Technical Appendix

Technical Specification

Automatic Fare Collection System

1. Farebox

1. Farebox Functionality

1. The Farebox shall be service proven and shall be installed on the entire fixed route bus fleet for AC Transit. The contractor shall demonstrate that the equipment can be conveniently used by persons with disabilities, including persons with limited manual dexterity and persons with sight disabilities without the need for assistance or special training. The demonstration must show how persons with sight disabilities will locate the machine, have access to instructions, and carry out transactions.

2. The Farebox shall automatically identify and count all U.S. coins in general circulation, including any U.S. coins that may be issued during the service life of the Automatic Fare Collection system.

3. Coin mechanism shall be capable of processing coins at an insertion rate of not less than five items per second sustained.

4. The Farebox shall have a minimum of twenty (20) fare class presets per fare set. There shall be a minimum of 10 fare sets. The preset amounts shall be between $000.01 and $999.99.

5. The bill validator shall accept $1, $2, $5, $10, and $20 bills. The Farebox shall be capable of accepting bills of “street quality” inserted flat and unfolded. The Farebox shall accept, correctly identify, and total valid U.S. bills while rejecting and returning to the passenger torn, mutilated, partial, and counterfeit or foreign bills.

6. The Farebox shall be capable of recognizing all U.S. legal tender that may be issued over the service life of the system.

7. All U. S. coins and bills shall be deposited into a single Cashbox, securely compartmentalized to separate the coins and bills.

8. The Farebox shall be capable of electronically verifying all coins and bills inserted for fare payment. All coins and bills shall be automatically verified and identified by denomination, without operator action. All U. S. coins and bills that cannot be electronically verified shall be automatically rejected and returned to the passenger.
9. The Farebox shall assist operators with verification of the fare deposited by showing an immediate display of the value of coins and bills inserted. If the coin verification functionality is not available due to a jam or equipment malfunction, the operator shall have the ability to place the coin module into bypass mode. While in bypass mode, all coins inserted shall be directly deposited into the Cashbox.

10. Cashbox Receivers shall be installed in each of the operating facilities listed in this Section to securely transfer cash from surface vehicle to the Receiver. The Receivers shall empty the Cashboxes into mobile vaults that shall receive and store the cash. The Cashbox Receivers and the mobile vaults shall maintain complete secure separation of all coins from bills.

11. The system shall have provisions for secure transfer of the mobile vaults onto and off the money trucks that will transport the mobile vaults from each Base to the AC Transit money counting facility. The system shall have provisions for secure transfer of the mobile vaults from the money trucks into the interior of the counting room. Cash shall not be accessible by personnel or the public from the time of its insertion into the Farebox until the time of emptying the mobile vaults at the Revenue Collection Facility.

12. The farebox shall conform to the reliability requirements in this specification while in revenue service operations. The Farebox shall be accurate in its counting and data reporting, and shall be secure in its retention and transfer of data and collected revenue. The Farebox design shall keep operator intervention to a minimum while processing of fares on board the bus. The farebox shall automatically and accurately validate any and all optional fare media read by the magnetic stripe processing unit.

13. The farebox shall function under the environmental and operational conditions specified and shall be designed and manufactured to provide a high degree of security against forced entry and/or unauthorized manipulation.

2. Farebox Model and Maximum Dimensions:

1. The completed farebox will have the following specifications:
   
a. Acceptable models: GFI GENFARE Odyssey, GFI ‘Next Generation’ (optional), or an AC Transit approved equivalent version.
   
b. Maximum Dimensions: Height from the floor (including base mounting): 36.25”; Cabinet 10” x 10”. Fare collection unit: 10.15” x 9.65”.

2. The Contractor shall provide fully dimensioned scale drawings of the Farebox and base plate showing full views for each side and with the doors and covers both opened and closed.

3. Optional GFI Next Generation Model: The Contractor shall also furnish specifications, detailed design, and pricing for the optional delivery of the GFI ‘Next Generation’ Farebox, slated for production early 2013.
3. Farebox Position on the Vehicle

1. The Farebox shall be installed adjacent to the operator position in close proximity to the front door, and shall be positioned so that an entering passenger, including persons with disabilities, may easily insert the fare into the Farebox. The Farebox position shall allow the rapid and secure inspection of the OCU data or, if required, the positioning of the data probe, and convenient removal of the Cashbox from the Farebox.

2. The Farebox shall not impede the vehicle operator from ready access to the operator seat.

3. **Durable Knee Protectors For Operators:** The Farebox shall be equipped with durable padding or bumper material for the inside corner of the Farebox to protect operators entering the drivers area on the bus. Padding material must be a replaceable component that can be changed within one minute using basic hand tools.

4. Space and structural provisions shall be made for installation of the Farebox. Location of the fare collection device shall not restrict traffic in the vestibule, including wheelchairs if a front door loading device is used, and shall allow the driver to easily reach the farebox controls and to view the fare register. The Fare box shall not restrict access to the driver area, shall not restrict operation of driver controls and shall not — either by itself or in combination with stanchions, transfer mounting, cutting and punching equipment, or route destination signs — restrict the driver's field of view. The location and mounting of the fare collection device shall allow use, without restriction, by passengers. The Farebox location shall permit accessibility to the vault for easy manual removal or attachment of suction devices. Meters and counters on the fare box shall be readable on a daily basis. The floor under the fare box shall be reinforced as necessary to provide a sturdy mounting platform and to prevent shaking of the fare box.

5. AC Transit will approve the position of the fareboxes installation on all vehicles.

6. The Contractor shall provide all District approved mounting hardware and kits.

7. The Contractor shall analyze the correct placement of the Farebox on each different make and model of bus and shall provide drawings on the recommended placement for each different make and model of bus.

8. The Contractor shall ensure that the placement of the new Fareboxes meets the required maneuvering and reach ranges of ADA compliance. Relocation, removal or installation of new railings or other elements that may represent barriers that could be encountered in the vicinity of the new Farebox shall be performed as necessary to meet these requirements.

9. The Contractor shall position the farebox in such a way that oncoming passengers are not harmed in the event of an accidental fall or collision with the farebox. Optionally, the Contractor may supply farebox safety guards.
10. The Farebox position shall allow for the rapid removal of the Farebox from the vehicle. The Farebox shall be installed to permit complete unrestricted opening of all maintenance lids and doors and the cashbox access door. It shall be possible for an experienced maintenance technician, equipped with the proper tools, to remove the farebox from the bus in less than 15 minutes. In addition, the farebox top shall be removable without providing access to any fare media, coins, or bills in the farebox.

11. On all types of buses, the location of the Farebox and OCU will be established jointly between AC Transit operations personnel and the Contractor.

12. The design of the Farebox to meet all of the requirements of the Technical Provisions shall be submitted for review and approval by AC Transit.
2. Operator Control Unit

1. OCU Functionality and Mounting Options

   1. The Farebox shall be delivered with an Operator Control Unit (OCU) for operator entry of commands, passenger information and to display transactional information, errors, prompts, and other information as required by AC Transit of the operator.

   2. The OCU keyboard shall be large enough to allow easy use by the operator, and shall provide tactile and audible feedback to the operator on each key press. Contractor shall provide dimensional drawings of the OCU showing all buttons and displays and including the connection cable to the Farebox.

   3. The OCU mounting shall be adjustable to accommodate operator ergonomics.

   4. The OCU shall display operator logon and route information transferred by the CAD/AVL system.

   5. **Mounting Options:** The Contractor will provide optional mounting alternatives for the OCU with prices for each of the following mounting options:

      1. Dash Mounting
      2. Mounting to brackets secured to the farebox, placing the OCU on either the front side of the farebox or the back side of the farebox.

   6. The OCU mounting shall be adjustable, using a RAM mount or other type of mechanism that will allow simple and secure adjustments of the OCU by the operator within 10 minutes.

2. OCU Keypad and Display

   1. The OCU keypad shall have a minimum of 15 buttons, including the digits 0 through 9, ENTER, CANCEL, SHIFT and user defined function buttons.

   2. All keypad buttons shall be fully programmable.

   3. Keypad buttons shall have a second function assigned using a designated “shift” button.

   4. Buttons shall provide tactile, visual, and audio feedback. Keypad buttons shall be sealed from liquids and against foreign objects. The function of the definable buttons shall be displayed on the OCU display.
5. The OCU display shall allow the operator to monitor cash inserted, optional magnetic farecard and optional smart card transactions.

6. The OCU display shall indicate the type of fare transaction conducted, any fare problems, and other fare related messages.

7. For Optional Magnetic Media: If a magnetic farecard or smart card transaction is not completed, the farebox shall automatically reset and clear the OCU display after a user configured time limit has elapsed.

8. Cash fare registration buttons may be activated prior to, during, or after the insertion of money in the farebox to obtain a proper count.

9. The OCU display and keypad shall be used to facilitate maintenance through prompts and menus shown on the display.

10. The OCU shall have a glare resistant backlit liquid crystal display (LCD), with adjustable brightness and contrast for sufficient readability in the bus environment.

11. The OCU display shall have the capability to display the full ASCII character set with not less than 20 characters per line and a minimum of two (2) lines of text.

3. Operator Log-on Communication Links:

1. The operator shall log-on to the Farebox through the CAD/AVL system.

2. The Contractor shall ensure that the appropriate SAE J-1708 message structure is documented, implemented, and tested for this purpose. Communications error detection provided for by J-1708 and retransmission of damaged messages provided for by SAE J-1587 shall be supported by the proposed interface and tested.

3. The Contractor shall certify that the SAE J-1708 protocol within the Farebox is capable of handling all of the messages transmitted to it without loss of any messages due to capacity constraints from either the Farebox hardware or software.

4. The Farebox shall have the capability to receive consecutive J1708 messages separated by the minimum idle time described in SAE J-1708 (approximately 1.2 milliseconds apart).

5. In the absence of external SAE J-1708 login data from the CAD/AVL system, prior to the Farebox entering revenue service, the operator shall have the ability to log on to the Farebox. In this situation, the CAD/AVL system will be activated by the Farebox and the log-on or log-off process shall be established in the CAD/AVL system.

6. Successful log-on shall require a valid operator ID, and Block-ID. Operator IDs shall be securely maintained at the Base Computer System, and shall be downloaded to the Farebox.
7. **Optional Smart Card/Employee Id Operator Log In**: The Farebox shall permit the logon and activation of the Farebox using an optional smart card-based Employee ID. Operator ID may be entered via the keypad as well as using the optional smart card. This type of successful logon will activate the CAD/AVL system as described above.

8. The log-on information shall be retained in non-volatile memory. If the farebox is rebooted during revenue operation, the operator or AVL/CAD log-on shall not be required. The log-on information shall be cleared during probe.

9. The farebox shall also support relief operator log-on, supervisor log-on, and manager log-on. Non-revenue service log-on shall be possible for maintenance and revenue technicians.

10. Provision shall be included to display items entered, to display all entered selections, and to correct any mistaken entry without re-entering all previous correctly entered selections.

11. At a minimum, the following security levels shall be software configurable:
   - Normal Operator
   - Supervisor
   - In training Personnel
   - Manager
   - Maintenance Technician
   - Revenue Service Agent

12. Functions and commands requested from operators with insufficient security shall be denied, and a transaction documenting this denial shall be recorded in the Farebox transactional data. Alternatively, the Farebox shall only offer such functions that comply with the permissions for the logged-on user.

13. Upon completion of the log-on process, a log-on record shall be established defining all of the above selections, together with the date/time stamp.

3. **Operator Log-off**

   1. The bi-directional communication link between the Farebox and the CAD/AVL system will allow the operator to log-off both CAD/AVL and Farebox systems using either the CAD/AVL or the Farebox OCU.

   2. To initiate the log-off procedure the operator shall press an assigned button combination.

4. **Smart Card Communication Link Option**

   1. The Contractor will investigate implementation options for a communication link between the Farebox and the Smart Card (currently CLIPPER) device console.
2. Communication between the Farebox and the Smart Card device console may be implemented using Ethernet, J1708, or RS 232 connections.

3. A successful log on to the Farebox (whether via CAD/AVL or Farebox OCU) will activate the Smart Card device console.

4. Once activated, the Farebox will 'send' operator log on information: the operator’s badge and current route to the Smart Card device console.

5. Each Farebox log on shall activate the Smart Card device console unit and 'send' the operator log on information.

6. No communication is required from the Smart Card device console.

7. No validation inside of the Smart Card system is required.

8. A successful log off of the Farebox will initiate a log off and shut down of the Smart Card device console.
3. Farebox Passenger Display

1. Passenger Display Functionality

   1. The Farebox shall have a high intensity, industrial application type display that is visible to the passenger with normal vision at a distance of three feet and a viewing angle of 60 degrees from the top and sides. The display shall be capable of providing the passenger with information including transaction details, transaction assistance, and other messages as determined by AC Transit. The display shall be integrated with the Farebox. The Contractor shall ensure that the passenger display is ADA compliant.

   2. When fare media is processed, pertinent information shall be displayed on the passenger display. If the media is acceptable, the display shall indicate one of 20 messages. Message wording shall clearly define the transaction status in abbreviated form as necessary to fit the character limitations of the display. Value remaining on stored value media shall be displayed and amount remaining to full fare for cash transactions shall be displayed. The displayed message shall extinguish after a software configurable interval of up to 15 seconds after removal or immediately upon re-insertion of the same media or presentation of another media document. Wording on the display shall be subject to AC Transit approval.

   3. Under normal operations, when the Farebox is static for a continuous period of one (1) minute the display shall automatically extinguish, or go into a sleep mode to preserve its operating life. When a coin or bill is inserted, the passenger display shall display either “0.00”, if no monies were deposited, or the value of the monies inserted into the Farebox. As coins and bills are inserted, the passenger display shall display the amount remaining to full fare.

2. Passenger Visual Alerts

   1. To aide hearing-impaired passengers, a red and green light shall be integrated into the Farebox. The lights must be clearly visible to passengers. A green light shall indicate acceptance of all fare media. A red light shall indicate rejection of fare media.
4. Audible Signals and Feedback

1. Audible Feedback To Operator and Passengers

   1. The Farebox shall provide audio feedback or display an appropriate code to the driver depending upon certain operating conditions.

   2. Media accept or reject alerts shall be assigned to produce two unique audible tones to indicate to the operator whether the media has been processed correctly (accepted as fare paid) or rejected (not accepted for some reason).

   3. In the event that the fare media is invalid, a tone shall sound to indicate invalidity both to the passenger and to the operator.

   4. The Farebox shall be able to produce audible signals to alert the operator and passenger of errors or events, including, but not limited to the following:
      
      - Coin rejected.
      - Bill rejected
      - Bill jam.
      - Bill jam cleared.
      - Fare registered by operator command.
      - Fare registered automatically by Farebox.
      - Invalid operator command entered.

   5. The operator will have the ability to suppress any and all audible alerts.

   6. Optional Fare Annunciation: The Contractor will report on existing capabilities of the Farebox to announce to the operator the amount of fare deposited in the Farebox by a passenger, as well as the remaining amount due.

   7. Forward facing alerts should be configurable and should not be worded or displayed in a manner that will confuse the operators on the overall operational state of the farebox.

2. Cashbox Alerts

   1. The Farebox shall display codes related to a cashbox condition:
      
      - Cashbox coin area 80% full or greater
      - Cashbox bill compartment 80% full or greater
5. Farebox Memory, Tables, Transactions and Validations

1. Farebox Memory

1. The Farebox shall make use of solid-state memory for the storage of all transactional data.

2. Memory shall be retained without the use of batteries. Power spikes or transients, or the complete loss of power shall not cause any information or data contained in memory to be lost or altered.

3. The Farebox memory shall store counts of all actions with fare media that results in a message displayed and/or an audible tone produced. Data relating to the type of media shall be stored.

4. The Farebox control and management system shall be retained in solid-state memory and not require battery backup.

5. All persistent files shall be stored in solid state memory.

6. Persistent files are fare sets, functions and values of the trip category keys, class and activity data storage, Farebox door open, cashbox removed, and all other events and alarms.

2. Fare Sets

1. The Farebox shall allow up to 10 fare sets for selection either by operator command or through commands received via the SAE J1708 Interface.

2. Fare sets shall provide, at a minimum, the following information:
   - Default fare for automatic fare registration.
   - Time/day validity
   - Route/run validity.

3. The fare class available for selection within a fare set shall be software configurable. Fare classes shall be assignable to any OCU soft key to permit rapid selection by the operator.

4. Contractor shall provide details on the fare set configuration, set-up and capacities.
5. Fare set updates shall be transmitted to the Farebox by way of the Base Computer System. Fare sets shall be updated as a regular component of the daily probing sequence and shall occur within the maximum probing time specified under probing.

3. Hotlists

1. The Farebox control unit shall have two separate “hot lists” for invalid optional magnetic stripe farecards and optional smart cards.

2. All farecards shall contain a unique serial number that can be inserted into the farecard hot list to reject use of the farecard. The farecard hot list shall allow 20,000 entries without degradation of the processing time of the optional magnetic farecard processing unit or the magnetic farecard swipe reader.

3. All optional smart cards shall contain a unique serial number that can be inserted into the smart card hot list to reject use of the smart card. The optional smart card hot list shall allow 20,000 entries without degradation of the processing time of the card interface device.

4. Farebox Transactions

1. The farebox shall securely and accurately record all transactional information, including sales data, operational errors and exception conditions, passenger information, and operator commands. At a minimum, the farebox shall record data for all transactions as follows:
   1. All payment transactions
   2. Type of media processed.
   3. All operator fare classification commands
   4. Route
   5. Block
   6. Latitude and Longitude
   7. Farebox power off
   8. Farebox power on
   9. Operator log-on
   10. Operator log off
   11. Door/cover opened (including identification of door/cover)
   12. Door/cover closed. (including identification of door/cover)
   13. Successful data probe of transactional data
   14. Unsuccessful data probe of transactional data
   15. Successful download of Farebox configuration data
   16. Unsuccessful download of Farebox configuration data
17. Cashbox access door opened other than after probing
18. Cashbox access door closed
19. Cashbox removed by unique asset ID
20. Cashbox inserted by unique asset ID
21. Farebox errors and failures
22. Security errors and intrusions
23. Coin jams
24. Clearance of coin jams
25. Bill jams
26. Clearance of bill jams
27. New fare set selected
28. Lost Connection
29. Date and time of payment

2. The Farebox shall permit the operator to enter Passenger classifications through the
   OCU, which shall match such Passenger classifications to fare amounts.

3. The Farebox shall record all errors and exceptions including errors resulting from jammed
   bills or coins, mechanical malfunctions, operator errors, and all such conditions where
   the normal operation of the Farebox may be disrupted. An individual record with date,
   time, and other relevant details, shall be written for each occurrence of an error or
   exception. Errors and exceptions shall be recorded in such detail that an analysis of this
   information shall represent a full and complete picture of the Farebox performance.

4. In addition to transactional data, the farebox shall maintain running counts and totals such
   as total number of coins rejected, total number of bills rejected, and other items as
   required.

5. Under no circumstances shall the farebox discard detail data or substitute summary data,
   other than as configured by AC Transit.

6. All transaction and revenue data shall be date and time stamped to the highest resolution
   of the Farebox clock.

7. All transaction and revenue data shall be assigned a unique (per farebox) incrementing record sequence number at the time it is recorded

8. The farebox shall provide adequate data storage capacity to store accurately and securely
   a minimum of 30 days of full revenue and transactional data. When the capacity of the
   Farebox data storage is reached, the Farebox shall suspend normal service and indicate
   that data probing is required.
9. Transactional data shall be transmitted to the Base Computer System when data is probed prior to revenue service. After successful data probing, the Base Computer will direct the Farebox to delete the data from the Farebox.

10. Alternative technologies for the storage of data, which provide the same capacities and functionality, shall be permitted, subject to the approval of AC Transit.
6. Revenue Collection

1. General

1. While in revenue mode, the Farebox shall be capable of continuously and automatically accepting and verifying all coins and bills presented for payment. Coins and bills that are successfully verified shall be deposited into the Cashbox, and their value shall be displayed on the OCU and on the passenger display.

2. The default fare is “Adult Fare”. The Farebox shall automatically classify a transaction as “Adult Fare” if that amount is entered and the operator does not press a fare class key within a software configurable timeout period.

2. Coin Handling

1. The coin validator shall be capable of processing and validating coins and tokens. The coin validator shall determine the validity of inserted coins based on their metallic content and shall be capable of distinguishing between ten (10) different valid coins/tokens provided each item has a distinctive metallic signature.

2. The coin validator shall accept, validate, and count the value of pennies (1¢), nickels (5¢), dimes (10¢), quarters (25¢), and Susan B. Anthony and Sacagawea dollar coins ($1.00) and two (2) sizes of tokens.

3. The validator and associated logic shall be solid state, employing no motors or moving parts for the validation process. Coins accepted by the validator shall have their value recorded in the Farebox ECU unit. The passenger and OCU shall correctly display the fare paid.

4. The cash handling mechanisms shall accept and accurately count “street quality” coins. The Farebox shall be resistant to jams or malfunctions created by coins, or foreign objects.

5. The operator shall have the option to bypass the coin return and accept a rejected coin.

6. The coin mechanism shall allow the addition, deletion, and modification of coins and coin series quickly and easily without modification to Farebox hardware.

3. Bill Handling

1. The bill validator shall be capable of processing and validating US issued banknotes.

2. The bill validator shall not be susceptible to the accidental entry of coins.
3. The mechanism used to transport the inserted bills to the validator shall not require precise insertion by the passenger. A guide surface shall assist in the entry of the banknote into the validator.

4. The bill transport shall accept "street" condition bills including wrinkled, torn, folded, or damp bills without jamming.

5. The validator shall show a green light when it is ready to accept bills or alternatively, by means of a red light, that it is not ready or able to accept bills.

4. Currency Insertion and Rejection

1. The bill validator shall accept an inserted bill in any one of four orientations – face up, face down, either end first. The acceptor logic shall examine the inserted bill and determine its validity and denomination.

2. Invalid currency and denominations that have not been programmed for acceptance by the Farebox shall be rejected.

3. Any of the bills listed may be configured by the system for temporary rejection for policy reasons until that policy is changed.

4. All bogus bills, foreign currency, and photocopies of valid currency shall be rejected. Additionally, The Farebox shall reject:
   - Bills inserted into the transport in folded condition, thus reducing the overall length of the bill by more than 1/2" (one-half inch).
   - Bills having tears more than 1/2" (one-half inch) long.
   - Bills having internal holes or tears
   - Bills having tape or other foreign material adhering to it

5. If a bill is rejected, the transport mechanism shall reverse and the item shall be returned to the passenger.

6. Processing time shall be less than two (2) seconds per bill regardless of the denomination being processed, as measured from the time the bill acceptor begins to draw in an inserted bill until it is ready to accept another bill.

5. Bill Transport

1. The bill validator shall feed an accepted bill into a bill transport, which shall deposit the bill into the cashbox. No force shall be required to cause the bill transport to start. Solid-state devices shall be employed to start the bill transport.

2. The transport shall operate until the bill has been deposited into the Cashbox.
6. Manual Override

1. Upon examining a rejected bill and deciding that it should be accepted, the bus operator shall have the ability to activate an “accept next bill” feature using the Farebox keypad. This feature shall allow the bill validator to accept the next inserted item without regard to its validity.

2. One and only one bill shall be accepted upon activation of the “accept next bill” feature.

3. AC Transit shall have the ability to limit or prohibit use of certain features for certain denominations of bills.

4. It is understood that due to the possibility of human error manually accepted bills are to be excluded from Farebox accuracy calculation.

7. Accuracy

Valid bills shall be accepted at a rate of not less than 95% on first insertion and 99% on second insertion.

8. Unit Configuration

The currency acceptor mechanism shall allow the addition, deletion, and modification of bills and bill series quickly and easily without modification to Farebox hardware.

9. Jam Clearing and Bypass

1. The farebox shall continuously monitor the coin and bill handling systems, and shall automatically sense and report bill and coin jams.

2. All detected jam conditions shall be recorded in the Farebox transactional data, and displayed to the operator on the operator control unit display.

3. Upon sensing a jam, the coin or bill processing shall be disabled until the jam is cleared.

4. Through OCU commands, the operator will have the ability to attempt to clear bill jams, if possible. After completion of the jam clearance function, bill processing shall be automatically re-enabled.

5. In the event that the coin slot is jammed or the coin validator is inoperative, a means shall be provided to permit coins to pass directly from the coin insertion slot to the Cashbox, bypassing the coin validator. Coins processed in this manner shall not be counted or registered by the Farebox.
6. Use of the coin bypass mechanism shall not affect the security of the Farebox or the collected revenue. Activation of the coin bypass mechanism shall require deliberate action by the operator. The Farebox shall provide visual indication of the bypass to alert the operator of the bypass mode. The operator shall have the capability to deactivate the bypass with a minimum of two keypad actions. The Farebox shall note in its memory and retain for data transmission the exact times when the bypass was activated and deactivated.

7. When the coin bypass is activated, bills and optional electronic farecards shall continue to be accepted, registered and processed in a normal manner.

8. When probed, any farebox that has been placed in bypass since the last time it was probed shall emit a tone that is noticeably different from the normal probe tone to indicate that the farebox is in the bypass mode and requires remedial action.

9. The bill and coin handling units shall be designed for ease of clearing coin and bill jams while the bus is in service. The procedure to clear a bill or coin handling unit jam shall not require more than 2 minutes from start to finish.
7. Cashbox

1. **Cashbox Design and Functionality**

1. The Cashbox shall have two individual and separate compartments to receive and retain coins and bills in their respective compartments. The Cashbox shall maintain separation of coins and bills at all times. The Cashbox shall have a minimum storage capacity of 600 bills, $500 in mixed coins and 200 tokens.

2. The Cashbox shall be constructed of a durable, lightweight material. Rough service shall not cause the Cashbox to become distorted or inoperable. A fully loaded Cashbox shall suffer no operational impediment or security breach, if dropped in the upright position to a hard floor and landing on its bottom or bottom corner from a height of 36 inches. The Cashbox shall not distort when filled to capacity.

3. The Cashbox shall be designed in such a way that it securely locks during revenue service. After removal from the Farebox, the Cashbox shall remain locked until placed in a Receiver Vault as described below. The cashbox shall have an interlock that requires the Cashbox to be vaulted before it can be re-inserted in a farebox. The interlock is enabled when the cashbox is pulled from the farebox and disabled or reset by the Cashbox Receiver.

4. Cashboxes shall be interchangeable among Fareboxes. The Cashbox shall fit into the Farebox only in a singularly correct position and shall easily be placed into the ready position to collect revenue. The Cashbox insertion and removal procedure shall be designed to guide positively the Cashbox into and out of the Farebox and the Cashbox Receiver.

5. Under normal operations, the Farebox shall recognize the presence of a Cashbox properly engaged and ready for service. The absence of a Cashbox properly engaged shall cause the Farebox not to accept monies until the Cashbox is properly engaged. The method employed shall be subject to the approval of AC Transit.

6. The Cashbox shall be designed to minimize risks to personnel associated with lifting, replacing and carrying the Cashboxes between the buses and the Receivers.

7. The Farebox shall automatically monitor the level of bills and coins deposited in the Cashbox, and shall, without disclosing the contents of the Farebox, send an alarm to the operator and the CAD/AVL system via the Farebox interface when the Cashbox reaches a software configurable percentage of bill or coin capacity for appropriate action (i.e., notify dispatcher). The alarm shall remain active until the Cashbox is extracted. Separate alarms shall be provided for the bills and coins.
8. When coin capacity reaches 100% of the configuration amount, the Farebox shall notify the operator and CAD/AVL system via the Farebox interface and automatically disable coin acceptance. After coin acceptance is disabled, the Farebox shall reject all inserted coins and return them to the passenger. When bill capacity reaches 100% of the configuration amount, the Farebox shall automatically cease accepting bills. The Farebox passenger display shall be software configurable to notify passengers automatically when coin and/or bill acceptance is turned off.

9. Each Cashbox shall be delivered with a unique electronic ID that is readable by the Farebox and the vault/Base equipment counting station Receiver. This ID shall be indelibly printed on the Cashbox in text and bar code formats. All cashbox alarms shall be reported to CAD/AVL system via the Farebox interface.

10. The means and methods employed for Cashbox electronic ID shall not require electrical contacts, plugs, or other physical connections between the farebox and the cashbox.

2. Electronic Cashbox Access Door Locking System
1. The Farebox cashbox access door shall be mechanically latched.

2. The mechanism to unlatch and gain access to the cashbox during normal operation shall be by an electronic key security system that is enabled in the probe mode.

3. The farebox control system shall permit the cashbox door to be unlatched for maintenance by entering special access control codes on the OCU.

4. The cashbox door shall be capable of being unlatched mechanically from inside the farebox.

5. The electronic key shall be modifiable by downloading Farebox configuration data under a secure transmission from the Base Computer System.

6. In the event that the cashbox security door is opened longer than a configurable duration, an alarm signal shall be recorded within the Farebox memory and transmitted to the J1708 interface at the time of occurrence. The alarm shall be reported to the Base Computer System upon probing.
8. Optional Magnetic Fare Collection Units

1. MCPU

1. The District requires pricing for an optional Magnetic Card Processing Unit (MCPU) if this unit is not built into the Farebox.

2. Additionally, these specifications are applicable whether the MCPU is elected as an option or delivered as built into the Farebox.

3. Finally, AC Transit’s future use of magnetic media will depend on the outcome of the District’s fare policy review.

4. The MCPU shall perform the following functions:

   • Accept and read a previously issued magnetic farecards such as a stored ride or stored value card, transfer, or pass

   • Verify and print on valid cards as appropriate and return to passenger

   • Reject invalid cards and return to passenger

   • Upon operator command, issue, print, encode and verify a transfer, pass, proof of payment, change card, receipt, audit ticket or other agreed upon farecard from an internal cassette of blank un-encoded farecards

   • Process transfers, proof of payment, or passes with or without driver intervention. For transfers or passes processed without driver intervention, downloadable acceptance parameters shall include the ability to:

     • Permit or exclude round tripping on transfers and to permit a stopover privilege on a continuing trip.

     • Accept transfers based on direction of continuing trip.

     • Issue a transfer, day pass, or proof of payment without changing farecard stock.

     • Process optional change cards

5. Upon manual or automatic command, the MCPU shall issue a transfer or pass encoded with the conditions of use and expiration on the magnetic track and printed in human readable form. The transfer or pass shall be printed on the die cut thermal stock contained within the MCPU.

6. The MCPU shall accept previously issued transfers or passes from other AC Transit fareboxes and determine their validity and authorized use. It shall accept the transfer, read it
to determine validity, route of issue, and other agreed-upon restrictions of use, print on and
re-encode the transfer as appropriate, register the completed transaction in memory, and
return the transfer.

7. **Optional Change Card:** the MCPU shall create and issue a ‘change card’, a magnetic
farecard provided to the passenger when the currency amount inserted into the farebox is
greater than the fare the passenger is required to pay. When the bus operator selects the
correct fare product on the OCU, the change card will be issued if applicable. On subsequent
use, the change card shall function as a nonrenewable stored-value card.

8. Valid and undamaged magnetic farecards inserted will be read on the first proper insertion at a
rate of not less than 99.5%.

9. Magnetic farecard re-encoding and verification rate shall not be less than 99.9%. Re-encoding
failure is defined as a magnetic farecard that cannot be read by the MCPU after re-encoding.

10. AC Transit shall receive the ownership of the magnetic stripe format that is supplied under this
contract. Contractor may customize its existing magnetic stripe format to convey the title to AC
Transit.

11. The MCPU shall be capable of printing text in a variety of fonts and sizes in either landscape
or portrait orientation. The MCPU shall be capable of printing graphics of any size up to the
limit of the printing space on the farecard.

12. The MCPU shall have an internal removable cassette that shall hold not less than 700
cards 0.007 inches thick. The cassette shall be removable to enable additional cards to
be inserted or another full cassette inserted in its place.

13. The MCPU shall have sensors to indicate when the card stock is low, with approximately
100 cards remaining. The indications shall be visual on the driver’s display.

14. A viewing window shall be incorporated into the farebox design to permit observation of
the vertical stack of card stock in the MCPU. This window shall make it possible to
determine the approximate amount of stock in the MCPU without having to open any lids
or covers.

2. **Optional Magnetic Farecard Swipe Reader**

1. The optional Magnetic Card Swipe Reader shall permit passengers to swipe cards
through a slot easily and rapidly. The reader shall have its slot oriented so that cards can
be easily swiped from either direction. The read mechanism shall accommodate ISO Thin
Flexible Card plastic stock.

2. Valid and undamaged magnetic farecards swiped through the card reader shall be
successfully accepted and read on first proper insertion at a rate of not less than 99%.
The cumulative acceptance following second swipe shall equal or exceed 99.5%.
3. The swipe card reader shall allow automatic processing of a correctly swiped, valid magnetic card in 0.5 seconds or less. Use of the swipe reader shall not impede passenger boarding or flow in any manner. The processing time is defined as when the magnetic stripe information is beginning to be read by the magnetic reader head in the swipe reader until the display is presented to the passenger and including the validation against the full 10,000 hot card list.

3. Optional Credit Card Processing

The optional Magnetic Card Swipe Reader shall be configurable for credit card processing. Credit card transactions will be stored for subsequent uploading to the data system when the bus is probed at the bus Base.

4. Optional Smart Card Processing

The Farebox shall incorporate as an option, an integral ISO/IEC 14443 compliant optional Contactless Smart Card processing unit. The optional Contactless smart card processing unit shall comply with all fare-processing requirements. The optional Contactless Smart Card processing unit shall perform all functions without the media having to leave the passenger's hand.

5. Optional Mobile App Ticket Reader

1. The Farebox shall incorporate as an option, the ability to read a mobile app for fare processing.
9. Farebox Power

1. General

1. The Farebox power supply shall include adequate filters and other provisions to regulate the vehicle supplied power to suppress power spikes, noise and low voltage transients that could contribute to availability, erroneous signals or corruption of data.

2. The power supply shall be isolated from electrical interference caused by such items as fluorescent lights, bus alternators, air conditioning units, radios, etc. Loss and restoration of power shall not result in any corruption of the data in farebox memory.

3. The Farebox shall have a 24v operation to eliminate need for an external power converter.

4. The farebox shall monitor and record each instance of the primary power source dropping below ten volts DC. In addition, after data probing these occurrences shall be available on the Base Computer System for on-line inquiry and reporting. Power supply monitoring information may be used to determine possible problems with power systems.

5. A manually operated on and off switch shall be provided to turn off the power to the Farebox. It shall be accessible by authorized personnel only and located behind a locked door or cover. This switch shall be rugged, in construction, intended for industrial use and shall have two positions (ON/OFF). It shall be clearly labeled so that the switch handle position points to or is aligned with the conditions indicated by the label.
10. Farebox Communication with CAD/AVL System

1. General

1. The fare collection system shall communicate with the District’s computer-aided dispatch/automatic vehicle locator (CAD/AVL) system for the exchange of data and in support of integrated operational functionality.

2. AC Transit currently uses ACS Transit Management Systems (formally Orbital TMS) CAD/AVL system, and is in the process of studying available CAD/AVL systems for future procurement. The contractor shall enable bi-directional communication between the farebox and the current CAD/AVL system. The Contractor shall ensure that upon purchase of a new CAD/AVL system, farebox communication with the new CAD/AVL system will be enabled.

2. Architecture

1. External communication architecture will be designed in conformance with open systems standards. The farebox shall be provided with an asynchronous serial communications port compliant with the SAE J-1708 and J-1587 standards in addition to communications ports utilized by Contractor provided devices.

2. AC Transit is interested in alternative communication standards such as Ethernet for communication between the farebox and the CAD/AVL system.

3. Operation

1. The CAD/AVL system will be the primary log-on and log-off system for the bus operator. The farebox startup sequence shall require receipt and validation of AVL log-on information consisting of:

   • Operator ID
   • Block-ID
   • Log on date and time

2. The farebox shall monitor the J1708 interface for connection and data. If the AVL or J1708 link is determined to be out of service after several communication attempts, the Farebox will prompt the operator to log-on manually to the Farebox.

3. A connection timeout period shall be a configurable parameter. The farebox shall automatically resume communication with the AVL when the connection is restored.

4. Optional: Farebox time would sync with that of the CAD/AVL system
5. In revenue mode, as the vehicle door opens, the farebox shall automatically tag each transaction with the following information from the AVL:

- Stop location (GPS Coordinates)
- Operator ID
- Block-ID

6. Upon loss of AVL communication, the farebox shall detect invalid location (e.g., lat/long field is zero) or loss of AVL communication and prompt the operator to enter the Block-ID, which is updated automatically when the AVL communication is restored. When AVL communication is restored the farebox shall transfer the following information to the AVL system:

- Log on/Log off activity
- Farebox Alarms

7. The farebox shall enter non-revenue mode or lockout fare transaction upon operator log-off or the farebox has been idle for a time period. The farebox idle timeout shall be a configurable parameter.

8. The following alarm conditions shall be communicated to the AVL in real time:

- Cashbox full.
- Cashbox removed - Alarm shall be created whenever a Cashbox is removed from a vehicle on the road.
- Farebox bypass set – Alarm shall be created when the vehicle operator sets the farebox to bill or coin bypass mode.
- Cashbox door opened in service - Alarm shall be created when the Cashbox door is opened on a vehicle on the road.
- Maintenance Access - Alarm shall be created when any maintenance cover/door of the farebox is opened when the vehicle is on the road.
- Farebox out of service - Alarm shall be created whenever a farebox event causes the farebox to be automatically shutdown.
- Cashbox inserted – if a cashbox has been removed and inserted without being vaulted, an alarm is required. If a cashbox has been removed from a vehicle on the road and immediately reinserted. The Cashbox number shall be included with the message.
- Media level below a preset number
11. Data Transmission and Reporting Systems

1. General

1. The data transmission system shall consist of the following:

   1. Data probes with appropriate supporting poles and lock boxes to secure probe when not in use
   2. Junction boxes
   3. Interconnecting cabling
   4. Lightning protected isolation boxes
   5. Support Equipment
   6. Portable data probe system

2. Manufacturers wishing to make substitutions to the above list must propose those substitutions at the time of proposal. Proposals should provide a complete description of the proposed data transmission equipment, listing all hardware and software to be provided, with name, model, version number.

2. Basic Probing

1. The Base computer system shall provide the necessary transmission requirements, error checking and data input parameters, for the reliable transfer of data between farebox, cashbox receiver and the AC Transit Base Computer System.

2. As part of the revenue service process, and prior to the removal of the cashbox, the Farebox shall be connected to the Base computer system for the transfer of revenue and transactional information from the farebox and for transmittal of operational updates to the farebox. Probing in this context shall mean the bi-directional communications, using a data probe and/or wireless access points and shall be based upon industry standards.

3. Probe access security shall be guaranteed by use of cryptographic authentication prior to all probe functions. At no time shall a cryptographic key be stored or transmitted wireless.

4. After revenue and transactional information is transferred to the Base computer system, any control or configuration information required including operational software updates shall be downloaded from the Base computer system to the farebox. The standard information to be transmitted by the farebox, and received and stored by the AC Transit Base Computer System shall include all data accumulated by the farebox since its last probing.

5. After configuration information is downloaded from the Base computer system to the Farebox, a coded number is transmitted to the Farebox, causing the 'unlocking' of the cashbox and allowing the cashbox to be removed.

6. The probe shall clear all logon data.
3. Optional Data Integration with AC Transit WLAN

1. The Contractor shall provide design documents with technical specifications for integration between the farebox and the garage computer via wireless WLAN.

2. The Contractor shall be responsible for system security and firewall protection with the use of wireless communications. The latest techniques for machine security shall be employed and shall require approval of AC Transit.

4. Portable Data Probe System

1. The portable data probe system shall consist of a standard data probe and a portable, industrial grade, controller/data storage unit, such as a laptop.

2. The portable data probe system will allow the updating of fareboxes and collecting farebox data from buses, as well as testing farebox equipment.

3. The laptop shall act as a test or ‘mini’ garage computer, fully installed with the base data system.

4. The portable data probe system shall function in the following manner:
   a. Accept date and time and other update information for the fixed data system computer for transmission to fareboxes
   b. Receive and store all raw data transmitted by the fareboxes during probing, including accuracy checking that all data has been transmitted accurately.
   c. Reset all farebox daily counters to zero position
   d. Unlock the farebox security door
12. Security and Access

1. Security Design

1. The farebox and fare collection system shall be designed in a manner that establishes a direct audit trail between revenue deposited into the farebox (“registered revenue”) and revenue counted in the money room (“deposited revenue”).

2. The fare collection system shall provide the following functions to support the secure revenue audit trail:

   • Each Cashbox shall be delivered with a unique electronic ID resistant to duplication and counterfeiting.
   • The Farebox shall read the Cashbox electronic ID upon insertion of the Cashbox and periodically during revenue service.
   • The Farebox shall record and track all revenue deposited into the Cashbox, along with all other transactional detail information, and shall report this data to the Base Computer System when probed for data during revenue service.
   • The Farebox shall be capable of storing no less than thirty (30) days of full revenue and transactional detail information, without resorting to storing such information in summary form.
   • The Cashbox shall close securely and automatically lock prior to removal from the Farebox, and the Cashbox shall be designed to prohibit removal from the Farebox unless it is in a closed and locked state.
   • Upon removal from the Farebox, no revenue within the Cashbox shall be visible or accessible.
   • Unlocking of the Cashbox to access the revenue shall not be possible without the “Cashbox revenue key,” which shall be available only in the money room or Receiver/vaults. Alternative mechanisms for unlocking the Cashbox will be considered as long as they maintain revenue security.

3. Cash Vaults shall have both a visible and an embedded electronic unique identifier code or serial number. Embedded ID shall be readable by other components of the fare collection system.

2. Cashbox Access Door Security

1. A set of contacts shall be provided to indicate the cashbox door open. The contacts shall be pre-wired for external termination. The Contractor shall be responsible for connection to the ACS terminal and for verifying proper operation of the interface.
2. Cashboxes and Cashbox Receivers shall have a common Cashbox key. If the removal and insertion of a Cashbox into the Farebox or Cashbox Receiver is awkward and/or lends itself to damaging or misaligning the Cashbox, Farebox, Cashbox Receiver or lock/key mechanisms, the system shall be rejected. Alternative vaulting concepts, which provide the same security and similar access controls, shall be considered.

3. Lock combinations and keys for all identical functions shall be keyed alike. Different combinations shall be provided for each function. Keys shall be separately serialized to permit easy insertion into the key control program.

4. Cashbox shall lock into Farebox housing with an electronically activated lock to prevent unauthorized removal.

5. Cashbox must securely close and automatically lock prior to removal from the Farebox.

6. Access control card based farebox security and access system for revenue collection and maintenance is a preferred method.
13. Farebox Self Test and Diagnostics

1. General

1. The Farebox shall automatically test all components and functions on every power up. Errors detected during this self-test function shall be recorded in the Farebox transactional data, and displayed to the operator on the OCU display.

2. The performance of the Farebox shall be continuously monitored during operation, and all errors, exceptions, and anomalies shall be recorded in the Farebox transactional data reported to the operator on the OCU.

3. All circuits within the Farebox shall be designed to permit testing and/or voltage measurement of the various components/boards through designated test points that are clearly indicated and accessible. If test points are not provided, the use of extended boards is permissible with AC Transit approval.
14. Base Computer and Central Systems

1. General

1. Each operating garage will contain one base computer system. The Base Computer System, or Data system, shall provide the necessary transmission requirements, error checking and data input parameters, for the reliable transfer of data between farebox, cashbox receiver and the Central Computer System.

2. The standard information to be transmitted by the farebox, and received and stored by the Base Computer System shall include all data accumulated by the farebox since its last probing:

   1. All transaction level data
   2. The date and time of probing
   3. The bus number and farebox number
   4. The stored operator badge numbers.
   5. The Block-ID numbers.
   6. The cumulative number of times the farebox has been probed.
   7. The date and time of the last six probes, including the probe number
   8. The revenue totals.
   9. Bill, coin, and optional smart card fares
   10. Selective registration of fares (e.g., key categories 1-9)
   11. Cashbox number
   12. All alarms activated with the date and time alarms were activated.
   13. Card serial number identified as hot list items sensed.

3. The transmission of data from the farebox to the Base Computer System shall not exceed three (3) seconds for all data identified.

4. Optional Bus Stop Database: The Base Computer System shall optionally store the AC Transit Bus Stop Database, enabling the correlation of GPS coordinates to AC Transit Bus Stop ID numbers in AC Transit Farebox transactional reports.

5. The Base Computer System shall download into the farebox memory new fares for the presets, associated keypad values and the serial numbers of negative listed cards each time a farebox is probed.
6. The Central Computer System shall be used to enable these updates, such as fare changes and time changes. Updates are transferred from the Central Computer to the Base Computer System, which shall be used to update the fares, and the time within each of the fareboxes being probed. These updates shall include as a minimum:
   • Values of the preset full fares,
   • Values and function of each individual operator keypad button
   • Time of day shall automatically be transmitted to adjust the clock in
     the farebox.
   • Hotlist of invalid pass numbers and optional smart cards
   • Positive list of optional smart card numbers ready to receive autoload.

7. Upon successful uploading and downloading of all data between the farebox and the Base Computer System, the farebox shall allow the opening of the revenue door to permit removal and vaulting of the Cashbox.

8. Optionally, all other transactional data may be sent via the wireless communications mechanism. The Contractor shall be responsible for system security and firewall protection with the use of wireless communications. The latest techniques for machine security shall be employed and shall require approval of AC Transit.

9. The Base Computer system shall run on a commercial Microsoft operating system that communicates over a network using TCP/IP. The physical media shall be any mixture of land-based or wireless based technologies. The Base Computer systems shall be server based hardware with RAID 5 storage and backup software.

10. The Base Computer System will be installed in an industrial environment and shall be qualified for normal operation in that environment.


12. The Base Computer System database shall be compatible with standard reporting tools using Contractor supplied report building capability or commercially available database report builder applications.

13. All data shall be exportable to an external computer on the network. The export format shall be selectable and shall include Microsoft Excel, CSV compatible formats.

14. The Base Computer shall be complete and fully functional, with all necessary items of hardware and software installed and tested, and shall be furnished with such software licenses as may be required.

15. The Base computer system shall include the software for changing the fare structure in the Fareboxes. The fare structure information is as specified for the Central computer system.
2. Power

1. An uninterruptible power supply (UPS) shall be provided for each Base computer. The combined data system and UPS shall insure accurate transmission of data between a farebox and the Base computer. The UPS shall isolate the Base system from power fluctuations as stated below:

3. Role Based Access Control

1. A Role Based Access Control security feature shall be provided for AC Transit administration of access to the farebox management and control system software, files, the Base Computer System applications and data files and the Central Computer System. Access to farebox raw data files, Base Computer files and applications shall be defined by roles within each AC Transit organization with responsibility or rights for use, maintenance and security. The Role Based Access Control feature shall allow AC Transit to define rules and access rights within a role.

4. Central Computer System

1. The Central Computer System will operate on a single server that will contain all data from the four garage computers.

2. The Central Computer System must operate on an MS SQL Server 2008 R2 Windows platform.

3. The Central Computer Server must operate in a VMware server virtualization environment.

4. Authorized users that make fare structure changes must be able to access the Central Computer via Remote Access from their workstation and successfully make necessary changes that will download to the Base garage computers.

5. Fare changes and time changes will download from the Central Computer to the Base computers, then to the fareboxes via probes.

6. Daylight Savings Time changes will be managed from the Central Computer. If the Daylight Saving Time changes, the date and necessary parameters will be changed in the Central Computer. This information will download to the Base Computers at each garage, and will subsequently download to the fareboxes through the probe. On Daylight Savings Time day, the time will automatically change accordingly, based on the parameters that were downloaded.

7. The Base Computer system will stay in constant communication with the Central Computer system for download to the fareboxes.

8. Once per day, the base computer system will upload daily fare transaction data to the Central Computer System. The times for the system upload will be configurable for each garage.
9. The farebox shall accurately maintain date and time and/or day of week and time. The date/day of week and time data shall originate at the Central Computer System and shall be distributed to each farebox by the Base Computer System when the farebox is probed. The process of updating time/date and maintaining the system in synchronization shall be clearly explained in the Contractors proposal. The farebox electronic time clock shall not deviate more than 15 seconds between probing, and time and date shall be protected from a power failure for at least 14 days. The clock shall use the presently employed Network Time Protocol for the update of date and time information at the Central Computer.

10. The Central Computer System will provide data archiving with configurable data retention values.
15. Base Revenue Collection System

1. Stationary Vault

1. The cashbox in each farebox shall be ‘unlocked’ for removal when the farebox receives and electronic code from a probe device.

2. The revenue deposited into the Cashbox in each farebox shall be transferred manually to a stationary vault. The stationary vault will consist of a Cashbox Receiver, secure vault housing and a Mobile Bin.

3. The Cashbox Receiver shall accept a Cashbox and by means of a mechanism operated in a secure manner. The Receiver shall open the Cashbox and discharge its contents (coins and bills) into separate compartments in the Mobile Bin located below the Receiver.

4. The Mobile Bin shall accept the separated coins and bills from the Receiver and store them in separate compartments. The Mobile Bin shall be removable from the vault structure but only in a closed and locked condition. The Mobile Bin structure and design shall permit lifting by a forklift for transport to the money counting room.

5. The vault structure shall be permanently installed. The vault structure and appurtenances shall be installed in the existing vault room at each Base division. The Contractor shall specify the installation, structural, environmental and power requirements to operate and maintain the vault system. The specification shall be detailed for AC Transit assessment of the impact of the Contractors vault system on cost and resources. The specification shall be quantitative and delineate construction and installation details.

2. Data System Interface

1. Each Cashbox Receiver System shall be connected to the Base garage Computer System via a serial communications link. The Base computer system shall be capable of automatic tracking of cashboxes and the mobile vault by a unique identification number.

3. Cashbox Receiver

1. The Cashbox Receiver shall have a mechanism at the top of the vault into which a Cashbox is inserted. The Cashbox shall be accepted by the Receiver in one and only one orientation for revenue transfer. The Receiver shall have a heavy interlocked door and designed so that the Cashbox is positively guided in and out. Once the door is closed and locked the Cashbox contents shall be securely transferred into the dual compartments of the vault. The Receiver door shall remain locked until the revenue transfer process is complete. During the transfer process, neither the interior of the cashbox nor the vault shall be visible nor shall access be allowed.

2. The revenue transfer process shall be manual in operation, require no electrical devices or components. In the event of power or battery failure, it shall be possible to continue transfer revenue in a secure manner.
3. The revenue transfer process shall take no longer than ten (10) seconds, as measured from the time the cashbox receiver door is closed until the door is opened.

4. Keys shall not be required to operate the Cashbox Receiver in normal revenue transfer use. All engagements and/or alignments shall be positive and automatic.

5. All Cashbox Receivers shall be of the same dimensions and shall accept all Cashboxes supplied under this contract.

4. **Vault Housing**

   1. All parts of the vault shall be made of non-corroding or plated materials or shall have been cleaned, prepared, and painted with weather resistant coating. The front surface, door and interior of the Receiver shall be stainless steel for corrosion resistance and wear. All doors on the vault and Receiver shall be structurally rigid with heavy-duty hinges, with high security locks.

   2. The interior of the vault shall have guide rails and plates to guide and correctly position the Mobile Bin upon insertion. The vault shall have mechanical interlocks that sense the presence of a Mobile Bin properly seated and ready for operation. If the interlocks are not satisfied, the Cashbox Receiver will not accept or process a Cashbox.

5. **Mobile Bins**

   1. The Mobile Bin shall be configured with two separate interior compartments, one for coins and tokens and the other for U.S. bills and tickets. During the revenue transfer process, the coins from the Cashbox will go into the coin compartment while the bills and tickets will remain separated from coins and go into the bills and tickets compartment.

   2. The Mobile Bin will have two large revenue discharge doors, one for coins and one for bills. Each door will be secured by a high quality security lock. Coins will be discharged from the bin by gravity using sloped stainless steel bottom surfaces to aid in the process. Revenue discharge doors and openings will be securely designed to prevent exposure of revenue except when opened in an authorized manner.

   3. The Mobile Bin shall have capacity to hold not less than a total of 10,000 in "street" money bills and not less than a total of 10,000 in coin and tokens.

   4. All of Mobile Bins provided under this contract shall be identical in manufacture and dimensions and shall be interchangeable between any of the Cashbox Receivers and vault housing. The Contractor shall submit braking system design for approval at the Preliminary Design Review.

6. **Revenue Audit Unit**

   1. A revenue audit unit shall be provided for the purpose of emptying a Cashbox and examining the contents without the use of a vault.

   2. The unit shall be provided with a high quality security locking system to secure the containers into which revenue is emptied and to prevent unauthorized use.
16. Warranty

1. General

1. The Contractor shall warrant to AC Transit that all of the equipment furnished under the procurement shall be free from defects in material and workmanship under normal operating use and service.

2. The Contractor shall provide such a Warranty beginning at the time of final acceptance of the system and continuing for a period of two (2) years on all equipment, with an extension at AC Transit's option to a total of three (3) years.

3. The Warranty shall cover all parts and labor costs during the Warranty period.

4. It is expressly understood that this Warranty covers all parts and labor costs necessary and that all cost for the necessary labor and material during the Warranty period shall be borne by the Contractor and not by AC Transit except as provided for herein.

5. The Contractor shall also agree to provide all labor and material to replace, during the period of this Warranty, without expense to AC Transit, any and all parts which may be damaged due to defects in, or failure of such parts or of any other part or parts of the equipment furnished under the Procurement.

6. AC Transit shall maintain the equipment in accordance with the Contractor's instructions in order to maintain this Warranty, and the Contractor shall be responsible for all shipping charges.

7. The Contractor shall be solely responsible for all materials and workmanship, including all specialties and accessories, whether manufactured by it or others, used in the construction of the fare collection system and for adequate installation and connection of all equipment, accessories, specialties and components. Under no condition shall Contractor delegate this responsibility to suppliers or other sources.

8. Any apparatus, device or material which experiences an "item" failure during the warranty period shall be brought to the attention of the Contractor by AC Transit at the conclusion of the first year but prior to the expiration of the Warranty. The Contractor shall be required to repair or replace the apparatus, device or material (at his determination of the problem and its cause) at no expense to AC Transit.
9. Should a "fleet defect" occur during the warranty, the Contractor may be required by AC Transit to extend the Warranty on that item or class of equipment until the fleet defect problem has been eliminated. A fleet defect shall be defined as a defect, failure or malfunction that affects 5% or more of any class of equipment delivered under this contract, or a systematic defect in the data system, software, several receivers or other subsystem, that affects the ability of the fare collection system to achieve its intended purpose. The determination of a "fleet defect" shall be by AC Transit and shall assume that all equipment within its respective category has these defects and shall ultimately experience these same failures.

10. In the event the Contractor fails to comply within ten working days to a request by AC Transit to repair, replace or correct damaged or defective work, materials, specialties, equipment and accessories, AC Transit shall, upon written notice to the Contractor, have authority to deduct the cost of labor and material incurred by AC Transit itself in making such repairs from any compensation due or to become due the Contractor. In the event the Contractor has been paid, the Contractor agrees to reimburse AC Transit for the cost thereof.

11. It is understood, however, that the said Warranty or Guarantee will not apply to any equipment which has been repaired or altered without the knowledge or consent of the Contractor and which repair or altering affected its stability and/or reliability; nor will said Warranty or Guarantee apply if the equipment has been subjected to other than normal use under conditions which prevail in AC Transit service. The burden of proof for any negligence on the part of AC Transit shall rest with the Contractor. Temperature, humidity, bus vibration and ambient electric conditions shall be considered normal operating conditions for this equipment. The Warranty shall not cover the replacement and maintenance items (such as light bulbs) made in connection with normal maintenance service.

12. AC Transit does reserve the right to perform 'hot swaps', the exchange of faulty components, subassemblies, or equipment, for working components, subassemblies, or equipment into Farebox equipment by qualified AC Transit staff at the Contractor’s consent and expense during the warranty period.

13. Labor costs for AC Transit to diagnose and to exchange faulty components, subassemblies or equipments and the shipping costs to return such items to a service location nominated by the Contractor for repair or replacement as provided for herein shall be at the expense of the Contractor. In event of a "fleet defect" labor to exchange faulty components, subassemblies or equipments and the shipping costs to return such items to a service location nominated by the Contractor for repair or replacement as provided here shall be at the expense of the Contractor. The shipping costs, including packing and insurance, to ship repaired or replaced items to AC Transit shall be at the expense of the Contractor.
14. The Contractor shall provide or approve service locations near AC Transit facilities that stock spare parts, thus allowing for expedient shipping of replacement parts.

15. Contractor guarantees that a stock of replacement parts for the system, and all components thereof, will be available for a period of not less than 15 years after the date of acceptance of the completed system under this contract by AC Transit.

16. The above warranties are in addition to any statutory implied warranties or remedies imposed on the Contractor.
17. Testing

1. Contractor Testing

The Contractor shall test each item of equipment provided under this Contract to assure that it is compliant with the specifications and is free of manufacturing and/or material defects. The Contractor shall submit to AC Transit evidence in the form of test reports that the equipment has been tested to operate in the stated environment and electrical conditions.

2. Factory Inspection

1. If desired by AC Transit, a factory inspection may be scheduled at the Contractor's facility, prior to shipment of any equipment. This test shall review at least five of the fareboxes to be provided, observe farebox operations, and samples of all reports to determine that they are correct and complete before any equipment is shipped. A sample revenue collection vault and mobile bin from the order to be provided to AC Transit shall be provided for inspection.

2. In the event it is determined that any equipment does not pass inspection, the Contractor shall be required to make such changes as are required to bring the equipment into compliance before any equipment will be shipped. Further inspection by AC Transit at the Contractor's facility may be required in this case. If such additional inspection is required, travel and per diem cost for AC Transit's designated personnel shall be at the Contractor's expense.

3. A decision by AC Transit not to conduct an inspection at the Contractor's facility, or failure of AC Transit's representatives to identify defects in equipment or services in the course of such a test, shall not relieve the Contractor from any obligations under the Contract.

3. First Article Testing

1. The first article tests shall be conducted by the manufacturer and may be observed by AC Transit representatives. Each equipment type shall be tested against three test procedures, as shown in the following table. The procedures include tests for compliance with functional, maintenance and interface specifications.
2. In the event the manufacturer has already conducted substantially similar tests to those described herein, AC Transit may be willing to accept the results of those tests as satisfying the requirements of this Article. The procedures and results of any such tests must be submitted to AC Transit for review at least 60 days prior to scheduled conduct of the First Article Test.

3. Contractor shall be responsible to maintain a complete log of all First Article Tests conducted under this Article, showing each test conducted and results. This log shall be submitted to AC Transit at conclusion of the First Article Test for review and approval. Results not meeting specification requirements are to be fully documented and explained by the Contractor and a plan for corrective action submitted. AC Transit may delay delivery of any equipment until First Article Test procedures are successfully completed and documented.

### 1. Functional Test

1. The purpose of this test is to demonstrate that for each item of equipment the functions specified throughout this document, including all limiting conditions, are met. Each equipment shall be required to execute all hardware and software functions, as detailed in these specifications and meet the performance criteria requirements. The procedures for handling maintenance (troubleshooting, fixing faults, etc.) and service functions (replacing paper, emptying cashboxes, extracting data, etc.) shall also be demonstrated.

2. Each test conducted shall be repeated a minimum of three times prior to confirming success or failure. Each equipment shall have passed the functional test before the environmental tests are started.

3. The contractor shall be responsible for developing a functional test procedure that satisfactorily demonstrates all equipment functions, including Ethernet or J-1708/I587 compliance, and shall submit this test procedure to AC Transit for approval at the Final Design Review.

### 2. Maintainability Test

1. The contractor shall conduct a maintainability test of the equipment. The purpose of this test is to demonstrate that each of the equipment types tested conforms to the specified maintainability requirements. This will be accomplished by introducing faults into the equipment and then measuring the time required for a technician to correct the fault.
2. At the Final Design Review the Contractor shall submit to AC Transit a list of the faults to be introduced into the equipment. The list of faults shall represent at least 100 known failure mode for each unit of equipment. Next to each fault, the contractor shall identify a reasonable time limit for repair performed by an average technician, based on field experience with the equipment. AC Transit must approve this list prior to conducting the maintainability test.

3. The test shall be conducted in the following steps:

   a. The contractor shall provide multiple units of each type of equipment and introduce failed components, maladjustments and incorrect settings into the equipment. The simulated failures shall be introduced in proportion to their expected failure rate.

   b. The contractor's maintenance personnel shall be unaware of the simulated failures and shall be assigned to repair the equipment.

   c. The repair times shall be recorded and compared with the advance list provided by the contractor.

   d. All results will be reviewed by AC Transit.

4. **Equipment Interface Test**

   1. The Contractor shall perform the Equipment Interface Test. The purpose of this test is to demonstrate that all units of fare collection equipment operate correctly together as a system and that all hardware, software and data transmission functions are as specified.

   2. One hundred fares, including a selection of pass, ticket, coin, and bill fares shall be entered into the fare collection system. The operations of the complete system shall then be demonstrated including:

      - Exchange of data between the CAD/AVL system and the Farebox
      - Optional communication sent to the Smart Card device console
      - Wi-Fi uploading of data to the base Computer system
      - Comparison of transmitted data to actual data entered
      - Reporting all data in fully transactional format, suitable for database reporting and summarization
      - Emptying of the cashbox and operations of all related hardware functions
5. Environmental Test

1. Contractor shall provide certification to AC Transit that all equipment has been subjected to environmental testing that proves the suitability of the system or subsystem to the environment in which it is intended to operate. This shall include temperature, vibration, shock, electromagnetic interference, and radiated electromagnetic energy. Contractor shall supply certification for these tests to include test protocols and procedures, actual test data documenting the appropriate tests performed on the equipment and having successfully tested the equipment in conditions that simulate or duplicate transit in-service conditions. The Contractor shall supply to AC Transit the name, address and phone number of all testing facilities used to perform such testing.

6. Installation Acceptance Test

1. Before any equipment is permitted to go into revenue service, a functional test shall be conducted on all installed equipment. This test shall be performed by the Contractor as part of the installation procedure. The installation acceptance test shall be a sequential operation of all fare collection and processing functions on board the bus.

2. The Contractor shall submit a plan for the Installation Acceptance Test at the Final Design Review. Satisfactory performance of the installation acceptance tests shall be documented by the Contractor and approved by AC Transit.

7. Pilot Testing by AC Transit

1. At Final Design Review, AC Transit will submit plans to conduct a Pilot installation acceptance test at a single AC Transit division.

2. An initial pilot test will consist first of a ‘mini fleet’, an AC Transit approved quantity of installations, no less than 1 bus per vehicle series.

3. Upon successful completion of the mini fleet test, all equipment including all fareboxes and associated equipment, as well as the Data System and the Central Computer System shall be installed and tested at that location.

4. Determination of the administration, schedule, duration, acceptance criteria, and actions upon failure for the pilot test will be made by AC Transit and the Contractor at Final Design Review.

5. Equipment shall be tested by AC Transit to ensure that it is compliant with the specifications, and performs in an acceptable manner.

6. After successful completion of the ‘mini-fleet’ test, the Contractor will be given clearance to begin installation of the remaining buses at the pilot division.
7. Upon successful completion of testing at the pilot division, the Contractor will be given clearance to begin installation and testing at the next division.

8. Failure at any level during the pilot test will require the Contractor to make corrections or adjustments to the equipment, after which pilot testing will start over.

9. Payments tied to pilot testing will be withheld until successful completion of testing.

10. Contractor shall be required to complete all training at the division prior to initiation of acceptance testing.

8. Final Acceptance

1. Final Acceptance will occur upon acceptance by AC Transit of all critical items, including but not limited to AC Transit verified successful operations of all delivered farebox equipment at all AC Transit divisions, AC Transit approved documentation, and training. AC Transit approved acceptance criteria will be defined by the time of Final Design Review.
18. Training

1. General

1. Contractor will provide AC Transit with a proposed training outline for AC Transit approval at the Final Design Review

2. AC Transit reserves the right to video or record training presentations for its sole use without further costs, obligation or liability

3. The Contractor's instructor will be well versed in the designated training area

4. AC Transit reserves the right to ask that an instructor be replaced or to request a particular area of training be repeated

2. Training Outline and Manuals

1. Each Training outline shall include:
   
   a. Topics to be covered
   b. Description of Training media to be used
   c. Training time expected
   d. Identification and credentials of Training instructor
   e. Identification of audience type

2. The Contractor shall provide detailed training manuals for AC Transit approval no less than 30 days prior to commencement of training.

3. Operator's Training

1. The Contractor shall provide to AC Transit experienced and qualified instructors who shall conduct one-day classes at the AC Transit Training facility.

2. This training program shall be oriented toward AC Transit Trainers who will in turn train AC Transit operators.

3. The training program shall include the operations of the farebox and log ins to the related onboard systems, and shall make use of one of the fareboxes provided under this procurement.
3. **Cashbox-Vault Operations Training**

1. The Contractor shall provide to AC Transit the services of a qualified experienced instructor to conduct at least one one-day class in the proper insertion and removal of the cashbox from the farebox and in the operating of the vault receiver.

5. **Equipment Maintenance Training**

1. The Contractor will provide a comprehensive farebox and related equipment maintenance and repair training program. The instructor provided by the Contractor will be well versed in the maintenance and repair of the Contractor’s equipment.

2. The following topics are to be covered thoroughly in the training program:

   1. Basic construction and functional operation and interaction of the components of the fare collection system

   2. Examination and disassembly of the farebox and subassemblies including, but not limited to:

      i. Bill transport
      ii. Coin Mechanism
      iii. Inspection plates and chutes
      iv. Electronic chassis
      v. Lower stanchion and cashbox
      vi. Electrical wiring harnesses

   3. Preventive maintenance on all subassemblies

   4. Electrical wiring/troubleshooting

   5. Field repair of the farebox

   6. Use and nominal maintenance of assessor equipment required to maintain the revenue collection system

   7. Disassembly, repair and preventative maintenance on RCVs and MCBs

   8. Review of the computers, probes and other parts of the data transmission and reporting system, its components and troubleshooting

   9. Overview of the portable probe system, its components and troubleshooting

   10. Electronic theory and function of the farebox, computer and system components

   11. J-1708 and RS-232 ports and how they interface with other on-bus systems
12. Software overview of all interrelated systems

13. Disassembly and repair of cashboxes and vaults

3. The Contractor’s instructor must make use of visual training aids to further reinforce the material presented.

4. AC Transit and the Contractor may elect to conduct portions of training at the Contractor’s facility.

5. Near the end of the equipment warranty period, the Contractor will provide training on bench level repair of all farebox subassemblies, including instruction on circuit board repair.

6. Maintenance Test Stands

1. The Contractor will provide maintenance test stands to allow AC Transit staff to test all farebox components. This will include complete farebox wiring harness; plug in receptacles for all modules including the coin mechanism, bill transport, circuit board testing etc., as well as lights and diagnostics.

2. The Contractor will provide devices for testing and calibrating the farebox coin mechanisms and bill transports to maintain specification accuracy.

3. The Contractor will provide a list and price of ordinary and special tools needed to maintain the fare collection system.

7. Data System Training

1. The Contractor shall provide the services of a qualified representative to train AC Transit personnel in the proper operation and use of the data collection and reporting system as well as the Central Computer System. Training shall include:

   1. How to run the applications
   2. Functions of individual applications
   3. Interpretation of all alarms, indicators and printed messages
   4. Restart procedures in the event of prolonged power failure
   5. Explanation of how to access the database for additional analysis
   6. Troubleshooting
19. Documentation

1. General

1. The Contractor shall provide samples of all of the following documents for approval by AC Transit 60 days before delivery of the fareboxes. Final acceptance of the system shall not take place until the Contractor has received approval of all of these documents:

   a. Farebox Maintenance Manuals
   b. Farebox Operations Manuals
   c. Vault Manuals
   d. Security Manuals
   e. Base Computer System Operations Manuals
   f. Base Computer System Data Dictionary
   g. Base Computer System Manuals Maintenance
   h. Central Computer System
   i. Troubleshooting Guides
   j. Special or Customized Tools
   k. Communications Protocols
   l. Printed Circuit Boards
   m. Microprocessor Programs
20. Maintenance Agreement

1. General

   1. The Contractor will present options for maintenance and support of the entire fare collection system:
      i. For a period of up to 5 years, commencing after completion of system warranty.
      ii. After the Maintenance agreement

   2. The proposed options shall include, but are not limited to:
      i. On-Call maintenance support
      ii. Patch/update installations
      iii. Base Computer system updates
      iv. Parts and parts availability
      v. Communications