#### **23.4.7 Web Portal Data**

The Contractor-supplied web portals shall utilize data stored in the CDS as necessary to track and identify users, transactions, product selection and prices, and all other dynamic and configurable data.

All web portals shall be designed to limit potential excess data queries that could affect system response times for other Web Portal users and users of the CTDOT CDS. For example, the Web Portals shall include a CTDOT-configurable limit on the date range of queries. As initially deployed, Web Portal queries involving historical data (such as usage transactions) shall be limited to data for the current and two preceding calendar months.

The Contractor shall provide comprehensive documentation describing all Web Portal data requirements, inputs, and outputs, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 23-4**

At minimum, the following information shall be recorded, managed, and available for query via the CDS, to be used as needed by the web portals:



#### 23.4.7.1 **Customer Records**

Stored in one or more tables, data records for each registered Customer shall include at minimum:

- Customer identification number (unique for each Customer)
- Customer profile type *e.g.*, General public, Ride Sponsor, Retailer, Student Admin, etc.
- Customer login ID (unique for each Customer)
- Customer login password (This field shall be encrypted)
- Customer selected security question and answer
- Name (Title, Last, First, Middle, Suffix)
- Mailing address (Street, City, State, ZIP and equivalents for addresses in Canada)
- Billing address (Street, City, State, ZIP and equivalents for addresses in Canada)
- Customer home phone (not required)
- Customer cell phone number (not required, for SMS text messages)
- Customer email address (not required, for email messages)
- Preferred communication method (email, SMS text, none)
- Account type
- Sequential serial numbers of cards (maximum of 10) associated with Customer account
- Cell phone numbers of devices used to receive mobile tickets (maximum of 10 associated with Customer account)
- Customer status (By manually setting this field to “deny,” it shall be possible for CTDOT to deny a Customer further purchases, but the Customer’s record shall remain in the database for recordkeeping purposes.)

#### 23.4.7.2 **Transaction Records**

The web site shall support transactions that contain multiple distinct items in a single purchase, as well as multiples of each item purchased. While each transaction shall have a unique identifying number, to support multiple different items in a single transaction, it shall be possible for multiple records in the transaction database to share a common transaction ID. Each completed transaction record shall at minimum include:

- Sequential transaction ID
- Transaction item number
- Subscription identification number (if applicable)
- Customer identification number (anonymous users shall have identification numbers assigned automatically)
- Order date
- Product identification number
- Purchased quantity
- Unit price, sales tax (where applicable, only one tax rate for all taxable items), and total
- Payment information (compliant with PCI DSS)
- Serial number (as applicable)
- Shipping method, tracking number and cost (as applicable)
- Order status





#### 23.4.7.3 **Product Records**

Each product for sale on the web site shall have a unique identification number and the following data fields at minimum:

- Product identification number (unique for each product)
- Product description
- Price
- Additional shipping cost
- Sales tax rate
- Subscription availability
- Bulk purchase availability
- Serial number
- Maximum quantity per transaction

#### 23.4.7.4 **Sponsor Table**

The database shall include a single table that contains information about all Employers and institutions participating in the transit benefits subsidy programs. Each record in this table shall contain at minimum:

- Sponsor ID number (unique for each Sponsor)
- Sponsor name
- Sponsor address
- Contact name
- Contact phone number
- Contact email address
- Sponsor billing method (pre-paid / post-billed)
- Sponsor payment method (credit card / invoiced)
- Sponsor ACH payment information (This information shall be stored in encrypted form)
- Invoicing periodicity for information purposes only)
- Sponsor account login
- Sponsor account password (At minimum, this field shall be encrypted);
- Sponsor status (It shall be possible to deactivate a Sponsor's participation in the program, but all records of the Sponsor shall be retained in the database for recordkeeping purposes.)

The Contractor shall provide one or more CTDOT Administrative web pages to enable authorized staff members to add, modify, and delete entries in the Sponsor Table.

#### 23.4.7.5 **Sponsor-Beneficiary Tables**

For each Sponsor participating in the subsidy program, a table shall contain information about all of the Sponsor's participating beneficiaries. Each record in the table shall contain at minimum:

- Beneficiary ID number (unique for each Sponsor)
- Beneficiary name (not required)
- Provided product identification number
- Periodicity (*i.e.*, weekly, monthly, quarterly, annually)
- Smart Card type
- Assigned Smart Card serial number



The Sponsor-Beneficiary table shall include no privacy-sensitive data such as social security numbers. It shall be the responsibility of the Sponsor to manage the associations between the Beneficiary ID assigned by the system to the Sponsor's internal identification methods.

To minimize the administrative burden on CTDOT, the Contractor shall develop one or more Sponsor Administrative web pages. To facilitate the initial population of this table, the Contractor shall also provide a means by which a simple spreadsheet, comma-delimited file, or other such means may be used to import data into the table.

#### **23.4.7.6 Sponsor Transaction Records**

Similar in nature to the transaction records for individual Customers described herein the Sponsor Transaction Records table shall include information about every completed Sponsor transaction. Data fields in this table shall enable CTDOT and the Sponsor to track the progress of orders and payments, as well as to review historical data regarding previously completed transactions.

#### **23.4.8 Synchronization with Smart Card System**

The Contractor shall be responsible for ensuring that the CDS Database and the hosted web portals interact securely; this interaction shall be designed in concert with CTDOT security and technical IT staff. The web portals shall be responsible for publishing information to the CDS any time a record is added, deleted, or modified. This includes when any transaction is completed or when a Customer has updated any on-line information. In addition, web portals shall be capable of receiving updated information from the CDS database at any time, for any record. This includes media information, Customer information, as well as fare tables.

The web portals shall retain no information that is not published to the CDS.

#### **23.4.9 Automated Customer Messages**

The NFTS (either the web portals or the CDS) shall automatically send reminder messages (e-mail or SMS text, based on customer selection) to subscription customers when their on-file payment method (e.g., credit card) is about to expire, and when a subscription is about to expire. These reminder messages shall be sent to the Customer's email address or cell phone on file. The warning period and frequency of e-mails shall be configurable (a single global parameter for all accounts) by authorized CTDOT users.

#### **23.4.10 Web Page Functionality and User Interface**

The Contractor-designed E-commerce web pages shall follow standard web page design practices and utilize "radio buttons," check boxes, pull-down menus, fill-in-the-blank spaces, and other common features to simplify product selection and purchases. Where appropriate, the web pages shall include a "shopping cart" feature that allows users to add, delete, and modify selections, and when ready, conduct a single transaction to complete the purchase.

Each distinct web page type identified herein shall be consistent within that type. (For example, if multiple Product Selection pages are required, all shall share a common appearance and format.) Each distinct web page type shall be designed and optimized according to the purposes of the page.

Where user input is required, the Contractor-designed web pages shall support standard browser data entry operations such as the TAB key moving to the next data field, the ENTER key acting as "Submit" or "Go," etc.



After a CTDOT configurable period of inactivity, all users logged into web portal shall be automatically logged out, at which time the user's session shall be directed to the associated web portal Start page.

All CTDOT and Sponsor Administrative pages shall also include a Log off button or tab, which when pressed shall terminate the user's session.

#### **23.4.11 CTDOT Web Portal Administrative Pages**

Access to these pages shall be restricted to authorized CTDOT personnel using login and password protection. These pages shall not be accessible by a link on any CTDOT web site; authorized users shall be required to enter the secure web page address into their browser to gain access to the CTDOT Administrative Login page.

Once a user logs into the CTDOT Web Portal Administrative pages, a menu shall be displayed to provide configuration control, administrative oversight, report and query generation, and other administrative tasks as required herein. Navigation around the Administrative Pages shall be straightforward, and shall be facilitated by the use of common buttons or tabs.

All CTDOT Web Portal Administrative Pages shall be cable of being restricted such that they may only be accessed by specified IP addresses.

### **23.5 General Public Web Portal Functionality**

The General Public portal shall permit CTDOT customers to establish Transit Accounts, acquire and register CTDOT Smart Media, add value and period passes to smart cards, review media usage and status, as well as perform Autoload and other replenishment transactions. This portal shall be easy to use, intuitive, and integrated with the existing CTDOT general public portal. The portal shall also support the mobile ticketing application described.

At minimum, the General Public web portal shall allow users to:

- A. Create, modify, and delete a user account
- B. Order one or more new smart cards, in single multiple, and combinations of single and multiple quantities, with or without a product or value
- C. Delete or modify one or more unfilled orders
- D. Establish a preferred method of delivery, including CTDOT-configurable prices for each delivery method
- E. Establish a method of payment via customer selection of credit, debit, PayPal®, or ACH
- F. Order a one-time (*i.e.*, directed) autoload of additional stored value, stored ride, or pass
- G. Establish, modify, or cancel a subscription for a recurring autoload
- H. Download and print receipts, compliant with relevant Federal Reserve regulations
- I. Register a new or existing card for loss replacement
- J. Report a lost or stolen card and request a replacement
- K. Query the CDS for the current balance and status of a card
- L. Review the recent use of a card
- M. Query the CDS and download for printing, a user-specific monthly report of ridership, orders, and transaction history

Where activities require payment (current or future), the General Public web portal shall conduct credit card transactions in full compliance with PCI DSS and other relevant security standards.



### 23.5.1 Navigation Buttons

Except for the General Public portal Start page, all web pages for the portal shall include a common set of buttons or tabs to facilitate navigation on the portal. These common buttons or tabs shall include at minimum:

- CTDOT Home – when pressed, this button shall request confirmation, and if confirmed, shall cause the user's web portal session to terminate (log off) and return the user to the CTDOT home page
- Logout – when pressed, this button shall request confirmation, and if confirmed, shall cause the user's web portal session to terminate and return the user to the portal Start page
- Registration – when pressed, this button shall navigate to the Customer Registration page
- Subscriptions – when pressed, this button shall navigate to the Customer Subscription page
- Shopping Cart – when pressed, this button shall navigate to the Shopping Cart Contents page
- Check Out – when pressed, this button shall navigate to the Checkout page
- Continue Shopping – when pressed, this button shall navigate to the first Product Selection page
- Order Status – when pressed, this button shall navigate to the Order Status page

### 23.5.2 General Public Web Portal Pages

The following web pages define required functionality, which may be incorporated in an alternative design. The Contractor shall submit all web page designs and the site map for the General Public Web Portal for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 23-5**

#### 23.5.2.1 *General Public Web Portal Start Page*

The Start Page shall be the destination for all links to the E-commerce web site from other CTDOT web pages. The page shall provide general information about the portal's features. In addition, the page shall include:

- Fill-in blanks for the user to enter ID and password to begin a session and enter the site;
- A "Go" button to submit the entered ID and password
- A link to enter a new user registration
- A "Enter Site without Login" button to allow users to access the portal anonymously
- A check box to create a cookie on the user's device to remember the user's ID and pre-populate that space. (By default, the checkbox shall be unselected.)

Previously registered users who successfully log into the General Public portal and those who opt to use the site anonymously shall be directed to the first Product Selection Page.



#### 23.5.2.2 *Customer Registration Page*

Users shall not be required to register with the CTDOT to access the General Public web portal. First-time users who opt to create an account shall be directed to this page by selecting the appropriate link on the Start page. Previously registered users shall be able to navigate to this page to review and edit registration information.

Data entry on this page shall be user-friendly and shall include pull-down menus and error checking where appropriate. Data fields to be entered shall include those identified in the above sections. Required fields shall be identified on the screen, and shall be determined during the Preliminary Design Review. **CDRL 23-6**

Upon completing the form and pressing a "Submit" button, the user shall be directed to the first Product Selection Page.

#### 23.5.2.3 *Product Selection Page*

Driven by a Products database table in the CDS, one or more Product Selection pages shall provide users with an easy-to-use interface to select products and quantities for purchase. Each product type available shall include a check box for selection, and a fill-in box for quantity. Each line on the Product Selection page shall also include the product's unit price.

The General Public Web Portal shall display product selections tailored to the fare category profile of the user. By default, the portal shall provide anonymous users and Full Fare users only Full Fare product selections. Because CTDOT will require all Half Fare users to register with the system, the General Public Web Portal shall present Half Fare selections only to those users with such permissions. The portal shall not display full fare product selections to users with Half Fare permissions. (Stored value replenishment selections shall be available to all users.)

When a product's check box is selected, a value of one shall be automatically entered into the quantity fill-in box. The user shall be able to enter other quantities in the fill-in box, but valid quantities for purchase shall be limited according to the parameter defined in the Products database table.

Each Product Selection page shall include one or more highly visible "Check Out" and "View Shopping Cart Contents" buttons to facilitate the purchase process.

In addition, each Product Selection page shall include a highly visible "Customer Subscriptions" button to navigate to the Customer Subscription page.

#### 23.5.2.4 *Shopping Cart Contents Page*

The Shopping Cart Contents page shall display a summary of the user's current product selections, quantities, extended prices for each item (unit price multiplied by the quantity), any additional shipping costs per item, and total purchase value. Where applicable, the Shopping Cart Contents page shall also indicate whether a product is to be autoloading to an existing smart card, delivered to a mobile device, or shipped to an address specified by the user.

The Shopping Cart Contents page shall enable users to delete any item and change the purchase quantity.

The Shopping Cart Contents page shall include highly visible "Check Out" and "Continue Shopping" buttons to facilitate navigation and the transaction process.



#### 23.5.2.5 **Checkout Page**

Upon completion of product selection and pressing a “Check Out” button, the user shall be directed to the Checkout page. This page shall include the user’s registration information (such as name and address) already filled in, and shall provide additional fill-in blanks, drop-down menus, radio buttons, and check boxes as required to complete the transaction. Fields populated from the User Registration page shall not be alterable on this page; any changes to this information shall require the user to navigate to the User Registration page.

The Checkout page shall provide a complete summary of the purchase, including the selected products, quantities, unit prices, extended prices, total product prices, sales taxes, shipping costs (including any per-item additional shipping costs), and total transaction value.

A default shipping method shall be displayed in a selection pull-down menu, with its associated price filled into the appropriate space on the transaction summary. Users shall be able to select an alternate shipping method; upon doing so, the transaction summary shall update automatically. At a minimum, the Checkout page shall offer shipping method choices of Regular (First Class mail), Preferred (Express Mail), and Overnight.

Users shall be required to select a payment method from a selection pull-down menu. Upon doing so, the appropriate fill-in boxes shall appear for the user to complete. Based on the selected payment method, the Checkout Page shall offer separate billing address fill-in blanks, along with a check box to use the user’s delivery address as the billing address. If the “use delivery address” check box is selected, the billing address information shall be automatically populated from the user’s delivery address data. Credit card payments shall also require the user to enter the Credit card ID number (which is usually printed on the back of the card).

At a minimum, the Checkout page shall offer the following payment methods:

- Visa®
- MasterCard®
- Discover®
- American Express®
- PayPal®
- ACH (direct deduction from the user’s bank or checking account)

The Checkout page shall include highly visible buttons to:

- Submit – completes the transaction
- Return for More Shopping – saves all information and returns the user to the first Product Selection Screen
- Change User Information – navigates to the User Registration page. Upon return to the Checkout page, any changes in the user’s registration information shall be incorporated in the relevant page fields

#### 23.5.2.6 **Purchase Confirmation Page**

Upon successful completion of transaction processing, a Purchase Confirmation page shall appear containing the transaction summary and a transaction number.

#### 23.5.2.7 **Order Status Page**

The Order Status page shall allow users to view the status of recent orders. For registered users, the page shall show a selection of prior orders within a CTDOT-configurable time period



in a pull-down menu. Anonymous users shall be required to enter the transaction number provided at the time of the order.

For the selected order, the page shall list:

- The transaction number
- The date the order was placed
- The value of the order
- The current status of the order
- The date of the current status
- The shipping method (if applicable)
- The shipping tracking number (if applicable)

The transaction number and the shipping tracking number shall be hypertext link fields. When the user clicks on the transaction number, the Purchase Confirmation page for the transaction shall be displayed. When the user clicks on a hypertext shipping tracking number, the user shall be redirected to the shipping company's web site for package tracking, with all appropriate fields pre-populated.

#### 23.5.2.8 *Customer Subscription Pages*

When a registered user selects the Customer Subscription Page, the page shall display all smart cards registered to that user. Anonymous users of this page shall be prompted to enter the sequential serial number and truncated UID number of their card.

Upon selecting a card or entering the identification numbers for a card, the system shall present a series of pages that shall enable the user to:

- View all subscriptions in effect
- Add, delete, and modify subscriptions, including product types, quantities, frequency, subscription expiration date, payment method, shipping method, etc.
- Review the status of a subscription order

The Customer Subscription web pages shall appear and function similarly to the one-time transaction pages described above (Product Selection, Shopping Cart, Checkout, Purchase Confirmation, and Order Status), but be optimized for the subscription process. For example, the selection of products shall appear similar to the Product Selection page, except that only products that are eligible for subscription shall be shown (based on the contents of the Products database table in the CDS).

If the user has any products in the Shopping Cart, the Customer Subscription page shall display an error message that informs the user that creating or modifying a subscription requires an empty shopping cart.

After adding a new subscription, or changing or deleting an existing subscription, the checkout process shall result only in the recording of the user's payment information. The Subscription Confirmation page (similar to the Purchase Confirmation page) shall provide the Subscription Transaction Identification number in lieu of a transaction identification number.

## 23.6 Corporate Partner Web Portal Functionality

The Corporate Partner web portal shall enable benefits coordinators (also known as "Sponsors") for participating organizations to manage the transit benefits offered to their employees and



constituents (also known as “Beneficiaries”). The web portal shall, at minimum, provide the following features:

- A. Add and modify beneficiary accounts, individually, including uploading a digital photo of the beneficiary
- B. Delete beneficiaries from the displayed list. (The beneficiary’s entry in the Sponsor / Beneficiary data table shall not be deleted, but the beneficiary status field shall be changed to indicate that the entry is no longer to be displayed)
- C. Add multiple new beneficiary accounts by uploading a properly formatted list of beneficiaries, in .xls, .csv, or other standard formats, including digital photos of all beneficiaries
- D. Select the preferred fare media for each participant (smart card, mobile phone, etc.)
- E. Assign and re-assign CTDOT-issued smart cards to individual beneficiaries (for those using smart cards)
- F. Assign, modify, or delete a mobile phone number authorized to receive transit benefit fare products (for beneficiaries using mobile ticketing)
- G. Assign, modify, suspend, reactivate, and delete benefits (e.g., stored value, pass) to individual beneficiaries
- H. Order new smart cards (individually or in bulk) for beneficiary, including uploaded photos, graphics, and other information to be printed on the personalized cards
- I. Establish and manage method of payment via corporate / institutional check, credit card, or ACH
- J. Establish a preferred method of delivery, including CTDOT-configurable prices for each delivery method
- K. Review status and usage history of assigned cards, individually and in groups
- L. Modify account information of authorized benefits coordinators
- M. Review status of sponsor account (e.g., invoice history)
- N. Submit payment to CTDOT via Credit Card. (Sponsors not authorized to pay by credit card shall receive an invoice generated by web portal and sent by CTDOT.) The Portal shall generate a receipt for credit card transactions for delivery to the Corporate Partner benefits administrator, via email or SMS text message.

The Contractor shall submit all web page designs and the site map for the Corporate Partner Web Portal for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 23-7**

## 23.7 Student Pass Administrator Web Portal Functionality

Similar to the Corporate Partner web portal, the Student Pass Administrator web portal shall enable participating schools to manage their student pass programs. Because of the large volume of participants and the high levels of turnover as students enroll, graduate, drop out, re-enroll, etc., this web portal shall also support bulk data exchange of lists of participants and their associated cards, mobile phone numbers, digital photos, and privileges.





As changes are made to the lists of cards and mobile devices eligible for student pass privileges, the Student Pass Administrator web portal shall cause the CDS to generate the necessary changes to the autoloading and action lists for propagation to the Validating Fareboxes.

The Contractor shall submit all web page designs and the site map for the Student Pass Administrator web portal for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 23-8**

## 23.8 Retailer Web Portal Functionality

The Retailer web portal shall support corporate and store management personnel in the administration of the retail sales network. At minimum, the web portal shall:

- A. Enable corporate managers to review the sales and revenue for all stores in the retail chain and sales and revenue from an individual retailer
- B. Enable store managers to add, modify, delete authorized clerk IDs
- C. Enable corporate managers and authorized store managers to order new smart card inventory for sale, and specify delivery location and method

The Contractor shall submit all web page designs and the site map for the Retailer / POS Web Portal for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 23-9**

## 23.9 CTDOT Customer Service Web Portal Functionality

The Customer Service web portal shall support the following functions:

- A. Review customer transaction history
- B. Create, modify, or delete user accounts
- C. Replace lost, damaged, or stolen smart cards
- D. Deactivate a card
- E. Suspend a card
- F. Reactivate a card
- G. Revalue fare products to a customer smart card using autoloading
- H. Generate a receipt for a Customer's previously completed transaction for delivery to the Customer via email or SMS text message
- I. Query the system to generate various reports, including card usage history and current status

The Contractor shall submit all web page designs and the site map for the CTDOT Customer Service Web Portal for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 23-10**



## 24 Support Systems

### 24.1 Maintenance and Test Facility

CTDOT will allocate a test CDS, two Validating Fareboxes complete with necessary cables and antennas, two SAPs, one vaulting station, one HFIT, one Administrative POS Terminal, and one GCS and access point for use in the NFTS Maintenance and Test Facility.

For the Maintenance and Test Facility, the Contractor shall install and configure all NFTS device and GCS hardware and software, and all application software for the test CDS.

The Contractor shall supply suitable stands on which to mount the Validating Farebox equipment, and install and configure the equipment to be operationally identical to equipment as installed in CTDOT vehicles and at CTDOT locations.

CTDOT shall assign one spare MVM and two PVs to the CTDOT designated Electronics Maintenance Shop. The Contractor shall mount the MVM to a steel plate of sufficient size and thickness to permit the MVM door to be opened and internal modules to be extended on rails without risk of tipping. The Contractor shall connect this equipment, together with any required network interface devices (such as a hub/router) into a station LAN, and install the necessary communications equipment to connect the maintenance test station to the CDS.

This maintenance test station shall appear to the CDS as a normal station. All data from the test station shall be received by the CDS and ~~handled in accordance with CTDOT policy, acted on accordingly.~~ Additionally, as with any other station, it shall be possible to download all parameters to the maintenance test station.

Once the system is in revenue service, all NFTS software and hardware updates supplied by the Contractor shall be tested first in the Maintenance and Test Facility before being propagated to the in-service equipment.

The Contractor shall install and configure the Maintenance and Test Facility prior to commencing the System Integration Test. As necessary, the Contractor may utilize the Maintenance and Test Facility for the training program.

### 24.2 Vehicle Equipment Training Stands

CTDOT will allocate additional spare Validating Fareboxes, complete with necessary antennas, for operator training.

For each item of onboard equipment allocated for training and the Maintenance and Test Facility, the Contractor shall supply a self-contained training stand, complete with requisite 120VAC-to-12VDC power supplies and mounting points, for all NFTS equipment on a vehicle. The Contractor shall configure each training stand to be a fully operational system, as configured on in-service vehicles.

The Vehicle Equipment Training Stands shall be easily transportable, and shall be designed to facilitate operator training. All equipment on the training stand shall be securely mounted to a stable wheeled platform.

The Contractor shall deliver the complete Vehicle Equipment Training Stands prior to the commencement of NFTS training.

Design of the Vehicle Equipment Training Stand shall be submitted for CTDOT review and approval at the Final Design Review. **CDRL 24-1**



## 24.3 Smart Card Certification Workstation

### 24.3.1 General

CTDOT requires the System to expand, *e.g.*, adding equipment from other suppliers, admitting other transit agencies, increasing deployment on the fleets of participating agencies, etc. This expansion may involve third parties in the design and production of System-compliant equipment and software.

During deployment, CTDOT requires the ability to confirm that the NFTS equipment is properly processing smart cards, and that the equipment is capable of detecting improperly encoded, expired, counterfeit, and defective smart cards.

To address this need, the Contractor shall provide a Smart Card Certification Workstation (SCCW) that has the following functions:

- Reads smart card and displays the contents of all data fields encoded on the media in a readable form
- Identifies smart cards which can be used by the NFTS and which cannot
- Readily identifies any data fields and elements that are not used by the NFTS on cards which are valid for the NFTS
- Creates and modifies smart cards with valid or invalid data, including media of types and categories not in revenue service but supported by the smart card encoding format
- Processes all smart media identified
- For special test purposes, the SCCW operator shall have the capability to change data on smart media to create “fraudulent” or “expired” media and to test the treatment of that media by the field devices.

### 24.3.2 User Interface

The SCCW shall automatically read, interpret and display a readable version of the encoding format of the smart card being evaluated.

The design and layout of all SCCW screens shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 24-2**

### 24.3.3 Hardware Requirements

The SCCW shall be comprised of a desktop computer interfaced with a Contactless Smart Card Processor. This unit shall be suitable for desktop mounting.

Hardware for the SCCW shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 24-3**

### 24.3.4 Operational Updates

The SCCW shall remain consistent with CTDOT fare policies and fare products as they evolve over the course of the NFTS life. To do so, the SCCW shall communicate with the CDS to retrieve and use information stored in the current Fare Table to properly read and write data from and to smart cards.



### 24.3.5 Encryption Keys

The SCCW shall include a secure method of receiving and storing the encryption keys used to read from and write to smart cards. The method of transporting and securing the encryption keys shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 24-4**

## 24.4 Barcode Decoding Workstation

The Contractor shall provide a complete Barcode Decoding Workstation (BDW).

### 24.4.1 General

This BDW shall permit authorized users to:

- Read encrypted barcodes of mobile tickets generated by the Mobile Ticketing Application described, and CTDOT-printed barcode tickets. The BDW shall display barcode contents such that the encoded data fields are shown in human-readable form. The displayed content of barcodes shall include the following fields as a minimum:
  - Serial number
  - Fare category (Full, Half, Employee, etc.)
  - Ticket type (local, express, regional, parking, etc.)
  - Date/time of print/generation
  - Validity start date/time
  - Validity end date/time
  - Checksum and other data as required
- Verify that barcode media is valid according to CTDOT fare policies
- Readily identify any data fields and elements that are invalid

The Contractor shall submit a description of all BDW parameters and settable values, with the valid ranges for CTDOT review at the Preliminary Design review and CTDOT approval at the Final Design Review. **CDRL 24-5**

### 24.4.2 User Interface

The BDW shall incorporate a Data Analysis Tool that shall provide a simple user interface consisting of a series of field names and values. The field names shall correspond to the data fields encoded in the barcode media; the BDW shall display all data fields and values in easily understandable format. (Acronyms and abbreviations shall be kept to a minimum).

Since the barcode data shall likely be encoded as numeric or shorthand values (e.g., ticket type “1” means “local,” ticket type “2” means “express”), the workstation shall “interpret” those values and display the meanings of the values in each data field. Each data field defined as part of the barcode for the media shall be included on the standard display presented to the user with all interpreted values included. The process to interpret encoded values shall not include hardcoded translations; rather, the interpretations shall be based on values retrieved from the current Fare Table.

The BDW Data Analysis Tool shall operate only when a valid user has properly logged on.

The design and layout of all BDW screens shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 24-6**



#### **24.4.3 Hardware Requirements**

The BDW shall consist of a desktop computer interfaced with a bar code reader. This unit shall be suitable for desktop mounting. The BDW shall operate only when a valid user has properly signed on and shall track all activity performed. Hardware for the BDW shall be subject to CTDOT review and approval at the Preliminary Design Review. **CDRL 24-7**

Alternatively, the Contractor may integrate the BDW application software and barcode reader with the Smart Card Certification Workstation, as long as both applications can operate on the same computer platform.

#### **24.4.4 Operational Updates**

The BDW shall remain consistent with CTDOT fare policies and fare products as they evolve over the course of the NFTS life. To do so, the BDW shall communicate with the CDS to retrieve and use information stored in the current Fare Table to interpret data fields encoded on the barcode tickets.

#### **24.4.5 Encryption Keys**

The BDW shall include a secure method of receiving and storing the encryption keys used to decode barcode data. The method of transporting and securing the encryption keys shall be subject to CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 24-8**

### **24.5 Electronic Lock Management System**

The Contractor shall supply and install support systems for the electronic locking systems employed at each CTDOT garage equipped with Validating Fareboxes and Vaulting Systems. At each such garage, the Contractor shall supply key "vaults" to securely store and program no less than 16 electronic keys. Authorized management personnel at each garage shall be able to assign and program keys for maintenance and revenue service staff.

The Contractor shall supply similar support systems and key "vaults" at the centralized Multi-Function Vending Machine maintenance facility, and for the MVM revenue servicing staff. For these locations, each key "vault" shall securely store and program no less than 4 electronic keys.

The Contractor shall supply complete component and configuration details for the electronic locking system support devices for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 24-9**

### **24.6 Special Tools and Test Equipment**

The Contractor shall provide all special tools, test and inspection equipment necessary for maintaining, exchanging, troubleshooting, testing, repairing, calibrating and inspecting all NFTS equipment, devices, and modules, down to the Lowest Level Replaceable Unit (LLRU).

At minimum, the Contractor shall supply the following:

- A. Coin Validator Programmers – To reprogram the coin validators in the Validating Farebox and the MVM to accept new or different coins



- B. Supplemental Coin Hopper Audit System – The Contractor shall supply a module that can empty the MVM supplemental coin hopper without dismantling or opening the hopper and provide an accurate count of all coins dispensed.
- C. Bill System Test System(s) – As necessary to diagnose, maintain, and configure the Bill Processing modules in the Validating Farebox and MVM, the Contractor shall supply one or more diagnostic test systems to permit detailed analysis of the operation of the bill system's mechanisms, sensors, data recording, and communications interface. Bill System Test System(s) shall be able to perform all authentication and bill processing functions, as well as providing access to and utilizing all diagnostic capabilities inherent in the bill system.
- D. Other Module Testers – The Contractor shall supply test equipment which includes all necessary power and signal connections for diagnostic test and adjustment of all NFTS modules.
- The testers may be integrated into the NFTS equipment in the form of self-diagnostic routines, or may be provided as independent hardware that diagnoses each assembly, or a combination of both configurations.
  - In either case, the testers shall permit a technician to determine conclusively if all aspects of a module are functioning correctly. The testers shall successfully distinguish between module failure and erroneous inputs, power supply failures, output signal loading, etc. The testing units shall provide all simulated signal inputs.

The Contractor shall provide the complete list of special or custom tools, instruments, test and inspection equipment for CTDOT review at the Preliminary Design Review, and CTDOT approval at the Final Design Review. **CDRL 24-10**

For each special tool and test device on the final approved list, the Contractor shall provide:

- Generic name and supplier trade name
- Supplier's part number
- Description and purpose
- Identification of function and use
- Software employed
- Price (suggested retail or typical)
- Third-parties and web sites where these tools can be purchased (if applicable)

For those special tools that are needed for maintenance to be performed by CTDOT, including the Bill System Test System(s) and Other Module Testers, the Contractor shall provide four complete sets to CTDOT no less than 30 days prior to the commencement of NFTS revenue service. **CDRL 24-11**

No less than 30 days prior to the commencement of NFTS revenue service, the Contractor shall also supply CTDOT 10 sets of all special tools and equipment required for the installation or removal of the NFTS equipment. **CDRL 24-12**



## 25 Supplied Fare Media

The Contractor shall supply the following media in quantities specified, pre-printed and encoded as required to operate in the NFTS.

### 25.1 General Smart Card Media Requirements

#### 25.1.1 Production Requirements

The Contractor shall provide media produced in a manufacturing facility which complies with ISO 27001 for security. Upon request, the Contractor shall deliver all graphics and related material in electronic and other pertinent forms, used in the manufacture of the cards to CTDOT's Project Manager.

#### 25.1.2 Encoding

The Contractor shall deliver all media pre-encoded with CTDOT-specific sensitive data, including the encryption keys. Data encoded to the media shall include the unique sequential serial number.

#### 25.1.3 Encryption Keys

Encryption keys and the encryption algorithms employed form the core of the security mechanisms for smart card transactions. The Contractor shall use the utmost care and security in defining, generating, deploying, transmitting, and storing the encryption keys employed in the NFTS.

If the Contractor's design requires the card manufacturer to write the encryption keys onto the smart card media, the Contractor shall use only trusted card manufacturers with suitable security mechanisms in place to ensure that CTDOT's keys remain safe and secure.

#### 25.1.4 Protection of CTDOT-Specific Sensitive Data

CTDOT-specific sensitive data includes for the encrypted token:

- Card data encoding format and definitions
- Card encoded data and field values
- CTDOT encryption keys

The Contractor shall treat this data with the utmost care and security. Under no circumstances shall the Contractor release, share, or expose this data without the express written consent of CTDOT's Chief Executive Officer. The Contractor shall be liable for all CTDOT costs to replace all CTDOT smart media in circulation and inventory and all system keys if the Contractor, through negligence or deliberate action, causes unauthorized release of some or all of this sensitive data.

#### 25.1.5 Quality Control and Defects Allowed

The Contractor shall verify proper functioning of every fare medium after manufacture. Defective media identified at time of manufacture shall be replaced prior to delivery, and all serial numbers shall be retained as sequential. (As delivered, there shall be no gaps in the sequential serial number sequence.)



It is understood that latent defects can occur subsequent to manufacture; however, delivered media shall function properly when first presented to a fare collection system read/write device, and shall fail at rates not greater than shown below:

Table ~~25.1.5~~~~25.1.5~~ 25.1.5: Allowed Media Defects

Media Type	Maximum First-Use Failure Rate	Maximum Premature Life-Cycle Failure Rate
Long-Term Media	0.05%	1%
Limited Use Media	0.1%	2%
Adhesive Media	0.1%	2%
CTDOT Employee Media	0.1%	2%

The Contractor shall replace all media that fail to function upon first use at no additional cost to CTDOT.

If the first-use failure rate exceeds those shown in Table 25.1.5, CTDOT may, at its discretion, reject the batch, and the Contractor shall replace the entire batch at no additional cost.

Over the expected useful life of the media, additional failures are expected; however, failures of distributed (in circulation) media that occur prior to the expected useful life, due to reasons other than abuse, shall not exceed those shown in Table 25.1.5.

#### 25.1.6 Serialization

Excluding plain paper ticket stock, each fare medium shall have a unique 20-digit number pre-encoded on the embedded chip. (This number is the "UID.") These UID numbers shall be unalterable. Additionally, each fare medium shall have a unique, sequential inventory control number assigned to it at the time of manufacture.

All serialized media, even those that are otherwise blank, shall have the sequential inventory control number laser etched or printed (under the clear laminate for long-term media) on one side. Additionally, the last 4 digits of the Card's UID shall be laser etched or printed (under the clear laminate for long-term media) directly beneath the sequential serial number. The printed and encoded sequential serial number shall accommodate numbers 10 digits long.

Within 90 days after the NTP is issued, CTDOT will supply the Contractor with the starting number for the sequential serial number for each media type. **CTDOT 25-1**

#### 25.1.7 Retail Sales Requirements

CTDOT-issued media shall support retail sales of new media and replenishment of associated account values. All media sold or replenished through the Retail Point of Sales Network, including at minimum all CTDOT-issued Long-Term Use Smart Card media, shall include design features to support sales and replenishment transactions at participating retailer cash registers.





### 25.1.8 Packaging and Deliveries

Deliveries of media shall be made under controlled conditions, with the media packaged in bundles of 200. The packaging for each bundle shall be sequentially numbered. Each bundle shall include a label identifying:

- The date and location of manufacture
- Media type (*i.e.*, full fare, reduced fare, employee, or specific fare instrument such as 2-trip, as appropriate)
- CTDOT batch number
- CTDOT bundle number (*e.g.*, "Bundle X of Y")
- The range of sequential serial numbers contained in the bundle

Printing on the bundle label shall also include all data in a standard barcode format.

CTDOT may, at its discretion, request delivery of the contracted quantity of media in discrete batches. For long-term and CTDOT employee media, each batch will contain at least 10,000 cards or the entire contracted quantity of a given fare medium type, whichever is less. For Limited Use and Adhesive media, each batch will contain at least 25,000 items or the entire quantity of a given fare medium type, whichever is less.

The Contractor shall deliver the initial batch of media within 12 weeks of approval of the trial samples. The Contractor shall deliver subsequent batches of media within 10 weeks of receipt of CTDOT's order.

Until the contracted quantities are delivered, the Contractor shall store in reserve at least 10,000 media of each type, or all remaining media of a given type yet to be delivered, whichever is less, for future deliveries (*i.e.*, produced/encoded media). Upon request, the Contractor shall ship these reserve media to the Authority within 5 days of notice by CTDOT.

For each batch, the Contractor shall provide an electronic file, in .csv or .xls form, containing the UID and associated sequential serial number of all fare media in each bundle, for all bundles in the batch. **CDRL 25-1**

### 25.1.9 Production and Storage Security

The Contractor and its suppliers shall maintain security during the manufacture, production and storage of the media, and maintain full compliance with ISO 27001 security measures. The Contractor and its suppliers shall also:

- Track all materials used in the production of the media. The media shall be manufactured in a secured area, accessible only to personnel involved in the manufacturing and handling of the media. An accountability log shall be kept of the media at all times during production, packaging and delivery.
- With delivery of each batch, submit to CTDOT's Project Manager a certified record of the media produced on a form registered by the production equipment at the end of each production run.
- Pack all media under the supervision of responsible personnel, and store all media in a secure location prior to shipment.



- Dispose of all scrap and rejected media so that they are rendered unusable. The Contractor shall also provide a certified record of disposal to CTDOT's Project Manager after disposal of the defective media at the time of delivery of each batch.
- When requested by CTDOT's Project Manager, deliver all surplus media generated during production (separately) to CTDOT's Project Manager.

#### **25.1.10 CTDOT Acceptance Testing**

All delivered media shall be subject to acceptance testing by CTDOT's Project Manager. The CTDOT Project Manager or designee shall sample bundles of delivered media and verify that the media work with the NFTS. If media are found defective during this testing or not in compliance with any aspect of the requirements in the Contract, then CTDOT, at its discretion, may reject the entire batch and return it to the Contractor for replacement. In such case, the Contractor shall deliver replacement media in no more than 4 weeks from time of notification.

#### **25.1.11 Replacement Media**

The Contractor shall replace any first-use defective media found in a batch, at no additional cost to CTDOT. The replacement media shall be included in the subsequent batch order. (Replacement media shall not use the sequential serial number of the defective media; sequential serial numbers of delivered media shall always be unique.)

Except when all media of a given type are ordered in a single batch, for the final batch of any media type, in anticipation of first-use defective media proportionate to the defect rate in prior batches, the Contractor shall provide additional media representing the cumulative first-use defect rate from the previous batches. For example, if all previous batches had a cumulative first-use defect rate of 0.04%, then the final batch shall contain the ordered amount, the replaced defective media from the previous batch, plus 0.04% of the final batch order.

If premature failures (those that occur prior to the expected useful life and are due to reasons other than abuse) exceed the allowed rate, the Contractor shall provide replacement media for all premature failures at no cost to CTDOT.

### **25.2 Long-Term Contactless Fare Media**

Long-term contactless smart cards shall be compliant with ISO/IEC 14443, either type A or B. The cards shall include sufficient read/write memory to satisfy the encoding requirements with no less than 100% spare capacity. All application data encoded on the cards shall be protected by encryption compliant with AES.

All long-term contactless smart cards shall include an inner core of polyester or other material that resists cracking.



The long-term smart card media shall:

- Be a Mifare Plus or CTDOT approved equal
- Comply with ISO/IEC 14443-1 for Physical Characteristics and ISO/IEC 7810-ID1 size for all dimensions
- Comply with ISO/IEC 14443-2, ISO/IEC 14443-3, and ISO/IEC 14443-4
- Be constructed of laminated layers, with PVC outer surfaces to accommodate printing and a central layer of Polyester (PET) plastic
- When pre-printed with CTDOT-specified graphics, include a thin clear plastic layer laminated to the card. (When a card side is blank, no overlay shall be applied to the PVC surface.)
- Comply with most recent versions of ISO/IEC-10373 and ANSI INCITS 322 for durability.
- Be capable of repeated daily use over a minimum expected useful life of 3 years
- Be fully functional when held anywhere within an imaginary cylinder 3 inches high and with a diameter equal to the size of the read/write antenna, atop the surface of any read/write device antenna



### 25.2.1 Physical Characteristics

Table ~~25.2.125.2.1~~: Long-Term Media Physical Characteristics

Characteristic	Specification
<b>Physical Characteristics</b>	
Size (nominal)	Thickness: 30 mil (0.030 inches) Length: 3.375 inches Width: 2.125 inches
Card Body	Construction: Laminated, PVC surface layers, PET core Surface Finish: Glossy Color: White
Pre-Printed Graphics	In colors and designs as specified (one or both sides)
Post-Production Printing Compatibility (CTDOT applied)	Compatible with retransfer and dye sublimation printing Compatible with the Card Personalization Equipment supplied under this contract
<b>Durability and Operating / Storage Environment</b>	
Life Expectancy	Minimum 3 years in normal use Printing shall be readable and Cards shall operate for 3 years (provided that maximum write cycles have not been exceeded)
Mechanical, Electrical, Chemical Stress Tolerance	Per ISO/IEC-10373 and ANSI INCITS 322
Temperature	-20 to +50°C (-4 to +122°F) per ISO 10373
Humidity	93% at 23°C (73°F)
Surface Quality	No holes
Operating Distance and Range	Comply with Mifare Specifications
Mechanical Durability	The Cards shall operate even after 5 repeated applications of 500 Newtons of Force over the entire area of the card on the "flat" side within 5 seconds
Appearance Varieties	All Cards of a given variety shall be identical in appearance, except for pre-printed inventory control and UID numbers
Storage Environment (Up to 5 years)	Temperature: Up to 30°C (86°F) Humidity: Up to 60% (non-condensing)



Characteristic	Specification
<b>Memory and Logic Features</b>	
Card Identification	Unique UID (20 digits), sequential serial number (10 digits) and other data factory programmed
Security Features	Hardwired AES cryptographic algorithm
Anti-Collision	Handling of multiple cards in reader field, independent addressing of each card
Transaction Speed (no collision)	Card selection with anti-collision: 3 ms Mutual authentication: 2 ms Read a block: 2.5 ms Write a block: 9 ms
Maximum Read Operations	Unlimited
Maximum Write Operations	At least 100,000
<b>Contactless Communication Characteristics</b>	
Operating Frequency	13.56 MHz
Power Supply	Magnetic Induction
Modulation and Bit Encoding	Compliant with ISO/IEC 14443-2 / Type A or Type B
Communication Speed	106 kBaud or greater
Communication Integrity	CRC 16 and Parity Bit

### 25.2.2 Pre-Printed Graphics

Pre-printed graphics on the front of the Cards shall be in four colors, with “full bleed” (edge-to-edge) printing. Printing on the back shall be in one color.

All pre-printed graphics shall be protected by a clear overlay that covers the entire surface of the card.

CTDOT will supply designs for all pre-printed graphics in electronic form within 90 days of NTP.

#### **CTDOT 25-2**

Within 30 days of receipt of CTDOT’s graphic designs, the Contractor shall supply at least 10 proof samples of each card type identified above for CTDOT review and approval prior to commencing full production. Proof samples need not be functioning smart cards, but shall include samples of printed serial numbers and all other printed information. **CDRL 25-2**

CTDOT will approve or reject the proof samples within 14 days of receipt. **CTDOT 25-3**

For each proof sample CTDOT rejects, the Contractor shall provide at least 10 corrected proof samples within 14 days of notification of rejection.



### 25.2.3 Varieties and Quantities

The Contractor shall supply cards in the quantities and varieties in the table below.

Table ~~25.2.325-2.3~~: Long-Term Media Varieties and Quantities

Card Type	Printing On Front	Printing On Back	Intended Use
Full Fare	Standard Design	Full Fare Terms & Conditions Sequential Serial Number Last 4 Digits of UID	General Public
Reduced Fare	No Printing	Reduced Fare Terms & Conditions Sequential Serial Number Last 4 Digits of UID	Half Fare & Concession Fare

### 25.3 Die-Cut Limited Use Contactless Fare Media

Limited use contactless smart cards (“Limited Use Media”) shall be compliant with ISO/IEC 14443, either type A or type B. The cards shall include sufficient memory to satisfy the requirements herein. All data encoded on the cards shall be protected by encryption compliant with DES or greater.

The Die-Cut Limited Use Media shall:

- Be a Mifare Ultralight C type smart card or CTDOT approved equivalent
- Comply with ISO/IEC 7810-ID1 size for all dimensions (except thickness)
- Comply with ISO/IEC 14443-2, ISO/IEC 14443-3, and ISO/IEC 14443-4
- Be constructed of laminated layers, with paper outer surfaces to accommodate printing and a central layer of Polyester (PET) plastic
- Be capable of repeated daily use over a minimum expected useful life of 60 days.
- Be supplied in individual die-cut stock
- Be fully functional when held anywhere within an imaginary cylinder 3 inches high and with a diameter equal to the size of the read/write antenna, atop the surface of any read/write device antenna



### 25.3.1 Physical Characteristics

Table 25.3.125-3.1: Limited Use Media Physical Characteristics

Characteristic	Specification
<b>Physical Characteristics</b>	
Size (nominal, when die cut)	Thickness: 14.6 mil (0.0146 inches), nominal Length: 3.375 inches Width: 2.125 inches
Card Body	Construction: Laminated, paper surface layers, PET core Color: White
<b>Durability and Operating Environment</b>	
Life Expectancy	Minimum 60 days in normal use Memory retention minimum of 2 years
Temperature	-25 to +70°C (-13 to +158°F)
Surface Quality	No holes
Operating Distance and Range	Comply with Mifare Specifications
<b>Die-Cut Stock Characteristics</b>	
Die Cut Shape	Per ISO/IEC 7810-ID1
Graphics	Standard ink printing on both sides
<b>Memory and Logical Features</b>	
Total Memory	512 bits (minimum)
Application Memory	384 bits (minimum) EEPROM
Card Identification	Unique UID (20 digits), sequential serial number (10 digits) and other data factory programmed
Anti-Collision	Handling of multiple cards in reader field, independent addressing of each card
Transaction Speed (no collision)	Card selection with anti-collision: 3 ms Mutual authentication: 2 ms Read a block: 2.5 ms Write a block: 9 ms
Maximum Read Operations	Unlimited
Maximum Write Operations	At least 100,000
<b>Contactless Communication Characteristics</b>	
Operating Frequency	13.56 MHz
Power Supply	Magnetic Induction
Modulation and Bit Encoding	Compliant with ISO/IEC 14443-2 / Type A or Type B
Communication Speed	106 kBaud or greater
Communication Integrity	CRC 16 and Parity Bit

### 25.3.2 Pre-Printed Graphics

Pre-printed graphics on the front of the die-cut Limited Use Media shall be in two colors.

All printing on the back shall be in one color.



CTDOT will supply designs for all pre-printed graphics in electronic form within 90 days of NTP.

**CTDOT 25-4**

Within 30 days of receipt of CTDOT’s graphic designs, the Contractor shall supply at least ten proof samples of each variety of die-cut stock for CTDOT review and approval prior to commencing full production. Proof samples need not be functioning smart cards, but shall include samples of printed serial numbers and all other printed information. **CDRL 25-3**

CTDOT will approve or reject the proof samples within 14 days of receipt. **CTDOT 25-5**

For each proof sample CTDOT rejects, the Contractor shall provide at least ten corrected proof samples within 14 days of notification of rejection.

**25.3.3 Varieties and Quantities**

Die-Cut Limited Use Media shall be supplied in the quantities and varieties in the table below.

Table 25.3.325.3.3: Die-Cut Limited Use Media Varieties and Quantities

Card Type	Printing On Front	Printing On Back
<b>Die Cut Limited Use Media</b>	Standard Text & Graphics PLUS:	CTDOT Terms & Conditions Sequential Serial Number Last 4 Digits of UID
One Trip	One Ride	
Two Trip	Two Rides	
Ten Trip	Ten Rides	
1-Day Pass	Day Pass	

**25.4 Roll Stock Limited Use Contactless Fare Media**

The Contractor shall supply Limited Use Contactless Fare Media in roll stock form for use in the Multi-Function Vending Machines supplied as part of this Contract.

**25.4.1 Physical Characteristics**

The Roll Stock Limited Use Media shall be functionally identical to the Die-Cut Limited Use Media but provided in rolls with not less than 1,000 cards per roll, and with a thermally-sensitive coating on the front side of the stock.

**25.4.2 Pre-Printed Graphics**

Pre-printed graphics on the front of the roll stock Limited Use Media shall be in one color. The front of the roll stock Limited Use Media shall also be coated with a thermally-sensitive material compatible with the thermal printing used in the MVM Ticket Printer/Encoder Module.

All printing on the back shall be in one color, which may differ from the color used on the front.

CTDOT will supply designs for all pre-printed graphics in electronic form within 90 days of NTP.

**CTDOT 25-6**

Within 30 days of receipt of CTDOT’s graphic designs, the Contractor shall supply at least one partial roll containing no less than 100 proof samples of roll stock for CTDOT review and approval prior to commencing full production. Proof samples need not be functioning smart





cards, but shall include samples of printed serial numbers and all other printed information.

**CDRL 25-4**

CTDOT will approve or reject the proof samples within 14 days of receipt. **CTDOT 25-7**

**25.4.3 Varieties and Quantities**

Roll Stock Limited Use Media shall be supplied in the quantities and varieties in the table below.

Table 25.4.3: Roll Stock Limited Use Media Varieties and Quantities

Card Type	Printing On Front	Printing On Back
<b>Roll Stock Limited Use Media</b>	Standard Text & Graphics with Thermally-Sensitive Coating	CTDOT Terms & Conditions Sequential Serial Number Last 4 Digits of UID

**25.4.4 Packaging and Bundling**

Each roll shall contain at least 1,000 Limited Use Media. As delivered to CTDOT, each roll shall be individually banded to prevent accidental unwinding.

**25.5 Adhesive Contactless Fare Media**

The Contractor shall supply adhesive contactless fare media that shall:

- Be functionally identical to the Long-Term contactless smart media
- Be no more than approximately 2 square inches in size, with an antenna no less than 1.5 square inches in total area
- Be water-resistant adhesive, suitable for application to smooth surfaces, and of sufficient strength to resist peeling
- Be rendered inoperative if removed
- Contain no shielding substrate
- Be ISO/IEC-14443 compliant, either Type A or Type B
- Be supplied in a single CTDOT-supplied design
- Include pre-printed identification numbers as defined herein for other media (10-digit sequential serial number and last 4 digits of UID)
- Be designed for repeated use over a minimum expected life of 2 years
- Be fully functional when held anywhere within an imaginary cylinder 2 inches high and with a diameter equal to the size of the read/write antenna, atop the surface of any read/write device antenna



### 25.5.1 Physical Characteristics

Table 25.5.1: Adhesive Media Physical Characteristics

Characteristic	Specification
<b>Physical Characteristics</b>	
Size (nominal)	Maximum 2 square inches
Antenna Size	Minimum 1.5 square inches
Thickness	Nominal 10 mil (0.010 inches)
Pre-Printed Graphics	In colors and design as specified (top side only)
Adhesive	Water resistant
<b>Durability and Operating / Storage Environment</b>	
Life Expectancy	Minimum 2 years in normal use Printing shall be readable and labels shall operate for 2 years (provided that maximum write cycles have not been exceeded)
Temperature	-20 to +50°C (-4 to +122°F) per ISO 10373
Humidity	93% at 23°C (73°F)
Surface Quality	No holes
Operating Distance and Range	Comply with Mifare Specifications
Appearance Varieties	All labels shall be identical in appearance, except for pre-printed inventory control and UID numbers
Storage Environment (Up to 5 years)	Temperature: Up to 30°C (86°F) Humidity: Up to 60% (non-condensing)
<b>Memory and Logic Features</b>	
Card Identification	Unique UID (20 digits), sequential serial number (10 digits) and other data factory programmed
Security Features	Hardwired AES cryptographic algorithm
Anti-Collision	Handling of multiple cards in reader field, independent addressing of each card
Transaction Speed (no collision)	Card selection with anti-collision: 3 ms Mutual authentication: 2 ms Read a block: 2.5 ms Write a block: 9 ms
Maximum Read Operations	Unlimited
Maximum Write Operations	At least 100,000
<b>Contactless Communication Characteristics</b>	
Operating Frequency	13.56 MHz
Power Supply	Magnetic Induction
Modulation and Bit Encoding	Compliant with ISO/IEC 14443-2 / Type A or Type B
Communication Speed	106 kBaud or greater
Communication Integrity	CRC 16 and Parity Bit



### 25.5.2 Pre-Printed Graphics

Pre-printed graphics on the front of the Adhesive Media shall be in two colors.

CTDOT will supply designs for all pre-printed graphics in electronic form within 90 days of NTP. **CTDOT 25-8**

Within 30 days of receipt of CTDOT’s graphic designs, the Contractor shall supply at least ten proof samples of adhesive media for CTDOT review and approval prior to commencing full production. Proof samples need not be functioning smart cards, but shall include samples of printed serial numbers and all other printed information. **CDRL 25-5**

CTDOT will approve or reject the proof samples within 14 days of receipt. **CTDOT 25-9**

For each proof sample CTDOT rejects, the Contractor shall provide at least ten corrected proof samples within 14 days of notification of rejection.

### 25.5.3 Varieties and Quantities

Adhesive Media shall be supplied in the quantities and varieties in the table below.

Table 25.5.3: Adhesive Media Varieties and Quantities

Type	Printing On Front
<b>Adhesive Label</b>	Standard Text & Graphics Sequential Serial Number Last 4 Digits of UID

Adhesive media shall be supplied in either sheet or roll form, and shall comply with other delivery and packaging requirements.

## 25.6 CTDOT Employee Combination Media

The Contractor shall supply CTDOT employee media that shall provide fare media and access control functionality. To do so, CTDOT employee media shall include both the ISO 14443 compliant interface and an HID® access control interface.

When used as a contactless smart card, the CTDOT Employee media shall function identically to the Long Term contactless media.



### 25.6.1 Physical Characteristics

Table 25.6.125-6-1: CTDOT Employee Media Physical Characteristics

Characteristic	Specification
<b>Physical Characteristics</b>	
Size (nominal)	Thickness: 30 mil (0.030 inches) Length: 3.375 inches Width: 2.125 inches
Card Body	Construction: Laminated, PVC surface layers, PET core Surface Finish: Glossy Color: White
Pre-Printed Graphics	Black, one side (back) only
Post-Production Printing Compatibility (CTDOT applied)	Compatible with retransfer and dye sublimation printing Compatible with the Card Personalization Equipment supplied under this contract
<b>Durability and Operating / Storage Environment</b>	
Life Expectancy	Minimum 3 years in normal use Printing shall be readable and cards shall operate for 3 years (provided that maximum write cycles have not been exceeded)
Surface Quality	No holes
Operating Distance and Range	Comply with Mifare Specifications for ISO 14443 Comply with HID <sup>®</sup> specifications for Prox
Appearance Varieties	All Cards of a given variety shall be identical in appearance, except for pre-printed inventory control and UID numbers, and barcode data
Storage Environment (Up to 5 years)	Temperature: Up to 30°C (86°F) Humidity: Up to 60% (non-condensing)



Characteristic	Specification
<b>ISO 14443 Memory and Logic Features</b>	
Card Identification (ISO 14443)	Unique UID (20 digits), sequential serial number (10 digits) and other data factory programmed
Security Features	Hardwired AES cryptographic algorithm
Anti-Collision	Handling of multiple cards in reader field, independent addressing of each card
Transaction Speed (no collision)	Card selection with anti-collision: 3 ms Mutual authentication: 2 ms Read a block: 2.5 ms Write a block: 9 ms
Maximum Read Operations	Unlimited
Maximum Write Operations	At least 100,000
<b>ISO 14443 Contactless Communication Characteristics</b>	
Operating Frequency	13.56 MHz
Power Supply	Magnetic Induction
Modulation and Bit Encoding	Compliant with ISO/IEC 14443-2 / Type A or Type B
Communication Speed	106 kBaud or greater
Communication Integrity	CRC 16 and Parity Bit
<b>HID® Proximity Communication Characteristics</b>	
Operating Frequency	125 kHz
Power Supply	Magnetic Induction

### 25.6.2 Pre-Printed Graphics

Pre-printed graphics on the back of the CTDOT employee cards shall be in black.

In addition to CTDOT-supplied text (and the identification numbers), the CTDOT employee card shall also include a two-dimensional barcode. This barcode shall include the unique sequential serial number of the card, encoded in a standard format that shall be readable by the 2D barcode reader included as part of the Passenger Interface Module. The 2D barcode content shall be encrypted.

CTDOT will supply text and other content for all pre-printed graphics in electronic form within 90 days of NTP. **CTDOT 25-10**

Within 30 days of receipt of CTDOT's graphic designs, the Contractor shall supply at least ten proof samples of adhesive media for CTDOT review and approval prior to commencing full production. Proof samples need not be functioning smart cards, but shall include samples of printed serial numbers and all other printed information. **CDRL 25-6**

CTDOT will approve or reject the proof samples within 14 days of receipt. **CTDOT 25-11**

For each proof sample CTDOT rejects, the Contractor shall provide at least ten corrected proof samples within 14 days of notification of rejection.

### 25.6.3 Encoding

CTDOT will use the APOS Terminal Smart Card Printer / Encoder to personalize and issue all CTDOT Employee cards. At the time of personalization, the Smart Card Printer / Encoder shall



encode the smart card portion of the CTDOT Employee cards with profiles as CTDOT Employee media.

CTDOT will provide detailed information on content and format of the access control (HID® proximity) portion of the CTDOT Employee cards no later than 90 days after the NTP is issued.  
**CTDOT 25-12**

#### 25.6.4 Varieties and Quantities

CTDOT Employee Media shall be supplied in the quantities and varieties in the table below.

Table 25.6.4: CTDOT Employee Media Varieties and Quantities

Card Type	Printing On Front	Printing On Back
<b>CTDOT Employee</b>	None	Employee Terms & Conditions 2D Barcode as Specified Sequential Serial Number Last 4 Digits of UID

### 25.7 Barcode Ticket Stock

#### 25.7.1 Transfer / Receipt Ticket Stock

Roll or fan-fold stock to be dispensed by the Magnetic Ticket Processor (if applicable) and the Barcode Ticket Dispenser shall be supplied in rolls or stacks as defined herein. All roll or fan-fold ticket stock shall include pre-printed graphics in one color on the non-thermally sensitive side, plus a low-cost security measure such as a watermark, photocopy-resistant graphic, white-ink pseudo-watermark or other CTDOT-approved feature.

#### 25.7.2 Plain Paper Ticket Stock

Roll or fan-fold stock to be dispensed by the MVM Ticket Printer/Encoder shall be supplied in rolls or stacks as defined herein. All roll or fan-fold ticket stock shall include pre-printed graphics in one color on the non-thermally sensitive side, plus a low-cost security measure such as a watermark, photocopy-resistant graphic, white-ink pseudo-watermark or other CTDOT-approved feature.

As delivered to CTDOT, each roll or fan-fold stack shall be individually banded to prevent accidental unwinding.



### 25.7.3 Blank Stock for Bulk Printed Barcode Tickets

The Contractor shall supply stock for use in the Front Office APOS Terminal in the production of CTDOT-printed barcode tickets. The barcode ticket stock shall:

- Be of heavy paper (nominally 120g/m<sup>2</sup>)
- Be based on commercially-available, pre-perforated stock
- Provide multiple tickets per sheet
- Include custom, pre-printed graphics and text of CTDOT design on one side (identical printing for all tickets on each sheet)
- Include features to deter copying and counterfeiting, such as simulated watermarks, visible printing in light colors that can be discerned, but shall not interfere with barcode printing or reading
- 

CTDOT shall supply the graphic designs for each barcode ticket no later than 90 days after the NTP is issued. **CTDOT 25-13**

The Contractor shall supply 3,000 sheets of barcode ticket stock, pre-printed and pre-perforated, no later than 120 days prior to the start of NFTS revenue service. **CDRL 25-7**

## 25.8 Magnetic Read/Write Media

CTDOT will provide existing die-cut ticket stock for use in the Validating Farebox Magnetic Ticket Processor. If the supplied Magnetic Ticket Processor uses roll or fan-fold stock, the Contractor shall supply magnetic media for use during the transition from magnetic to barcode transfer tickets.

### 25.8.1 Thermal Coating

CTDOT's existing ticket stock is coated with thermally sensitive material on the same side as the magnetic stripe. The thermal coating shall be compatible with CTDOT's existing bus fare collection system and shall be of a sensitivity sufficient to provide printed information of suitable clarity and contrast. The thermal coating shall not interfere with the performance of the magnetic stripe.

### 25.8.2 Preprinted Graphics

Text and graphic designs, similar to those on the current tickets, shall be printed on one side of the tickets. All text and graphics shall be free of smudges and shall be printed in such a way to withstand normal handling and use without degradation. Text shall be printed in sizes ranging from 8 point to 50 point (0.08" to 0.5" high) using fonts similar to those currently in use. All graphics shall be printed in one color, similar to that currently in use. All graphic designs shall be submitted to CTDOT for approval at the Preliminary and Final Design Reviews. **CDRL 25-8**

### 25.8.3 Packaging and Bundling

Each roll or stack of ticket stock shall contain at least 500 tickets. As delivered to CTDOT, each roll or bundle of ticket stock shall be individually banded to prevent accidental spillage or unwinding.



## 26 Mobile Ticketing Application

### 26.1 General

The Contractor shall supply a mobile ticketing application and other supporting software that shall allow customers with smart phones and tablets, including those at minimum running Apple iOS®, Google Android®, and Windows Mobile® operating systems, to perform the following:

- A. Purchase a CTDOT unlimited ride pass for immediate use or for future use to be activated later by the customer.
- B. When necessary, conduct a secure payment transaction for the purchase, including methods of payment that do not require a credit card (to allow the unbanked to participate in mobile ticketing).
- C. Receive transaction receipts via email, SMS text message, or both.
- D. Easily and securely repeat prior transactions on-demand with minimal data entry, and automatically via "subscription" transactions.
- E. Display a secure 2D barcode representing the purchased fare product.
- F. Easily re-generate and display the barcode (with modified data as necessary) for subsequent boardings while the purchased fare product is valid.
- G. Easily access other related travel functions including but not limited to schedules, next scheduled bus, CTDOT Bus Time, service alerts, and a trip planner.
- H. The mobile ticketing application shall be able to easily expand and accommodate:
  - new ticket types and prices for existing participating agencies
  - new services for participating agencies
  - new services from new agencies
  - new agencies and shared fares
  - modifications to the software and parameters to properly operate the mobile ticketing system

### 26.2 Functional and Performance Requirements

- A. The mobile ticketing application shall support a wide range of fare product and pricing solutions, including:
  - All current CTDOT fare products
  - Reduced and concessionary fares (e.g., children, senior citizens, etc.)
  - Distance-based fares
  - Time of day / peak hour pricing
  - Discounted pricing based upon total number and value of purchases within a period of time
  - Discounted pricing for multiple tickets purchased at once
  - Purchase a pass for 1 person or a group of persons traveling together
  - Integrated packaging and pricing of transit products and other services such as parking





- B. For general public users (*i.e.*, users not associated with a university or corporate program), the mobile ticketing application shall support existing and new CTDOT fare products suitable for read-only use, including but not limited to:
- Floating period passes in any length up to 366 days
  - Fixed calendar passes, including monthly and student semester passes
  - Special event tickets
- C. Authorized employees of participating Corporate Partners shall have the ability to activate and use fare products made available by their employer through the Corporate Partner Web Portal.
- D. Authorized students attending participating universities shall have the ability to activate and use fare products specific to the university. (University fare products shall be available only to authorized students.) The Student Pass Administrator Web Portal, shall enable university administrators to authorize students for mobile ticket use, and to select the products available.
- E. The NFTS shall provide sufficient controls to ensure that a fare product purchased or made available through Corporate Partner or University programs cannot be assigned simultaneously to a smart card and a mobile device.
- F. At any time, CTDOT shall be able to easily configure, activate and deactivate the availability of any read-only fare product sold via the mobile ticketing application.
- G. When generating and displaying a 2D barcode ticket, the mobile ticketing application shall be capable of operating in an offline manner (without wireless connectivity). Wireless connectivity shall be required for customer purchases of fare products and other functions described herein. Offline functionality shall include a variety of methods to minimize fraud, since SAPs will be offline while in revenue service.
- H. The application shall adhere to industry best practices for accessibility in web and mobile applications, including Mobile Web Application Best Practices (World Wide Web Consortium).
- I. Setup of the account in the mobile ticketing software shall provide the customer with the opportunity to set defaults for the language desired, as well as whether the information displayed will be also audibly annunciated. Language selections shall include the languages identified in Section 17.5.2.3
- J. The mobile ticketing system shall provide web-based services that are sufficiently integrated with other CTDOT and NFTS web portals to allow for a seamless online experience. This shall include but not be limited to the ability to view/print receipts, purchase passes and view transactions.
- K. The mobile ticketing system shall allow a customer to buy a pass for another person/account (*e.g.*, parent purchase for child) and “send” the pass to the other person’s mobile device.
- L. The mobile ticketing application and support systems shall allow a customer to transfer accounts and tickets (whether active or not yet activated) to a different device, such as when a customer obtains a new mobile phone or utilizes more than one mobile phone. This functionality shall be configured based on agency-determined business rules to reduce the potential for fraud.
- M. The mobile ticketing application and system shall comply with all Federal and State laws and regulations, be ADA compliant and be fully compliant with all PCI requirements.



- N. Excluding network latency and other factors beyond the Contractor's control, purchase of a mobile ticket shall complete (that is, the barcode shall be displayed on the customer's phone) no more than 5 seconds after the customer commits to the purchase.
- O. The mobile ticketing application shall provide customers the ability to complete repeat purchases in 15 seconds or less while no less than 350 concurrent users are conducting on-line purchase transactions. (Initial purchase/account set-up may take longer.)
- P. The mobile ticketing system shall support peak transaction rates of no less than 20,000 purchase transactions per hour.
- Q. Purchase and activation of special-fare mobile tickets shall be subject to additional user verification, such as entry and validation of a student ID number, Half Fare authorization number, employee number, etc.
- R. The mobile application shall provide for a variety of customer notifications within the application and via email and SMS text messages, such as notification of passes that will soon expire, pending recurring payments, etc.
- S. The mobile ticketing system shall quickly process all transactions while being highly accurate and reliable, achieving:
  - No less than 99.9% in-service availability for all functionality
  - No less than 99.99% accuracy for all transactions and data transmissions

The complete mobile ticketing application and system shall be subject to CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 26-1**

## 26.3 Application Distribution

CTDOT does not have accounts for smart phone and tablet platform distribution channels. All releases of the mobile ticketing application will go through approved channels. With coordination and support from the Contractor, CTDOT will be responsible for any necessary "app store" accounts and license agreements.

The Contractor shall provide CTDOT with the appropriate release package, icons, and release notes for all "app stores" to receive the application. Upon CTDOT approval of the application, the Contractor shall publish the application, and any ongoing updates, to the associated "app stores" for the supported smart phone and tablet platforms. At its sole discretion, CTDOT may assume application publication responsibility at any time.



## 26.4 Barcode Content

The displayed 2D barcodes shall contain:

- A. Data encrypted with a CTDOT-controlled and configurable encryption key, and using a 3DES or AES encryption algorithm
- B. A unique identification number no less than 10 digits in length
- C. Information sufficient to identify the barcode as a valid CTDOT fare product, including at minimum:
  - Fare category (Full, Half, Student, etc.)
  - Ticket type (local, express, regional, etc.)
  - Validity start date and time
  - Validity end date and time
- D. The date and time that the barcode was generated
- E. Other security information, such as a hash sum generated using the encoded data and by an algorithm of sufficient complexity to make decoding difficult

The Contractor shall submit comprehensive documentation describing the mobile ticket 2D barcode content, format, encryption, and security measures for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 26-2**

## 26.5 Other Displayed Content

While displaying the barcode, the mobile ticketing application shall also cause the user's smart phone to display some animated graphics. These animations shall be easily discernible when shown to the vehicle operator from a distance of 5 feet, and shall include high contrast colors and other features to enhance visibility. CTDOT shall have the ability to change the animated graphics without the need for customers to download a new version of the application.

For users of special fare products (*i.e.*, not Full Fare), the mobile ticketing application shall support the display of a digital photograph of the user. Such photographs shall originate from CTDOT, and the Corporate Web Portal (for employees) and the Student Pass Administrator Web Portal (for authorized students).

The Contractor shall submit documentation describing the additional displayed content, CTDOT's ability to modify that content, and methods to populate dynamic content (such as user photos) for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 26-3**

## 26.6 Interactive Content

While displaying the barcode, the mobile ticketing application shall respond to any user input (via touching the screen or other input button) by altering the background animation design or colors in a way that is easily discernible from a distance of 5 feet.

## 26.7 Customer Purchase and Payment Process

Customers shall be able to enter new or updated payment information from within the application, which shall also have the ability to store payment methods to facilitate repeat



purchases. The system shall also support split-payments (e.g., more than one payment method for a specific payment transaction) and shall utilize best practices to minimize financial transaction processing costs (e.g., through the use of aggregation of small ticket transactions).

The Contractor shall document the customer purchase and payment process for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 26-4**

## 26.8 Payment Collection and Revenue Reconciliation

For tickets purchased using the mobile ticket application, the Contractor shall process mobile ticketing electronic payments, using CTDOT's selected payment entity. In addition to comprehensive web-based reporting tools, all transaction data for the mobile ticketing application shall be loaded into the CDS database for inclusion in all applicable NFTS reports. This data shall also enable full reconciliation of mobile ticket purchases with the funds deposited into CTDOT's bank accounts by CTDOT's payment entity.

The Contractor shall provide a complete description of the payment collection and revenue reconciliation processes, including interfaces with CTDOT's payment entity, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 26-5**

## 26.9 Customer Support

The system shall allow for most customer service issues (such as refunds, ticket removal from a device, or ticket re-issuance) to be resolved by CTDOT customer service personnel using comprehensive on-line web-based tools. This shall include the ability to deactivate (temporarily or permanently disable) mobile ticketing accounts (including tickets previously purchased but not yet expired) based on CTDOT business need.

Comprehensive system configuration tools shall enable CTDOT personnel to manage fare products, pricing, branding, etc. to manage the mobile ticketing solution. The tools shall also support tariff modifications and maintenance to permit CTDOT to add, delete and modify fares and other electronic products to meet their needs, including non-transit products.

All customer support functions shall be limited to personnel with the appropriate high-security password and privileges.

## 26.10 Security

The Contractor shall provide documented evidence that the mobile ticketing application and applicable server software passes independent risk-based security tests performed by a qualified firm, including but not limited to code reviews and penetration testing. Prior to commencing the Factory Integration Test, the Contractor shall submit the mobile ticketing system security assessment for CTDOT review and approval. **CDRL 26-6**

## 26.11 Compensated Transaction Fees

Excluding mobile ticket purchase transactions conducted prior to and during on-site Systems Integration Testing, CTDOT shall compensate the Contractor for mobile ticket services on a fixed per-purchase transaction fee basis. CTDOT shall also compensate the Contractor for tickets that do not require purchase, but activation only (such as university semester passes);



for each such activation, CTDOT shall compensate the Contractor the same per-purchase transaction fee.

Upon commencement of the Pilot Test, the Contractor shall invoice CTDOT monthly for completed mobile ticket purchase transactions at the contracted per-transaction fee.



## 27 Management

### 27.1 Program Management

The Contractor's program management shall be sufficiently comprehensive to enable CTDOT to ascertain that the Contractor shall meet the requirements of the Contract Documents, and to enable CTDOT to monitor the contractual effort.

The Contractor shall designate a responsible individual, subject to approval by CTDOT, to serve as Program Manager for the entire term of the Contract. This individual shall have prior experience in management of Fare Collection System procurements and be familiar with design, subcontractor equipment procurements, construction, test, and inspection of Fare Collection Equipment.

The Contractor shall establish an organization to properly manage this Fare Collection System procurement program. The organization shall be highly responsive to the needs of CTDOT as required in this Contract.

#### 27.1.1 Management Plan

Within 30 days of NTP, the Contractor shall submit a Management Plan to CTDOT for approval.

**CDRL 27-1** The Management Plan shall be updated as necessary to incorporate changes in the project or its schedule. The plan shall include:

- An organization chart including a definition of the authority, responsibilities, and qualifications of all personnel therein.
- The methods and communications to be used to control the program schedule, design reviews, technical performance, program changes, subcontracts, purchase orders, material procurement, in-service support, hardware and software warranties, systems assurance analysis, tests, and demonstrations.
- A description of the process to track and control project correspondence.
- A Submittal List and Schedule listing drawings, documents, and data to be submitted for review and approval during the design review phase of the program and a schedule for the submittal of this information.
- A CDRL based on the information in this contract. The CDRL shall contain the specific format of the deliverable, quantity, frequency, and contract paragraph reference as required. The CDRL shall be in accordance with the following column headings:
  - Item Number
  - Deliverable Description
  - Reference Section (*i.e.*, location of requirement within the Contract Documents)
  - Scheduled Delivery Date(s)
  - Current CTDOT acceptance status (*i.e.*, pending, approved, conditionally approved, disapproved)
  - Quantity: Number of documents, units, or copies required.

#### 27.1.2 Master Program Schedule

The Contractor shall use the approved Master Program Schedule for executing the work for this Contract. The Master Program Schedule shall be generated using a currently supported version of Primavera Project Planner for Windows, Microsoft Project, or other similar program approved by CTDOT. The Master Program Schedule shall conform to this Scope of Work and to schedule and delivery requirements set forth in the Terms and Conditions of this Contract; only



a Contract Change Order may modify such portions of the Master Program Schedule. In addition to printed copies, all submittals of the Master Program Schedule shall be provided on CTDOT-approved electronic media.

The Master Program Schedule shall include the following:

- Work item descriptions that convey the scope of work indicated. Work items shall be discrete items of work that will be accomplished under the Contract. Work items shall include the scheduled dates for submittal and required response dates for approval of Contractor drawings and documentation. It shall include the schedule for design reviews, procurement of materials and equipment, fabrication of materials and equipment and their installation and testing, delivery of CTDOT-furnished and other third party items and information, qualification tests and delivery, and testing of the NFTS. Estimated work item duration in whole working days shall be indicated for each work item of the schedule.
- The sequence, successor, and predecessor interrelationships among work items shall be considered in developing the schedule and shall be so indicated.
- Work item descriptions shall be accompanied by narrative explanation of what the work item comprises and the basis for the estimated work duration.
- Sufficient detail shall be provided to indicate the manufacturing, testing, shipment, storage, and installation status of each NFTS device.
- Testing and installation activities for the CDS.

A Preliminary Master Program Schedule showing key milestones and events, including those identified in the Contract Documents, shall be submitted within 30 days after the NTP is issued. **CDRL 27-2**

CTDOT shall review the preliminary schedule and provide comments within 30 days of receipt. **CTDOT 27-1**

A Final Master Program Schedule shall be submitted to CTDOT within 90 days after the NTP is issued. **CDRL 27-3**

The Contractor shall submit an as-built Master Program Schedule within 30 days of completion of all installations and upgrades. **CDRL 27-4**

### **27.1.3 Action Item Log**

The Contractor shall maintain a log of all identified action items. These action items shall be identified at design review meetings, monthly Progress Review Meetings, and through correspondence. All action items shall have a responsible party assigned. No action item shall be assigned to CTDOT without the CTDOT's knowledge and consent. Each action item in the log shall contain:

- Item Number
- Description
- Requesting Party
- Assigned Party
- Status (open / closed / in progress / deferred / etc.)
- Date Opened
- Date Closed
- Progress Notes



#### **27.1.4 Correspondence Log**

The Contractor shall maintain a log of all project correspondence with CTDOT. For each letter between the parties, the Contractor shall record:

- Letter Number
- Date Issued
- Issuing Party
- Topic
- Keywords
- Author
- References to other Contract Documents
- References to other Contract Correspondence

#### **27.1.5 Project Document Control**

The Contractor shall store and maintain all Contract documents, project submittals, and correspondence in electronic form in a web-based system that shall restrict access to authorized Contractor and CTDOT personnel. The Contractor shall supply the software, such as Microsoft SharePoint®, and web hosting services and administration as necessary to provide project document control.

#### **27.1.6 Contract Start-up Meeting**

Within 30 days after the issuance of the NTP, a Contract Start-up Meeting shall be held in the offices of CTDOT. In attendance shall be CTDOT's Contracting Officer, CTDOT's Project Manager, the Contractor's program manager, and other appropriate CTDOT and Contractor personnel. CTDOT shall prepare an agenda for distribution. **CTDOT 26-2**

The Contract Start-up Meeting shall permit all parties to the contract to understand the overall schedule, terms and conditions, scope of work, and responsibilities. In addition, the parties shall discuss and identify the items to be submitted for the design reviews.

The Contract Start-up Meeting shall allow the Contractor and CTDOT to coordinate their activities. At the meeting, the Contractor shall also present a conceptual description of its intended design and identify interface requirements.

The Contract Start-up Meeting shall also cover the following topics:

- CTDOT and Contractor to review and confirm the procedural requirements of the Contract
- Contractor to provide conceptual information on proposed equipment design, configuration and layout
- CTDOT and Contractor to review intended operations and maintenance requirements
- CTDOT and Contractor to identify interface requirements between CTDOT and Contractor, especially regarding data communications and installation interfaces
- Contractor to identify information and decisions required by CTDOT, subject to the approval of CTDOT
- Contractor to identify PDR and FDR submittals for which waivers will be requested, subject to the approval of CTDOT





### **27.1.7 Progress Review Meetings**

Progress Review Meetings (PRMs) shall be held at least every two weeks, at the offices of CTDOT or the Contractor as selected by CTDOT; approximately one half of the PRMs may be conducted via teleconference. The Contractor's program manager and other appropriate Contractor and sub-contractor personnel, based upon anticipated agenda, shall attend either in person or via telephone conference call. The topics to be discussed and reviewed shall include:

- Minutes of the previous Progress Review Meeting
- Updated Master Program Schedule
- Updated CDRL
- Updated Submittal List and Submittal Schedule
- Updated action item log
- Work accomplished since previous meeting, including: design status, fabrication problems, product delivery problems, schedule slippages, problems arising from proposed changes, and other circumstances which might affect progress of the work
- Sequence of critical work and schedule of manufacturing using the Master Program Schedule and Monthly Progress Reports
- Engineering, manufacturing, and quality control summary
- Contract budget, milestone payment, and invoice status and schedule
- Any needed corrective measures to maintain Program Schedule
- Any other issues related to the project

The Contractor shall prepare a PRM agenda at least five days prior to the scheduled meeting date. **CDRL 27-5**

The Contractor shall provide all other material for the PRM at least one day prior to each meeting. **CDRL 27-6**

The Contractor shall prepare meeting minutes for each PRM. The Contractor shall submit meeting minutes no later than two days after the meeting date. **CDRL 27-7**

## **27.2 Contractor's Quality Assurance Program**

### **27.2.1 General**

The Contractor shall plan, establish, and maintain a Quality Assurance (QA) program. The Contractor's QA program shall be imposed upon all entities within the Contractor's organization and on all subcontractors whenever Contract work is performed.

The Contractor shall prepare and submit for approval a Quality Assurance Program Plan that addresses control of the quality of the Contractor's design, equipment furnished, testing, training, and documentation. This Plan shall also include Reliability Assessment Program elements.

### **27.2.2 Quality Assurance Program Plan**

A QA Program Plan shall be submitted within 60 days after the NTP is issued for CTDOT review and approval. **CDRL 27-8**



The Contractor shall use and abide by the QA Program Plan to execute the work for the Contract. The QA Program Plan shall describe the methods for planning, implementing, and maintaining quality, schedules, and cost. The QA Program Plan shall contain a company policy statement that clearly defines the responsibilities of QA personnel. An organization chart shall be included to show the reporting relationships of all QA staff, and shall indicate the Contractor's QA representative, who shall be a full-time employee of the Contractor.

The QA Program Plan shall also contain a collection of all forms to be used for the documentation of quality control activities, which assure compliance of materials, processes, personnel, and products to the applicable specifications.

The QA Program Plan shall at minimum include procedures for the following activities:

- A. Factory inspection and test procedures and records
- B. Configuration Management Program, procedures, and records for Change Control and version management
- C. Procedures and records for equipment handling; inventory; storage; delivery; design control; changes to documents, drawings, data, and specifications; release for shipment; shipping; evidence of compliance; corrective action; calibration/verification of measuring equipment and audit
- D. Software Development Quality Assurance Program, consistent with that indicated in IEEE Standard 730, IEEE Standard for Software Quality Assurance Plans or equivalent ISO 9001 standards for software quality assurance
- E. Quality Assurance program requirements for subcontractors
- F. System test procedures and records
- G. Surveillance over all work, including subcontractors, for conformance and verification thereof with all Contract requirements
- H. Discrepancy control
- I. Evaluation and assessment of subcontractors' QA programs
- J. Feedback of problems, their resolutions to the Contractor's engineering and production departments, and corrective action
- K. Qualification and certification of all personnel performing work for this Contract

### **27.2.3 CTDOT Quality Assurance**

CTDOT may, at its discretion, perform its own QA monitoring of work done under this Contract, including monitoring of the Contractor's or subcontractor's QA activities. Such activities shall not reduce or alter the Contractor's QA responsibilities, nor reduce or alter the Contractor's obligation to meet the requirements of this document.

After the issuance of NTP, CTDOT shall have the right of free access to facilities of the Contractor and subcontractors. This right shall permit CTDOT to inspect, examine, and test items during manufacture and prior to shipment. On demand, the Contractor's Quality Assurance Plan, procedures, and records shall be made available to CTDOT for inspection and audit. In addition, copies of all drawings, diagrams, schedules, changes, and deviations shall be made available promptly upon request.

If so requested, the Contractor shall provide to CTDOT a temperature-controlled and adequately lighted private office at the Contractor's manufacturing facility to accommodate a minimum of



two people, and shall have access to toilet facilities. A telephone and high-speed Internet access (DSL minimum) shall be made available.

## 27.3 Version Control and Configuration Management

The Contractor shall maintain strict control and records of all hardware and software design changes throughout the development, testing, production, and warranty periods.

### 27.3.1 Hardware Versions

Subsequent to First Article Configuration Inspection (FACI) approval, the Contractor shall make no changes to the hardware design of any component or subcomponent without written approval of CTDOT. CTDOT reserves the right to require the Contractor to repeat any portion of the testing program described in Section 29 when the Contractor requests a post-FACI change to the hardware design.

When post-FACI hardware changes are required and approved, the Contractor shall submit a hardware update plan for CTDOT review and approval. The Contractor shall then implement the approved hardware change according to the approved hardware update plan.

Throughout the Hardware Warranty period, the Contractor shall maintain accurate records of the versions of all serialized components of the NFTS, including all spare parts in inventory. After completing an approved hardware update, the Contractor shall submit a Microsoft® Excel® spreadsheet with an updated listing of the serial numbers and version numbers of the affected hardware components; this listing shall include the date the revision was applied to each item.

### 27.3.2 Software Versions and Configurations

Throughout the performance of this Contract, the Contractor shall adhere to the software quality and version control procedures submitted and approved as part of the QA plan described in Paragraphs 27.2.2B and 27.2.2D.

Throughout the Contract, the Contractor shall provide and deploy ongoing updates/enhancements/support for new smart phone and tablets' operating system versions as they are introduced. To ensure the least lag in deployment, when the beta version is released for developers, effort shall commence on the development and implementation of necessary application software to accommodate the changes in the operating system.

#### 27.3.2.1 *Application Software*

Upon successful completion of the Factory Integration Test, all software shall be considered ready for revenue service. Any subsequent change to fare collection system software shall be subject to strict testing and deployment procedures.



- A. The Contractor shall submit all post-FIT software changes to CTDOT for review and approval. Accompanying each proposed software change, the Contractor shall submit comprehensive Software Release Notes for each proposed software release. Software Release Notes shall provide:
- A description of the change
  - Affected equipment and modules
  - A listing of the software modules updated by the release, including file names, version numbers, sizes, and checksums
  - A listing of all defects corrected, including references to CTDOT correspondence where applicable
  - A listing of all new features included
  - Copies of all test procedures and test results documentation
  - Complete installation instructions, including steps to verify proper installation and steps to remove the updated software
  - A deployment plan to implement the proposed change
- B. CTDOT shall review the Software Release Notes, and upon approval, install the proposed software change in the Maintenance Test Facility. Upon successful verification of the software change, CTDOT shall authorize the Contractor to deploy the software change according to the approved deployment plan included in the Software Release Notes.
- C. When all software updates are installed, the Contractor shall provide a report (generated by the CDS) confirming the successful deployment.
- D. The version identifiers for all application software shall be unique. When CTDOT approves a software version in the Maintenance Test Facility, the Contractor shall install the same software, with the same version identifiers, throughout the fare collection system.

#### **27.3.2.2 Configuration Files**

Configuration files, including fare tables and files governing operating parameters, shall be similarly managed with strict version controls. Upon successful completion of the Factory Integration Test, all configuration files shall be considered ready for revenue service. Any subsequent change to fare collection system configuration files shall be subject to strict testing and deployment procedures.

Proposed post-FIT changes to any configuration file shall be subject CTDOT review and approval, and CTDOT verification in the Maintenance Test Facility. Upon CTDOT approval and CTDOT verification, CTDOT shall authorize the Contractor to implement the configuration update.

Once revenue service has commenced, CTDOT may make configuration changes without Contractor assistance, but the Contractor shall provide technical support when requested as required.



## 28 Design Reviews

The Contractor shall conduct a comprehensive program of submittals and reviews for all aspects of the NFTS project. Two design reviews shall be held: Preliminary and Final. For each of these reviews, the Contractor shall submit a series of documentation, samples, and demonstrations to CTDOT for review and approval.

*The submitted design documents shall include all those specified herein. In addition, the Contractor shall submit any additional documents necessary to present to CTDOT a complete description of the NFTS design, operations, user interfaces, fare processing, configurability, maintenance, administration, accounting, monitoring, reporting, and all other aspects of a modern fare collection system.*

The Contractor shall furnish the exact models of equipment and materials identified in CTDOT-approved submittals unless otherwise approved by CTDOT.

The approval by CTDOT of any design submittal does not imply that CTDOT has accepted any responsibility for the Contractor's design or that CTDOT has accepted any item of equipment, software, or material.

Acceptance of a design submittal that contains exceptions or deviations from these requirements shall not constitute CTDOT approval of the exceptions or deviations. Only design exceptions and deviations approved through the formal Contract Change Process shall be considered part of this Contract.

### 28.1 Design Review Requirements

Design review meetings as scheduled in the approved Management Plan shall be held in which the Contractor conducts a presentation in accordance with a previously approved agenda. In its presentation, the Contractor shall address design approaches, concepts, and design details. During these design review meetings, action items shall be identified, with each action item assigned to an individual for disposition by a pre-determined response date.

At least 14 calendar days prior to each design review meeting, the Contractor shall submit the agenda and a data package covering information to be addressed in the meeting. **CDRL 28-1**

The Contractor shall prepare and submit design review meeting minutes for CTDOT review and approval within 7 days after each meeting. **CDRL 28-2**

Attendance at design review meetings shall include representatives of the Contractor and appropriate Subcontractors.

### 28.2 Preliminary Design Review

Upon reaching agreement with the design concepts presented at the Contract Start-up Meeting, the Contractor shall prepare preliminary design drawings, documentation, and data for review and approval by the Contracting Officer. Upon receipt of preliminary design review submittals, a Preliminary Design Review Meeting (PDR), as scheduled in the approved Management Plan, shall be held at CTDOT offices or, at CTDOT's option, at the offices of the Contractor in the United States. The PDR shall be held within 90 calendar days after the NTP is issued.



## 28.3 Final Design Review

The Final Design Review (FDR) shall take place when the design is essentially complete, and as scheduled in the approved Management Plan. The FDR shall provide the opportunity to review, revise, and agree on the details of the final design prior to release of the designs for manufacture. FDR submittals shall include finalized submittals of all required drawings, documents, and data. CTDOT shall identify to the Contractor within 30 calendar days after the PDR those submittals from the PDR that shall be resubmitted in greater detail for the FDR.

### **CTDOT 28-1**

Upon receipt of final design review submittals, a Final Design Review Meeting (FDR), as scheduled in the approved Management Plan, shall be held at CTDOT offices, or at CTDOT's option, at another approved location in the United States. The FDR shall be held within 150 calendar days after the NTP is issued.

In addition to reviewing design submittals, the FDR shall also include a review of the spare parts required to support the NFTS. The Contractor and CTDOT shall jointly review the spare parts listed on the NFTS Pricing Forms and reallocate, delete, and add parts as necessary, as well as identify any parts to be purchased using the Spare Parts Allowance. The recommended list shall identify supplemental parts necessary to achieve an adequate parts supply for a minimum of five years from the start of revenue service. These additional parts shall consist of items specific to the Contractor's design that are not identified in the Pricing Forms, and those subcomponents that are the most common causes of failure of major components. The supplemental list shall also include components that are subject to normal wear and vandalism.



## 29 Factory Testing and Inspection

### 29.1 General

The Contractor shall plan for, perform, monitor, and document all tests required to prove the design and acceptability of the Fare Collection System, including all elements, subsystems, and the system as a whole, furnished under this Contract. The Contractor shall furnish Fare Collection Equipment that meets the criteria specified for all tests. Testing shall not commence until all designs affecting the respective equipment and all related testing procedures have been approved.

The Contractor shall begin no portion of the inspection and testing regimen unless all prerequisite tests and Design Reviews have been successfully completed and approved by CTDOT, or CTDOT provides written authorization.

CTDOT may require the Contractor to submit proof of acceptability of any item at any time during the duration of this Contract. A statement by the contractor, manufacturer, or supplier of any item, without appropriate substantiating evidence, shall not constitute adequate proof of acceptability, unless approved by CTDOT. Appropriate substantiating evidence shall include one or more of the following:

- A. Testing witnessed by CTDOT or designated representative.
- B. Testing performed by an independent testing organization, approved by CTDOT.
- C. Testing performed in accordance with approved test procedures.
- D. Testing performed on same hardware equipment or components with substantial revenue service experience under similar operating environments and functions.

The Contractor shall furnish all test instruments and other equipment and materials necessary for performing all tests required.

#### 29.1.1 Testing Plan

The Contractor shall prepare and submit an overall Testing Plan to CTDOT for approval within 30 days after successful completion of the Final Design Review. **CDRL 29-1** The Testing Plan shall include descriptions, approximate scheduling, sequencing, and dependencies of all inspections, factory acceptance tests, and revenue service acceptance tests to be performed. These inspections and tests shall demonstrate that the equipment produced is in compliance with this Contract. The Testing Plan shall include the format for test results documentation.

#### 29.1.2 Test Schedule

The Contractor shall submit a test schedule for all factory tests and inspections to CTDOT for approval 60 days prior to the start of any testing. **CDRL 29-2**



The test schedule shall include, as a minimum, the following requirements:

- Scheduled test dates
- Dates that the test procedures shall be submitted
- Dates that the test procedures approval is required
- Hierarchy of tests

The schedule shall accommodate the fact that CTDOT may witness all such activities and, as such, the Contractor shall not schedule concurrent tests or inspections without prior approval by CTDOT.

### **29.1.3 Test Procedures**

Test procedures for each shall be submitted to CTDOT for approval at least 30 days prior to the start of each test. **CDRL 29-3**

The test procedures shall include, as a minimum, the following requirements:

- Objective of test
- Test environmental conditions
- Detailed description of test units including drawings, part numbers, inspection and earlier test records, maintenance records and calibration records
- Detail of test procedure
- Sequence of test with other tests
- Test equipment to be utilized during the test and the calibration of such equipment
- Pass/fail criteria
- Re-test procedure, if appropriate
- Level and schedule of preventive maintenance during the test
- Test data sheet format
- Test report format

### **29.1.4 Test Results Reports**

Test reports shall be prepared in accordance with the test procedure and signed by all responsible witnessing parties. The results of the tests shall be submitted to CTDOT for approval within 30 days of test completion. **CDRL 29-4**

Inspection reports, test certifications, and test reports shall be signed and certified by the Contractor's authorized Quality Assurance/Quality Control representative. The QA/QC representative shall submit all relevant inspection reports, identifying participating personnel, equipment, material tests, results, and defects. Such reports shall be signed and certified by the Contractor's authorized QA/QC representative.

### **29.1.5 Test Waivers**

At CTDOT's sole discretion, factory acceptance or other tests may be waived upon written request from the Contractor and sufficient written proof that the equipment has previously passed similar tests. The Contractor shall submit any requests for waivers and accompanying evidence of previous results at least 60 calendar days prior to the scheduled start of the test that is the subject of the waiver request.

### **29.1.6 Additional Testing by CTDOT**

CTDOT may perform additional testing beyond that specified herein of any equipment, material, hardware, and software function down to the LLRU level to determine acceptability. CTDOT will





perform this additional acceptance testing in accordance with the Contract Documents and reserves the right to perform additional testing at any time to determine conformance with the Contract Document requirements.

Additional testing by CTDOT shall not be considered as a replacement for any testing conducted by the Contractor or a manufacturer producing materials for the Contract.

#### **29.1.7 Additional Testing by the Contractor**

CTDOT may require that the Contractor perform additional testing, beyond that specified herein, of any equipment, material, hardware, and software down to the LLRU level to determine acceptability and proof of design. CTDOT shall pay for such testing, unless the testing shows that the equipment or material did not comply with the Contract Documents, in which case the Contractor shall receive no additional compensation for performing the tests.

## **29.2 First Article Configuration Inspection**

First Article Configuration Inspections (FACIs) shall be performed **by the Contractor** on the first production unit of each device. Such FACIs shall be incorporated into the Master Program Schedule.

At the Contractor's risk, additional production units may be produced as part of the FACI test to expedite subsequent testing. However, should any problems arise during FACI or factory acceptance tests, the Contractor is responsible for making corrections to all FACI units.

The FACI shall be used to establish the baseline of the quality of workmanship that shall be maintained in the balance of the production. CTDOT and the Contractor shall establish this quality baseline jointly.

No equipment shall be shipped from the point of manufacture until the FACI has been successfully completed. The Contractor shall provide a minimum of 21 days notification to the Contracting Officer before the commencement of any FACI. **CDRL 29-5**

Although the FACI shall be a static (non-functional) inspection of the equipment, the Contractor is encouraged to provide working demonstrations of the equipment to facilitate future factory acceptance testing and to foster better understanding of the equipment.

The following requirements shall apply to the FACI:

- A. A complete set of approved drawings for the item to be inspected shall be available.
- B. Inspection forms that controlled the in-process work and documented the inspections performed on the item to be inspected shall be available.
- C. Tools and labor required for mechanical or electrical measurements to confirm Contract and drawing/documentation compliance shall be provided.
- D. Tools and labor to do limited disassembly and removal of covers, as required for proper inspection, shall be provided.
- E. The configuration of the equipment shall be verified that it complies with the approved drawing and design configuration. Drawings, documents, and data necessary to establish that the production equipment complies with the design shall be submitted to CTDOT.

The FACI shall be conducted at the earliest possible time in the manufacturing stage on the first production units that are representative of the approved production configuration. These inspections shall be conducted far enough in advance of subsequent production units to permit



resolution of any problems identified during inspection and allow incorporation of any changes necessary prior to the beginning of production.

Upon review and approval of the drawings, documentation, and data, and completion of the First Article Configuration Inspection, the design shall not be changed, nor any drawings or documentation changed, without CTDOT approval.

## 29.3 Factory Acceptance Testing

The Contractor shall perform Factory Acceptance Tests to demonstrate that the NFTS equipment and software meet the requirements of the Contract Documents. Such demonstration of compliance shall be performed through testing, analysis, or certification that equipment is proven operational, reliable, and maintainable in similar transit applications under the same conditions, and for the same specification requirements. Factory Acceptance Tests shall be performed on the first articles of equipment that have successfully passed FACI, and prior to delivery of the equipment to CTDOT. The Contractor shall perform these tests far enough in advance of subsequent production units to permit resolution of any problems identified during testing and allow incorporation of any changes necessary prior to the beginning of production.

All transactions conducted during the device Functional and Cycle tests shall be transmitted to the test CDS installation. These data records shall be used to perform CDS testing as well as to verify the results of the device Functional and Cycle tests.

For each Factory Acceptance Test, records shall be maintained of the versions of all software modules installed on the equipment. These records shall include the date and time the software was created, size of each file, and version number. All software changes since the previous Factory Acceptance Test shall be fully described in documentation provided by the Contractor at the outset of each test.

If any equipment fails to meet reliability, accuracy, speed, environmental, or other required performance criteria, the Contractor shall modify the equipment and retest at no cost to CTDOT until all test criteria have been satisfied.

To the extent practical, all Factory Acceptance Tests shall utilize the fare tables and other configuration parameters to be in place at the time of revenue service.

### 29.3.1 Functional Testing

For the functional portion of the FAT, the fare collection equipment and software shall be connected together with additional equipment or simulators as necessary to create a functional model of the NFTS. This test setup shall include a garage LAN with at least two of each equipment type, a test CDS and all other devices which are to interface with the CDS.

The Contractor shall conduct a test to verify that each type of NFTS equipment and the Mobile Ticketing software can perform all functions, sense and report all conditions and demonstrate correct operation as defined within this Scope of Work including all of the functions specified throughout this document, and all limiting conditions. Successful completion of the Functional Test requires no discrepancies in function to those as agreed at the Final Design Review and further included in the design based on executed Change Orders.

After successful completion of the functional portion of the FAT, the Cycle Test can commence.



**29.3.2 Cycle Testing**

Cycling testing shall be performed for each type of equipment provided and installed as a part of the NFTS. To perform the Cycle Test, a single unit of equipment shall be used. The type and number of the various transactions to be performed for each equipment type are identified in the sections below.

**29.3.2.1 Validating Farebox Cycle Test**

The Validating Farebox Cycle Test shall consist of no less than 2,500 completed transactions using a total of not less than 200 different smart cards with various fares stored. Fare media used during this Cycle Test shall be issued and replenished using both the Retail and Administrative POS Terminals.) The test shall consist of 10 sets of 250 transactions with each set of tests comprised of the following:

- 50 Full Fare 31-day floating period pass transactions (25 with autoloading 31-day passes)
- 65 Full Fare stored value transactions (25 with autoloading stored value, and no less than 5 transactions shall result in “capped” fare “purchase” of a Day Pass)
- 50 Full Fare day pass transactions (25 with autoloading day passes)
- 50 mixed reduced fare transactions for the various service modes (25 with autoloading)
- 10 Employee transactions for the various service modes
- 25 upgrades from Zone 1 Passes on a Zone 2 bus (25 with autoloading stored value)

Successful completion of the Validating Farebox Cycle Test requires no more than one relevant failure, and no more than two cards not processed on the first tap.

**29.3.2.2 Administrative POS Terminal Cycle Test**

The Administrative POS Terminal Cycle Test shall consist of four separate cycle test regimens as described below.

**A. Administrative POS Terminal Card Issue Cycle Test**

For the Card Issue Cycle Test, the Administrative POS Terminal shall issue no less than the cards listed in the Table below. All CTDOT Employee cards shall include the necessary encoding to make them immediately valid for use. Half of the other cards shall be issued with varying products and stored value; all others shall have no initial value.

Table 29.3.2.2A: Administrative POS Terminal Cards Issued

Card Type	Media Type	Action	Quantity
Full Fare	Pre-Printed Long-Term	Issue Only	250
Reduced Fare	Adhesive Label	Issue Only	100
Reduced Fare	Blank Long-Term	Personalize & Issue	100
CTDOT Employee	Blank Multi-Function		50
<b>Total</b>			<b>500</b>

Successful conclusion of the Card Issue Cycle Test requires all cards to be properly encoded and printed with no equipment or software failures, and 100% accuracy of data sent to the CDS.

**B. Administrative POS Terminal Replenishment & Usage Cycle Test**

All payment methods shall be simulated; where transactions include payment, methods shall be distributed as follows:



Table 29.3.2.2B: Administrative POS Terminal Payment Method Distribution

Payment Method	Percent of Payment Transactions
Cash Only	25%
Credit Only	20%
Debit Only	20%
PayPal®	10%
Check Only	5%
Media Exchange Only	5%
Cash + Credit	5%
Cash + Debit	5%
Two or More Credit	5%
<b>Total</b>	<b>100%</b>

Where the transaction involves cash, the cash drawer shall be activated (opened and closed) as appropriate. Where the transaction involves credit or debit, the credit/debit payment terminal shall be used, including entry of a signature for credit, and PIN for debit. All transactions shall produce a receipt. The test shall consist of 4 sets of 250 transactions with each set of tests comprised of issuing the following:

- 50 Full Fare transactions adding stored value (of varying amounts) to a card with no valid (active or pending) unlimited ride pass
- 50 Full Fare transactions adding stored value (of varying amounts) to a card with a valid (active or pending) unlimited ride pass
- 25 Full Fare pending unlimited ride passes added to cards with no other pass product (active or pending)
- 25 Full Fare pending unlimited ride passes added to cards with an active unlimited ride pass
- 25 Full Fare pending unlimited ride passes added to cards with another pending unlimited ride pass
- 25 Reduced Fare transactions for the various service modes adding stored value (of varying amounts)
- 25 Reduced Fare transactions for the various service modes adding unlimited ride passes
- 10 smart cards replaced as lost/stolen
- 5 smart cards replaced as damaged
- 5 smart cards reactivated from dormant – with no stored value
- 5 smart cards reactivated from dormant – with stored value



Successful completion of the Replenishment and Usage Cycle Test requires no more than one functional failure, 100% accuracy of issued receipts, 100% accuracy of data sent to the CDS, and no more than two cards not processed on the first tap.

C. Administrative POS Terminal Multi-Card Cycle Test

The test shall consist of no less than 5 transactions where each transaction results in the issuance of multiple, identically-encoded fare media, as shown in the Table below:

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Table 29.3.2.2C: Administrative POS Terminal Multi-Card Transactions

#	Fare Product	Media Type	Quantity
1	Full Fare \$10 Stored Value	Pre-Printed Long-Term	50
2	Full Fare Day Pass	Limited Use Media	100
3	Full Fare 1-Ride Ticket	Limited Use Media	150
4	Full Fare Day Pass	Limited Use Media	150
5	Reduced Fare \$5 Stored Value	Adhesive Label	50
	<b>Total</b>		500

Successful conclusion of the Multi-Card Issue Cycle Test requires all cards to be properly encoded with no equipment or software failures, and 100% accuracy of data sent to the CDS.

D. Barcode Ticket Printing Cycle Test

The Contractor shall supply no less than 500 sheets of the commercially-available, pre-perforated paper stock for which the barcode ticketing application is designed. Using this paper stock, the Contractor shall conduct a Barcode Ticket Printing Cycle Test wherein no less than 200 tickets each of at least 4 different ticket types are produced. Randomly selected samples of at least 20 tickets of each ticket type shall be verified using the Barcode Decoding Workstation described in Section 24.4. In addition, each randomly selected ticket shall be verified for proper functionality (including passback prevention) using no fewer than 3 Validating Fareboxes.

Successful conclusion of the Barcode Ticket Printing Cycle Test requires all tickets to be properly printed and verified, and 100% accuracy of data sent to the CDS.

29.3.2.3 ***Multi-Function Vending Machine Cycle Test***

The Multi-Function Vending Machine Cycle Test shall consist of no less than 2,500 completed transactions using a total of not less than 200 different smart cards with various fares stored. The test shall consist of 10 sets of 250 transactions with each set of tests comprised of issuing the following:

- 75 Full Fare transactions adding stored value (of varying amounts) to a card with no valid (active or pending) unlimited ride pass
- 50 Full Fare transactions adding stored value (of varying amounts) to a card with a valid (active or pending) unlimited ride pass
- 25 Full Fare pending unlimited ride passes added to cards with no other pass product (active or pending)
- 25 Full Fare pending unlimited ride passes added to cards with an active unlimited ride pass



- 25 Full Fare pending unlimited ride passes added to cards with another pending unlimited ride pass
- 25 Reduced Fare transactions for the various service modes adding stored value (of varying amounts)
- 25 Reduced Fare transactions for the various service modes adding unlimited ride passes

Payment for the transactions shall be split as follows:

- Cash - 50%
- Credit Card - 25%
- Debit/ATM card - 25%

Successful completion of the Multi-Function Vending Machine Cycle Test requires no more than one relevant failure, and no more than two cards not processed on the first tap.

#### 29.3.2.4 **Stand Alone Processor Cycle Test**

The Stand Alone Processor Cycle Test shall consist of no less than 2,500 completed transactions using a total of not less than 200 different smart cards with various fares stored. Fare media used during this Cycle Test shall be issued and replenished using both the MVMS and Administrative POS Terminals. The test shall consist of 10 sets of 250 transactions with each set of tests comprised of the following:

- 50 Full Fare 31-day floating period pass transactions (25 with autoloader 31-day passes)
- 65 Full Fare stored value transactions (25 with autoloader stored value, and no less than 5 transactions shall result in "capped" fare "purchase" of a Day Pass)
- 50 Full Fare day pass transactions (25 with autoloader day passes)
- 50 mixed reduced fare transactions for the various service modes (25 with autoloader)
- 10 Employee transactions for the various service modes
- 25 upgrades from Zone 1 Passes on a Zone 2 bus (25 with autoloader stored value)

Successful completion of the Stand Alone Processor Cycle Test requires no more than one relevant failure, and no more than two cards not processed on the first tap.

#### 29.3.2.5 **Platform Validator Cycle Test**

The Platform Validator Cycle Test shall consist of no less than 2,500 completed transactions using a total of not less than 200 different smart cards with various fares stored. Fare media used during this Cycle Test shall be issued and replenished using both the Retail and Administrative POS Terminals.) The test shall consist of 10 sets of 250 transactions with each set of tests comprised of the following:

- 50 Full Fare 31-day floating period pass transactions (25 with autoloader 31-day passes)
- 65 Full Fare stored value transactions (25 with autoloader stored value, and no less than 5 transactions shall result in "capped" fare "purchase" of a Day Pass)
- 50 Full Fare day pass transactions (25 with autoloader day passes)
- 50 mixed reduced fare transactions for the various service modes (25 with autoloader)



- 10 Employee transactions for the various service modes
- 25 upgrades from Zone 1 Passes on a Zone 2 bus (25 with autoloader stored value)

Successful completion of the Platform Validator Cycle Test requires no more than one relevant failure, and no more than two cards not processed on the first tap.

**29.3.2.6 Vehicle Installed Environmental Tests**

The Contractor shall conduct Environmental Tests upon completion of the FACI, prior to, during or subsequent to the completion of the functional portion of the FAT, at the discretion of the Contractor. The Environmental Tests shall subject the equipment to the environmental extremes specified herein, and a scaled down version of the cycling test, to demonstrate the capability of the device to operate successfully within these extreme conditions. Equipment hardware and software used for the Environmental Test shall be identical to that used for the Functional Test.

The Environmental Test shall consist of no less than 5 sets of transactions; each set shall consist of representative samples of all transaction types using all types of fare media, and shall be conducted under the environmental conditions stipulated Table 29.3.2.6. Before conducting a set of test transactions, the equipment shall sit idle (operating) for a period of three hours at each given environmental condition setting. Thereafter, the number of transactions to be processed shall be as indicated in Table 29.3.2.6 and the equipment cycled as per procedures established for Cycling Tests.

Table 29.3.2.6: Environmental Test Conditions

Run No.	Ambient Temperature	Relative Humidity	Solar Loading	Input Voltage	# Transactions
1	Minimum Operating Temperature per Table 2.7.1A	Minimum per Table 2.7.1A		24 VDC	50
2	Maximum Operating Temperature per Table 2.7.1A	50%	Maximum per Table 2.7.1A	24 VDC	50
3	80° F	95%		Maximum Operating Voltage per Section 2.16.1	50
4	80° F	Maximum per Table 2.7.1A		Minimum Operating Voltage per Section 2.16.1	50
5	32° F	80%		24 VDC	50

During the solar loading test in Table 29.3.2.6, the maximum solar flux loading shall be applied to the front face of the equipment displays.

Successful completion of the Environmental Test requires no relevant failure.

**29.3.2.6.1 Vehicle-Installed Equipment Shock and Vibration Test**

The Contractor shall conduct a Shock and Vibration Test using a complete Validating Farebox and SAP, installed on a simulated bus floor, fully wired consistent with the approved design. The Shock and Vibration Test shall subject the Validating Farebox and SAP to a series of shocks, vibrations, impulses, forces, and other conditions necessary to demonstrate the



device's compliance with the requirements defined. During the test, the Validating Farebox shall be powered and fully functional.

Successful completion of the Shock and Vibration Test requires the Validating Farebox and SAP to experience no mechanical or hardware failures, and to subsequently conduct 100 cash transactions, 25 smart card and 25 barcode transactions, and dispense and subsequently process 25 transfers, all with no relevant failures.

**29.3.2.6.2 Vehicle-Installed Equipment Electro-Magnetic Susceptibility Tests**

The Contractor shall conduct a series of Electro-Magnetic Susceptibility Tests to confirm the Validating Farebox/SAP satisfies the requirements defined.

Successful completion of the Electro-Magnetic Susceptibility Tests requires the Validating Farebox/SAP to experience no electronic or hardware failures, and to subsequently conduct 100 cash transactions, 25 smart card and 25 barcode transactions, and dispense and subsequently process 25 transfers, all with no relevant failures.

**29.3.2.7 Station/Garage Installed Equipment Environmental Test**

Subsequent to the successful completion of the Functional Test, the Station/Garage Installed Equipment shall be subjected to the environmental extremes specified in Table 29.3.2.7 and a portion of the cycling test run to demonstrate the capability of the equipment to operate successfully under these conditions. Note that if hardware modifications are required to resolve any issues identified with the Station/Garage Installed Equipment during Factory Qualification Tests conducted during or after the Environmental Test, CTDOT may, at its sole discretion, require the Contractor to repeat the Environmental Test with the modified hardware.

The equipment shall be subjected to the following environmental test. Before conducting test transactions, the equipment shall sit idle (operating) for a period of three hours at each given environmental condition setting. Thereafter, the number of transactions to be processed shall be as indicated in Table 29.3.2.7 and the equipment cycled as per procedures established for Cycling Tests.

Table 29.3.2.7: Environmental Test Conditions

Run No.	Exterior Temperature	Exterior RH (%)	Solar Loading	Input Voltage	# Transactions
1	Minimum per Table 2.7	Minimum per Table 2.7		125	100
2	Maximum per Table 2.7	50	Maximum per Table 2.7	125	100
3	80° F	95		Maximum per Section 2.16	100
4	80° F	Maximum per Table 2.7		Minimum per Section 2.16	100
5	32° F	80		125	100
RH = Relative Humidity (non-condensing)					

During the solar loading test in Table 29.3.2.7, the maximum solar flux loading shall be applied to the front face of the MVM.

Successful completion of the Environmental Test requires no relevant failure.





#### **29.3.2.7.1 Station/Garage Installed Equipment Shock and Vibration Test**

The Contractor shall conduct a Shock and Vibration Test using complete Station/Garage Installed Equipment, fully wired consistent with the approved design. The Shock and Vibration Test shall subject the equipment to a series of shocks, vibrations, impulses, forces, and other conditions necessary to demonstrate the device's compliance with the requirements. During the test, the equipment shall be powered and fully functional.

Successful completion of the Shock and Vibration Test requires the equipment to experience no mechanical or hardware failures, and to subsequently conduct 100 cash transactions, 25 smart card and 25 barcode transactions, and dispense and subsequently process 25 transfers, all with no relevant failure.

#### **29.3.2.7.2 Station/Garage Installed Equipment Electro-Magnetic Susceptibility Tests**

The Contractor shall conduct a series of Electro-Magnetic Susceptibility Tests to confirm the Station/Garage Installed Equipment satisfies the requirements defined.

Successful completion of the Electro-Magnetic Susceptibility Tests requires the equipment to experience no electronic or hardware failures, and to subsequently conduct 100 cash transactions, 25 smart card and 25 barcode transactions, and dispense and subsequently process 25 transfers, all with no relevant failures.

#### **29.3.2.7.3 Water Ingress Test**

In addition, a water ingress test shall be conducted, simulating rain and wind conditions of 25% of the worst-case conditions. Simulated wind-driven rain shall be applied to all four sides and the top of the Station/Garage Installed Equipment for 15 minutes per surface. After each 15-minute period, the MVM interior shall be inspected for water ingress. Any water inside the equipment shall be minimal and shall not result in hazardous conditions or potential component failure.

#### **29.3.2.7.4 Touch Screen Environmental Test**

If the MVM employs a touch screen user interface, the Contractor shall conduct additional tests during the Environmental Test and the Water Ingress Test. The Touch Screen Environmental tests shall confirm that the touch screen interface remains fully functional, with no degradation in sensitivity and usability, during all temperature extremes, while (simulated) precipitation is occurring, and while the outer surface of the screen is wet.



### **29.3.3 Handheld Fare Inspection Terminals**

#### **29.3.3.1 Handheld Fare Inspection Terminal Cycle Test**

The Handheld Fare Inspection Terminal cycling test shall consist of no less than 500 completed transactions using a total of not less than 100 different smart cards. The test shall consist of 2 sets of 250 transactions with each set of tests comprised of the following:

- 50 Full Fare 31-day floating period pass transactions (25 with autoload 31-day passes)
- 30 Full Fare stored value transactions used within the transfer period (25 with autoload stored value, and no less than 5 transactions shall result in “capped” fare “purchase” of a Day Pass)
- 50 Full Fare day pass transactions (25 with autoload day passes)
- 50 mixed reduced fare transactions for the various service modes (25 with autoload)
- 10 Employee transactions for the various service modes
- 25 upgrades from Zone 1 Passes on a Zone 2 bus (25 with autoload stored value)
- 35 sales of one way fares

Successful completion of the Cycle Test requires no more than one functional failure and no more than 2 cards not processed on the first tap, and 100% accuracy of data sent to the CDS.

### **29.3.4 Garage and Central Data Systems**

In addition to the functional testing to be performed, the tests described below shall be performed for the GCS and the CDS.

#### **29.3.4.1 Data Import and Export Test**

The CDS Data Import and Export Test shall demonstrate, exercise, and verify all functions of and integration with the CDS and all user-accessible screens and commands. These tests shall include verification of the following functions, as a minimum:

- Manual data loading from all devices (using backup memory modules) and verify updated reports
- Manual upload of configuration and fare structures to each of the various device types (using backup memory modules)
- Export of various data sets to standard export formats (excluding Legacy Systems Interfaces)
- Import of various data sets (excluding Legacy Systems Interfaces), such as bulk data uploads using File Transfer Protocols

Successful conclusion of the Test requires 100% accuracy of all data exchanges.

#### **29.3.4.2 Legacy Systems Interface Test**

During the Legacy System Interface Test, the Contractor shall demonstrate all CDS interfaces with other CTDOT systems (excluding the Bankcard Clearinghouse) Prior to conducting this test, the Contractor and CTDOT shall agree on a secure method of interfacing the CDS with CTDOT's systems.



Data representing known transactions, events, and other information as required, shall be transmitted from the CDS to the external systems. CTDOT shall confirm proper receipt of the data.

CTDOT shall then initiate transfer from the external systems to the CDS of data representing that which the CDS is to receive. The Contractor shall confirm that the CDS properly received and responded to the imported data.

Successful conclusion of the Test requires 100% accuracy of all data exchanges.

#### **29.3.4.3 Report Generation Test**

Data from the Cycling Tests shall be used to populate the CDS database in preparation for the Report Generation Test. In addition, transaction records created or modified to simulate CTDOT's installation containing all data, event, transaction, and record types, shall be used to augment the records from the Cycling Tests. In total, the simulated data shall contain at least 5,000 transaction records and no less than 500 events, randomly distributed over all device types, and representing a period of 2 years.

The CDS shall generate samples of all reports available. Format, layout, page and column headers, etc. shall be reviewed to confirm compliance with the designs approved at the Final Design Review. Contents of the reports shall be compared with the known contents of the data.

Successful completion of the Report Generation Test requires no discrepancies between report contents and known data, and only minor discrepancies in report formats and the approved designs.

#### **29.3.5 Web Portals**

The Web Portal Functional Tests shall demonstrate, exercise, and verify all Web Portal functions of and integration with the CDS, all user-accessible web pages and commands, and all CTDOT administrative functions required to manage the Web Portals.

Successful completion of the Web Portal Functional Test requires no discrepancies in function to those as agreed at the Final Design Review and further included in the design based on Change orders executed.

#### **29.3.6 FAT Software Release for Revenue Service**

With successful completion of the FAT, all software and configuration files shall be "frozen" and the Contractor shall make no changes without authorization of the Contracting Officer. The Contractor shall record version information for all software modules and configuration files installed on the equipment. These records shall include the date and time the software or file was created, size of each file, and version number. Unless CTDOT authorizes changes, software released for revenue service shall match that which was used to pass the FAT. The Contractor shall provide the "as-tested" software documentation to the Contracting Officer at the conclusion of the FAT.

### **29.4 Post-Production Testing**

Each production unit of equipment shall be subjected to a functional test after assembly, performed at ambient temperature conditions. The test shall utilize all modes of operation in the same manner as the cycling tests.



The Post-Production test shall also include a 72-hour idle burn-in, where the completed equipment is left powered on in an idle state for at least 72 hours. Subsequent to this burn-in period, a small quantity of transactions shall be conducted to confirm that all modules remain fully operational.

## 29.5 Pre-Shipment Inspection

CTDOT retains the right to conduct pre-shipment inspections of fare collection equipment.

All deficient items indicated in QA reports shall be corrected before pre-shipment inspection takes place. The Contractor shall provide a qualified supervisor to accompany CTDOT or its representative during pre-shipment inspection.

The Contractor shall notify CTDOT at least 10 days in advance of all scheduled shipments.

### **CDRL 29-6**

Within 5 days of this notification, CTDOT shall inform the Contractor whether inspections will occur. CTDOT shall issue written authorization to the Contractor for shipment upon successful completion of inspection, or upon deferral of inspections. **CTDOT 29-1**

The Contractor shall not ship nor permit its subcontractors to ship any NFTS equipment or subsystems without first obtaining specific written authorization from CTDOT.



## 30 Deployment and Installation Services

### 30.1 Deployment Deliverable Items

Deployment of the NFTS shall occur in a carefully planned manner. The deployment shall include:

- The Central Data System (CDS)
- Validating Fareboxes on all CTDOT buses
- Stand Alone Processors
- Multi-Function Vending Machines at specified locations
- Platform Validators on all CT *fastrak* platforms
- Handheld Fare Inspection Terminals (HFITs) for fare inspection on CT *fastrak* vehicles
- Administrative Point of Sale (POS) Terminals at CTDOT sales facilities
- Retail Sales services
- Garage Communications Servers (GCS) at all CTDOT garages
- Web Portals
- Support Equipment
- Contracted Support Services
- Smart Card Media
- Bar Coded Media
- Spare parts
- Training
- Documentation

### 30.2 Deployment Plan

The Contractor shall provide a detailed NFTS Deployment Plan that at minimum shall cover:

- All aspects of NFTS device installation, including but not limited to site preparation, prototype installations, antenna testing, pre-wiring, vehicle staging and movements, scheduling, and quality control
- Installation and configuration of the CDS
- Installation and configuration of the GCS
- Installation, configuration, and wireless network coverage testing of the facilities Wi-Fi networks
- Installation and activation of the Web Portals
- Fare media order scheduling requirements, reflecting necessary lead times and approval intervals
- Fare media distribution planning prior to and immediately after commencing revenue service
- All Post-Installation testing discussed in Section 31, including Systems Integration Testing, Pilot Testing, Revenue Service Testing, and the Disaster Recovery Exercise

The Contractor shall submit the NFTS Deployment Plan for CTDOT review at the Preliminary Design Review, and for CTDOT approval at the Final Design Review. **CDRL 30-1**



### 30.3 General Installation Requirements

All equipment installation work shall be performed in accordance with industry standards and in compliance with all local, state, and federal regulations.

While it is not NFTS's intention to restrict or limit the Contractor's innovation in the installation of the equipment, NFTS reserves the right to reject any equipment installation that does not meet industry and/or NFTS standards for quality, form, fit, or finish, appearance, or durability.

The installation shall be a complete, turnkey operation. The System shall be in full operation and compliance with the requirements of the specification upon completion of the installation.

NFTS will provide work space as well as basic air and electrical services for the installation. To avoid disruption to NFTS operation, the Contractor shall coordinate the installation schedule with NFTS. NFTS may require the Contractor to perform the installation at night or on the weekends when the buses are available.

#### 30.3.1 Installation Quality Control and Assurance

Contractor shall implement a quality assurance program to insure the quality of the equipment installation. Contractor shall provide a check off sheet for each vehicle installation. For each installation, the installers shall fill out the check off sheet and certify that all required installation steps, operational checks and quality control reviews have been performed. The check off sheets shall be submitted to CTDOT at least weekly and will be a required item for system final acceptance.

#### 30.3.2 New Equipment Installation

The Contractor shall supply all labor, supervision, and materials required for installation of all new equipment. Installation of the new equipment shall include fastening and anchoring the equipment and making connections to electrical power and communications. The Contractor shall also be responsible for all connected and integral equipment and software for required interfaces with other systems, including CTDOT's existing data networks. Procedures and drawings depicting the typical installation of each NFTS device type shall be provided for review and approval by CTDOT at the Final Design Review. **CDRL 30-2**

#### 30.3.3 Site Access and On-Site Work

On-site work for the installation and acceptance testing of NFTS equipment will be located in and around CTDOT facilities. The Contractor shall plan and execute safe access to the work site for on-site work. Such safe access shall be afforded to construction equipment, vehicles, and personnel in accordance with CTDOT policies and OSHA regulations.

Installation and testing of equipment on CTDOT Operators' vehicles shall be the responsibility of the Contractor and shall be conducted at CTDOT and other Operator's facilities throughout Connecticut.

The Contractor responsible for this contract shall take into consideration the following guidelines for on-site work:

- Avoid disruption of CTDOT and Operator's service and operations.
- Avoid restricting public rights-of-way.
- Access to busses and garage facilities shall be coordinated with each garage. Refer to access restrictions and constraints within this agreement.



- Extremely noisy or otherwise burdensome activities that may disrupt operations shall be scheduled for after business hours.
- Contractor shall be responsible for security to prevent theft of or damage to garage property.

The Contractor shall be responsible for protecting all utilities, CTDOT and Operator's equipment and property, streets, and private property, and shall repair any damage to same at Contractor's expense.

Access dates will be subject to revision as delivery, testing and installation of the NFTS equipment progresses. Therefore, the Contractor shall incorporate flexibility into its installation schedule.

#### **30.3.4 Installation Requirements**

The Contractor shall adhere to the following installation requirements:

- A. The System shall be installed to allow compliance with all governmental regulations including ADA.
- B. All equipment shall be installed in such a way to allow easy maintenance access and removal.
- C. Contractor shall clean up and properly dispose of all debris resulting from the installation each day.
- D. All wiring shall be secured but with sufficient slack to allow movement without strain on wire terminals, connectors, or other wire termination hardware, and must be protected against chafing, and any contact with conductive, sharp or abrasive objects. Wiring shall be located such that normal equipment motions, maintenance access, heat sources, radiation, and the environment do not damage or reduce the life of the wiring.
- E. Wire dress shall allow for sufficient slack at terminals to provide for shock and vibration induced movements, equipment lifting, alignment, cover removal and component replacement.
- F. Wiring shall be uniformly color coded or permanently marked.
- G. All ground connections shall utilize bolted terminals. All ground pads shall be through-drilled and the ground wire fastened with a bolt, flat washer and lock nut.
- H. All cables, wiring, inter-connectors, switches, circuit breakers/fuses shall be heavy duty and specifically designed for their purposes and for automotive applications.
- I. There shall be no splices between terminals.
- J. All wire sizes and insulations shall be based on the current carrying capability, voltage drop, mechanical strength, temperature, and flexibility requirements. All communication and signal wires shall be selected to minimize signal loss.
- K. All general wire insulation shall be made of a flexible material.
- L. Wiring shall be prefabricated into standardized harnesses, wrapped and tied with nylon wire ties.
- M. Wherever there is a possibility of interference, wiring shall be properly shielded with shielding sleeves, ferrite beads, etc.



- N. All terminals and connectors shall be properly crimped using crimping tools specifically designed for the purpose, and soldered or brazed and properly insulated with heat shrink tube. No butt connectors or wire nuts are allowed.
- O. All circuits shall be protected by fuses or circuit breakers. The main power circuit from the vehicle to the system shall be protected by a circuit breaker similar to what already exists in the vehicle. All circuit breakers and fuses shall be permanently labeled to show their functions.

## 30.4 Bus System Equipment Installation

The Contractor shall provide all labor, supervision as well as materials necessary for the proper installation of the Non-Validating Fareboxes, SAPs and Validating Fareboxes, vehicle-mounted antennas, and integration with other equipment as necessary in CTDOT vehicles.

Contractor shall supply and install all the necessary wiring, protective devices, and mounting hardware necessary for the proper installation and operation of the equipment. All new undercarriage wiring shall be suitably protected against the road elements and fastened in a manner so as not to interfere with normal vehicle operation and/or maintenance. No "butt connectors" shall be utilized under the vehicle.

Installation design for all vehicle equipment and cabling shall be submitted for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 30-3**

### 30.4.1 Prototype Installations

The Contractor shall perform a prototype installation for each sub-fleet and variety of vehicles. The prototype installations shall be subjected to at least one week of service to ensure the robustness and integrity of the installation design. All installation designs shall be approved by CTDOT before the Contractor proceeds with the installation of remaining buses.

Subsequent to completing installation of each prototype, the Contractor shall conduct an antenna interference test to confirm that all existing antennas on the vehicles remain fully functional (*i.e.*, that the Contractor-installed antennas do not interfere with the operation of the existing antennas), and that the Contractor-installed antennas function as intended (*i.e.*, that the new antennas do not interfere with each other).

The Contractor shall document the approved installations by creating photos or CAD drawings of the equipment locations and electrical wiring routing, and electrical schematic of wiring installation. The document shall be submitted to CTDOT prior to production installation.

### 30.4.2 Installation Procedures

Proper communication with CTDOT Vehicle Maintenance personnel during the installation process is of utmost importance. Installers shall check in with CTDOT Maintenance Supervisors at the start of the work day and check out to report the work progress at the end of the work day. Contractor personnel shall comply with all CTDOT policies and procedures while on CTDOT property.





### 30.4.3 Installation Requirements

The Contractor shall adhere to the following installation requirements:

- A. The installation shall not obstruct the operator's view out the windshield or side windows nor decrease the operator's ability to safely operate the vehicle.
- B. The installation shall not impede or restrict the flow of passengers. The equipment shall not result in a decrease in seating capacity of the vehicle. Equipment, electrical connections, and wiring shall be protected and concealed from view as much as possible and shall be designed so that there is no hazard to the passenger in the event of accidental contact. Potential damage to passengers' clothing shall be minimized.
- C. All installations shall be consistent and uniform with the approved prototype installations in quality, equipment location, and wire routing.
- D. The equipment shall be firmly secured to the bus to prohibit tampering and to avoid damage by accidental abuse of the equipment. Tamper-proof hardware to secure the equipment shall be required.
- E. All equipment mounted in a vehicle shall be installed in such a manner that the equipment cannot be moved, blocked or otherwise disabled by passengers, accidentally or intentionally. The equipment shall be designed to blend in with the surrounding environment and shall not have sharp edges that could harm the riding public or their possessions, either directly or indirectly.
- F. The Contractor shall exercise extreme care when drilling into the vehicle body panels and structure to prevent damage to components hidden behind the drilling surface. Drill stops shall be used to prevent unnecessary penetration of drill bits. Drill shaving shall be contained to prevent contamination or shorting out of other bus equipment. Drilling into the bus structure shall require prior approval by CTDOT.
- G. Any damages to the vehicle or its equipment due to the mistake or negligence of the Contractor during installation shall be corrected at the Contractor's expense.
- H. At the same time, the equipment shall be rigidly mounted to prevent movement and rattle during bus operation.
- I. All cables and wiring shall be routed inside conduits that are located in electrical panels or behind body panels. These conduits may be rigid or flexible, and shall be non-conductive. Any exposed cables and wiring must be approved by CTDOT.
- J. Components installed on the roof of the vehicles shall provide a good seal to prevent entrance of water and dirt into the vehicle and shall be mounted in such a way to minimize damages caused by tree branches, overhead doors, etc. Such components shall be installed with a gasket and a bead of sealant material around their perimeter. The Contractor shall insure proper separations with existing antennas and other components on the roof to avoid signal interferences.

### 30.5 Validating Farebox Vaulting System Installation

The Contractor shall provide all labor, supervision as well as materials necessary for the proper installation of the Farebox Vaulting System as necessary in CTDOT garages. Contractor shall supply and install all the necessary wiring, protective devices, and mounting hardware necessary for the proper installation and operation of the equipment. All new wiring shall be



suitably protected against the garage environmental elements and fastened in a manner so as not to interfere with operation and/or maintenance.

Installation design for all equipment and cabling shall be submitted for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 30-4**

### **30.5.1 Installation Procedures**

Proper communication with CTDOT Maintenance and garage supervisory personnel during the installation process is of utmost importance. Installers shall check in with CTDOT Maintenance Supervisors at the start of the work day and check out to report the work progress at the end of the work day. Contractor personnel shall comply with all CTDOT policies and procedures while on CTDOT property.

### **30.5.2 Installation Requirements**

The Contractor shall adhere to the following installation requirements:

- A. Contractor shall be permitted to perform effort at the installation sites prior to the scheduled installation period. This "pre-installation work" shall be defined and identified within the Installation and Interface Plan. This pre-installation work shall in no way preclude CTDOT from the ability to collect revenue from any passenger or obstruct passenger flows at that location.
- B. Communications and power conduit shall be separated sufficiently to minimize interference.
- C. Contractor shall provide all means necessary to move the equipment into position for installation
- D. The Contractor shall be responsible for all construction and installation activities associated with changes to the garage.
- E. Conduit shall be installed as needed to meet the installation requirements of all garage equipment, including wireless access points, from the point of demarcation for the communications and power to the equipment installation locations.
- F. Surface mounting of conduit within the garage shall be permitted except on or near the floor.
- G. Installation of the wireless communications system shall be performed as agreed between CTDOT and the Contractor according to the installation plan
- H. The wireless access points shall be installed in the locations identified on the installation drawings. As a minimum one or more WAPs shall be installed near the revenue servicing lanes and other WAPs within the garage to provide complete coverage within the garages and bus yard to provide coverage while parked within the garage.
- I. Installation of the revenue collection hardware in the revenue service lanes shall be performed such that the new equipment shall replace the existing equipment.



- J. The revenue collection hardware shall be bolted to the concrete by means of four (as a minimum) stainless steel, 0.5-inch diameter anchor bolts, to be provided by the Contractor, which shall be embedded in the concrete platform by the Contractor according to the bolt manufacturer's instructions.
- K. Installation shall not impair the operation of the cashbox receiver, removal/reinsertion of the vault or maintenance of any portion of the revenue collection equipment.
- L. Installation shall provide sufficient clearance to normally operate the equipment without encumbrance, including access to any cover or door.

## 30.6 Platform Equipment Installation

### 30.6.1 Typical Station Description

The CT*fastrak* stations will consist of center and side platforms. The platforms will be constructed of concrete and concrete paving bricks over concrete, and will provide nearly level boarding to the CT*fastrak* vehicles. In all stations, some fare collection equipment shall be installed on the station platforms; in some stations, fare collection equipment may also be installed in designated areas off the platforms, including sidewalks.

Where NFTS platform equipment, including MVMs and PVs, is to be installed, concrete beneath the equipment will be at least 8 inches thick. Station platform transverse slope (perpendicular to the guideway) of up to 2% will be provided for drainage while a longitudinal slope (parallel to the guideway) of up to 3% may also be encountered.

Where equipment is to be installed on-platform, the data and power conduits for the fare collection equipment shall be installed by the Station Finishing Contractor.

In most cases, electrical and communications wiring and cabling shall enter from underneath the equipment. Power and data conduits will be terminated in flush-mounted junction boxes or stubbed flush with the finished surface. The platform equipment shall be installed over the junction boxes or stubbed conduits such that no wiring or cabling is exposed outside the NFTS device cabinet or base.

In some other cases, no conduits may be available beneath platform equipment. In such instances, subsequent to mounting the device to the platform, other CTDOT contractors shall install rigid conduit directly to the base of the device at or near the platform surface. The other CTDOT contractors shall then install power and data wiring in these conduits and into the NFTS device base. When such installations are necessary, the Contractor shall coordinate with other CTDOT contractors in the installation of exterior rigid conduits to the NFTS platform equipment base.

### 30.6.2 Platform Equipment Mounting

Platform equipment mounting shall be in a secure, robust, manner that resists vandalism and burglary, and can withstand the environmental conditions, especially wind loading, as defined in Table 2.7. Equipment cabinet mounting to the station platform shall be by means of at least four stainless steel anchor bolts, no less than 0.5 inches in diameter, to be provided by the Contractor. The Contractor shall submit the method of anchoring the equipment mounting bolts into the concrete for CTDOT review and approval at the Preliminary Design Review. **CDRL 30-5**



The device cabinet shall include a mounting pedestal with suitable means for leveling the machines upon installation to accommodate the platform slope. Access to the anchor bolts shall be through the hinged service front door or other access panels, subject to CTDOT approval, in a manner that shall prevent unauthorized access.

Each NFTS platform device shall be aligned, positioned, and installed in accordance with CTDOT requirements. The CTDOT shall provide such requirements not later than 120 days prior to the first delivered NFTS platform device. **CTDOT 28-1**

It shall be possible to remove and replace platform equipment without damage to the platform, anchor bolts, or the equipment, and without having to reposition the anchor bolts.

The Contractor shall submit the platform device installation designs for CTDOT review and approval at the Preliminary Design Review. **CDRL 30-6**

### **30.6.3 Station Wiring**

Other CTDOT contractors will install all station power and data wiring in conduits terminating directly beneath the platform device locations, or in surface-mounted rigid conduit connected to the MVM base.

The Contractor shall:

- A. Make the proper electrical power connections to each NFTS platform device.
- B. Make the proper communications link connections, including installation of connector terminals as necessary.

Subsequent to completing wiring connections at each NFTS platform device, the Contractor shall conduct continuity and other qualitative tests to verify power and communications.

### **30.6.4 Finishing Requirements**

The interface between the base of the NFTS platform equipment and the station platform shall be sealed with a material approved by the CTDOT at the Preliminary Design Review. The seal shall perform as a durable, attractive, watertight seal and shall be resistant to abrasion, weather, staining, and migration. The seal shall not deteriorate in any manner except as indicated in manufacturer's data. The Contractor shall install the seal in compliance with the manufacturer's requirements and recommendations.

The Contractor shall submit the seal, its color, performance specifications, and physical characteristics for CTDOT review and approval at the Preliminary Design Review. **CDRL 30-7**

### **30.6.5 Installation Procedures**

Not less than 60 days prior to delivery of the first NFTS platform device, the Contractor shall submit for CTDOT's review and approval drawings of the equipment installation, indicating details on all equipment installation, location, orientation, and electrical and communications connections. In addition, the installation and removal procedures shall be sufficiently detailed such that CTDOT could perform NFTS platform equipment installation and removal. **CDRL 30-8**



### 30.7 Point of Sale Terminal Installation

The Contractor shall install all Front Office Administrative Point of Sale Terminals at locations specified by CTDOT. Administrative POS Terminal installations shall maximize operator ergonomics and patron convenience.

When installing Front Office Administrative POS Terminals, the Contractor shall dress cables neatly, and to the extent possible, out of view of the public.

Modules that do not involve operator or patron interface, such as UPS, network hubs, power supplies, etc., shall be installed out of public view but easily accessible for maintenance.

### 30.8 Handheld Fare Inspection Terminals

No installation is required for the Handheld Fare Inspection Terminals.

### 30.9 GCS Installation

The Contractor shall supply, install, and configure:

- All GCS equipment in Contractor-supplied racks
- GCS operating system and application software
- Interface cabling between the GCS and the Cashbox Vaulting Systems
- GCS communications interfaces and cabling

The Contractor shall configure all GCS operating parameters, configure the software as necessary, and test the installed GCS to confirm that it functions as required in this contract. GCS installation shall occur at each of CTDOT's garage facilities.

The Contractor shall also supply, install, and configure the wireless networks, access points, and access point controllers at all CTDOT garage facilities no later than 120 days prior to commencement of on-site NFTS installation. **CTDOT 30-2**

### 30.10 Web Portals

The Contractor or its hosting subcontractor shall install all Web Portals in secure off-site locations suitable for mission-critical web site servers. Section 23.2 and the Web Hosting Services Agreement provide additional Web Portal hosting requirements.

### 30.11 Support Systems

The Contractor shall supply, install and configure all Support Systems (including NFTS devices and a test CDS) and special tools defined in Section 24. , including the Maintenance Test Facility. The Contractor shall furnish and mount all equipment onto which Maintenance Test Facility shall be installed.

Installation of equipment and software for the Maintenance Test Facility shall be provided in an enclosed, protected environment at a location selected by CTDOT. This location shall be an office or garage-type environment but not necessarily environmentally controlled.

Equipment shall be installed free-standing. All equipment shall be connected to the Test CDS to permit software, configuration and other modifications to be verified. Power will be provided by CTDOT sufficient to operate all Maintenance Test Facility components. Means will also be



provided for the interface of the Test CDS to the hosted CDS to permit software transfer to the hosted CDS as necessary to perform required functions.

Installation locations shall be the Maintenance Test Facility, CTDOT's maintenance shops, or CTDOT's training facility, as specified by CTDOT no less than 30 days prior to the commencement of on-site NFTS installation. **CTDOT 30-3**



## 31 Post-Installation Testing

### 31.1 System Integration Testing

Upon completion of all installation activities for which the Contractor is responsible, the Contractor shall conduct an on-site System Integration Test (SIT) wherein all devices, the CDS (production and Disaster Recovery installations), all Web Portals, the mobile ticketing application, Legacy System Interfaces, bankcard processing, and all other aspects of the NFTS are exercised in what shall become the production environment. The SIT shall demonstrate that the system is ready to enter revenue service, and shall be successfully completed no less than 1 week before the scheduled start of Pilot Testing.

### 31.2 Pilot Testing

Upon successful completion of the on-site System Integration Test, CTDOT and the Contractor shall cooperatively conduct an NFTS Pilot Test, conducted for no less than 4 weeks.

At least 90 days prior to the scheduled start of the Pilot Test, the Contractor shall convene a Pilot Test planning session with CTDOT. During this planning session, CTDOT and the Contractor shall jointly develop the structure, timing, and pass/fail criteria of the Pilot Test. Using the results of the Pilot Test planning session, the Contractor shall develop a comprehensive Pilot Test Plan; the Contractor shall submit the Pilot Test Plan for CTDOT review and approval no later than 30 days prior to the scheduled start of the Pilot Test.

#### **CDRL 31-1**

Employing a limited and controlled user population, the Pilot Test shall exercise all NFTS fare products, fare policies, and functions.

During the performance of the Pilot Test, CTDOT and the Contractor shall meet no less than three times per week to discuss testing progress, issues, and results.

The Pilot Test shall continue for its scheduled duration so long as no failures occur in any element of the NFTS classified as Critical or Urgent. Any Critical or Urgent failures shall cause the suspension of the Pilot Test until the issue is resolved, at which point the Pilot Test shall resume for a duration defined by CTDOT, up to and including a complete repeat of the Pilot Test.

Satisfying the pass/fail criteria developed during the Pilot Test planning session shall govern successful conclusion of the Pilot.

### 31.3 Revenue Service Testing

Upon successful completion of the Pilot Test, CTDOT will commence full deployment of the NFTS, but will implement only those features, fare products, and fare policies selected by CTDOT for initial deployment. When initial full deployment is complete, the Contractor shall commence the Revenue Service Test (RST), which shall verify that the NFTS and all equipment satisfy CTDOT requirements for reliability, system accuracy, and availability.

Fare products not included in the initial full deployment will continue in circulation for the duration of the Revenue Service Test (RST), but only in quantities tested during the Pilot Test.



The Contractor shall submit the procedures to be followed for the resolution of test problems, failure recurrence control and general test rules at least 30 days prior to the commencement of NFTS revenue service. **CDRL 31-2** These procedures shall be subject to approval by CTDOT.

If the reliability, system accuracy, and availability requirements specified herein are not attained during the RST, the Contractor shall be liable to redesign, provide retrofit kits and furnish labor to correct or change the equipment at no additional cost to CTDOT. The corrective action and the resolution of the problem(s) shall be subject to CTDOT approval.

CTDOT shall have the option to require all or part of the RST to be repeated to prove out the equipment performance.

### **31.3.1 Failure Review Board**

During the first 4 weeks of revenue service, all normal operations for revenue service shall be carried out with reliability, system accuracy, and availability data being recorded and documented. During this period a Failure Review Board (FRB) shall be established. The FRB shall consist of two representatives chosen by CTDOT and one representative from the Contractor. In concert with terms and definitions included in this contract, the FRB shall ascertain what constitutes a failure and what satisfactory corrective actions can be made to prevent recurrence. Failures shall be established in conformance with guidelines.

The FRB shall review all data from this settling period and set ground rules for the Revenue Service Test (RST). The RST shall then begin and shall be conducted over the next 8 weeks.

The FRB shall convene weekly during the RST to review incident reports, classify failures, assess system accuracy, and calculate availability. (The Contractor's representative may attend the meetings via telephone.) CTDOT shall document results of each meeting.

#### **CTDOT 31-1**

At the end of the 8-week RST period, the FRB shall make a decision to accept the test results or to extend the RST as necessary.

If the FRB opts to extend the RST, all reliability, accuracy, and availability calculations shall consider only data from the most recent 8-week period. That is, all calculations shall be on a "floating 8-week" basis. The RST shall continue until the FRB recommends accepting the test results, based on the results of the previous 8-week period.

Once the RST is successfully completed, the FRB shall continue to meet on a monthly or quarterly basis for the remainder of the Hardware and Software Warranty periods. During this time, the FRB shall be responsible for monitoring adherence to system reliability, accuracy, and availability requirements.

### **31.3.2 Failure Severity Definitions**

The FRB shall be the sole arbiter of failures and their severity. For incidents declared failures, the FRB shall assign severities according to the following general guidelines, subject to modification by the FRB.

1. **Level 1 – Critical:** A widespread incident that produces a major business impact, including significant loss of revenue or expense impact; extremely negative customer / passenger impact; multiple end users are unable to run a production application; the New Fare Collection system is operating at a seriously degraded level such that normal business operations cannot be conducted.
2. **Level 2 – Urgent:** Incident produces substantial business impact or normal business operations are severely impeded; non-trivial loss of revenue or expense impact; negative





customer / passenger impact; the NFTS is operating at a degraded level such that application or system functionality is severely limited for multiple end users; application or system experiences continual or repeated incidents.

3. **Level 3 – Important:** Incident produces limited business impact and negligible loss of revenue or expense impact; the NFTS is operating at a degraded level such that normal business operations are minimally impeded; little negative customer / passenger impact.
4. **Level 4 – Low:** The NFTS is operating at a degraded level such that normal business operations are barely affected; CTDOT is losing little or no revenue; little or no negative customer / passenger impact.

### **31.3.3 Fleet Defects**

In its review of incidents and classification of failures, the FRB shall also monitor hardware failure patterns. The FRB shall declare a “fleet defect” when the same hardware failure is observed in a given component or device in 10% of an NFTS device type (e.g., Validating Farebox, PV) within the warranty period. Fleet defect analysis shall apply only to device types with 50 or more units installed.

### **31.3.4 Revenue Service Reliability Monitoring**

CTDOT shall measure reliability on a continuous basis for the duration of the warranty for each piece of fare collection equipment. All incidents shall be recorded and the machine cycles shall be recorded on a regular basis so that a continuous measure of relevant failures versus machine cycles and time can be made (MCBF/MTBF). The Failure Review Board shall make classification of failures as relevant or non-relevant.

In the event that the average measured relevant failure rate for any 8-week period during the warranty exceeds the limits set forth in this Contract, the Contractor shall take corrective action. This corrective action shall be subject to CTDOT approval.

Reliability of the Fare Collection Equipment system shall be evaluated in terms of Mean Cycles Between Relevant Failures (MCBF) or Mean Time Between Relevant Failures (MTBF), whichever condition is satisfied first.

### **31.3.5 Revenue Service System Accuracy Monitoring**

During the course of the acceptance test period, the overall accuracy of the fare collection system shall be evaluated.

#### **31.3.5.1 Cash Accounting**

Weekly totals of the cash receipts collected from the Administrative POS Terminals shall be tabulated by the CTDOT Finance Department. These totals shall be compared against the revenue totals as reported by the CDS during the service period in question.

The physically counted revenues, when compared to the CDS-reported totals, shall be within  $\pm 0.1\%$ . Failure to meet this requirement for any week shall be fully investigated and reported by the Contractor.

Passage of the RST shall require the system accuracy of the reported cash receipts to be within  $\pm 0.1\%$  of the physically counted revenues during the previous 8 weeks of revenue service.

If discrepancies in the system accuracy of the fare collection equipment for any 8-week period during the warranty exceed  $\pm 0.1\%$ , the Contractor shall take corrective action. This corrective action shall be subject to CTDOT approval.



#### 31.3.5.2 *Smart Card Transaction Accounting*

The Failure Review Board shall subject all smart card transactions, including all issuance, usage, POS sales and replenishment transactions, and autoloads, to careful scrutiny.

- A. Using historical transaction queries and reports, the FRB shall “reconstruct” the history of randomly selected smart cards to verify that all transactions are properly recorded and that the net result of those transactions properly balances with the latest reported status and value for each card. No less than 100 randomly selected cards shall be evaluated during the RST.
- B. The FRB may also conduct controlled tests during the RST using no more than 10 randomly selected smart card participants to carefully track all transactions (in diary form) and compare those records with the reported results from the CDS.
- C. No less than 1,000 randomly selected transaction records representing all Validating Fareboxes shall also be compared to results of relevant reports generated by the CDS, CTDOT’s existing fare collection system, and other computer management systems.

Discrepancies in the comparisons shall not exceed  $\pm 0.01\%$  by stored value and no more than 1 discrepancy in all other transaction types. If discrepancies in the accuracy of smart card transactions for any 8-week period during the warranty exceed  $\pm 0.01\%$  by stored value or more than 1 discrepancy of other transaction types, the Contractor shall take corrective action. This corrective action shall be subject to CTDOT approval. After corrective action has been taken and system accuracy records indicate that the action taken was successful for a minimum period of 4 weeks (even if the system accuracy monitoring period has ended), the fix shall be deemed satisfactory. If not, the Contractor shall take further action until system accuracy is equal to or better than the specified requirements.

#### 31.3.5.3 *Electronic Funds Transfer Accounting*

The value of all bankcard transactions as shown by CDS reports shall be compared to account reconciliation reports provided by CTDOT’s clearing house service provider. Discrepancies between the values of the CDS-reported totals and the clearing house-reported totals shall not exceed  $\pm 0.01\%$ . If discrepancies in the accuracy of bankcard transactions for any 8-week period during the warranty exceed  $\pm 0.01\%$ , the Contractor shall take corrective action. This corrective action shall be subject to CTDOT approval. After corrective action has been taken and system accuracy records indicate that the action taken was successful for a minimum period of 4 weeks (even if the system accuracy monitoring period has ended), the fix shall be deemed satisfactory. If not, the Contractor shall take further action until system accuracy is equal to or better than the specified requirements.

#### 31.3.6 *Revenue Service Event Audits*

Periodically during the RSAT, CTDOT shall audit reports generated by the data system to confirm the accuracy and completeness of information presented. All event records shall be reviewed and compared to known events such as door openings for revenue service or maintenance, alarms, power outages, etc. All such known events shall be correctly represented in the CDS reports.

#### 31.3.7 *Availability Monitoring*

During the RST, the FRB shall monitor the availability of the CDS, all GCS servers, and all Web Portals. The FRB shall thoroughly investigate any incident that causes any monitored system to



fail to meet availability requirements. The Contractor shall provide a detailed assessment of each incident, including its cause, severity, and likelihood of recurrence.

The FRB shall determine whether any incident affecting system availability warrants extending the RST, modifying the impacted system, or accepting the system without modification. Additionally, the Failure Review Board shall investigate each failure leading to a loss of system availability to validate the correct disposition of the failure as well as the calculations for system unavailability.

### 31.4 Disaster Recovery Exercise

Within 3 months of final system acceptance, CTDOT and the Contractor shall jointly perform a Disaster Recovery Exercise wherein the activities of the production CDS are temporarily transferred to the Disaster Recovery site. While the Disaster Recovery site is functioning, at least 5 Validating Fareboxes and 2 each of the Retail POS Terminal, Administrative POS Terminal, and Handheld Fare Inspection Terminal shall upload transaction and event records. After confirming proper operation of the Disaster Recovery site CDS, operations shall then be transferred back to the production CDS.

The Disaster Recovery Exercise shall test all procedures included in the Disaster Recovery Procedures Manual. The Contractor shall correct any errors and omissions identified in the Disaster Recovery Procedures Manual and deliver manual updates within 60 days of completing the test. **CDRL 31-3**

During and after the exercise, CTDOT and the Contractor shall confirm integrity of the CDS database. This shall include proper synchronization of the databases reflecting all data polled from the devices during the test properly reside in the production CDS database.



## **32 Contractor Technical Support Responsibilities**

### **32.1 On-Site Support**

The Contractor shall provide on-site technical support, with at least two qualified technicians resident in a CTDOT facility, for at least 90 days upon commencement of revenue service, or until Final System Acceptance. On-site technical support shall be available from 7:00 AM to 11:00 PM Eastern time Monday through Friday. On weekends and holidays, on-site technical support shall be available on-call with response time not to exceed 60 minutes.

On-site Contractor personnel shall be subject to the approval of CTDOT.

The on-site support personnel shall assist in troubleshooting and shall act as field instructors for CTDOT personnel who maintain, service, and use the NFTS hardware, data, and software.

### **32.2 Telephone-Based Support**

The Contractor shall provide telephone-based factory technical support commencing with on-site installation and through the completion of the NFTS warranty. The Contractor shall provide factory and on-site technical support, who shall be available from 8:00 AM to 5:00 PM Eastern time, Monday through Friday excluding recognized national holidays. During these normal business hours, the Contractor's qualified technical support staff shall respond to CTDOT requests within 1 hour. During other times, the Contractor shall provide on-call support with no greater than 2-hour response time.



## 33 Warranty Services

During the Hardware and Software Warranty Periods (defined in Contract Documents), the Contractor shall provide remedial repair services for defective NFTS equipment, and corrections for defective Contractor-supplied software, according to the terms of the Warranty defined in the Contract Documents.

During the warranty periods, the Failure Review Board shall meet regularly to review system performance and to classify failures.

The FRB shall review all failures and determine whether any failure is systemic and is caused by a design, workmanship, or manufacturing flaw. All software failures shall be considered “systemic” to any device type because all devices of a given type shall have identical software. In addition, the FRB may designate hardware failures as systemic “fleet defects” according to definitions provided herein.

The Contractor shall provide corrections or CTDOT-approved workarounds for all systemic flaws within time periods defined herein or established by the FRB.

Unless deferred by the FRB, if a resolution to a systemic flaw is not identified within the time specified, the Contractor shall dispatch a qualified technician or engineer on-site to CTDOT until a resolution is found and implemented.

### 33.1 Hardware Warranty Services

#### 33.1.1 Maintenance Responsibilities

During the Hardware Warranty Period, CTDOT and the Contractor shall perform NFTS maintenance services as described below:

##### 33.1.1.1 Level 1 (Field) Maintenance

Level 1 (Field) Maintenance is performed on-site and does not require workshop facilities, specialized test equipment or tools. Only basic technical knowledge is required as per the training, and work is performed according to set procedures.

Typical field maintenance activities include:

- Periodic and preventative maintenance, *e.g.*, cleaning, lubricating, replacement of consumables
- Removal and installation of devices
- Periodic monitoring, recording and reporting of equipment performance data;
- Commissioning of equipment
- Identification and assessment of fault and damage indications and the preparation of fault reports

CTDOT shall perform all reasonable Level 1 Maintenance activities according to the Contractor-supplied procedures as reviewed and approved by CTDOT, unless exercised as an option.

##### 33.1.1.2 Level 2 Maintenance

Level 2 Maintenance is defined as any action necessary to diagnose and restore any out of service equipment where Level 1 Maintenance was not appropriate, or was unsuccessful in resolving the problem.



Typical Level 2 Maintenance activities include:

- Identifying problems and faulty modules
- Removal and installation of simple interchangeable sub-assemblies using standard tools and methods
- Testing of equipment, including adjustments, calibrations and the use of software diagnostic tools
- Commissioning and re-loading of software

CTDOT shall perform all reasonable Level 2 Maintenance activities according to the Contractor-supplied procedures as reviewed and approved by CTDOT, unless exercised as an option.

#### 33.1.1.3 *Level 3 (Workshop) Maintenance*

Maintenance activities of this category are normally performed in workshop facilities. They require a degree of technical knowledge and may require the use of some specialized tools. Value judgment and decisions as to the usability and serviceability of equipment may be required.

Typical Level 3 (Workshop) Maintenance activities include:

- Periodic and preventive maintenance including the dismantling and re-assembly (including refurbishment) of subassemblies, soldering, crimping and assembly of connectors
- Faultfinding to functional block level, using electronic test equipment and standard fault-finding methods
- Identification and exchange of faulty printed circuit boards
- Functional testing and certification of equipment
- Adjustments and calibrations
- Monitoring, recording and reporting of equipment performance

During the Hardware Warranty Period, the Contractor or its assigned subcontractor shall perform all Level 3 Maintenance activities.

#### 33.1.2 **Hardware Repair Services**

For any warranted hardware malfunctions or failures, which may include software defects within the subject Hardware, excluding "Fleet Defect" failures, CTDOT shall remove and replace the defective devices and components. CTDOT shall follow all reasonable Contractor-defined procedures to verify the malfunction or failure, and comply with all reasonable Contractor-defined procedures to return defective components to the Contractor's designated repair facility.

During the Hardware Warranty Period, the Contractor shall pay all costs to ship defective components from CTDOT to the Contractor's facility, and to return repaired or replacement components to CTDOT. For those items the Contractor deems fragile, the Contractor shall supply shipping containers in sufficient quantity to support anticipated need.

The Hardware Warranty shall cover all parts and Contractor labor associated with the factory repair or replacement of the equipment during the Hardware Warranty Period, and as required for Level 3 Maintenance activities as described herein.

For each defective NFTS component returned to the Contractor's facility, the Contractor shall, at its discretion, repair or replace the defective component and return the functioning unit to CTDOT within an average of 30 calendar days, not to exceed 45 calendar days of receipt of the defective component.



For "Fleet Defect" failures, the Contractor shall commence a modification program to repair or replace all such components affected by the fleet defect within 10 days after receiving notification from CTDOT. To correct fleet defects, the Contractor shall provide all necessary personnel, tools, and materials at its own expense, and provide such additional components and devices for CTDOT's use while the repairs are taking place to minimize the effects on normal CTDOT operations. The Contractor shall meet with CTDOT to determine the schedule of fleet defect repairs; all repair schedules and procedures shall minimize impacts on CTDOT operations. The Contractor may, at its option, perform the required repairs at CTDOT's garages, but only if CTDOT is able to accommodate the request without unduly affecting operations; CTDOT retains the right to reject such requests.

## 33.2 Software Warranty Services

During the Software Warranty Period, the Contractor shall provide the services described below.

### 33.2.1 Software Corrections

The Failure Review Board shall define software defect severities.

Corrections for software Defects shall be made available to CTDOT for evaluation (at the NFTS Maintenance and Test Facility) according to the schedule shown in Table 33.2.1 below. For Critical and Urgent defects, the Contractor may deliver temporary workarounds, which may be deployed at CTDOT's discretion, to alleviate the effects of the defect; in such cases, the Contractor shall continue working toward a final solution to be made available as soon as possible.

All corrections and workarounds for software Defects shall be accompanied by software release documentation that describes the defect and proposed solution, identifies software modules affected and new version control numbers, defines means to confirm the effectiveness of the fix, and provides installation and removal procedures.

Corrections and workarounds for warranted software Defects shall be considered delivered on time if the software correction or workaround and accompanying software release documentation are delivered to CTDOT in the time allotted in Table 33.2.1, and the correction or workaround is verified by CTDOT in its NFTS Maintenance and Test Facility. If CTDOT determines that the proposed solution fails to resolve the reported Defect, or if the proposed solution exposes or introduces one or more previously unknown software Defects of equal or greater severity, the proposed solution will be declared ineffective. If the proposed fix is declared ineffective, the original correction due date shall be extended only by the time elapsed between initial delivery and CTDOT's declaration of ineffectiveness.



Table 33.2.1: Software Defect Resolution Delivery Requirements

Defect Severity	Resolution Due
1 – Critical	Temporary Workaround in 48 Hours Final Solution As Mutually Agreed
2 – Urgent	Temporary Workaround in 5 Calendar Days Final Solution As Mutually Agreed
3 – Important	Final Solution in 120 Calendar Days or As Mutually Agreed
4 – Low	Next Scheduled Software Release or As Mutually Agreed

Deployment of verified software corrections shall be at CTDOT’s discretion. CTDOT may elect to defer deployment of software corrections and to bundle multiple software corrections into a single deployment. At CTDOT’s request, the Contractor shall prepare the necessary procedures to enable the deployment of any such bundled corrections, which may include Software Updates provided as described below.

### 33.2.2 Software Updates

During the Software Warranty Period, the Contractor shall make available updates to all software supplied as part of the NFTS. These updates shall include all routine “service packages” provided by Contractor-supplied Commercial Off-the-Shelf (COTS) software suppliers, as well as all relevant updates to NFTS Software developed by the Contractor during the course of servicing the NFTS and other customers with similar systems. Unless the Contractor notifies CTDOT that the software update is required, CTDOT shall determine whether to apply the software update to the NFTS Software. For each update the Contractor mandates or CTDOT elects to apply, the Contractor shall develop the procedures to do so and provide all labor required to install the updated software.

All software updates shall be accompanied by software release documentation that describes the fixes, enhancements or changes in the software as well as any known problems/caveats or potential problems/caveats, identifies software modules affected and new version control numbers, defines means to confirm the effectiveness of the fix, and provides installation and removal procedures.

All software warranties shall remain in effect after any software update is applied, and if CTDOT elects not to apply a non-mandatory software update.





## 34 Manuals

### 34.1 General

The Contractor shall supply to CTDOT the manuals more particularly outlined in this Section 34. Manuals are a critical component of the project, and the Contractor shall provide all manuals as specified herein.

- A. Manuals provided by the Contractor shall be written in clear and concise English and to a level of detail as determined by CTDOT. Care shall be taken to provide easily understood directions and explanations and step-by-step instructions with cross-references to all drawings, diagrams, and photos, with no extraneous material such as advertisements or irrelevant information.
- B. The Contractor shall provide a complete documentation plan, identifying all manuals and the development and delivery schedule for each, for CTDOT review and approval at the Preliminary Design Review. **CDRL 34-1**
- C. The Contractor shall supply all manuals in hardcopy and electronic form. Electronic file formats will be compatible with Microsoft® Office® 2010. Provided media will not be copy protected or encrypted in any way.
- D. Electronic forms of the manuals shall make use of hyperlinks from the Table of Contents, Index, and other internal cross-references to referenced points in the manual and to external sources of additional information, such as OEM web pages.
- E. The content and organization of all manuals shall be coordinated with training, special tools, and test and diagnostic equipment. Together, the manuals and other support services and materials shall constitute a uniform approach in addressing the level of repair and maintenance required to support the Fare Collection System. The supported level of repair shall include basic preventive maintenance, field repair and replacement, routine bench repairs and overhauls, and modest levels of circuit board and subcomponent repairs that can be sustained by CTDOT's existing maintenance technicians.
- F. For the repair and maintenance support of third party standard products, the Contractor shall supply manuals, special tools, test and diagnostic equipment commercially available from the product manufacturer and to the extent reasonable and possible, consistent with the overall Fare Collection System maintenance and level of repair concept.
- G. The Contractor shall submit manuals in progressive steps as follows:
  - 1. The general outline of manual contents shall be submitted to CTDOT for review and approval as part of the Preliminary Design Review. **CDRL 34-2**
  - 2. Final drafts of the manuals shall be submitted to CTDOT for review and approval as part of the Final Design Review. **CDRL 34-3**
  - 3. All copies of complete manuals, including both hardcopy and electronic formats, in final form no less than 14 days prior to commencement of revenue service. **CDRL 34-4**
  - 4. Updates to all manuals, reflecting changes incorporated during any warranty period, shall be submitted upon completion of the warranty period. **CDRL 34-5**



## 34.2 Manual Requirements

All manuals supplied as part of this Agreement shall meet the following general conditions.

- A. For every item of machinery and equipment furnished by the Contractor, the Contractor will furnish operating manuals giving complete instructions relative to assembly, installation, operation, adjustment, lubrication, maintenance, and complete parts list. If needed maintenance and repair information is included, manuals from OEM suppliers will also be provided.
- B. Manuals will treat each item of equipment as a single integrated system of components, subassemblies, and accessories designed to work together, and will not be merely a collection of disassociated sections from various suppliers. The Contractor will ensure that all its suppliers' efforts are compatible and that interfaces among various subsystems are represented in sufficient detail to provide a clear and complete functional description of the NFTS. In general, manuals will be logically organized with systems and elements considered in descending order of importance.
- C. Manuals furnished may be the Contractor's standard publications in regard to size and binding provided they comply with specified requirements relative to quantity and quality of information and data, and upon approval by CTDOT.
- D. Manuals will be bound in hard or flexible covers. Illustrations will be clear, and printed matter, including dimensions and lettering on drawings, will be easily legible. If reduced drawings are incorporated into manuals, original lines and letters will be emboldened as necessary to retain their legibility after reduction. Larger drawings may be folded into manuals to page size. Any reproduction will be of near-perfect quality. No blotched or poorly readable areas on any reproduction are allowed.
- E. All manuals will use nomenclature, symbols and designations common to those found and approved by such bodies as the IEEE, which are common to the USA work place. References to supplemental information will be included where necessary.
- F. All information judged to be of a sensitive nature by CTDOT or the Contractor will be identified by the contractor no later than the Final Design Review and will be handled in a manner to be determined by CTDOT. **CDRL 34-6**
- G. Manuals will be designed for continuous, long-term service in a maintenance shop environment.
- H. Manuals will lie flat when opened and will permit adding and replacing pages. Contents will be divided by section.
- I. Manuals will be identified on both the front and spine of each binder.
- J. Margins will be of sufficient size so that all printing avoids punched holes.
- K. Manual pages will be nominally 8½ inches by 11 inches (excluding Quick Reference Guides, which will be pocket-sized foldouts or soft-cover bound).
- L. Manuals will not exceed 3 inches in thickness. If necessary, manuals will be split into multiple volumes to keep binder size at most 3 inches.



### 34.3 Manual Format

The Contractor may provide manuals with differing formats than specified below, but the general content and sequence will satisfy the following requirements.

- A. Title page: Include the name and function of the equipment, manufacturer's identification number, and the Project Specifications number and title.
- B. Table of contents, in number order listing each section and subsection title of the manual with reference to the page on which each starts and a list of included diagrams and drawings.
- C. Frontispiece: Recognition illustration of the equipment described in the manual.
- D. A description of each piece of equipment, including major assemblies and subassemblies, and giving manufacturer's model number and drawing number.
- E. Operation instructions including step-by-step preparation for start-up, initialization, operation, shutdown, and identifying all hazards (such as sharp edges and high voltages).
- F. Control diagrams, as installed by the manufacturer.
- G. Sequence of operation by the control manufacturer.
- H. Wiring diagrams, as-installed.
- I. Diagrammatic location, function and tag numbers of each component.
- J. Maintenance instructions: Include step-by-step procedures for inspection, operation checks, cleaning, lubrication, adjustments, repair, overhaul, disassembly, and reassembly of the equipment for proper operation of the equipment. Include list of special tools that are required for maintenance with the maintenance information.
- K. Possible breakdowns and repairs. Troubleshooting flow charts and/or symptom-action tables will be included for diagnosis of any major system or control.
- L. Manufacturer's parts list of functional components, control diagrams and wiring diagrams, giving manufacturer's model number and manufacturer's part number.
- M. "Long-Lead-Time" spare parts list for parts not readily available on the open market or for which it is anticipated ordering and delivery time exceeds 10 days.
- N. List of nearest local suppliers of all equipment parts.
- O. Recommended preventive maintenance schedule for major system components.
- P. Manufacturer's warranty and guarantee data.
- Q. Spare parts data including complete list of parts and supplies, with current unit prices and sources of supply.
- R. All equipment or tools required for the general up-keep, maintenance and overhaul of the equipment or product. Suggested suppliers for all specialty tools will be shown.
- S. Index, in alphabetical order.
- T. Appendices: Include safety precautions and procedures, a glossary, and, if available at time of submittal, copies of test reports, and other relevant material not specified to be submitted.



## 34.4 Operating Diagrams

Where provided, operating diagrams shall conform to the following.

- A. Electrical wiring diagrams and other diagrams necessary for operation of the equipment shall be provided for NFTS Equipment.
- B. No single diagram shall show more than one system, or parts thereof.
- C. Diagrams shall be reproduced by Xerographic process to a size not to exceed 18 inches by 24 inches and shall be complete and legible in all respects.

## 34.5 Required Manuals

Manuals shall be organized and shall include, as a minimum, the information as follows. If all information required herein is supplied, alternative manual breakdowns and structures shall be permitted, subject to CTDOT approval.

The Contractor shall provide two high-quality reproducible master, two electronic copy (excluding OEM manuals), and the following quantities of each manual identified in the tables below.

### 34.5.1 NFTS Device Manuals

For each NFTS device, the Contractor shall supply a comprehensive set of manuals, tailored to the device and the intended audience of each manual.

In general, where applicable, these manuals shall cover the following topics:

- A. Operating Instruction Manual – shall contain all information needed for safe, proper, and efficient operation of the NFTS device and the Mobile Ticketing software. Manuals shall include general orientation and familiarization with all features and functions. Detailed information shall be provided regarding location, function and operation of all controls, indicators, switches, hardware and reset buttons, and trouble diagnosis. All normal operational sequences shall be described in detail.
- B. Bus Operator's Fare Collection Manual – shall be provided to all bus operators to provide information on the new system, including what they need to know about the purpose/benefits of the NFTS in serving the public, the components of the fare collection system, and a thorough explanation of the Operator's interaction with the system, from signing into the system, to activating it for their trip, monitoring fare collection, processing and accounting for fare media, troubleshooting and fingertip maintenance they would perform.
- C. Trainer's Guide to Presenting Fare Collection System Training for Bus Operators – shall be used in concert with the Bus Operator's Fare Collection Manual and provide direction for trainers in introducing the NFTS and its benefits, and in presenting the lectures, equipment demonstrations, and practice exercises that will ensure Bus Operator's mastery of the knowledge and skills required for using the NFTS. This shall include quizzes for trainers to use in evaluating trainee's mastery of the system at the end of training as identified in Section 36.
- D. Preventive Maintenance Manual – shall contain all information needed to enable maintenance technicians to perform all periodic inspection and preventive maintenance tasks for the NFTS device. The manual shall contain recommended preventive maintenance schedules grouped, as much as possible, into compatible and convenient



intervals of time, or operating hours. If binder size limitations permit, this manual may be combined with the Corrective Maintenance Manual.

- E. Corrective / Field Maintenance Manual – shall contain all information needed to enable maintenance technicians to diagnose problems, exchange field-replaceable devices and modules, and to make adjustments and repairs to all device components and subassemblies. Repairs include activities that can be reasonably performed in the field, including exchanges, adjustments, repairs or replacements prescribed to restore the device components and subassemblies to a normal operational condition in an efficient and timely manner. The manual shall include, at a minimum:
- A general description of each subsystem, component and subassembly
  - Procedures to exchange all major components
  - Functional block diagrams
  - Detailed schematics
  - Wiring diagrams
  - Pictorials with exploded views to permit easy parts identification
- F. Shop Repair and Overhaul Manual – shall contain a detailed description of each assembly and subassembly to enable maintenance technicians to service, maintain, repair, replace, rebuild, and overhaul the device in the maintenance facility. The manual shall include:
- Complete systematic procedures
  - Wear and tolerance limits for determining when overhauls are needed
  - Overhaul procedures for all major components
  - Special tools and equipment required
  - Bench test equipment information and instructions
  - Pictorials with exploded views to permit easy parts identification

If binder size limitations permit, this manual may be combined with the Parts Manual.

- G. Parts Manual – shall enumerate and describe every device component with its related parts, including the supplier's number, the Contractor's number, and provision for entry of CTDOT store's number. Cutaway and exploded view drawings shall be used to permit identification of all parts not readily identified by description. Parts common to different components, such as screws, shall bear the same Contractor's number with reference to the other components where they are found. Each part or component shall be identified as being part of the next assembly. Commercially available items such as standard fasteners, fuses, lamps, fittings, switches, solenoids, and motors shall be identified by standard hardware nomenclature in addition to the Contractor's number.
- H. Software and Programming Manual – shall describe how to install, operate, configure, and maintain the device software. The manual shall include procedures for updating device application software (for when the CDS is not available). The manual shall also include a high-level description of the device application software design and the function of all executable modules.
- I. Software Source Code Manual – One or more manuals shall also be provided (separately if necessary) that fully documents the device application software source code, including data files, data file structure, and data file mapping and cross-referencing. If necessary, the device software source code documentation shall be provided to the software escrow agent.



- J. User Quick Reference Guides – These manuals shall be pocket-sized guides tailored to the device and the user, and shall assist the user in operating the device.
- K. Field Maintenance Quick Reference Guide – This manual shall be a pocket-sized guide tailored to assist field maintenance personnel in conducting common activities and the service commands used to perform them.
- L. OEM Manuals – Where OEM devices are provided, OEM manuals shall be provided complete and unaltered.

Table 34.5.1: NFTS Field Device Manual Quantities

Manual	Device						
	Validating Farebox	Stand Alone Processor	MVM	Platform Validator	Non-Validating Farebox	Admin POS	HFIT
Operating Instruction Manual	20	10	6	5	10	20	5
Bus Operator's Fare Collection Manual	800	100	-	-	100	-	-
Preventive Maintenance Manual	20	10	2	4	10 (Merged)	5 (Merged)	-
Corrective / Field Maintenance Manual	20	10	2	4			-
Shop Repair and Overhaul Manual	20	10	2	4			-
Parts Manual	2	2	2	2	2	2	-
Software and Programming Manual	20	10	2	2	10	5	5
Software Source Code Manual	2	2	2	2	2	1	1
User Quick Reference Guides	750	100	6	4	100	Front Office: 10 Portable: 10	100
Field Maintenance Quick Reference Guide	50	20	6	4	20	-	-
OEM Manuals	10	2	2	2	2	4	10

### 34.5.2 Central Data System Manuals

For each element of the CDS, a comprehensive set of manuals shall document the system, networking interfaces, software design, database structures, and so on. These manuals are summarized as follows:

- A. Administrator's Manual – shall supply all necessary procedures to administer the computer system and the associated networking hardware and software. Administrative requirements of the computer system's operating system software shall be described in detail or specific references to the manufacturer's operating system documentation shall be supplied. All administrative procedures, including managing user accounts,



configuring operating parameters, data archiving, and backup creation and restoration (full and incremental) shall be provided in this documentation.

- B. User's Manual – shall provide complete documentation on the use of the associated CDS user functions, segregated by user community (such as finance, operations, maintenance, customer support, retailer support, ride sponsor support). All user functions and procedures shall be fully explained, including logging into the system, querying the database, generating reports, altering fare tables and other operating parameters, downloading data, polling devices for data, and proper responses to all input requests. The manuals shall make extensive use of sample screen images.
- C. Report Formatting Manual – shall provide instructions on how to create new queries and reports and to modify existing reports. Instructions on how to add reports to the list of prepared reports, to schedule reports for automated generation at predetermined times, and to delete unused reports shall also be provided. If necessary, specific references to manufacturer's documentation shall also be provided to clarify instructions. If binder size limitations permit, this manual may be combined with the Design and Database Structure Manual.
- D. Design and Database Structure Manual – shall describe the design of the CDS network architecture and the communications protocols used between the CDS, and NFTS devices, and external interfaces (such as the Web Portals, the bankcard clearing house and CTDOT's Legacy Systems). The manual shall provide a complete description of the database structure, including definitions, parameters, and relations for all database fields, records, and tables, and shall incorporate the Entity Relation Diagram (ERD) for the as-built database.
- E. External Interface Manual – shall describe the file format, communication protocols, and other aspects of an Application Program Interface (API) employed to exchange information between the CDS and all external sources, including but not limited to the Web Portals, Legacy Systems, Retail POS Terminals, and Handheld Fare Inspection Terminals, but excluding the bankcard clearing house.
- F. Bankcard Clearing House Interface Manual – shall describe the communication protocols and data formats for the interface between the CDS and CTDOT's bankcard clearing house. This document shall be delivered under separate cover to the Contracting Officer, and shall be developed under strict compliance with the Payment Card Industry Data Security Standards. **CDRL 34-7**
- G. Disaster Recovery Procedures Manual – shall contain a comprehensive discussion of the procedures to maintain and restore NFTS operations in the event of a disaster to the CDS. The manual shall include a description of the steps to transfer CDS production to the Disaster Recovery site, any differences in CDS and NFTS operations that may occur at the Disaster Recovery site, and any functions not supported by the Disaster Recovery CDS (such as Legacy Systems interfaces). The manual shall also document the procedures necessary to transfer operations back to the primary CDS production site and to re-synchronize all data.
- H. Software Source Code Manual – One or more manuals shall also be provided (separately if necessary) that fully documents the CDS application software source code, including data files, data file structure, and data file mapping and cross-referencing. If necessary, the CDS software source code documentation shall be provided to the software escrow agent.



- I. OEM Manuals – shall be provided unaltered. The Contractor shall supply original OEM manuals for all Contractor-supplied OEM software and hardware associated with the CDS. Where appropriate, these manuals may be bound with the Contractor's documentation.

Table 34.5.2: Central Data System Manual Quantities

Manual	Quantity
Administrator's Manual	5
User's Manual	5
Report Formatting Manual	5
Design and Database Structure Manual	5
External Interface Manual	5
Bankcard Clearing House Interface Manual	5
Software Source Code Manual	5
OEM Manuals	As supplied

### 34.5.3 Garage Communications Server Manuals

For each element of the CDS, a comprehensive set of manuals shall document the system, networking interfaces, software design, database structures, and so on. These manuals are summarized as follows:

- A. Administrator's Manual – shall supply all necessary procedures to administer the computer system and the associated networking hardware and software. Administrative requirements of the computer system's operating system software shall be described in detail or specific references to the manufacturer's operating system documentation shall be supplied. All administrative procedures, including managing user accounts, configuring operating parameters, data archiving, disaster recovery, and backup creation and restoration (full and incremental) shall be provided in this documentation.
- B. External Interface Manual – shall describe the file format, communication protocols, and other aspects of interfaces employed to exchange information between the GCS and the Validating Fareboxes.
- C. Wireless Network Design – shall describe the location and design of the wireless access points and the network addressing scheme employed for each garage network.
- D. Software Source Code Manual – One or more manuals shall also be provided (separately if necessary) that fully documents the GCS application software source code, including data files, data file structure, and data file mapping and cross-referencing. If necessary, the GCS software source code documentation shall be provided to the software escrow agent.
- E. OEM Manuals – shall be provided unaltered. The Contractor shall supply original OEM manuals for all Contractor-supplied OEM software and hardware associated with the CDS. Where appropriate, these manuals may be bound with the Contractor's documentation.





Table 34.5.3: Garage Communications Server Manual Quantities

Manual	Quantity
Administrator's Manual	10
External Interface Manual	5
Wireless Network Design	10
Software Source Code Manual	5
OEM Manuals	As supplied

#### 34.5.4 Support Systems Manuals

All support systems, special tools, and test equipment defined in Section 24 shall be accompanied with operation and maintenance manuals to the same level of detail as that supplied for the NFTS equipment. The manuals shall permit CTDOT to operate, maintain, and repair all support systems and test equipment without assistance from the Contractor, and shall document the operation of the support systems described in Section 24, and shall include complete descriptions of the devices and their respective use and purpose, all functions, adjustments, operator commands, configurations, inputs and outputs, and all other aspects necessary for the proper operation and long-term maintenance of the systems.

Table 34.5.4: Support Systems Manual Quantities

Manual	Quantity
Operations and Maintenance Manual	2 per Support System and Tool
OEM Manuals	As supplied

#### 34.5.5 Other Manuals

The Contractor shall also supply the following manuals:

- A. Web Portal Design and Administration – shall provide complete description of each Web Portal design, including the underlying coding architecture. In addition, the manual shall provide instruction on the administration of all Web Portals, including procedures to modify configurations, change selections, add, delete, and modify links to other pages, and other common web site maintenance tasks.

Table 34.5.5: Other Manual Quantities

Manual	Quantity
Web Portal Design and Administration Manual	1



## 35 Documentation

### 35.1 Time and Scope of Submittals

Within 30 days following final acceptance of the equipment, the Contractor shall supply quality reproducible drawings of all fabrication assemblies, subassemblies, circuit diagrams and arrangements of the NFTS equipment, as finally furnished, accepted and modified.

**CDRL 35-1** Included shall be reproducible drawings of all material furnished to the Contractor by its suppliers down to and including the module and circuit board level and parts used on those modules and boards. In both cases, outline drawings shall include a complete and specific reference to all other drawings that represent the next higher order of assembly. Drawings shall be sufficient to execute all manner of maintenance, replacement, repair, overhaul and rebuild, but not manufacture.

The Contractor shall supply quality reproducible originals for the following items:

- All Contractor's and suppliers' drawings, details, bills of material, and catalog cuts that are required by CTDOT for future installation, maintenance and repair purposes
- All assemblies, subassemblies, and arrangements of the equipment
- All items which are special purpose or fabricated by the Contractor
- All materials furnished by the Contractor and by its suppliers, down to and including the module and circuit board level

### 35.2 As-Built Drawing Requirements

#### 35.2.1 General

The Contractor shall submit for each set of as-built drawings the following:

- Two copies of all drawings on electronic media, in a format approved by CTDOT.  
**CDRL 35-2** Electronic copies of as-built drawings prepared for this Contract shall be submitted to CTDOT as digital, CADD files created in, or formatted in such a way to be directly converted into the most recent AutoCAD® file format (.dwg) which CTDOT supports. Drawing format to be identified by CTDOT within 90 days after the NTP is issued. **CTDOT 35-1**
- Two reproducible CADD-generated hardcopies.

All drawings germane to the subject shall be submitted as a package, with index, cover sheet, and symbols and abbreviations table. All nomenclature and labels shall correspond to actual labels on installed equipment. Each connection to each piece of equipment, junction box, or terminal block shall be identified by function and color code. All dimensions, physical details, connections, and other information pertinent to system diagnostics, maintenance and troubleshooting shall be shown.

#### 35.2.2 Master Drawing Index

A master index of drawings shall be submitted that clearly indicates the organization of the as-built drawings, listed by drawing number. The master drawing index shall also provide cross-references to related drawings, and shall indicate the hierarchy of all drawings and drawing layers.



### 35.2.3 Vehicle Installation Designs

For each vehicle type on which NFTS equipment is installed, the Contractor shall supply As-Built drawings showing the routing of all wires and the method and location of all device mounting installations. As necessary, these drawings may include digital photographs of sufficient detail and clarity to convey the necessary information.

Where variations are identified within a given vehicle type, the Contractor shall submit additional drawings depicting the variations and the vehicles to which the variations apply.

## 35.3 As-Installed Inventory

CTDOT intends to utilize Spear® to track the configuration of the NFTS equipment and manage the warranty and inventory for the NFTS equipment. To support this functionality, the Contractor shall provide all information in electronic format required to perform those functions, including but not limited to:

- The asset and component hierarchy for all NFTS equipment
- The attribution information associated with the asset and component master data
- The problem cause and remedy codes for assets and components
- System relationships for each asset and component
- Troubleshooting guides and maintenance practices or job plans
- The materials and inventory master data set (*i.e.*, serial numbers and location)
- All warranty related information

All information shall be in electronic format and shall be capable of a one-time interface into Spear® as well as when changes and updates occur from the Contractor.

The Contractor shall deliver a comprehensive data set for the entire NFTS, reflecting the serial numbers and locations of every NFTS device and spare part, within 24 hours of commencement of NFTS revenue service. **CDRL 35-3**

Thereafter, CTDOT will assume responsibility for maintaining the accuracy of the NFTS equipment inventory.

## 35.4 Revisions to be Included

The electronic and hard copies shall include all revisions made during manufacture and installation, and reflect as-built and as-installed configurations.



## 36 Training Services

### 36.1 General Training Requirements

- A. The Contractor shall provide all training as outlined in this section. All training materials and training classes will be completed no less than 30 days prior to the commencement of NFTS Revenue Service.
- B. The Contractor shall ensure that instructors teaching the training courses are not only familiar with technical information and all hardware and software functions, but are able to utilize proper methods of instruction, training aids, audiovisuals, etc. to provide effective instruction.
- C. The hours for each training course contained herein are approximations only. Training courses shall provide the scope of instruction as specified below. The Contractor shall define the time required to provide the specified training in the preliminary training plan, which will identify all courses to be taught, location for each, estimated training hours, class sizes, presumed student prerequisite skills, and the development and delivery schedule for each. The preliminary training plan will be provided at the Preliminary Design Review and include flexibility and coordination with other training activities.  
**CDRL 36-1**
- D. The Contractor shall develop and provide all training aids, student workbooks, guides, audiovisual equipment and visual aids necessary to conduct these courses.
- E. The Contractor shall digitally record (to .mpeg or other standard format) at least one training session of each course, and provide a DVD of all such recordings at the conclusion of each class. **CDRL 36-2** The Contractor shall permit CTDOT or its designated representative to record any and all training sessions. CTDOT shall have unrestricted use of all video records and not be subject to any use fee.
- F. All training materials developed or used by the Contractor to conduct these instructional sessions will become the property of CTDOT at the conclusion of training. **CDRL 36-3**
- G. Maintenance and revenue service technician training shall commence only after delivery and installation of the Maintenance and Test Facility and provision of all training materials, special tools, and test equipment.
- H. Training shall be conducted at a location approved by CTDOT. Hours for training will be between 6:00 AM and 6:00 PM Eastern time, Monday through Friday, unless otherwise specifically permitted. Training will be limited to a maximum of eight hours per training session per day.
- I. At CTDOT's request and expense, the Contractor shall, during the warranty period, provide additional repeated sessions of any of the courses provided under this contract.



## 36.2 Training Curricula

- A. The Contractor shall submit for CTDOT's review and approval training curricula as part of the Final Design Review. The curricula will meet all training requirements and indicate course content, training time requirements, and who should attend. **CDRL 36-4**
- B. The Contractor's trainer(s) shall meet with CTDOT not later than 60 days prior to the start of formal training. At that time, Contractor shall submit lesson plans and an outline of each training session, as well as demonstrate any training aids involved. **CDRL 36-5**
- C. Two Instructor's Guides, which will contain all the information and direction necessary for instructors to make an effective presentation, will be submitted at least 60 days prior to the scheduled date of the commencement of training. **CDRL 36-6** It will include adequate guidelines to conduct a comprehensive training program. Individual lessons within the course will be organized as separate blocks (or modules), which may be taught as a unit. In some instances, the same module could be used in more than one course. The Instructor's Guide should contain, at a minimum:
  1. Student prerequisite knowledge and/or experience
  2. Program overview
  3. A statement of overall program goals
  4. Lesson plans (a session-by-session outline containing the following):
    - a. Student learning objectives, stated in measurable terms
    - b. Overview of each lesson
    - c. Suggested instructional methods/learning activities
    - d. Required equipment and/or resources. This should include graphics or charts as needed to make effective presentations.
- D. Evaluation device(s): Written and/or hands-on practical tests designed to measure the extent to which students have met the learning objectives, with an answer key for each of the tests developed.
- E. Student Instructional Materials: The Contractor shall supply all instructional materials for all students to interact in the learning situation. **CDRL 36-7** It will contain, at a minimum:
  1. Program overview and introduction
  2. Statement of overall program goals
  3. Learning objectives, stated in measurable terms, the knowledge to be gained
  4. A fully developed prose treatment (not outline format) of content presentation, developed in the same modular format as the Instructor's Guide
  5. Illustrations, charts, or graphics, as needed to enhance content presentation
  6. Problems and questions related to lesson content, as appropriate
- F. The Contractor shall outline specific objectives for each of the courses to be presented. A training course or session will be provided for each equipment item, including each element of the CDS and all communication interfaces.
  1. The course will include sessions in safety, equipment operation, and a comprehensive seminar on learning basic skills/knowledge of each operation. The course will include both classroom and practical exercise sessions and will provide the student with the basic knowledge necessary to utilize all training materials. The



Contractor shall provide a detailed schedule outlining the length and content of each of these sessions in accordance with the guidelines established.

2. The training program will include familiarization with equipment operation and performance and detailed instruction in operation, troubleshooting, maintenance, repair, and test procedures.

### 36.3 Learning Management System

The training to be provided will be based on a web-based Learning Management System (LMS) that utilizes training materials (text, graphics, videos, etc.) and interactive content (tests and other context-related prompts and responses) that are compliant with training industry standards, specifically the Shareable Content Object Reference Model (SCORM). For NFTS training courses so specified, the Contractor shall augment live instructor-led training with training materials and other interactive content that is SCORM-compliant, enabling CTDOT to export the material to its Learning Management System. Where LMS training materials are specified herein, the Contractor shall also supply video or audio recordings of live training sessions in a format compliant with SCORM and CTDOT's LMS.

Contractor-developed material exported to CTDOT's LMS will become the property of CTDOT. CTDOT shall have unlimited rights to use and modify the material for use in training CTDOT employees and contractors.

The Contractor shall submit documentation describing the material types, interactive content, and the methods to transfer these materials and content to CTDOT's LMS, for CTDOT review at the Preliminary Design Review and CTDOT approval at the Final Design Review. **CDRL 36-8**

### 36.4 Training Courses

The Contractor shall supply the following training courses for each phase as needed to support the modifications of the equipment and software:

#### 36.4.1 NFTS Field Device Training

- A. Field Maintenance and Servicing (Level 1 and Level 2) – All CTDOT maintenance personnel who may be required to perform scheduled maintenance and support activities will attend a training course. This course will provide the employee all knowledge necessary for operation, troubleshooting, maintenance, repair, component change-out, and scheduled maintenance of all NFTS field devices. The Contractor shall train up to 20 CTDOT personnel, and provide all course content and training materials in SCORM-compliant format.
- B. Bench Repair (Level 3) – A selection of mechanics and electricians who will perform the periodic overhaul, remedial repair, and adjustment of NFTS components, shall be given a comprehensive instruction course in the operation, troubleshooting, maintenance, repair and overhaul of the equipment. The Contractor shall train up to 15 CTDOT personnel, and provide all course content and training materials in SCORM-compliant format.
- C. Operation, Configuration, and Administration – Supervisory personnel who will manage the NFTS equipment and the service technicians shall receive specialized training in the operation, configuration, and administration of the devices. This class shall provide instruction on those activities that are limited to administrative and maintenance logins



on the NFTS field equipment, as well as those infrequent activities governing the configuration of the devices. The class shall focus on those activities that may occur at the device. Up to 10 CTDOT personnel shall attend the class. The Contractor shall provide all course content and training materials in SCORM-compliant format.

### 36.4.2 Central Data System Training

- A. CDS User Training – Personnel who will use the CDS shall be trained in the use of all application programs and functions provided by the system. The Contractor shall structure this training as a series of logically arranged topics so that individual users may attend only those portions of the course of interest. The Contractor shall provide all course content and training materials in SCORM-compliant format. Up to 20 CTDOT personnel shall attend this course. This training shall at minimum include:
- General CDS user procedures
  - Device management functions
  - Device configuration parameters
  - Status monitoring functions
  - Media inventory management
  - Customer account management
  - Generation of all standard reports
  - Master Status List management
  - Fare Table management
  - Autoload List management
  - Third Party-Issued List management
  - Bankcard authorization operations and configuration
  - Backup memory module data retrieval procedures
  - Interfaces with other CTDOT systems
- B. CDS Accounting – Those management personnel who will generate and use revenue and ridership reports from the CDS shall receive specialized training to be familiar with revenue and ridership report contents and uses. Using sample data created from testing intervals or other sources, reports shall be generated from the CDS and used to explain the resulting data output. Up to 10 CTDOT personnel shall attend this course.
- C. CDS Administration – Systems personnel who will be responsible for administration and systems maintenance shall be trained in all aspects of CDS administration and to ensure optimal performance as well as correcting minor system problems. Up to 10 CTDOT personnel shall attend this course, which shall provide the personnel with the fundamentals to perform all CDS administrative functions, including but not limited to:
- Backup and restore
  - Disaster Recovery
  - User login administration
  - Anti-virus definition updates
  - Load balancing
  - Networking configurations
  - Interfaces with other agency computer systems
  - Bankcard clearing house interfaces
- D. Report and Query Generation and Customization – The Contractor shall instruct up to 10 CDS users and administrators in report and query generation and customization, including use of the Report Writer tool.



### 36.4.3 Support Systems Training

The Contractor shall provide a course that shall cover the use, operation, and maintenance of all Support Systems and special tools described in Section 24.

Up to 10 CTDOT personnel ~~shall~~ may attend the class.

### 36.4.4 On-Board Equipment Operator Training

The Contractor shall provide a course, tailored to CTDOT training staff, on the operations of the On-Board equipment. The course shall focus on On-Board equipment (Validating Farebox, SAP, Non-Validating Farebox) usage, and shall cover, at minimum, the following topics:

- General description of On-Board equipment modules and functions
- NFTS Fare products, policies, and transactions
- Operator login and logout
- Pull-out and pull-in procedures
- Operator adjustments
- Entering and modifying service parameters
- In-service operator commands
- Transaction processing
- Transaction results messages and meanings
- Validating Farebox error and alert messages

Up to 10 CTDOT trainers ~~shall~~ may attend this course. The Contractor shall provide all course content and training materials in SCORM-compliant format.

### 36.4.5 Station Equipment Operations

The Contractor shall provide training courses for the operation of each type of station equipment and assistance of customers with equipment-related problems. Training shall focus on understanding the operation of the equipment to provide customer assistance with problem resolution.

The training shall take place using actual station equipment. At least four (4) units of each type of equipment shall be supplied for the training and this equipment shall be provided for the entire period of the training.

Up to 5 CTDOT trainers ~~shall~~ may attend this course. The Contractor shall provide all course content and training materials in SCORM-compliant format.

### 36.4.6 Retail Network Liaison Training

The Contractor shall develop and provide a course for CTDOT staff responsible for managing the agency's Retail Partner program. At minimum, the course shall instruct the liaisons in:

- General Retail Terminal functionality
- Retail Terminal login administration
- Retail Terminal user operations (clerk and store manager)
- Use of the Retailer Web Portal
- Retailer invoicing procedures
- Retailer media inventory procedures

Up to 5 CTDOT staff ~~shall~~ may attend this course. The Contractor shall provide all course content and training materials in SCORM-compliant format.





#### **36.4.7 Corporate Partner / University Administrator Liaison Training**

The Contractor shall develop and provide a course for CTDOT staff responsible for managing the agency's Corporate Partner and University coordination programs. At minimum, the course shall instruct the liaisons in:

- NFTS fare products, policies, and transactions relevant to Corporate Partners
- NFTS fare products, policies, and transactions relevant to Institutions
- Use of the Corporate Partner Web Portal
- Use of the University Administrator Web Portal
- Creating, modifying, deleting employee / student (beneficiary) accounts
- Assigning, modifying, deleting benefits (fare products) to individual beneficiaries
- Bulk upload process for new accounts
- Payment methods (where relevant)

Up to 5 CTDOT staff shall may attend this course.

#### **36.4.8 Administrative Point of Sale Terminal User Training**

The Contractor shall develop and supply training materials, and conduct a comprehensive training class to instruct CTDOT sales clerks and sales supervisors in the operation of all configurations of the Administrative POS Terminal.

Up to 20 CTDOT staff shall may attend this course. The Contractor shall provide all course content and training materials in SCORM-compliant format.

#### **36.4.9 Handheld Fare Inspection Terminal User Training**

The Contractor shall provide a course, tailored to CTDOT training staff, on the operations of the Handheld Fare Inspection Terminal. The course shall focus on HFIT usage for CTfastrak fare inspection activities, and shall cover, at minimum, the following topics:

- General HFIT user functions
- Fare products, policies, and transactions
- Operator login and logout
- Transaction processing
- Transaction results messages and meanings
- Recharging the HFIT

Up to 5 CTDOT trainers shall may attend this course. The Contractor shall provide all course content and training materials in SCORM-compliant format.



#### **36.4.10 CTDOT Customer Service Training**

The Contractor shall provide comprehensive training to CTDOT Customer Service Representatives and Front Office APOS Terminal operators on all aspects of the NFTS that will be visible to and used by the public, and the Web Portals and tools that these CTDOT staff will employ. The course shall cover, at minimum, the following topics:

- All NFTS fare products, policies, and transactions
- Validating Farebox functionality and user interfaces
- HFIT functionality
- Retail and Administrative POS Terminal replenishments
- Use of the Mobile Ticketing Application
- Autoloading
- Action List Purpose and Function
- Use of General Public Web Portal
- CTDOT Customer Support Web Portal
- Web-based tools supporting the Mobile Ticketing Application described.

Up to 15 CTDOT personnel ~~shall~~ may attend this course. The Contractor shall provide all course content and training materials in SCORM-compliant format.

#### **36.4.11 Garage Communications Servers Administration**

The Contractor shall provide a course that thoroughly describes the procedures required to administer the GCS computers and facility Wi-Fi networks. The course shall, at minimum, provide instruction for administration, monitoring, and configuring the GCS computer hardware and software, and managing all NFTS facilities Wi-Fi networks.

Up to 5 CTDOT staff ~~shall~~ may attend this course.

#### **36.4.12 Web Portal Administration**

The Contractor shall train CTDOT staff responsible for administering the Web Portals described in Section 23. At minimum, the course shall:

- Instruct the administrators in how to configure all pages of the Web Portals
- Review all procedures to modify CDS database tables that affect Web Portal content
- Discuss the underlying design of all Web Portals
- Describe how to modify links on the Web Portals (to CTDOT and other websites)
- Demonstrate how to monitor the status and operating conditions of all portals.

Up to 5 CTDOT staff ~~shall~~ may attend this course.

#### **36.4.13 Mobile Ticket Application Training**

Contractor shall provide as part of the mobile ticketing application, online training software that provides step by step instructions for its operation. In addition, the application shall provide a section of frequently asked questions and online help to assist the user.

#### **36.4.14 Course Completion**

The Contractor shall provide at least three (3) post-training tests for each type of training course. The tests shall be administered to those who have attended the course in its entirety. These tests shall provide not less than fifty (50) questions for each completed training class. Instruction shall be concluded when 90% of the participants achieve a score of 90% or higher



on the tests. Re-tests, as needed, shall be conducted using a different post-test than the initial test used.

Each version of the test shall be provided to CTDOT as a part of each Training Plan submittal for their review and for verification that the testing appropriately reflects, the material provided as part of the training. **CDRL 36-9**

The Contractor shall issue participants completing the course in its entirety and passing the administered tests a certificate of course completion. A list of these individuals shall be forwarded to CTDOT.



## 37 Intellectual Property

### 37.1 Smart Card Encoding Schema

The NFTS shall employ machine-readable smart card fare media as secure tokens for accessing a customer's account. CTDOT assumes the smart card fare media shall utilize one or more security data schema that is previously developed for another agency and is the intellectual property of the Contractor.

The Contractor shall grant to CTDOT perpetual access rights to all information regarding the security data schema, including:

- A. Documentation defining all data fields, valid data values and ranges for each field
- B. Transaction processing effects on each data field and value
- C. Encryption algorithms
- D. All other information necessary for a skilled third party software developer to produce fare media and systems compatible with the NFTS

Collectively, this information is the "Smart Card Encoding Schema."

CTDOT agrees to only deliver the Smart Card Encoding Schema to a third party upon execution of a proper non-disclosure agreement between CTDOT and the third party, in which:

- The Contractor retains all of its ownership rights to the Smart Card Encoding Schema
- CTDOT retains its access rights to the Smart Card Encoding Schema
- The Contractor gains no ownership or access rights to any related work products evolving from the relationship between CTDOT and the third party

The Contractor shall deliver to CTDOT a complete, comprehensive, and up-to-date documentation package covering all elements of the Smart Card Encoding Schema as implemented for the NFTS. **CDRL 37-1**

### 37.2 Device Interface Protocol

The Contractor shall provide all Interface Protocols and definitions of message structure between all NFTS equipment at all levels of the system, including communication between all equipment and sub-systems and the CDS, its constituent servers and application processes. The Contractor shall submit this information for CTDOT review at the Preliminary Design Review and for CTDOT approval at the Final Design Review. (Only the documentation shall be subject to review and approval, not the protocols themselves.) This information shall become the property of CTDOT. **CDRL 37-2**

The ability to provide this information to third parties shall not be hindered by any proprietary technologies, licenses or other encumbrances.



### 37.3 Legacy System Interfaces

The Contractor shall provide comprehensive documentation defining all programming interfaces, database queries, and other communications protocols between the CTDOT legacy systems defined and the Central Data System.

Queries, Application Program Interfaces (APIs), and other Contractor-developed software for the legacy system interfaces and their associated documentation shall become the property of CTDOT.

### 37.4 Web Portal Application Program Interfaces and Source Code

The Contractor shall provide comprehensive documentation defining all Application Program Interfaces (APIs) between the Contractor-hosted web portals described in Section 23 and the Central Data System. Web Portal API documentation shall be submitted to CTDOT for review at the Preliminary Design Review and approval at the Final Design Review. **CDRL 37-3**

The Web Portal APIs and their associated documentation shall become the property of CTDOT, enabling CTDOT to select alternate hosting services upon expiration of the Contractor's web portal hosting services contract.

The Contractor shall also supply all source code for all CTDOT-specific portions and pages of the Web Portals. Web Portal source code shall be delivered separately from source code, and shall be supplied directly to CTDOT, accompanied by comprehensive documentation describing the underlying Web Portal design and other aspects as necessary for CTDOT or a qualified third party to understand, configure, administer, and modify the Web Portals.

### 37.5 Secure 2D Barcode Content

The Contractor shall provide complete documentation on the secure 2D barcode format used for the mobile ticket application and the printed barcode tickets. The document shall identify the barcode standards employed, and describe the layout, content, data field values (*i.e.*, how to interpret each data field and the definitions of each supported value), encryption algorithm, and other aspects of the barcodes in sufficient detail to enable CTDOT or a qualified developer to replicate the barcodes.

The secure 2D barcode design documentation shall become the property of CTDOT, and shall provide CTDOT license to employ the barcode formats for other CTDOT uses.

### 37.6 Encryption Keys

The Contractor shall transfer to CTDOT ownership of all encryption keys used in conjunction with Smart Card Encoding Schema and the reading and writing data from and to the NFTS smart card and barcode fare media, including working keys, master keys and transport keys. Delivery of the encryption keys shall be under separate secure cover, directly to CTDOT's Director of Information Technology, prior to System Acceptance. **CDRL 37-4**

The Contractor shall convey ownership to CTDOT of Contractor-developed tools, documentation, and procedures to securely generate (if necessary), copy (if necessary), and propagate encryption keys to devices used in the NFTS, and for propagation to devices that may be used in the future to expand the NFTS prior to System Acceptance. **CDRL 37-5**



## 37.7 NFTS Software Source Code and Documentation

CTDOT requires software source code and documentation to be provided either to CTDOT or to an escrow account to ensure that should the need arise after expiration of the warranty and the Contractor is unable or unwilling to provide technical support, the State or a software consultant will have the capability to perform any needed software modifications.

### 37.7.1 Time and Scope of Submittals

Within 30 days following final acceptance of the equipment, the Contractor shall supply software source code and documentation, in both electronic and hardcopy forms, for all software developed by the Contractor for the fare collection system purchased under this contract.

**CDRL 37-6** Contractor-produced software source code and documentation to be provided shall include all application software for the fare collection equipment and the CDS as well as any software developed for embedded microprocessors that are integrated into any modules for the fare collection equipment.

Software documentation shall provide the following:

- General description and operation
- Software architecture and basic program functions
- Data flow information
- Annotated source code listing, with comments and descriptions pertaining to each module sufficient allow an experienced programmer to understand the program
- Detailed memory map and listing
- Input/output port map

In addition to the software source code and documentation described above, within 90 days following final acceptance of the equipment, the Contractor shall also supply:

- A licensed copy of all software tools such as debuggers, assemblers, and compilers, needed to convert the supplied source code into executable form used by the target processors
- Hardware devices, such as EPROM programmers, with their accompanying software tools, necessary to transfer the executable programs onto the storage device used by any embedded microprocessor
- Documentation that describes the procedures necessary to convert the supplied source code into executable format **CDRL 37-7**

### 37.7.2 Alternative Delivery to Escrow Agent

Should the Contractor prefer, all deliverables may, within 30 days following final acceptance of the NFTS, be put in escrow with a third party. CTDOT shall select the escrow agent and pay for the escrow services. **CTDOT 37-1**

If an escrow agent is used, a complete inventory of the items deposited shall be supplied to CTDOT at the inception of the escrow. **CDRL 37-8**

At the conclusion of the Software Warranty, the Contractor shall update all software source code and other deliverable items in escrow to reflect the software and systems in place at that time. **CDRL 37-9**



## 38 System Acceptance

The Contractor and CTDOT agree that final acceptance of the NFTS system shall be contingent on satisfying all of the following conditions. CTDOT shall grant final acceptance of the NFTS when:

1. Resolution of outstanding issues have been agreed between the CTDOT and the Contractor and a resolution plan has been approved by the CTDOT.
2. All requisite contract deliverables have been delivered to CTDOT and approved.
3. All required NFTS equipment and software are delivered, installed, and operate properly.
4. All CDS software, including all required reports and system interfaces, is installed and fully functional.
5. All Web Portals are hosted, live, and fully functional.
6. All support systems and special tools are delivered, fully functional, and accepted by CTDOT.
7. All required batches of fare media have been delivered and accepted by CTDOT.
8. All testing has been successfully completed and the results accepted by the CTDOT.
9. The Disaster Recovery Exercise has been successfully completed.
10. Warranty and technical support services have commenced.
11. All required documentation has been delivered and accepted by CTDOT.
12. All required training has been provided and accepted by CTDOT.
13. All required intellectual property has been delivered to CTDOT or the escrow agent.
14. All spare parts have been delivered.
15. Corrections for all hardware fleet defects are implemented system-wide and accepted by CTDOT.



## 39 Options

### 39.1 Extended Hardware Warranty Services

If CTDOT exercises the option to extend the NFTS Hardware Warranty, the hardware warranties for all devices shall be extended for a period of two years, commencing at the conclusion of the base contract Hardware Warranty. All terms and conditions of the original Hardware Warranty shall remain in effect.

### 39.2 Extended Central Data System Hosting Services

If CTDOT exercises the option to extend services for hosting the CDS, the Contractor shall continue to provide these services for a period of an additional two years, commencing at the conclusion of the period of performance for the base contract. This option shall be reviewed again every two years to determine if CTDOT wishes to exercise the subsequent two year option. Costs for any two year option exercised shall be negotiated at that time with escalations not exceeding 5% per annum, unless justified by the Contractor based on additional services being provided or another external factor.

### 39.3 Central Data System Migration

Upon conclusion of the CDS Hosting Services (including any optional extensions), upon CTDOT's exercise of the relevant option, the Contractor shall migrate the CDS to production and Disaster Recovery facilities of CTDOT's choice. The Contractor shall install, configure, test, and commission the CDS application software and Relational Database Manager software, and replicate all historical data in the CDS database to the migration facilities.

Upon demonstrating the proper functioning of the migrated CDS, the Contractor shall activate the CDS in the new facilities and discontinue all functioning of the hosted CDS. At that time, the Contractor shall remove all data storage modules containing NFTS data, including all backup storage media, from the Contractor's hosted CDS facilities and deliver the modules and media to CTDOT.

### 39.4 Revenue Services

CTDOT will be responsible for revenue servicing of the System through the conclusion of the System Warranty period. Revenue servicing activities shall include any or all services in support of System Equipment deployed:

- Cash Container Exchange;
- Coin Supply Replenishment;
- Fare Media/Receipt Stock Replenishment;
- Cash Counting;
- Cash Deposits;
- Prepare reports on revenue and transactions and on equipment performance and status;
- Reconciliation and Settlement;
- Third Party Payment follow-up and Reconciliation.





Revenue Services shall cover only that equipment provided as part of the System and shall exclude the fareboxes and vaulting systems.

In order for CTDOT to ensure that the Contractor provides Revenue Services that meet the expectations of CTDOT and fulfill the revenue service and auditing requirements as identified within this Section 39.4, the Contractor shall provide the following for CTDOT review and approval:

- A Revenue Services Plan which shall fully describe all of the elements of the Revenue Services to be provided as well as a description of how all of its requirements shall be implemented by the Contractor **CDRL 39-1**; and
- Fully developed and documented Procedures for all revenue service and auditing services provided **CDRL 39-2**.

#### **39.4.1 Responsibilities of the Contractor**

Contractor responsibilities shall include the following, which are specified in greater detail in subsequent subsections:

- System Equipment Revenue Servicing: Remove cash-handling modules from the System equipment and transport them to a location designated by CTDOT.
- Sales Office Revenue Collection: Pick up the cash revenue receipts from sales locations at Regional Rail and Subway/Elevated stations and transport to a location designated by CTDOT.
- Equipment Change and Fare Media Resupply: Replenish change-making coin supply, Fare Media, and paper receipt stock in System equipment.
- Sales Office Fare Media Resupply: Transport Fare Media and collect Fare Media from CTDOT and third party Fare Media sales offices (sales offices).
- Cash Revenue Processing and Reporting: Count and record cash removed, and transport for deposit purposes to a banking location designated by CTDOT.
- Periodic Audit Support: Remove, transport, count and record under CTDOT direction and supervision, all coin, currency, and Fare Media on hand in a selected item of System equipment and reconcile against reports of the expected contents.
- Revenue Accounting: Maintain financial records of revenue transactions and reconcile reports from CDS, bank, and clearinghouse.
- Fare Media Procurement: Procure and supply Fare Media to be issued from the System equipment and to internal and external sales locations. Inspect and test ordered Fare Media stock as a condition of acceptance upon delivery to ensure that the products meet specifications.

#### **39.4.2 Contractor Local Point-of-Contact**

The Contractor shall identify a local point-of-contact that can be contacted by CTDOT personnel on a 24/7 basis. The point-of-contact shall be the individual in charge of local Contractor revenue service personnel at the time of the call. The Contractor shall submit a schedule each month of the designated point-of-contact at all times of each day including the phone number for contacting the individual.



### **39.4.3 Fare Media Inventory Management**

The Contractor shall procure Fare Media for the System on behalf of CTDOT and for other Fare Media on behalf of Other Transit Agencies as defined in Section 2.1.4. The Contractor shall be fully responsible for securing and controlling its inventory of Fare Media. The Contractor shall maintain records that track the location of each item of Fare Media that has been consigned, while in secure storage, in transport, in System equipment, and awaiting disposal. Unusable rolls/stacks or partial rolls/stacks of Fare Media tagged for disposal shall be secured until delivered to CTDOT for destruction. A record of possession shall be maintained at all times.

The Contractor shall include the status of the Fare Media inventory with its end-of-month reports. CTDOT retains the right to audit and inspect the Fare Media inventory for the duration of the Contract.

### **39.4.4 System Equipment Revenue Servicing**

The Contractor shall be responsible for the revenue servicing of all System equipment. Contractor shall be permitted to use elevators at the Subway/Elevated stations for the transport of the Fare Media stock and cash containers to the System equipment locations and the revenue receipts from the System equipment location back to the revenue service vehicles. Revenue service shall involve the following activities:

- Retrieving revenue receipts from station and parking equipment. This entails removing coin and bill vaults from FVDs and inserting empty vaults in their place.
- Replenishing change-making coin supply. This entails removing hoppers from the FVDs and parking equipment and replacing each with a hopper containing a full supply of coin of the same denomination as the removed hopper.
- Replenishing Fare Media and paper receipt stock. This entails removal of an empty or partially-used roll/stack of stock and replacing it with a fresh supply. The number of Fare Media installed and the serial number of the first Fare Media are entered into System equipment memory to electronically monitor stock on hand. The Contractor shall also record the serial number manually for Contractor inventory control. Serial numbers may not be provided for receipts, dependant on stock type used

All revenue-handling modules removed from System equipment shall be delivered to the Cash Revenue Processing and Recording location prior to the end of the calendar day on which the modules are collected.

The Contractor personnel performing these duties shall follow proper step-by-step procedures during this activity to ensure that personnel and the general public are safe, revenue and Fare Media remain secure, transaction and revenue records are retained and secure, intrusion alarms are not inadvertently activated, hardware is not damaged and the System equipment is properly returned to customer-ready operation.

As a final step in revenue servicing, the assigned Contractor personnel shall perform a diagnostic check to ensure System equipment readiness for customer use.

The Contractor may perform revenue servicing during time periods pre-authorized by CTDOT. No more than one item of System equipment of any type at a station shall be out-of-service for revenue servicing or PM at the same time.



The Contractor shall be responsible for monitoring status via the CDS and scheduling and dispatching crew to perform revenue service before the System equipment can no longer accept additional cash transactions, or can longer issue change or Fare Media. The Contractor shall minimize Fare Media spoilage; that is, the unused Fare Media that is to be disposed.

Personnel performing any revenue servicing activity in the field shall not have access to information pertaining to the contents of any revenue-handling modules that are removed from the System equipment.

#### **39.4.5 Office Revenue Servicing**

The Contractor shall provide the following services to the Customer Service windows at all Subway/Elevated locations. The Contractor shall service these windows as part of each stop to revenue service the System equipment at that station.

#### **39.4.6 Change-Making Supply**

The Contractor shall be responsible for filling replacement hoppers prior to their transport to the field. Each unit shall be tested prior to their use.

Coins necessary to fill the change-making units in the FVDs will be provided by CTDOT.

Contractor shall maintain adequate inventory to ensure that FVDs band parking equipment can continue to make change as necessary. The Contractor shall maintain complete and up-to-date records that accurately account for the quantity of change by denomination in inventory and delivered to System equipment. The Contractor shall transmit these records daily via e-mail or as directed by CTDOT. These records and the inventory shall be made available for inspection and audit at any time by CTDOT.

When the change inventory reaches a pre-established level, the Contractor shall provide a written request for additional coins to CTDOT. CTDOT will approve the request, if valid, and authorize the bank to make the coins available to the Contractor. The bank fulfilling the authorization shall be the same bank to which Contractor makes the deposits.

#### **39.4.7 Cash Revenue Processing and Recording**

The Contractor shall be responsible for all cash picked up from the System equipment and sales offices until such cash is deposited into CTDOT bank accounts. Prior to deposit of cash, the Contractor shall sort and count the cash. The contents of each cash container shall be recorded individually for each cash container serviced. Deposits from the sales window shall be delivered to the bank by the Contractor on the same day.

Cash processed shall be deposited no later than the business day following the day the cash was collected. Reports on the contents of each cash container serviced shall be provided to CTDOT no later than two ~~business-Working De~~days immediately following the day the cash was collected. E-mailed reports are acceptable to meet this requirement.

Contractor shall be responsible for all shortages between deposited cash and accounting reports for each cash container, unless an exception is approved by CTDOT.



### **39.4.8 Audits**

CTDOT intends to audit at least one item of System equipment per week. This will entail removing all money and Fare Media, counting the money, and comparing the results to the contents that are reported by the CDS. The Contractor shall support this effort and this shall include (under CTDOT observation):

- Remove the cash containers;
- Remove all Fare Media;
- Empty the coins from hoppers into a sealed bag;
- Inspect the System equipment interior for coin, bills or Fare Media that may have fallen loose inside;
- Transport the removed contents to the Contractor cash counting facility;
- Count and record the contents, including money and Fare Media.

CTDOT will compare the actual recorded contents to the contents expected based on CDS reports. Discrepancies shall be further investigated by CTDOT as to cause.



### 39.4.9 Performance Requirements

The following requirements shall be achieved:

- All FVDs shall be revenue serviced prior to:
  - The bill vault reaching 90% of capacity
  - The coin vault reaching 90% of capacity
  - Any change unit being void of change for a period of more than two (2) hours
  - The depletion of any fare media stock for longer than one hour
- All PPSs shall be revenue serviced prior to:
  - The coin vault reaching 90% of capacity
  - Any change unit being void of change for a period of more than two (2) hours
  - The depletion of receipt stock for longer than one hour
- All deposits shall be made on the same business day as their reconciliation with the CDS.
- Sales offices shall be fully stocked by the first business day of each week. Orders shall be filled within 24-business hours of receipt of the order.
- Reconciliation of all revenues – manually counted versus as reported by the System – shall be not less than 99.75%.

## 39.5 Extended Web Portal Hosting Services

If CTDOT exercises the option to extend services for hosting the web portals, the Contractor shall continue to provide these services, including the concomitant system administration services, for a period of 2 years, commencing at the conclusion of the period of performance for the base contract.

## 39.6 Extended Retail Sales Services

If CTDOT exercises the option to extend services for providing retail sales services these services shall be provided for an additional period of 2 years, commencing at the conclusion of the period of performance for the base contract. This option shall be reviewed again every two years to determine if CTDOT wishes to exercise the subsequent 2 year option and this shall continue until either the CTDOT or the Contractor no longer wishes the option to be exercisable. Costs for any 2 year option exercised shall be negotiated at that time with escalations not exceeding 5% per annum, unless justified by the Contractor based on additional services being provided or another external factor.

## 39.7 Extended (Post-Warranty) Software Support Services

CTDOT may exercise an option for the Contractor to supply Extended Software Systems Support, subsequent to the conclusion of the Software Warranty. If CTDOT exercises this option, the Contractor shall provide on-site and remote technical support, system configuration and administration assistance, software development, and other services as described herein



for a period of three years, with three additional two-year options. These options are exercisable at CTDOT's sole discretion at any time prior to the conclusion of this contract and any previously exercised option.

During the initial three-year period of Extended Software Systems Support, the Contractor shall make available fare collection system software development, system administration, database administration, and other technical staff as necessary, for a total of 1,000 hours of direct labor. CTDOT shall use this "bank" of labor hours on a task-order basis. If, prior to the conclusion of the three-year service period, tasks performed by the Contractor exhaust the 1,000-hour labor bank, CTDOT may request additional hours of services, to be priced on a pro-rated hourly basis, up to a maximum of 1,500 total hours. Should CTDOT request services beyond the maximum hours, the Contractor may do so at its discretion.

Any hours remaining in the labor bank at the conclusion of the Extended Software Systems Support services agreement (or any exercised option), shall remain available for CTDOT use as described herein. For every month beyond the conclusion of the services agreement that labor bank hours remain unused, hours equal in value to the pro-rated fixed monthly fee for facilities maintenance shall be deducted from the labor bank.

### **39.7.1 Support Services to be Provided**

The Contractor shall perform five basic categories of tasks as part of Extended Software Systems Support:

- Remote technical support
- On-site technical support
- Software development
- Upgrades and updates to Contractor-supplied application software
- System migration to new computer Operating Systems and Relational Database Managers

#### **39.7.1.1 Remote Technical Support**

The Contractor shall provide telephone-based technical support, Monday through Friday during normal business hours (8:00 AM through 5:00 PM Eastern Time) with an average one hour response time. The Contractor shall provide telephone-based support at all other times, including weekends, holidays, and non-business hours with an average two hour response time. Any support services initiated by CTDOT outside of normal business hours shall consume the labor bank at 1.5 times the number of hours actually expended.

#### **39.7.1.2 On-Site Technical Support**

At CTDOT request, the Contractor shall supply technical support on-site at any CTDOT office or maintenance facility, or where any Contractor-supplied equipment is installed. Qualified contractor staff shall be available to provide on-site support within five ~~business days~~Business Days Working Days of the authorization of the task order. CTDOT shall compensate the Contractor for direct travel and living expenses incurred by Contractor's staff while performing authorized task orders.

#### **39.7.1.3 Software Development**

Upon acceptance of a task order requiring modification of Contractor-developed software, the Contractor shall commence development of the requested software. The Contractor shall provide regular status updates, shall test the completed software, and shall assist CTDOT as



directed in the installation of the software change. All software development work performed under a task order issued by this contract shall be warranted by the Contractor against defects for a period of one year after installation of the software. Labor required to correct defects in software developed under this contract shall not count against the labor bank.

#### **39.7.1.4 Upgrades and Updates to Contractor-Supplied Application Software**

If the Contractor releases major upgrades to Contractor-supplied application software for the NFTS devices, GCS, or CDS while the Extended Software Support Services agreement is in effect, CTDOT may opt to upgrade its software. (It is understood that the price of the software upgrade may be separately negotiated.) If CTDOT opts to upgrade software, CTDOT may request an estimate of the Contractor labor required to test, configure, and install the upgrade on CTDOT's equipment. If CTDOT accepts the proposal, CTDOT will issue a task order to satisfy the agreed-upon scope of work.

During the term of the Extended Software Support Services agreement, the Contractor shall provide all applicable modifications, corrections, and enhancements (scheduled and unscheduled) for installed versions of Contractor-developed application software for NFTS equipment, the GCS, and the CDS. At its discretion, CTDOT may install the software update, after independently testing such updates. No hours shall be deducted from the labor bank for these software updates.

#### **39.7.1.5 System Migration**

Within approximately two years of each major release of the OEM operating system and relational database managers used as part of the CDS, CTDOT may request the Contractor to migrate the respective portions of the CDS to the new OEM releases. At such times, CTDOT shall request a quote from the Contractor for the labor required to modify, test, deploy, and document the migration of the CDS application software or database to the new OEM release. Upon acceptance of the ensuing task order, the Contractor shall perform the migration work, test the results, and deploy the upgraded CDS in a controlled fashion as approved by CTDOT. All system migration work performed under a task order issued by this contract shall be warranted by the Contractor against defects for a period of one year after installation of the software. Labor required to correct defects in system migration under this contract shall not count against the labor bank.

### **39.7.2 Contractor Personnel and Support Facilities**

During the term of this contract, the Contractor shall:

- A. Retain technical support and software development personnel who are familiar with the fare collection system equipment and software, and who are qualified to perform the tasks described herein.
- B. Retain all software source codes and development and testing environments necessary to support and modify software for CTDOT's fare collection system.

### **39.7.3 Task Order Procedures**

Within 10 days of executing an option for Extended Software Support Services, CTDOT shall notify the Contractor in writing the identity of those individuals authorized to call for remote technical support, and those individuals authorized to initiate task orders. **CTDOT 39-1**

When an authorized individual initiates a call for technical support, one half hour (30 minutes) of the labor bank shall be deducted as soon as the Contractor's technical support staff



commences work on the request. If the request cannot be satisfied within 30 minutes, the Contractor shall only continue working on the issue under the direction of an individual authorized by CTDOT to initiate task orders, and the formal task order procedure shall take effect.

Formal task order requests shall be initiated by CTDOT in writing, by email, facsimile, or other written correspondence. Upon receipt of the formal request, the Contractor shall provide a good faith estimate of the number of labor hours required to satisfy the request, the proposed start date/time for the effort, the individuals assigned to the task, and other relevant information; the Contractor shall provide the information in written form to the individual making the request. Upon acceptance of the estimate by CTDOT, the Contractor shall commence work and notify CTDOT upon successful conclusion of the task and the number of hours consumed.

Expended labor hours in excess of 50% over the approved task estimate shall not count against the labor bank; in such cases, the Contractor shall continue working until the task is completed. If the Contractor cannot or chooses not to complete the task, all hours expended on the task shall be "refunded" to the bank.

#### **39.7.4 Labor Bank Accounting**

Upon commencement of the Extended Software Systems Support Services and each month thereafter, the remaining hours in the labor bank shall be decremented by the number of authorized hours expended (net of any "refunds").

#### **39.7.5 Compensation**

The Contractor shall invoice CTDOT on a monthly basis for the contracted fixed monthly fee for maintaining the necessary facilities, and the actual authorized labor hours expended (net of any "refunds"). Each monthly invoice shall document the number of hours remaining in the labor bank, and provide an accounting by task order and technical support request of the hours consumed, including the date, time, and individual authorizing the work.

Monthly invoices shall also include travel and living costs for authorized on-site support tasks. All such travel and living costs shall be documented to the satisfaction of CTDOT, and shall be in compliance with CTDOT policies for such expenses.

CTDOT shall make payment for invoices according to the terms of this Contract.

#### **39.7.6 Early Exhaustion of the Labor Bank**

If the labor bank is exhausted before the term of this contract expires, CTDOT shall have the sole right to terminate the Extended Software Support Services option, or to continue this support agreement in effect on a month-by-month basis until the option term is complete, or until the maximum hours have been used, whichever occurs first. If the maximum hours in this option are consumed before the term of the option expires, CTDOT shall have the sole right to exercise an additional option to extend the software support services provided herein.





### 39.7.7 Software Modification Procedures

While the Extended Software Support Services agreement is in effect:

- The Contractor shall test and document all software modifications prior to delivery to CTDOT. Documentation accompanying each software modification shall include comprehensive Software Release Notes. CTDOT shall review all software modifications and documentation.
- When authorized by CTDOT, the Contractor shall install software modifications according to CTDOT-approved installation procedures. At its discretion, CTDOT may independently test and verify these modifications prior to authorizing the Contractor to install the modification.
- The Contractor shall supply software modifications to correct all defects in the fare collection system software arising from installation of any modification provided under the terms of the Extended Software Support Services option. No hours shall be deducted from the labor bank for these software modifications.

### 39.7.8 Source Code Documentation Updates

Within 30 days of each anniversary of the commencement of the Extended Software Support Services agreement, the Contractor shall deliver updates to all source code documentation, reflecting all changes incorporated to the NFTS device, GCS, and CDS software. The Contractor shall deliver these updates either directly to CTDOT or the Escrow Agent. If the Contractor delivers the source code updates to an Escrow Agent, the Contractor shall at the same time deliver an updated inventory of the escrow deposit to CTDOT. **CDRL 39-3**

### 39.7.9 Options

If CTDOT exercises an option for additional Extended Software Systems Support services, all terms and conditions shall remain in effect, and unused hours in the labor bank shall be retained. For each option exercised:

- 24 months shall be added to the term of the contract
- 1,000 hours shall be added to any unused hours in the labor bank
- 1,500 hours shall be added to the maximum hours available

## 39.8 Customer Service Call Center Services

The customer service call center will be managed and operated by CTDOT and HNS, however, if this option is exercised by the CTDOT, the Contractor shall provide appropriate staffing, office facility, equipment and materials. Contractor shall provide assistance in the use of the NFTS devices and fare media. This staffing shall be provided for the following service hours to meet the CTDOT needs and cover the operational time periods of the CTDOT System:

- 5:00 AM to 9:00 PM local time on weekdays and Saturdays
- 8:00 AM to 7:00 PM on Sundays
- 8:00 AM to 5:00 PM on Holidays

Contractor shall submit a Staffing Plan for CTDOT to approve prior to implementation of the Customer Support Center prior to commencement of installation. **CDRL 39-4**



Contractor shall submit a Customer Call Center Services Plan which shall fully describe all of the elements of the Customer Services to be performed and how all of its requirements shall be implemented by the Contractor. **CDRL 39-5**

Contractor shall submit for CTDOT review and approval prior to Final Acceptance fully developed and documented procedures for all Customer Call Center Services to be performed **CDRL 39-6**.

### **39.8.1 Functionality**

The Customer Service Call Center shall incorporate an Interactive Voice Recognition (IVR) telephone system support for customer self-service. The following duties shall be performed by the Customer Service Call Center staff as a minimum:

- Respond to questions regarding overall, basic NFTS operation
- Resolution of NFTS Media related problems, such as malfunctions
- Set up a Customer Account
- Query status, transaction history and current fare value/products for a registered Customer Account
- Query status, transaction history and current fare value/products for an anonymous Account
- Provide information on the unused value or calendar pass product remaining in a Customer Account. Unused value information shall be as of the last data upload for remote inquiries
- Permit purchase of a smart card and assignment to a registered Customer Account
- Permit purchase of a smart card and creation of an anonymous account for that card
- Accommodate lost/stolen/damaged cards assigned to a registered Customer Account and provide new media as needed
- Set up/modify a recurring payment/replenishment of a fare product for a Customer Account
- Provide Auto-replenishment set-up, modifications and discontinuance
- Resolve Complaints and Discrepancies;
- Provide Prices for fare products;
- Send out Statements;
- Accommodate Group Fares
- Provide necessary refunds - individual and system wide.
- Accept payment for an anonymous account fare product
- Modify recurring payment methods for Customer Accounts, including the acceptance of Transit Benefits
- Reply to mail-in applications for fare media and account set up
- Assist Employers and institutional entities in the operation of their systems and operations

Customer Support Center representatives shall be trained to complete calls within three minutes. Supervisors shall monitor Customer Support Center representative call lengths and shall log on for calls no later than forty-five (45) seconds after the call is received.

For each Customer call transferred to a Customer Support Representative, the Call Detail Record shall include details invoked during the interaction between the Customer and the Representative. All Call Detail Records shall be transferred to the CDS

Contractor shall be responsible for recruiting, training, managing and providing feedback to Customer Support Center representatives to ensure a professional representation of services



delivered by CTDOT to the public. ~~The Contractor is a representation of CTDOT.~~ CTDOT reserves the right to replace the Customer support management operations if performance is not ~~considered representative of acceptable, as determined by~~ CTDOT.

### 39.8.2 Performance Monitoring

The Contractor shall enable CTDOT to monitor the performance of the Customer Support Center by reporting on Key Performance Indicators (KPI) in clearly measurable terms. The following levels of performance shall be met and demonstrated through ongoing data capture and reporting:

- Time of completion of fare media order (received via mail, internet). This time shall not exceed two (2) ~~business days~~**Business Days**~~Working Days~~ after receipt of the order;
- Time for handling incoming mail requests (i.e. applications, information requests) and outgoing mail. This time shall not exceed two (2) ~~business days~~**Business Days**~~Working Days~~ after receipt of the mail request;
- Average number of seconds a caller spends waiting for a Customer Support Agent to answer the phone after being placed in the Queue. This time shall not exceed forty-five (45) seconds between the hours of identified staffed hours;
- Availability of a Customer Support Agent or the IVR to respond to Customer calls. The wait time shall not exceed two (2) minutes;
- Time between a reported lost/stolen fare media and the fare media being added to the appropriate invalid cards list(s) in the NFTS. This time shall not exceed one (1) hour between the staffed hours;
- Customer satisfaction rating of Support Center activities.

This option may be exercised by CTDOT at any time prior to the completion of warranty. For pricing purposes, the yearly cost shall be provided, using a base year of 2016. To permit exercising of the option at a later time, Contractor shall provide escalation rates for years 2017 through 2020. Which shall be applied as necessary to match the time of option execution.

## 39.9 On-Site Maintenance Services

If CTDOT exercises an option, the Contractor shall provide on-site hardware maintenance services as described herein for all Contractor-supplied devices. Hardware Maintenance Services shall include both preventive and corrective maintenance activities defined as Levels 1, 2, and 3, for an initial period commencing with installation of the NFTS and continuing for two years from the start of CTfastrak revenue service, with additional options, exercisable by CTDOT, for additional years of services as defined in the Contract documents.

The option for Maintenance Services by NFTS shall be exercisable by ~~NFTS-CTDOT~~ sixty (60) days prior to the commencement of the effort of the Contract element. The remaining options shall be exercisable by the CTDOT up to ninety (90) days prior to the expiration of the existing Contract element, unless otherwise noted.

### 39.9.1 Definitions

For the purposes of these optional hardware maintenance services, the following definitions shall apply.

Available – An NFTS device shall be considered “available for revenue service” when all user interfaces are functional, all ticket types are available, and all payment modules are functional. Exclusions include when a ticket type or payment



method is unavailable due to issues related to revenue servicing (which will be supplied by others), when data communications or other issues beyond the Contractor’s control preclude the acceptance of bank cards, failures due to vandalism, or when *force majeure* is in effect. Because availability of the CDS will also affect acceptance of bank cards, and CDS availability is separately monitored and specified, failures due to CDS unavailability are also excluded.

**Availability** – Availability shall be calculated as the percent total time devices in the population are available for revenue service, calculated at a per-minute granularity. For example, if the population includes 10 PVs, for each hour, there are 600 “PV-minutes” of possible revenue service. If during an hour, one of the 10 PVs was out of service for 10 minutes, the availability for the hour would be calculated as:

$$\frac{(9 \text{ PVs} * 60 \text{ Minutes}) + (1 \text{ PV} * 50 \text{ Minutes})}{10 \text{ PVs} * 60 \text{ Minutes}} = 98.33\%$$

For purposes of these optional services, availability shall be calculated and compliance assessed once per week.

**Weekday Morning Service** – Shall be from 6:00 AM to 10:00 AM Monday through Friday, excluding recognized holidays

**Weekday Afternoon Service** – Shall be from 3:00 PM to 7:00 PM Monday through Friday, excluding recognized holidays

**39.9.2 Service Levels**

During the Hardware Maintenance Services period of performance, the Contractor shall provide preventive and remedial repair services such that the relevant NFTS equipment achieves the following levels of performance:

- A. For weekday morning service, PVs from Downtown New Britain to Union Station (inclusive) shall achieve an average availability of 98%
- B. For weekday afternoon service, PVs north of Parkville (Sigourney Street and all stations north) shall achieve an average availability of 98%
- C. For all other times, all PVs shall achieve an average availability of 95%
- D. All MVMs shall achieve an average availability of 95%

**39.9.3 Maintenance Services**

The Contractor shall perform all preventive and remedial maintenance services, including routine refurbishments, necessary to satisfy the Service Levels.

**39.9.3.1 Warranty Services**

During the Hardware Warranty period, the Contractor shall perform all preventive maintenance, all warrantable hardware repairs, and all routine refurbishments for the fixed monthly fee stipulated for the optional Hardware Maintenance Services. The Contractor shall invoice CTDOT for the Hardware Maintenance Services, and for the cost of non-warrantable repairs or replacements, on a monthly basis according to the terms and conditions set forth in this Contract. The costs for non-warranty repairs and replacements shall be based on the MVM and PV Parts and Repair Pricing Manifest.

The Contractor shall submit the MVM and PV Parts and Repair Pricing Manifest for CTDOT review and approval no more than 90 days after CTDOT exercises the option for Hardware



Maintenance Services, or 90 days after the Final Design Review, whichever is later. **CDRL 39-7**

#### 39.9.3.2 *Post-Warranty Services*

Upon expiration of the Hardware Warranty (and the expiration of extended warranties for any repaired or replaced parts as stipulated herein), the Contractor shall repair or replace broken and defective parts at prices defined in the MVM and PV Parts and Repair Pricing Manifest. The Contractor shall continue to provide all preventive maintenance and routine refurbishments, necessary to maintain the required Service Levels, for the fixed monthly fee stipulated for the optional Hardware Maintenance Services.

The Contractor shall invoice CTDOT for the Hardware Maintenance Services, including the cost of all repairs or replacements, on a monthly basis according to the terms and conditions set forth in this Contract.

#### 39.9.4 **Services Management**

During the Hardware Maintenance Services period of performance, the Contractor shall submit a weekly report to CTDOT indicating the service levels achieved during the prior week, and the prior 12 months. At ~~CTDOT~~CTDOT's request, the Contractor shall submit comprehensive documentation in support of the calculated Service Levels, including incident reports, repair histories, operating status logs, CDS data reports, etc.

When service levels fail to achieve the levels required for the previous week, the Contractor shall provide written explanation describing the incidents or reasons for the shortcoming, and any steps being taken to prevent further occurrence.

If the Contractor fails to meet the required Service Levels for three consecutive weeks, or if achieved Service Levels for one week are more than 5 percentage points below the levels required, the Contractor shall undertake immediate steps to rectify the problems. Failure to correct such serious performance shortcomings within the next weekly reporting period may, at CTDOT's sole discretion, result in payment penalties or constitute breach of Contract.

### 39.10 Maintenance Services - by Operator

Options shall be provided for the performance of Level 1, Level 2 and Level 3 maintenance of all Contractor supplied devices which are presently defined as the responsibility of the operators. The options shall be separately available for each operator for both during and after the warranty services are provided. Duration of the support shall be as follows:

- A. For those services that are provided during the warranty, they shall be provided through the completion of the hardware warranty
- B. For those services that are provided after the warranty, they shall be provided for a period of two (2) years.

If CTDOT exercises the option to extend these maintenance services, the Contractor shall continue to provide these services for a period of an additional 2 years, commencing at the conclusion of the period of performance for the base contract. The option shall be reviewed again every 2 years to determine if CTDOT wishes to exercise the subsequent 2 year option and this shall continue until either the CTDOT or the Contractor no longer wishes the option to be exercisable. Costs for any 2 year option exercised shall be negotiated at that time with escalations not exceeding 5% per annum, unless justified by the Contractor based on additional services being provided or another external factor.



### 39.11 On-Site Technical Support

In addition to the initial on-site technical support provided at the start of revenue service, additional 60-day periods for this on-site technical support shall also be available as options to be exercised by CTDOT. Up to ten (10) such periods shall be provided, individually exercisable by CTDOT, over a two year period. This on-site support shall be provided after CTDOT's approval of start date. The support personnel shall assist in troubleshooting and correction and shall act as field instructors for CTDOT personnel who maintain, service, and use the TVMS. On-site Contractor personnel are subject to the approval of CTDOT.

### 39.12 Solar Power for Station Equipment

As specified, station equipment shall primarily operate using a wired power source. To facilitate Platform Validator equipment installation at some remote (fixed route) locations, an option shall be provided to incorporate a self-contained solar power system for these items. Effort for this wireless implementation shall include both the design of the subsystem to ensure that 24/7 operation is maintained and the equipment suffers no degradation of operation or function when the solar power is used, as well as the actual implementation at the devices in the field. The Contractor may decline bidding on this option.

### 39.13 Additional Fare Media

The Contractor shall offer options for CTDOT to purchase additional fare media, of any type used within the system and initially provided by the Contractor. The unit prices provided for these fare media shall be for the five (5) years after the commencement of revenue service for Phase 1 and shall be for any quantity of fare media up to and including the maximum identified. CTDOT shall be able to exercise the option for any fare media at any time and in any quantities desired. Contractor shall provide the fare media no later than sixty (60) days after each option for that fare media is exercised.

### 39.14 Extended System Administration Services

As part of the CDS hosting services, the Contractor is also responsible for providing all system administration services to ensure proper and secure operation of the NFTS. When the hosting of the CDS ends, CTDOT shall have the option of the Contractor continuing to provide these system administration services for a period of two (2) years. This option must be exercised by CTDOT not less than sixty (60) days prior to the expiration of the CDS hosting agreement, including any and all exercised options.

### 39.15 Option - Additional Equipment

CTDOT shall be able to purchase additional units of the equipment identified within these technical specifications through the completion of the base warranty period. Up to five (5) units or ten (10) percent of the total units of a particular equipment type shall be able to be purchased by CTDOT. All Additional Equipment purchased shall be Factory Tested and Inspected and fully warranted for two years or through the warranty period, whichever occurs later. All hardware, software, parts and modules shall be similar, compatible and perform identically with the existing units provided under these specifications.



- If the units are purchased prior to the completion of the final design review for that equipment type, the costs per unit shall be as identified within the Price Schedule-Proposal.

If the units are purchased after the completion of the final design review for that equipment type but before warranty completion, the costs per unit shall be as identified within the Price Schedule plus annual escalation based on the same year U.S Department of Commerce Producer Price Index, calculated from the date of completion of the final design review for that equipment type.

Price Schedule Form

Form A - Summary

**BASE SYSTEM**

**Total Cost**

1	Form B - BRT Stations	\$	-
2	Form C - Buses	\$	-
3	Form D - Central Data System	\$	-
4	Form E - Special Tools and Spare Parts	\$	-
5	Form F - Fare Media	\$	-
6	Form G - Fixed Costs	\$	-
7	Form H - Customer Support System	\$	-
8	Form I - Support Services	\$	-
9	<b><u>TOTAL BASE SYSTEM COST</u></b>	\$	-

Date \_\_\_\_\_

Proposer \_\_\_\_\_

Name \_\_\_\_\_

Signature \_\_\_\_\_

Title \_\_\_\_\_



**CTDOT NFTS**  
**Form B - BRT Stations**

Item	Section	Description	Unit Price	Item Total*
<b>Equipment</b>			<b>Base Qty.</b>	
1	16	Platform Validators	25	0.00
2	17	MVMs	3	0.00
3	20	HFITs	10	0.00
4	20	Spare HFITS	5	0.00
5	20	HFIT Docking Stations	10	0.00
6	20	Spare HFIT Docking Stations	5	0.00
<b>Communications and Power Hardware and Materials</b>				
7	30.6	Station Network Hardware	25	0.00
<b>Implementation/Installation Tasks</b>				
8	16	Platform Validators	25	0.00
9	30.6	Station Network Hardware	25	0.00
10	17	MVMs	3	0.00
<b>BRT, Total of Items 1 through 10</b>				\$0.00
<b>Also Entered on Proposal Form A Item 1</b>				

**CTDOT NFTS**

**Form C - Buses**

Item	Section	Description	Unit Price	Item Total*
<b>Equipment</b>			<b>Base Qty.</b>	
1	11	Validating Fareboxes	520	0.00
2	11	Spare Validating Fareboxes	10	0.00
3	22	Garage Computer System - Hardware and Software	6	0.00
4	15.2.1	Stand Alone Vaulting Stations- Validating Fareboxes	8	0.00
5	15.2.2	Through the Wall Vaulting Stations- Validating Fareboxes	5	0.00
6	15.6	Portable Data Unit - Validating Fareboxes	18	0.00
7	11.12	Spare Cashboxes - Validating Fareboxes	4	0.00
8	15.5	Audit Units - Validating Fareboxes	16	0.00
9	14	Non-Registering Fareboxes	24	0.00
10	14	Spare Non-Registering Fareboxes	2	0.00
11	15.2	Vaulting System - Non-Registering Fareboxes	4	0.00
12	14	Spare Cashboxes - Non-Registering Fareboxes	2	0.00
13	12	Stand Alone Processors	29	0.00
14	12	Spare Stand Alone Processors	6	0.00
<b>Communications</b>				
15	22	Bus Facility Communications including Wireless Access Points as required	6	0.00
16	13	Vehicle Data Communications	549	0.00
<b>Implementation/Installation Tasks</b>				
17	11	Validating Fareboxes	520	0.00
18	14	Non-Registering Fareboxes	24	0.00
19	12	Stand Alone Processors	29	0.00
20	22	Bus Facility Communications including Wireless Access Points as required	6	0.00
21	22	Garage Computer System - Hardware and Software	6	0.00
22	15.2.1	Stand Alone Vaulting Stations- Validating Fareboxes	8	0.00
23	15.2.2	Through the Wall Vaulting Stations- Validating Fareboxes	5	0.00
24	15.2	Vaulting System - Non-Registering Fareboxes	4	0.00
25	13	Vehicle Data Communications	549	0.00
<b>Buses, Total of Items 1 through 25</b>				
<b>Also Entered on Proposal Form A Item 2</b>				\$0.00

**CTDOT NFTS**  
**Form D - Central Data System**

Item	Section	Description	Quantity	Unit Price	Item Total
<b>Fees</b>					
1	21.2	Monthly CDS Hosting Fee	60		0.00
<b>Equipment</b>					
2	21	Primary CDS Hardware and Software - Hosted Operation	1		0.00
3	24.1	Test CDS Hardware and Software - Hosted Operation	1		0.00
<b>Communications</b>					
4	21.5	Network Infrastructure	1		0.00
<b>Implementation/Installation Tasks</b>					
5	21	Primary CDS Hardware and Software - Hosted Operation	1		0.00
6	24.1	Test CDS Hardware and Software - Hosted Operation	1		0.00
7	21.5	Network Infrastructure	1		0.00
<b>Central Data System, Total of Items 1 through 7</b>					
<b>Also Entered on Proposal Form A Item 3</b>					\$0.00

## CTDOT NFTS

### Form E - Special Tools and Spare Parts

Item	Section	Description	Quantity	Unit Price	Item Total
<b>Test Equipment</b>					
1	24.6	Sets of Special Tools (attach List and Quantities)	6		0.00
2	24.1	Test Lab Equipment	1		0.00
3	24.6	Portable Test Equipment per Facility (attach List and Quantities)	6		0.00
<b>Installation</b>					
4	24.1	Test Lab	1		0.00
<b>Spare Parts</b>					
5	28.3	Recommended Spare Parts (attach List and Quantities)	LS		0.00
<b>Special Tools and Spare Parts, Total of Items 1 through 5</b>					\$0.00
<b>Also Entered on Proposal Form A Item 4</b>					

\*LS = Lump Sum

**CTDOT NFTS**  
**Form F - Fare Media**

Item	Section	Description	Quantity	Unit Price	Item Total
<b>Fare Media</b>					
1	25.2	Long Term Contactless Fare Media	200000		0.00
2	25.3	Die Cut Limited Use Media (LUM)	50000		0.00
3	25.4	Roll Stock LUM	75		0.00
4	25.5	Adhesive Fare Media	10000		0.00
5	25.6	Employee Media	3500		0.00
6	25.7.3	Blank Bar Code Media Perforated Sheets	3000		0.00
7	25.7.2	MVM Bar Code Ticket Rolls	500		0.00
8	25.7.1	MVM Receipt Stock	100		0.00
9	25.7.1	Receipt Stock for APOSS (Rolls)	100		0.00
10	25.7.1	Farebox Bar Code Ticket Stock (Rolls of 800)	3000		0.00
11	25.8	Farebox Magnetic Ticket Stock	1200		0.00
12	25.7.1	Receipt Stock for HFITs (Rolls)	100		0.00
<b>Fare Media, Total of Items 1 through 12</b>					\$0.00
<b>Also Entered on Proposal Form A Item 5</b>					

**CTDOT NFTS**  
**Form G - Fixed Costs**

Item	Section	Description	Quantity	Unit Price	Item Total
<b>Fixed Costs</b>					
1	27.1	Program Management	LS		0.00
2	28	Design Reviews	LS		0.00
3	29.3	Factory Acceptance Testing	LS		0.00
4	31	Post-Installation Testing	LS		0.00
5	34	Manuals	LS		0.00
6	36	Training	LS		0.00
7	37	Intellectual Property Deliverables	LS		0.00
8	ITP	Bonds	LS		0.00
9	SLA	Licenses and Permits required by Governmental Authority	LS		0.00
<b>Fixed Costs, Total of Items 1 through 9</b>					\$0.00
<b>Also Entered on Proposal Form A Item 6</b>					

## CTDOT NFTS

### Form H - Customer Support System

Item	Section	Description	Quantity	Unit Price	Item Total
<b>Equipment</b>			<b>Base Qty.</b>		
1	19.4.1	Admin POS	6		0.00
2	23	Customer Support System Hardware and Software, Including Web Portals	LS		0.00
3	24.3	Smart Card Support Equipment	LS		0.00
4	26	Mobile Ticketing Software - Complete	LS		0.00
5		Other Necessary Customer Support System Equipment (Attach List)	LS		0.00
<b>Customer Support System, Total of Items 1 through 5</b>					\$0.00
<b>Also Entered on Proposal Form A Item 7</b>					

\*LS = Lump Sum

**CTDOT NFTS**  
**Form I - Support Services**

<b>Item</b>	<b>Section</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Item Total</b>
1	18	Retail Sales Service - Monthly - Years 1-5	60		0.00
2	33.1	System Warranty - Hardware - Monthly	24		0.00
3	33.2	System Warranty - Software - Monthly	24		0.00
4	26	Mobile Ticketing Transaction Cost per Ticket Sale - Year 1 (Pro-rated as necessary)	250000		0.00
5	26	Mobile Ticketing Transaction Cost per Ticket Sale - Year 2 (Pro-rated as necessary)	250000		0.00
6	26	Mobile Ticketing Transaction Cost per Ticket Sale - Year 3 (Pro-rated as necessary)	250000		0.00
7	26	Mobile Ticketing Transaction Cost per Ticket Sale - Year 4 (Pro-rated as necessary)	250000		0.00
8	26	Mobile Ticketing Transaction Cost per Ticket Sale - Year 5 (Pro-rated as necessary)	250000		0.00
<b>Customer Support System, Total of Items 1 through 8</b>					
<b>Also Entered on Proposal Form A Item 8</b>					\$0.00



### Option 1 - Contractor Labor Rates

#### Form O1

Hourly rates for additional services after contract award (not included in total price)

Item	Description	Hourly Rate	Annual
<b>Optional Contract Labor, Hourly Rates</b>			
1	Software Programming		
2	Mechanical Hardware Design Engineering		
3	Electrical Hardware Design Engineering		
4	Documentation Development		
5	Factory Qualification Testing		
6	Program Management		
7	Training Development		
8	Shop Labor		
9	Project Manager		
10	Project Engineer		
11	Field Electronic Technician		
12	Software and System Engineer		
<b>Other</b>			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			

**CTDOT NFTS**

**Form O2 - Optional Equipment and Support Services**

Item	Section	Description	Quantity	Unit Price	Item Total
<b>Warranty and Maintenance</b>					
1	39.1	Extended Hardware Warranty Services - All Levels, after warranty - 2 year period	LS		0.00
2	39.2	Extended CDS Hosting Services - 2 year period	LS		0.00
3	39.3	CDS Migration	LS		0.00
4	39.5	Extended Web Portal Hosting Services - 2 year period	LS		0.00
5	39.6	Extended Retail Sales Services - 2 year period	LS		0.00
6	39.7	Extended (Post Warranty) Software Support Services - 2 year period	LS		0.00
7	39.8	Customer Services Call Center Services - 2 year period	LS		0.00
8	39.9	Extended Onsite Maintenance Services - 2 year period	LS		0.00
9	39.14	Extended System Administration Services - 2 year period	LS		0.00
10	39.4	Extended Revenue Services - 2 year period	LS		0.00
11	39.10	Maintenance Services - Level 1, during warranty	LS		0.00
12	39.10	Maintenance Services - Level 1, after warranty - 2 year period	LS		0.00
13	39.10	Maintenance Services - Level 2, during warranty	LS		0.00
14	39.10	Maintenance Services - Level 2, after warranty - 2 year period	LS		0.00
15	39.10	Maintenance Services - Level 3, after warranty - 2 year period	LS		0.00
16	39.11	Extended On-Site Technical Support (60-day periods)	10		0.00
17	39.12	Solar Power for PVs - Design Effort (This Line Item Price is not Mandatory)	LS		0.00
18	39.12	Solar Power Implementation for PVs (This Line Item Price is not Mandatory)	3		0.00
19	39.13	Additional Fare Media	TBD		
20	14	Additional Non-Registering Fareboxes, 0 - 10 each	10		0.00
21	14	Additional Non-Registering Fareboxes, 11 - 25 each	15		0.00
22	19.4.1	Additional Admin POS	2		0.00

\*LS = Lump Sum

**SCHEDULE F – TABLE 1**

<b>Item</b>	<b>Vehicle Type / Location</b>	<b>Quantity</b>	<b>Total</b>
Validating Fareboxes	See attached NFTS Bus Inventory	520	530
	Spares	10	
Stand Alone Processors	See attached NFTS Bus Inventory	29	35
	Spares	6	
Non-Registering Fareboxes	See attached NFTS Bus Inventory	24	26
	Spares	2	
Platform Validators	Installed	25	25
Multi-Function Vending Machines	HNS	3	3
Front Office Administrative POS Terminals	HNS	5	6
	Spare	1	
Portable Administrative POS Terminals	HNS	1	1
Handheld Fare Inspection Terminals	CTFastrak	10	15
	Spares	5	
Garage Communications Servers (Hardware, Software, Wi-Fi Networks and Access Points)	HNS and Operators	10	10

**SCHEDULE F – TABLE 1**

NFTS Bus Inventory, approximate quantities as of December 2013

<b>CTfastrak</b>						
Year	Make	Model	# of Buses	Validating Farebox	Non-Registering Farebox	Branding
2014	Nova	LFS60 Hybrid	12			Green
2014	MCI	D4500CT Hybrid	5			Blue
2014	New Flyer	XDE40 Hybrid	18			Green
2014	Gillig	30 ft Low Floor Hybrid	9			Green
<b>Total</b>			<b>44</b>	<b>44</b>	<b>0</b>	

<b>CTTransit - Hartford</b>						
Year	Make	Model	# of Buses	Validating Farebox	Non-Registering Farebox	Branding
2002	New Flyer	D40LF	40			Blue
2003	MCI	45' Coach	7			Blue
2003	New Flyer	D40LF	14			Blue
2003	New Flyer	40' Hybrid	2			Blue
2004	New Flyer	D40LF	42			Blue
2005	New Flyer	D40LF	48			Blue
2007	New Flyer	D40LF	65			Blue
2007	Van Hool	40' Hydrogen Fuel Cell	1			Blue
2008	New Flyer	D40LF	2			Blue
2010	Van Hool	40' Hydrogen Fuel Cell	4			Blue
2010	MCI	45' Coach	8			Blue
2011	Nova	LFS60	10			Blue
2011	New Flyer	35' Hybrid	3			Blue
<b>Total</b>			<b>246</b>	<b>246</b>	<b>0</b>	

**SCHEDULE F – TABLE 1**

<b>CTTransit - New Haven</b>						
Year	Make	Model	# of Buses	Validating Farebox	Non-Registering Farebox	Branding
1996	Nova	40'	6			Blue
2003	New Flyer	D40LF	42			Blue
2004	New Flyer	D40LF	42			Blue
2010	Nova	LFS60	12			Blue
2010	New Flyer	XDE40 Hybrid	14			Blue
2011	New Flyer	XDE40 Hybrid	2			Blue
2011	New Flyer	35' Hybrid	1			Blue
<b>Total</b>			<b>119</b>	<b>119</b>	<b>0</b>	

<b>CTTransit - Stamford</b>						
Year	Make	Model	# of Buses	Validating Farebox	Non-Registering Farebox	Branding
2001	New Flyer	D40LF	32			Blue
2010	MCI	45' Coach	4			Blue
2010	Nova	LFS60	13			Blue
2011	New Flyer	XDE40 Hybrid	2			Blue
<b>Total</b>			<b>51</b>	<b>51</b>	<b>0</b>	

**SCHEDULE F – TABLE 1**

<b>CTTransit - Waterbury (Northeast Trans)</b>						
Year	Make	Model	# of Buses	Validating Farebox	Non-Registering Farebox	Branding
2004	New Flyer	D40LF	5	5		Blue
2010	New Flyer	XD35	17	17		Blue
2010	New Flyer	XD35 - Hybrid	17	17		Blue
<b>Total</b>			<b>39</b>	<b>39</b>		

<b>DATTCO - New Britain</b>						
Year	Make	Model	# of Buses	Validating Farebox	Non-Registering Farebox	Branding
2010	New Flyer	D35LF	6	6		Blue
2010	MCI	45' Coach	5		5	Blue
2010	MCI	45' Coach	9		9	Blue
<b>Total</b>			<b>20</b>	<b>6</b>	<b>14</b>	

<b>New Britain Transportation</b>						
Year	Make	Model	# of Buses	Validating Farebox	Non-Registering Farebox	Branding
2008	New Flyer	D35LF	1			Blue
2010	New Flyer	D35LF	14			Blue
<b>Total</b>			<b>15</b>	<b>15</b>	<b>0</b>	



