



PURCHASING DEPARTMENT
1772 County Services Parkway
Marietta, Georgia 30008-4012
(770) 528-8400/FAX (770) 528-1154

Mark Kohntopp
INTERIM DIRECTOR

ADDENDUM No. 1

**Sealed Bid # 10-5517
Request for Proposal
Purchase and Installation of a Bus Automatic Vehicle Location (AVL)
Computer Aided Dispatch System
Cobb County Community Transit**

DATE: August 16, 2010

Page 1 of 276

The following addendum hereby amends and/or modifies the Proposal Documents and specifications as originally issued for this project. All proposers are subject to the provisions of this Addendum.

Proposers shall acknowledge receipt of this addendum.

Include this original form inside your proposal package.

This Addendum consists of:

- **Specifications Revisions/Clarification**

All bids must be received before 12:00 (noon) by the Bid Opening date. Bids shall be delivered to Cobb County Purchasing Department, 1772 County Services Parkway, Marietta, GA 30008.

Electronic / faxed bid response will not be considered.

I acknowledge that I have received Addendum No. 1

Sealed Bid # 10-5517

**Request for Proposal
Purchase and Installation of a Bus Automatic Vehicle Location (AVL)
Computer Aided Dispatch System
Cobb County Community Transit**

Company Name

Signature

Date Sent to Purchasing

Please Print Name

Please sign, date, and return this form ONLY to:
Cobb County Purchasing Department
Fax #: 770-528-1154
E-Mail: purchasing@cobbcounty.org

Please note: The deadline for questions is: August 31, 2010 by 5:00 pm
Any questions received after this deadline will not be considered.

Addendum No. 1

SEALED BID # 10 -5517
REQUEST FOR PROPOSAL
PURCHASE AND INSTALLATION OF A BUS AUTOMATIC VEHICLE LOCATION
(AVL)
COMPUTER AIDED DISPATCH SYSTEM
COBB COUNTY DEPARTMENT OF TRANSPORTATION
COBB COUNTY COMMUNITY TRANSIT

Date: August 16, 2010

Specifications Revisions/Clarification

- 1) The following information was inadvertently omitted from the Sealed Bid Specification. Please note:

Sample Agreement – Appendix A
Technical Specification- Appendix B
- 2) Page 4: Scope of Services

Delete: ...that is included herewith as Attachment 12.
Add: ...that is included as Appendix B.
- 3) The Technical Specifications includes the number of vehicles; however that number has changed. The total number of buses both Fixed and Para transit is now 131.

Appendix A

Sample Contract Agreement

CONTRACT AGREEMENT BETWEEN COBB COUNTY AND
_____ TO PROVIDE THE EQUIPMENT AND
INSTALLATION OF BUS AUTOMATIC VEHICLE LOCATION (AVL)
SYSTEM FOR COBB COMMUNITY TRANSIT

AGREEMENT dated the _____ by and between Cobb County, Georgia (hereinafter called the County), a governmental agency with its principal place of business located at 1890 County Services Parkway, Marietta, Georgia 30008 and _____ (hereinafter called Contractor) with its principal place of business located at _____.

WHEREAS the County desires to retain the Contractor, as an independent contractor, to provide equipment and installation of AVL system for Cobb Community Transit (CCT) to be located at the 800 South Marietta Parkway, Marietta, GA CCT facility.

WHEREAS the Contractor is willing and able to perform such work and furnish materials upon the terms and conditions hereinafter set forth.

NOW THEREFORE, in consideration of the mutual covenants herein contained for the sum not to exceed _____, The County and the Contractor agree as follows:

1. **STATEMENT OF WORK.** The Contractor will provide equipment and installation of AVL system as set forth in the RFP Documents, including Appendix B (Technical Specification), attached to this Agreement. The Contractor will work under the direction of the Cobb County Transit Manager or his/her designated agent and will obtain the prior approval for all work to be performed.
2. **COMPENSATION.** The Contractor's compensation will be in accordance with the Purchase Price and Terms set forth in RFP Special Provisions Section 6.20 (Purchase Price and Terms), which is hereby attached to this Agreement. The County's obligation to pay the Contractor for such work and materials will be subject to the County's approval of the work performed. Therefore, the Contractor's invoices to the County will be in such form as will enable the County to make payment for work approved.
3. **PERIOD OF PERFORMANCE.** The contract time for this project will be in accordance with the project schedule/timeline as proposed (See Attachment). This will include the procurement, delivery, and installation of AVL System equipment. The Contractor will commence work on the effective date, performing the activities described in Appendix B, Technical Specification.

4. INDEPENDENT CONTRACTOR. Under the Contract, the Vendor shall be an independent Contractor and not an agent of the County or the Board of Commissioners. The Vendor shall be fully responsible for all acts and omissions of its employees, subcontractors and their suppliers, and specifically shall be responsible for sufficient supervision and inspection to ensure compliance in every respect with the Contract requirements. There shall be no contractual relationship between any subcontractor or supplier and the County by virtue of the Contract with the Vendor. No provision of this Contract shall be for the benefit of any party other than the County and the Contractor.

5. PERMITS AND LICENSES. The Vendor is solely responsible for obtaining any license or other authorization required by law to perform the services required in this Contract.

Contractors who have an office or place of business within Cobb County shall provide the County, on the proper form, proof of being licensed to do business within Cobb County, Georgia. Contractors who do not have an office or place of business within Cobb County do not have to obtain a Cobb County business license, but must provide proof of being licensed to do business within the State of Georgia. Proof of proper business licenses shall also be provided by the Contractor for any and all Subcontractors coming under the jurisdiction of this contract. An out-of-state Contractor shall secure the proper permits and licenses required by the State of Georgia to perform work within Georgia.

6. INSURANCE AND BONDING. The Contractor shall procure and maintain for the duration of this Agreement, insurance against claims for injuries to persons or damage to property which may arise from or in connection with performance of the work hereunder by the Contractor, his agents, representatives, employees or Subcontractors.

A. MINIMUM LIMITS OF INSURANCE

The Contractor shall maintain general and automobile liability and Workers' Compensation and Employers Liability insurance limits of no less than:

1. General Liability: \$1,000,000 combined single limit per occurrence for bodily injury, personal injury, and property damage including products/completed operations coverage.
2. Automobile Liability: \$1,000,000 combined single limit per accident for bodily injury and property damage, when applicable.
3. Workers' Compensation and Employers Liability: Workers' Compensation limits as required by the Labor Code of the State of Georgia and Employers Liability limits of \$100,000 per accident.

B. DEDUCTIBLES AND SELF-INSURED RETENTION

Any deductibles or self-insured retentions must be declared to and approved by the County. At the option of the County, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the County, its officers, officials and employees; or the Contractor shall procure a bond guaranteeing payment of losses and related investigations, claim administration and defense expenses.

C. OTHER INSURANCE PROVISIONS

1. General Liability and Automobile Coverage

- a. The County, its officers, officials, employees, and volunteers are to be covered as insured's as respects: Liability arising out of activities performed by or on behalf of the Contractor; products and completed operations of the Contractor; premises owned, occupied or used by Contractor; or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to the County or, its officers, officials, employees or volunteers.
- b. The Contractor's insurance coverage shall be primary insurance as respects the County, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by the County, its officers, officials, employees or volunteers shall be in excess of the Contractor's insurance and shall not contribute with it.
- c. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the County or, its officers, officials, employees or volunteers.
- d. The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

2. Workers' Compensation and Employers Liability Coverage

The insurer shall agree to waive all rights of subrogation against the County, its officers, officials, employees and volunteers for losses arising from the work performed by the Contractor for the County.

3. All Coverage

Each insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, canceled by either party, reduced in coverage or in limits except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given the County. Each insurance policy required by this clause will include a provision showing Cobb County, Georgia as an additional insured.

- a. All insurance is to be placed with insurers with a Best's rating of no less than A in order to be acceptable to the County.
- b. The Contractor shall furnish the County with certification of insurance prior to the execution of any or the performance of any work.
- c. The Contractor shall include all Subcontractors as insured under its policy or shall require all Subcontractors to maintain in accordance with the requirements listed above.

7. INDEMNITY AND WAIVER OF BENEFITS. The parties shall at all times comply with all laws, ordinances, and rules, and regulations of state and federal governmental authorities regarding development and installation of the Bus AVL System described in the Technical Specification. To the extent allowed by law, the Contractor agrees to defend and save harmless the County, its officers, agents, and employees against all claims, demands, payments, suits, actions, recovery, and judgments of every kind and description out of the performance of this Agreement, for personal injury or property damage brought or recovered against it by reason of any negligent action or omission of the Contractor, its agents, or employees and with respect to the degree to which the County is free from negligence on the part of itself, its employees, and agents. Neither party shall be liable to the other for consequential, indirect or incidental damages, including, but not limited to, loss of tax revenue or claims related to valuation of property, whether based in contract, negligence, and strict liability or otherwise.

8. FAILURE TO EXECUTE AGREEMENT. Failure or refusal to execute and deliver this Agreement and/or furnish satisfactory proof of carriage of the insurance required within ten (10) days after notification of award shall be just cause for the annulment of the award. At the discretion of the County, the award may then be made to the next lowest responsible bidder, or the work may be re-advertised or performed directly by the County.

9. ENTIRE AGREEMENT. This signed Agreement, which includes the Contractor's complete Proposal and the Cobb County RFP, with all appendices, exhibits, attachments, and documents incorporated herein by reference, and in accordance with the Precedence of Documents identified in Section 6.7 (Precedence of Documents) of the RFP, constitutes the entire Agreement between the parties and supersedes all prior offers,

negotiations, exceptions and understandings, whether oral or written, between the parties. Every provision of law and every contract clause required by law to be inserted in this Agreement shall be deemed to be inserted herein and this Agreement shall be read and enforced as through they were included. This Agreement may not be amended, altered or modified except in a written document signed by the parties.

10. CHANGES. Changes in the Work and changes in the Contract can only be made by written amendments signed by both the Contractor and CCT, prior to implementation of such changes. Any part of the Contract that is not specially mentioned in an amendment or set of amendments shall not be changed. No implied changes are acceptable to either party to the Contract. The Contractor shall be liable for all costs resulting from, and for satisfactorily correcting, any change not properly ordered by written amendment to the Contract and signed by the both parties.

All changes shall be conducted in accordance with the procedure described in Section 6.6 (Changes) of the RFP

11. TERMINATION. In addition to other termination provisions of this Agreement, this Agreement may be terminated in the event the Contractor shall fail to substantially perform any obligation under this Agreement and shall not cure such failure within thirty (30) days after the County has given written notice thereof, or in the case of failure that cannot be reasonable cured within thirty (30) days, shall fail to begin to cure within such time and diligently to prosecute such cure to completion within a reasonable time thereafter.

12. ASSIGNMENT. Neither this Agreement nor any interest herein nor any claim hereunder may be assigned or subcontracted by the Contractor without the prior written consent of the County and any attempt to do so will constitute a breach of this Agreement.

13. NOTICES. In the event any circumstances under this Agreement calls for notice to a party, such notice must be in writing and will be effective when delivered to the recipient's address set forth at the beginning of this Agreement. Either party, by written notice to the other party, may change the address for notices to be sent to it.

14. MEASUREMENT AND PAYMENT. Payment shall be based on Contractor's successful completion of the payment milestones and processed in accordance with the procedures described in Sections 6.20.2 (Payment Milestones) and 6.20.3 (Invoices and Payments) of the RFP.

15. FTA CLAUSES:

The selected firm will be required to enter into a Contract with Cobb County for the provision of services hereby contemplated.

The project is subject to financial assistance through grants with the Federal Transit Administration and the State of Georgia. Accordingly, the Contractor will be required to

comply with all applicable provisions of the laws and regulations required by the Federal Transit Administration, and the State of Georgia, as well as those required by Cobb County.

An overall annual Disadvantaged Business Enterprise goal of 4% percent has been established for which utilization of any DBE's on this contract will count towards the cumulative attainment of the goal. The selected firm may utilize one or more firms in a prime-sub arrangement in order to count towards this goal.

Certain clauses and certifications including, but not limited to, the following will be required in the Contract:

- Access to records
- Federal changes
- Clean air
- Termination
- Government debarment (executed certification required)
- Lobbying
- Clean Water
- Breaches and dispute resolution
- Seismic safety requirements
- Clean water
- Incorporation of FTA terms
- Civil rights
- Lobbying disclosure (executed certification required)

IN WITNESS WHEREOF, the County and Contractor have caused this Agreement to be executed by their duly authorized officers.

Executed this _____ day of _____, 2010

COBB COUNTY, GEORGIA

ATTEST:

By: _____
Chairman, Board of Commissioners

County Clerk

Witness

(Seal)

ATTEST:

CONTRACTOR

By: _____

Secretary

Title: _____

Witness

(Seal)

Approved as to Form by:

Cobb County Department of Transportation

Give proper title of each person executing affidavit. Attach seal as required.

***COBB COUNTY DEPARTMENT OF TRANSPORTATION
COBB COMMUNITY TRANSIT***

***Bus AVL System
Technical Specification***

June 2010

Prepared by:



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Section 1

INTRODUCTION

Cobb County Department of Transportation (CCDOT) and Cobb Community Transit (CCT) are seeking to implement a Bus AVL system using Computer Aided Dispatch (CAD) and Automatic Vehicle Location (AVL) technologies to better manage fixed-route and paratransit services. This Specification defines the technical requirements for the Bus AVL system as well as requirements for the implementation process to be used by the Contractor to design, test, document, and deliver the system to CCT.

1.1 Specification Conventions and Terminology

For certain often used phrases and names (e.g., CAD and AVL), the general attempt in writing this Specification was to only show the full spellings along with their abbreviations or acronyms the first time it is presented, with the abbreviations or acronyms being used thereafter. Some of the more commonly known abbreviations (e.g., LAN) may not have been fully spelled out at any time in this Specification. However, a listing of all abbreviations and acronyms and their non-abbreviated spellings used in this Specification is provided in Appendix A.

CCT's revenue fleet can logically be divided into two sub-fleets consisting of fixed-route vehicles and paratransit vehicles. Unless indicated otherwise, all vehicle-related requirements and associated Bus AVL system functions contained in this Specification shall apply to the entire revenue fleet (i.e., both fixed-route and paratransit vehicles).

A glossary of terms used in this Specification is provided in Appendix B.

Text shown in italics font throughout this Specification contains specific instructions concerning information that must be provided in Proposals.

1.2 CCT Overview

CCT is located in the city of Marietta, Georgia and provides both fixed-route and paratransit public transportation services in Cobb County with some runs extending into neighboring counties. The following sections describe CCT's transit services and the facilities currently employed to manage CCT operations and fleet vehicles.

1.2.1 Transit Services

CCT's transit operations are managed and performed from the CCT Headquarters facility located at 463 Commerce Park Drive, Marietta, GA. CCT is responsible for providing transit services to the metropolitan area of Marietta and throughout Cobb County, including service to Downtown Atlanta and

surrounding communities. CCT's vehicle fleet consists of 95 fixed-route buses, 31 paratransit vehicles, 6 Supervisor vans, and 3 maintenance/support vehicles. CCT currently employs approximately 170 vehicle Operators.

1.2.1.1 Fixed-Route Service

CCT provides fixed-route bus service Monday through Saturday with a service area that encompasses approximately 1,137 square miles and services a population of approximately 2.2 Million people. Hours of operation are from 5:00AM to 1:00AM. The service currently consists of 24 routes. These routes service approximately 900 bus stops including 7 time points, accumulating approximately 43 million annual passenger miles with 4.5 million annual trips. Fixed-route service and operations are currently provided under contract with Veolia Transportation.

CCT services two major transfer centers: one located in Marietta and one in Cumberland. The Marietta Transfer Center (MTC) serves as CCT's main transfer point serving 10 CCT routes. The Cumberland Transit Center serves 6 CCT routes and 1 MARTA route. CCT also services 11 Park & Ride lots.

The fixed-route revenue fleet consists of 95 revenue vehicles with approximately 79 of those vehicles in service during peak periods. All fixed-route buses are wheelchair accessible. The average age of the fixed-route fleet is between 2 and 8 years. The total fleet of fixed-route revenue vehicles operated by CCT is expected to increase over the next ten years.

All fixed-route buses are dispatched from, and maintained at, the CCT Headquarters and Maintenance Shop facilities located at 463 Commerce Park Dr. in Marietta, GA. Fixed-route dispatch operations are performed in Suite 114 of the main facility using the existing County-owned and operated trunked, public-safety radio system, of which CCT is a subscriber. Operator check-in/out is performed by dispatchers using a proprietary Veolia dispatch system. Administrative tasks are recorded on paper or by using electronic forms created in-house on a networked personal computer. Dispatch operates in two shifts from 4:00AM to 1:30PM and from 11:00AM to 8:30PM with the designated supervisor handling operations after those hours each day.

Fixed-route scheduling and run cutting is performed manually using spreadsheets. Scheduling and dispatch operations are block-based. Major bookings (sign-ups) usually occur every 3 months or 4 times annually.

1.2.1.2 Paratransit Service

CCT's paratransit service provides curb-to-curb transportation for ADA-qualified customers unable to use the fixed-route service. The paratransit service area extends ¾-mile beyond all fixed-route service routes, per ADA requirements, plus some specific grandfathered areas of service. Service volume is approximately 290 trips per weekday with a peak of 20 vehicles. The paratransit service days and hours

are the same as for fixed-route service. Paratransit service and operations are currently provided under contract with Veolia Transportation.

The paratransit fleet currently consists of 27 vehicles, but will reach 31 vehicles once current new vehicle procurements are completed. As with fixed-route vehicles, all paratransit vehicles are dispatched from, and maintained at, the CCT facilities in Marietta. CCT's paratransit dispatch operation is currently co-located with fixed-route dispatch in Suite 114 of the main facility. However, a new facility for paratransit is currently under design adjacent to the main facility and paratransit dispatch will move there once it is completed. Paratransit dispatch is staffed using the same shifts and schedule as for fixed-route.

Paratransit scheduling and dispatch operations are performed using a RouteMatch paratransit scheduling system, which is currently owned and maintained by Veolia Transportation. CCT is looking into taking over ownership and maintenance of this system. Paratransit manifests are currently provided to Operators each day in paper form.

1.2.2 CCT Facilities

CCT's sole transit facility in Marietta includes vehicle storage, the vehicle repair and maintenance shop, operations, and administrative offices. The facility provides all fixed-route, paratransit, and other CCT services, including Customer Service operations.

CCT has a server room at the Marietta facility with floor space to accommodate approximately one new rack of equipment. In addition, Cobb County Information Services also has facilities that can accommodate additional server equipment. CCT offices are a part of the Cobb County network and have full LAN connectivity to other Cobb County facilities as well as to the transit centers.

A new backup generator is being installed as part of an expansion and renovations at the Marietta facility for customer service. This generator is sized with sufficient capacity to accommodate future loads, including the Bus AVL system. Server equipment is protected using dedicated UPS units.

1.3 Project Scope

The Contractor shall undertake the supply of a turnkey, fully integrated and functional Bus AVL system, including CAD/AVL functions for fixed-route and paratransit operations, with all hardware¹, software, spare parts, and services necessary to accomplish the supply, installation, testing, documentation, training, and startup of the complete system. The Bus AVL system functionality shall extend across fixed-site

¹ CCT may choose to supply all off-the-shelf hardware and software required for the system according to the contractor's required specifications. See Sections 4.1 and 5.1 for further information.

computer and network equipment, data communications equipment for mobile data communications, and on-board vehicle equipment.

All software and hardware components necessary to make the Bus AVL system meet all functional and performance requirements of this Specification shall be furnished by the Contractor regardless of whether those components are explicitly identified in this Specification. In addition, the Contractor shall provide all required components in the quantities necessary whether or not those components were identified during the procurement phase of the project.

1.4 Optional and Future Requirements

Most of the contents of this Specification are base requirements; however, some requirements are options that are designated by the inclusion of “(Option)” in the section title. An “Option” designation in a section title shall apply to that section and all of its sub-sections. Options may be individually selected by CCT at the time of Contract Award and/or up to one year following Notice to Proceed (NTP), except as noted otherwise. Executed options shall become part of the project scope and shall be governed by all applicable commercial, technical, and performance requirements specified herein.

Proposals shall provide all necessary descriptive information regarding each option and shall provide separate pricing for each option.

Future requirements are designated by the inclusion of (“Future”) in the section title. The purpose of this designation is to indicate CCT’s desire to add the indicated capabilities to the system at some future time, typically following acceptance of the initial system.

Proposals shall indicate whether each requested future capability is currently available for the initially delivered system and, if not, an estimated availability date for the capability if it is a planned future enhancement to the delivered system.

1.5 ITS Architecture

It is a goal of CCT that the Bus AVL system follow the guidelines and intent of the National ITS Architecture. While it is understood that some aspects of the ITS architecture have not been fully designed or implemented by proposers of systems like the Bus AVL system, CCT strongly desires that all elements that can be reasonably achieved be included in the Bus AVL system implementation. In order to encourage compliance and understand the extent to which the Bus AVL system meets the architecture, the Contractor shall:

- a. For internal data exchanges between Bus AVL system elements (i.e., between vehicle systems and the transit management fixed-end system), the Contractor shall utilize the appropriate ITS architecture where economically and operationally feasible.

The Proposer shall identify in its proposal, which, if any, internal interfaces meet the architecture guidelines, and if not, provide an explanation of why the ITS architectures have not been used.

- b. For data exchanges between the Bus AVL system and external systems, the Contractor shall utilize the appropriate ITS architecture guidelines.

The Proposer shall identify in its proposal the scheme proposed for external data exchanges and how they meet the ITS architecture.

1.6 CCT Participation

CCT intends to actively participate in this project. This participation will include project management, providing data required by the Contractor, reviewing and approving design documents, monitoring the Contractor's progress and schedule, attending progress review meetings, and participating in system testing.

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Section 2

SYSTEM FUNCTIONS

The following sections define functional requirements for the Bus AVL system. The Contractor shall supply all described functions, except for functions designated as options that are not executed by CCT and functions designated as “Future”.

2.1 Bus AVL System Overview

2.1.1 Bus AVL System Major Functions

The Bus AVL system specified herein shall support fixed-route and paratransit service operations for CCT. The Bus AVL system shall provide the following major functions:

- a. Data communications between Bus AVL system-equipped revenue and non-revenue vehicles and fixed locations, such as the dispatch offices
- b. Computer Aided Dispatch (CAD) functions to aid dispatchers in managing the fleet
- c. Automatic Vehicle Location (AVL) functions that are tightly integrated with the supplied CAD functions to aid dispatchers in managing the fleet
- d. Tools for creation and maintenance of CCT fixed-route scheduling data and the integration of that data into supplied CAD/AVL functions (CCT does not currently use a scheduling system to develop fixed-route schedules).

2.1.2 Bus AVL System Users

The Bus AVL system shall support the following types of users:

- a. Fixed-Route Dispatch
- b. Paratransit Dispatch
- c. Dispatch Supervisors
- d. Customer Service – for observing bus locations on the AVL map
- e. CCT Maintenance Shop – for monitoring mechanical alarms and other maintenance-related functions of the system
- f. Bus AVL System Administrators – for managing and monitoring the Bus AVL system

- g. CCT Management – for accessing reports and occasional view-only access to system displays
- h. CCDOT Staff – for occasional view-only access to system displays.

Bus AVL system workstations shall be supported as indicated in Appendix C in order to support the users described above.

2.2 General Requirements

2.2.1 Bus AVL System Scalability

The Bus AVL system shall initially support the functions specified herein with the quantities of vehicles, devices, workstations, and service parameters listed in Appendices C and E. However, the system shall be easily scalable over its estimated 10-year lifetime to support additional users, workstations, and transit facilities without replacement of initially installed components, including both hardware and software components.

The Bus AVL system shall, over its lifetime, be capable of interfacing to the ultimate number of vehicles, routes, and bus stops. In particular, proposers should note the anticipated ultimate size of the paratransit fleet due to the possible future addition of a Senior Services fleet of 50 vehicles (see Appendix C, Figure C-3).

The system shall support the ultimate number of workstations specified in Appendix C. The scaling of the system to handle additional locations and workstations to the extent defined in Appendix C shall be possible without replacement of existing major components, including both hardware and software components.

2.2.2 Functional Expandability

The Bus AVL system shall be designed to permit the addition of new functional capabilities over its lifetime without significant replacement of the initially delivered components. In particular, functions designated in this Specification as “Future” shall be capable of being readily added to the Bus AVL system during its lifetime without costly rework or replacement of initially delivered system components.

Proposers shall identify in their proposals how functions designated as “future” can be added to the Bus AVL system at a later time.

2.2.3 Contractor's Standard, Service-Proven Products

Contractors are encouraged to supply standard, unmodified, service-proven products of computer and communication equipment manufacturers, established third-party hardware and software suppliers and

their own baseline product offerings where they meet or exceed the functional requirements of this Specification.

Proposers shall describe their standard offering in their proposals and highlight those proposed features that exceed Specification requirements.

2.2.4 Adjustable Parameters

Computer programs typically reference a number of variables that must be given specific values during the execution of the program. These variables, or parameters, require adjustment from time to time.

All parameters in the Bus AVL system that may need to be modified to accommodate changes in CCT's service and operations shall be adjustable by authorized Bus AVL system users. At least three levels of parameter adjustment shall be provided, as follows:

1. Parameters designated in this Specification as "User-adjustable" shall be modifiable by authorized Bus AVL system users via workstation displays normally accessible to those users
2. Parameters designated in this Specification as "System Administrator-adjustable" or "Administrator-adjustable" shall be modifiable via workstation displays accessible only by a System Administrator
3. Parameters designated simply as "adjustable" shall be modified in either of the above ways, depending on the Contractor's standard approach.

Adjustments made to user-adjustable parameters shall become effective immediately without having to restart any part of the system. Adjustments made to System Administrator-adjustable parameters may require a restart of affected system components, but shall not require rebuilding and/or recompilation of programs, or regeneration of databases.

All parameters, including periodicities and time intervals, defined in this Specification shall be considered initial values to be used for planning purposes, but all shall be adjustable by authorized Bus AVL system users. The Bus AVL system shall log all parameter changes including identification of the user who made the modification, the original value, the modified value, and the time and date of the modification.

2.2.5 Activity Logging

The Bus AVL system shall log all user actions to an activity log. The activity log shall be real-time and accessible on-line. Each action shall result in an entry in the log that shall include, at a minimum, user ID, workstation ID, record/file ID(s), date/time, module/function ID(s), and other pertinent data associated with the action. The maximum size of activity log storage shall be configurable by the System Administrator in order to conserve storage capacity for critical system functions.

2.2.6 Output Requirements

Specific requirements for output of results are defined in this Specification along with the other requirements of each function. Whether or not explicitly specified in the function description, all data and results produced by Bus AVL system functions shall be accessible for display, printing, and transfer to external computer systems identified elsewhere in Section 2.

2.2.7 Reasonability of Data

In order to prevent invalid and unreasonable data from having a harmful effect on the Bus AVL system or CCT operations, data shall be checked for reasonability. All input data and parameters, whether collected automatically or manually entered by a Bus AVL system user, shall be checked for reasonability before allowing the data to be processed or used by the Bus AVL system. Data determined to be invalid and/or unreasonable shall be rejected.

When invalid and unreasonable input data or results are detected, diagnostic messages clearly describing the problem shall be generated. All programs and the system shall continue to operate in the presence of invalid and unreasonable data. Calculations using the invalid and/or unreasonable data shall be temporarily suspended or continue to use the last valid and reasonable data.

2.2.8 Data Integrity

The Bus AVL system shall be designed to protect Bus AVL system data integrity in a multi-user and multi-processing environment. Appropriate exclusion methods shall be employed to ensure that collected data is not corrupted from multiple concurrent accesses by different processes. User-entered data shall be protected by appropriate exclusion methods that prevent more than one user from simultaneously editing the same data. In general, users shall be notified and granted read-only access to data that is being updated by another user.

2.3 Access Security

Access to the Bus AVL system shall be strictly limited to authorized Bus AVL system users. Users without proper authorization shall be denied access to all Bus AVL system functions and data, including all Bus AVL system resources, such as servers, workstations, etc.

Each user logon and logoff shall be recorded in the historical event log. The recorded data shall include the date and time that the logon/logoff was executed, the name of the workstation and the identification of the user.

2.3.1 User Authorization

The Bus AVL system shall utilize CCT's existing network domain logon credentials for Bus AVL system user authorization. As a minimum, Bus AVL system user authorization shall require entry of a valid domain, username, and password combination that determines the user's level of access to Bus AVL system functions, data, and resources. Each Bus AVL system user shall have a unique username that is assigned by the System Administrator.

The logon/logoff status of a user shall be unaffected by any automatic failover recovery process in the Bus AVL system.

2.3.1.1 User Records

Each user logon and logoff shall be recorded in the historical event log. The recorded data shall include the user ID, the workstation ID, and the date and time that the logon/logoff was executed.

If a logon was unsuccessful, the Bus AVL system shall record all user-entered login text, workstation ID, and the date and time of each entry recorded.

2.3.2 Functional Partitioning

Access to Bus AVL system functions and capabilities shall be based upon each user's authorization level and not the physical workstation being used, though limitations in functional capabilities due to the configuration of the workstation may also apply (e.g., no voice equipment). CCT prefers that a user's functional access rights to the Bus AVL system be determined based on the user's domain group memberships.

Each user's authorization level shall be capable of being specified as "full", "view-only", and "no" access to each identified Bus AVL system function. A minimum of 8 distinct authorization levels shall be supported.

At a minimum, the levels of functional partitioning that shall initially be supported by the Bus AVL system include at least the following:

- a. General User — these users shall have read-only access to Bus AVL system historical data via the information server resources, but shall have no access to the Bus AVL system LAN, functions, and resources.
- b. Customer Service — these users shall have all the rights of a General User plus read-only access to selected Bus AVL system functions (e.g., AVL functions).

- c. Route Dispatcher — these users shall have all of the rights of a General User plus full access to Dispatcher functions and restricted Bus AVL system functions as determined by the System Administrator.
- d. System Administrator — these users shall have unrestricted access to Bus AVL system functions and shall have special privileges required to administer overall access security and to maintain the Bus AVL system.

A secure method shall be provided for the System Administrator to create and manage functional partitions and their assignment to users and groups.

2.3.3 Data Partitioning (Option)

System Administrators shall be able to define data partitions that specify, via selection criteria or other means, a subset of all Bus AVL system data, including events that users are permitted to access. CCT prefers that a user's data access rights to the Bus AVL system be determined based on the user's domain group memberships. A secure method shall be provided for the System Administrator to create and manage data partitions and their assignment to users and groups.

For each defined data partition the System Administrator shall also be able to specify the type of access, which shall include at least "full", "view-only", or "no" access. Data partitions shall be able to overlap in definition and each data partition shall be assignable to any number of Bus AVL system users and groups. A minimum of 8 distinct data partitions shall be supported.

As a minimum, data partitioning shall be based on any logical combination of the following criteria:

- a. **Vehicle Type** — Data associated with a specific vehicle type, such as "Fixed-route", "Paratransit", "DayTripper", "Supervisor", "Maintenance", etc.
- b. **Route Numbers** — Data associated with a list of specific route numbers and from designated ranges of route numbers
- c. **Event Type/Sub-Type** — Events of specific types and sub-types
- d. **Service Provider (Option)** — Data associated with different Service Providers including, as a minimum, their assigned vehicles. Service Providers limited in this manner shall have access strictly limited to only their own service data and vehicles.

2.3.4 Bus AVL System LAN Access Security

The Contractor shall work with CCT in the development of a secure Bus AVL system LAN. The Bus AVL system LAN shall be secured to prevent unauthorized access, use, and administration of its

resources from any networked node, regardless of whether that node is running Bus AVL system-specific software or some other software (e.g., a general purpose Windows workstation). This security shall include, but not be limited to, positive user authentication for access to Bus AVL system file, database, and application servers, as well as workstations, network devices, domain controllers, and other resources that may be used for managing the Bus AVL system LAN and its configuration. Separate levels of authentication shall be provided to distinguish, as a minimum, user access from administrative access to the Bus AVL system LAN resources.

2.3.5 WAN Access Security

Access to any Bus AVL system resources from the CCT WAN shall be strictly controlled to ensure that the system is not corrupted or disabled, intentionally or unintentionally, by any user on the CCT WAN. In addition to basic user authorization, WAN access to the Bus AVL system shall be further secured by enabling the System Administrator to control all access to Bus AVL system resources via the WAN. With the exception of the CCDOT workstations and vehicle data communications, all outside access to Bus AVL system resources shall be denied. Therefore, transfers of data that must take place between the Bus AVL system and all other systems that are not on the Bus AVL system LAN shall be initiated by a component from within the Bus AVL system.

In a WAN-connected configuration, local Bus AVL system users shall have transparent access to external resources on the WAN where the administrators of those external resources have granted such access, including external services for email, agency applications, and printing.

2.4 Computer Aided Dispatch Functions

The Bus AVL system shall provide a comprehensive set of computer-aided dispatch features that will allow for effective and efficient monitoring and control of revenue and non-revenue vehicles. The basic functional requirements for CAD are contained within the following sections. CAD functional requirements for Bus AVL system user support are contained in Section 2.5.

2.4.1 Wide Area Wireless Data Communications

The Bus AVL system shall support the transfer of control commands and data to and from the vehicle fleet while vehicles are operating throughout CCT's service area. Existing CCDOT/CCT radio infrastructure is not available to support the Bus AVL system's wireless data communications requirements. Therefore, offerings shall include a proposed wide area wireless data communications infrastructure solution that is capable of supporting all required Bus AVL system functions. CCT strongly prefers that the Bus AVL system implementation utilize leased communications services rather than require implementation of a private radio infrastructure. The Contractor shall demonstrate the coverage performance of the proposed solution prior to commencement of the design phase of the Bus AVL system implementation (see Section 7.4).

The Contractor shall optimize its communications design/protocol to ensure that all required system functions can be performed at the periodicities defined in this Specification, given the availability of data communications. The Contractor's proposed wide area wireless data communications design/protocol shall also be efficient in order to minimize recurring costs for leased data communications services.

Appendix E summarizes the quantities of vehicles that are expected for both the current and ultimate timeframes. Also included in Appendix E is the number of vehicles expected to be operating at once during peak periods.

2.4.1.1 Data Communications Protocol

A suitable data communications protocol shall be used to ensure the reliable delivery of data and control commands over the chosen data communications infrastructure. Protocol parameters, such as timeouts and retry counts and intervals, shall be Administrator-adjustable. Data communications errors shall be logged and excessive errors and communications failures shall be alarmed to the appropriate Bus AVL system users.

Due to the importance of receiving emergency alarms as quickly and reliably as possible, the Bus AVL system shall be designed to ensure the rapid and reliable presentation of emergency alarms to the appropriate Bus AVL system users. In addition, the data communications protocol shall ensure that emergency alarms are annunciated even when data communication conditions are marginal. This may include routinely retransmitting an emergency alarm on a frequent periodic basis, even before a failure to communicate has been detected, and continuing to retransmit the emergency alarm until the message is positively acknowledged. In this case, the emergency alarm shall be annunciated only once to the appropriate Bus AVL system users regardless of the number of times it is retransmitted.

2.4.1.2 Vehicle Data Monitoring

If a polling scheme is utilized to retrieve data transmissions from vehicles, then the Bus AVL system shall poll all active in-service vehicles at least every 90 seconds. The use of "smart polling" strategies is encouraged to provide the most frequent polling where it is needed most. These strategies should include more frequent polling of off-schedule and off-route vehicles, and less frequent polling of vehicles in the yard or during layovers. The polling of vehicles according to the routes on which the vehicles are operating is also encouraged. A fast poll function shall also be provided allowing Dispatchers to monitor a selected vehicle on a more frequent basis. This fast poll function shall provide vehicle position reports at an Administrator-adjustable polling rate between 15 and 60 seconds.

If an exception reporting scheme is utilized to retrieve data transmissions from vehicles, then all vehicles shall report to the Bus AVL system whenever data is available for transmission and periodically whenever the vehicle is operating either off-schedule or off-route. The Bus AVL system shall verify that it receives at least one transmission, either an exception report or a health-check, from each vehicle on a

regular basis. Each vehicle shall initiate "health-check" transmissions whenever no exception report transmissions have been made for a period not to exceed 90 seconds. This verification shall initially be pre-set to be performed every 60 seconds, adjustable by the System Administrator. The Bus AVL system shall alarm and log all vehicles failing to report within the pre-set period.

If any other reporting scheme is employed (e.g., non-pollled, non-exception), all communication requests and all data transmissions shall be retrieved from all active in-service vehicles at least every 90 seconds.

The Bus AVL system shall receive and process all data received from vehicles, even when the vehicle is not logged in. Each alarm (emergency alarm and other alarm) and other vehicle-initiated and vehicle Operator-initiated actions shall be handled in the same manner as for logged-in vehicles.

2.4.1.3 Future Data Requirements

As vehicles and system functions are added, expansion of the data communications to be supported by the Bus AVL system is expected in terms of the types and quantity of data exchanged. The Bus AVL system shall be designed such that additional data requirements can be readily accommodated.

2.4.2 Voice Communications

CCT will continue to use the Cobb County trunked radio system for all voice communications using existing radios installed in the revenue and non-revenue vehicles. The Bus AVL system is NOT required to provide voice integration and therefore need not interface to the radios or to the radio system infrastructure. Therefore, the existing radio system and the Bus AVL system shall operate independently of each other.

2.4.3 Fallback Communications

Whenever the Bus AVL system is unable to perform its assigned data communication functions, the Bus AVL system shall generate and present an event to the appropriate Bus AVL system user(s) in the event queue.

The Bus AVL system shall initiate the fallback communications mode of operation for all vehicles affected by conditions that shall include, but not be limited to, the following scenarios:

- a. Loss of data communication links (e.g., leased line) between CCT and the wide area wireless data communications provider
- b. Loss of availability of Bus AVL system CAD functions due to either software and equipment failure

- c. Vehicle loss of data communications due to equipment failure and out-of-range conditions.

When a vehicle enters the fallback mode of operation, an indication of fallback mode shall also appear on the VCH of every affected vehicle, informing the vehicle Operator that fallback mode procedures are in effect and data communications are not available. When data communications have been restored, all affected vehicles shall automatically return to the normal communications mode.

Vehicles that have not lost data communications shall continue to operate in the normal communications mode regardless of the data communications status of other vehicles.

2.4.4 Identifier Field Formats

Vehicle IDs, route numbers and block numbers shall identify all Bus AVL system-equipped vehicles. Vehicle Operators shall be identified by badge numbers and run numbers. For Supervisory and other non-revenue vehicle operators the run number may represent a work number.

The formats of the identifiers that shall be supported by the Bus AVL system are as indicated in Table 2-2, below.

	Revenue Vehicles	Non-Revenue Vehicles
Block Number	5 numeric digits	4 numeric digits
Route Number	3 numeric digits	Not Applicable
Run Number	5 numeric digits	4 numeric digits
Operator Badge Number	4 numeric digits	4 numeric digits
Vehicle ID	4 numeric digits	4 numeric digits

Table 2-2 Identifier Formats

Fewer digits may be utilized than the maximum lengths to be supported by the Bus AVL system as indicated above. Where the actual number utilized is shorter than the maximum lengths defined above, the Bus AVL system shall not require the entry of leading zeros.

2.4.5 Events

The Bus AVL system shall support the gathering, processing, storage, and presentation of events relating to vehicles, vehicle operators, and the status of the Bus AVL system. The following sections define requirements for events and event gathering. Requirements for event presentation to users are defined in Section 3.

2.4.5.1 Event Types and Priorities

The Bus AVL system shall support multiple event types and subtypes. Events shall be available within the Bus AVL system for presentation, processing, and storage within specified maximum time delays relative to the actual creation of the events in the field under the peak loading conditions defined in Appendix F. All events shall include sufficient identifying and descriptive data necessary for Bus AVL system users to properly interpret the event.

Event types shall have pre-defined priorities that are assignable by the System Administrator. A minimum of 8 priority levels shall be supported. However, the emergency alarm event type shall be assigned the highest priority.

The Bus AVL system shall include the following minimum set of event types and subtypes:

- a. Emergency Alarm (EA) – a signal from a vehicle that an emergency condition is occurring. This event shall have priority over all other events.
- b. Priority Request To Talk (PRTT) – a high priority request from an Operator to talk with a Dispatcher. This event shall have priority over all other events except for EA events².
- c. Request To Talk (RTT) – a normal request by an Operator to talk with a Dispatcher.
- d. Canned Text Message – a pre-defined text message selected by an Operator to a Bus AVL system user. Each canned text message shall be distinguishable as a unique message subtype and shall be configurable.
- e. Schedule Adherence Violation – an event indicating that a revenue vehicle is off schedule (early and late). The message shall indicate the amount of deviation from schedule in minutes. Early and late schedule adherence events shall be configurable to different priorities. Initially, schedule adherence violations having an early deviation from schedule shall be assigned a higher priority than those having a late deviation from schedule.
- f. Route Adherence Violation – events indicating that a fixed-route vehicle is off route. Initially, these events shall have the same priority as early schedule adherence violation events.
- g. Turn-back – events indicating that a vehicle has performed a turn-back (short turn).

² Note: Even though voice communications is not to be integrated into the system, the system shall retain a capability to support RTT and PRTT message types.

- h. Fill-in Service Start/Stop – events indicating starting and stopping of fill-in service for a specified route.
- i. Vehicle Movement Alarm – events indicating that a vehicle has left the garage/depot without a valid Operator log-on.
- j. Invalid Logon – events indicating a failure of an Operator logon. An invalid logon event shall be reported after three (3) consecutive failed logon attempts.
- k. Operator Logon/Logoff – events indicating successful Operator logons and logoffs.
- l. Manifest transaction failure – events indicating a delivery failure of a manifest, a manifest schedule change, or a manifest update (Option).
- m. Open Block Alarm – events indicating that a Block has been without service (i.e., no active vehicle) for more than a pre-defined and configurable time period.
- n. Relief Events – events indicating that an Operator relief has started, ended, and missed.
- o. Mechanical Alarm (MA) – a warning or failure event indicating a mechanical problem on a vehicle
- p. Excessive Idle Alarm – a warning that a bus has exceeded the set threshold for idle time (Option).
- q. Fallback – event indicating the vehicle is in the fallback mode for data communications
- r. Bus AVL system Alarm – events indicating a failure within the Bus AVL system itself, such as communications errors and failures, fixed-end component failures (e.g., servers, workstations, and network devices), on-board vehicle component failures, etc.
- s. Information Message – a data message that is logged for historical purposes, but is not normally presented to a Bus AVL system user. These events shall have the lowest priority.

EA and PRTT events shall be displayed in the event queue within 5 seconds from the time that the event is created. All other events shall be displayed in the event queue within 10 seconds of creation.

2.4.5.2 Event Recording

All events shall be recorded by the Bus AVL system and, if appropriate, shall be presented to the appropriate Bus AVL system users according to their functional and data partition assignments. The Bus

AVL system shall be designed with sufficient processing and storage capacity to record all events without loss of system performance under the peak load conditions defined in Appendix F.

Recorded events shall include at least the following data:

- a. Event type/sub-type(s)
- b. Event parameter data, if any (e.g., message text)
- c. Date/time of creation (at the source location of the event)
- d. Date/time of receipt (at the fixed end)
- e. Date/time of selection (by user)
- f. Identification of selecting user
- g. Data regarding the disposition of the event (e.g., incident report generated).

All recorded events shall be accessible via the Historical Data Storage and Retrieval functions.

2.4.6 Incidents

The Bus AVL system shall enable authorized users to create, maintain, track, and print incident reports that provide an official record with additional details concerning specific event occurrences. Incident types and subtypes shall be configurable by the System Administrator enabling modification of existing and creation of new incident types and sub-types. The following sections define basic requirements for incidents. Other requirements for incidents are defined elsewhere in Section 2.

2.4.6.1 Incident Types

The Bus AVL system shall support at least 20 different types of incidents. Each type of incident shall be associated with a unique incident report format that provides the information required for that particular incident type. The types of incidents and incident reports to be initially supported shall include the following:

- a. Emergency Alarms
- b. Maintenance problems, which shall include the following sub-types:
- c. Road call
- d. Destination sign

- e. Brakes
- f. Tires
- g. Wiper
- h. Driver seat
- i. Mechanical (automatic) alarms
- j. Door
- k. Bike rack
- l. Air conditioning
- m. Wheelchair lift
- n. Accident involving vehicle
- o. Incident involving vehicle
- p. Incident involving passenger
- q. Delay
- r. Relief vehicle
- s. Miscellaneous incident
- t. Twelve spare incident types.

The Contractor shall work with CCT to develop the final list of incident types and reports during the Bus AVL system design phase, following Contract Award.

2.4.6.2 Incident Recording

The general information common to all incidents shall be recorded and include, but not be limited to, the following:

- a. Incident number
- b. Time and date of the incident

- c. Incident type
- d. Incident subtype (if applicable)
- e. Incident description
- f. Event(s) associated with the incident
- g. Vehicle ID
- h. Route number and direction
- i. Block number
- j. Run number
- k. Operator name and badge number
- l. Incident location
- m. Incident disposition
- n. Bus swap (yes/no)
- o. Replacement bus ID
- p. Change location
- q. Change time
- r. Notes
- s. Time lost
- t. Responding Supervisor name and badge number
- u. Incident status (open/closed)
- v. Bus AVL system user who opened the incident
- w. Bus AVL system user who modified the incident
- x. Bus AVL system user who closed the incident

- y. Time and date the incident was modified
- z. Time and date the incident was closed
- aa. Bus AVL system user comments.

Additional information particular to each type of incident shall be supported by the Bus AVL system and shall be defined as part of the design process following Contract Award.

2.5 Automatic Vehicle Location

The Bus AVL system shall include an Automatic Vehicle Location (AVL) function. The AVL function shall provide tracking and reporting of the locations of Bus AVL system-equipped vehicles with a positional accuracy of nine meters or less, regardless of whether the vehicles are moving, on-route, off-route, have no assigned route; and whether or not the vehicles are logged in. This required level of accuracy shall not be adversely impacted by GPS errors resulting from selective availability and from other reception errors. All vehicle movement on AVL maps and displays shall be based upon actual vehicle location reports and shall not be simulated.

The AVL implementation shall provide both the vehicle Operators and Bus AVL system users with accurate and timely position, schedule, and route adherence data while minimizing the use of data communications for the transmission of vehicle location data. Design approaches such as on-board calculation and display of route and schedule adherence (RSA) information, with only schedule and route deviation and occasional on-demand RSA reporting to the fixed-end system, are encouraged.

Vehicles shall report the vehicle location whenever a timepoint is encountered, schedule or route adherence thresholds are exceeded, a communications request is transmitted, any vehicle alarm is transmitted, and whenever the vehicle responds to poll requests.

2.5.1 AVL Coverage

It is possible that there will be locations of momentary GPS signal blockage, such as in a downtown area. Accordingly, it is the Contractor's responsibility under the scope of this Contract to investigate the GPS satellite coverage throughout CCT's service area (see Appendix I) and to jointly determine with CCT if a backup to the GPS-based vehicle location data is required. Momentary loss of GPS signal less than a few minutes, which shall be Administrator-adjustable, may be acceptable as long as the last known good position is reported and the Operators and Bus AVL system users are not presented with unnecessary events and alarms.

2.5.2 AVL Map and Overlays

The Bus AVL system functions shall utilize the GIS base map obtained from Cobb County. The Bus AVL system map shall support all map features of the provided base map and shall support the import and export of map data in ArcInfo/ArcView format. The Contractor shall supply all software, scripts and procedures necessary for successful importation of the Cobb County base map into the Bus AVL system so that CCT can perform similar imports in the future without assistance from the Contractor.

Route traces, timepoints, bus stops, and other location-based service data shall be maintained in the Bus AVL system. The Bus AVL system shall be capable of maintaining all map overlay data required for the Bus AVL system.

Initialization of the Bus AVL system's AVL map shall be the responsibility of the Contractor. The Contractor shall be responsible for all refinements, updates, format conversions, adjustments, processing, and handling of the GIS data supplied to them by CCT or otherwise obtained as necessary for successful incorporation of the data into the AVL map and the proper operation of all Bus AVL system functions that directly and indirectly use this data.

All functions necessary for successfully entering and maintaining map data in the Bus AVL system shall be provided as part of the system. These functions shall enable the System Administrator to perform regular updates to, and replacement of the AVL base map and map overlays used by the Bus AVL system without requiring extensive or complex manual operating procedures and without requiring manual data entry. Selective updates of the base map and to any selected overlays shall be possible without re-importing the entire map and all overlays and without loss of prior map edits. Where minor edits or data entry are required to import map data, such edits, entries and corrections shall be stored (e.g., as a script) for re-application in subsequent imports. The System Administrator shall be able to reapply these edits, entries and corrections on subsequent imports via a minimal set of commands.

2.6 Bulk Data Transfer

The Bus AVL system shall support automated and secure wireless transfer of large amounts of data to and from all Bus AVL system-equipped vehicles. This function shall eliminate the need for CCT personnel to physically visit each vehicle to perform updates.

Wireless data transfers shall occur when the vehicles enter specific access zones, which shall include CCT's Bus Garage and Shop areas, as well as other areas that may optionally be designated by CCT. The posting of data for transfers shall be supported at any time. The bulk data transfer function shall enable authorized Bus AVL system users to post data for transfer to vehicles and to monitor the progress of all transfers on a per-vehicle basis. No user intervention shall be required to handle transfers once they are posted. Suitable interactive facilities shall be provided for the Bus AVL system Administrator to manage the bulk data transfer function.

The bulk data transfer function shall detect interrupted transfers, such as for a vehicle that leaves the access zone prior to completion of a data transfer. In this case, the transfer shall be completed normally when the affected vehicle returns to any access zone. For very large data sets, it shall not be necessary to re-start an interrupted transfer from the beginning.

In order to expedite completion of large transfers, the bulk data transfer function shall continue to operate without interruption following vehicle power down while within range of any access point. This mode of operation shall be limited in duration as necessary in order to avoid excessive vehicle battery drain.

Bulk data supported by this function shall include, but not be limited to, the following types of data:

- a. **Fixed-route Schedule Data** – Provide for the transfer of schedule data including routes, schedules, blocks, trips, runs, time points, arrival and departure times, map data, and other data required by the vehicles as dictated by the Contractor’s design approach. The bulk data transfer function shall permit all such updates to occur over a period of at least two weeks prior to the effective date of the new data and without disrupting current operations using the existing data. In addition, the Bus AVL system shall include a capability to download short-term changes to the route definition data (e.g., re-routes) to vehicles operating in the field.
- b. **Destination Sign Data** – Provide for download to vehicles of updated destination sign message data for vehicles with onboard signs that are interfaced to the Bus AVL system. The Bus AVL system shall support downloading of this data as required (typically with every schedule update).
- c. **Audio Announcement and Visual Display Data** – Provide for download of updated audio announcement data and visual display data to all vehicles equipped with an audio and visual announcement system. The Bus AVL system shall support downloading of this data as required (typically with every schedule update).
- d. **Automatic Passenger Counter (APC) Data** – APC data from APC-equipped vehicles shall be uploaded from vehicles on at least a daily basis. An upload method that does not require manual intervention shall be provided.
- e. **Manifest Data (Option)** – Manifest data shall be downloaded to Paratransit vehicles prior to pull-out for the current service day. The specific manifest required on a vehicle for the service day shall be downloaded to the vehicle no later than at the time of Operator login. In order to reduce recurring wide area wireless data communications costs, the bulk data transfer path shall be preferred over the mobile data communications path for transferring manifest data. **Note: Bulk Data Transfer capabilities are required on paratransit vehicles only if the “Online Manifest” option is executed.**

- f. **Vehicle Mileage Data** – The Bus AVL system shall support uploading of vehicle mileage data from all Bus AVL system-equipped vehicles. Vehicle mileage data shall be uploaded on at least a daily basis. No manual intervention shall be required for this process.
- g. **Vehicle Equipment Software Updates** – The download of software and configuration updates to any and all vehicle types.

All fixed-end and vehicle equipment and software required to transfer bulk data to and from Bus AVL system-equipped vehicles shall be provided by the Contractor (see also Section 5.12.1). The Contractor's design shall employ network access security (e.g., encryption and firewall) in order to prevent unauthorized access to the Bus AVL system LAN and CCT LAN/WAN via the wireless facilities. A design that allows retrieval of higher priority, more time critical data earlier and retrieval of less critical data at a later time is preferred.

The proposal shall describe the bulk data transfer mechanism that is proposed, including the method(s) of preventing unauthorized access to the Bus AVL system LAN and CCT's LAN/WAN.

2.7 Daily Schedule Selection

For fixed-route service, the Bus AVL system shall support a minimum of two complete sets of service schedules (bookings) – (1) the booking currently in effect and (2) the next booking to become effective at some future date. The daily schedule of trips for each service day shall be automatically selected by the Bus AVL system based upon the date, service schedule in effect, day of the week, and any special schedules applicable to particular days. The Bus AVL system shall support CCT's current Weekday, Friday, Saturday, Sunday, and Holiday schedule types. Each schedule type includes trips that only pertain to certain days of the week or particular dates. The Bus AVL system shall recognize such day-to-day variations in the schedules and only display and use the scheduled trips that apply to the particular service date. For each service schedule, the Bus AVL system shall support at least 10 schedule types in addition to the current CCT schedule types. All schedule types and associated service dates shall be definable by CCT.

CCT's scheduled service is generally not completed by midnight. Therefore, the Bus AVL system shall support service days that cover time periods over 24 hours in duration and that end at the time of the last pull-in. At midnight, the new day's schedule shall be utilized for vehicles that pull out after midnight. Those vehicles that pulled out before midnight shall continue to operate under the schedule of the day they pulled out until they complete their scheduled block, even if the block completion occurs after midnight. Therefore, for a time period after midnight, the Bus AVL system shall allow two schedules to be in effect concurrently.

2.8 Schedule Adherence Monitoring

The Bus AVL system shall accurately monitor the schedule adherence of all fixed-route revenue vehicles that are operating on defined schedules. Fill-in vehicles (extra vehicles placed on a route) and special event/service vehicles that are without defined schedules need not be monitored for schedule adherence.

Schedule adherence shall be calculated for each defined timepoint and accurately estimated between defined time points. The time delay between measuring a vehicle's position and the availability of the calculated/estimated schedule adherence status shall not exceed 10 seconds. Schedule deviations beyond pre-defined, System Administrator-adjustable thresholds shall produce an event.

Schedule adherence to defined timepoints shall be based on the scheduled departure time at each time point, with the exception of those specific stops that have only an arrival time or have both arrival and departure times. The Bus AVL system shall be capable of handling any number of timepoints per route direction. Timepoint arrivals and departures shall be determined to an accuracy of ± 15 seconds. For timepoint departures, determination to an accuracy of ± 15 seconds shall be regardless of whether the vehicle stops at the time point or passes the time point without stopping.

A vehicle's schedule adherence status shall be used for display to the Operator, and for generation and display of schedule adherence deviation events to Bus AVL system users. To minimize data transmission requirements under non-emergency conditions, a report-by-exception scheme is preferred, whereby schedule adherence information is maintained on-board each vehicle.

2.9 Route Adherence Monitoring

The Bus AVL system shall accurately monitor the route adherence of all fixed-route revenue vehicles, including fill-in vehicles and special event/service vehicles that are operating on defined routes. Route deviations that are beyond pre-defined, System Administrator-adjustable thresholds shall produce an event.

A vehicle's route adherence status shall be used for display to the Operator, and for generation and display of route adherence violation events to Bus AVL system users. To minimize data transmission requirements under non-emergency conditions, a report-by-exception scheme is preferred, whereby route adherence information is maintained on-board each vehicle.

2.10 Turn-back Monitoring (Option)

The Bus AVL system shall detect and adjust for fixed-route vehicle turn-backs (short turns) within an assigned block. The system shall issue a specific turn-back event when a vehicle has executed a turn-back before the end of its current trip and proceeds along the route in the opposite direction for a subsequent trip within the same block. Following the turn-back, the Bus AVL system shall automatically determine

which trip within the assigned block the vehicle has jumped to based on the current time, the vehicle's new geographic location, the vehicle's direction, and the vehicle's schedule. The Bus AVL system shall then resume RSA monitoring for the vehicle based on the new trip assignment. Missed trips and partially missed trips shall be identified and presented to Bus AVL system users in associated schedule-related displays, and recorded by the Bus AVL system for reporting purposes.

2.11 Interlining

The Bus AVL system shall insure the proper handling of interlined blocks by all fixed-route Bus AVL system functions. Additional user actions, selection criteria, and displays from those required to handle non-interlined routes shall not be required. Bus AVL system functions that shall properly handle interlining shall include, but not be limited to, the following:

- a. Group calls to a route
- b. Store and forward messages to a route
- c. Internal and external audio and visual announcements
- d. Destination sign changes, with and without an intermediate deadhead
- e. Correlation of RSA data to the proper routes
- f. Correlation of APC data to the proper routes
- g. Display of interlined routes on the AVL map
- h. Display of vehicles on interlined routes on the AVL map
- i. Data messages, text messages including store and forward messages, reroutes, and RSA functions through the selection of one or more routes via “rubber-banding”.

2.12 Operator Relief Status

The Bus AVL system shall monitor the status of scheduled reliefs for fixed-route vehicle Operators. A complete schedule of reliefs for the current service day shall be provided that shows the status of each scheduled relief. Possible status indications for reliefs shall include whether the relief has started, is completed, and has been missed.

2.13 APC Processing and Recording (Option)

The Bus AVL system shall include APC processing and recording capabilities for fixed-route service. Collected APC data shall be accurately processed in order to ensure that the data is valid for use in NTD reports and for planning purposes. The Contractor's standard APC reports shall be included.

APC data indicating the number of passengers boarding and alighting at each stop shall be collected on all fixed-route buses. APC boarding and alighting data shall have an accuracy of at least 95% at the stop level. Boarding and alighting data shall be correlated to bus stop IDs based upon a vehicle's route, block, trip, location, pattern, and date/time that the data was collected. APC data shall be correlated to an accuracy of at least 95% at the trip level. Data that cannot be correlated to a bus stop ID shall be recorded as an uncorrelated stop (using GPS coordinates or another similar approach) for the corresponding trip. A means of effectively managing uncorrelated data is desired, such as the ability to combine uncorrelated stops that are located close together.

Other APC data processing shall include flagging of clearly erroneous data, such as may occur from sensor failures. Processing shall also flag data for buses that would otherwise improperly affect statistical results for monitored bus routes due to temporary and unanticipated changes to the operation of buses on those routes. Changes of this type to be detected shall include, but not be limited to, significant off-route operation, significant off-schedule operation, breakdowns, and turn-backs. Flagged data shall be recorded, but shall be easily excluded from statistical reports and data analyses. Parameters for determining various filtering thresholds required by the processing shall be definable by the System Administrator.

2.14 Bus AVL System User Functions

The Bus AVL system shall provide functions to support Bus AVL system users as specified in the following sections. All user functions shall be available to both local and remote/shared users. Local users are defined as those users on the CCT LAN/WAN who require continuous or regular access to the Bus AVL System. Remote users are defined as users with workstations whose network interconnection to the Bus AVL system LAN is via a WAN infrastructure with limited bandwidth. Shared users are defined as users who will only intermittently access the Bus AVL system and do not require a dedicated Bus AVL workstation installation at their work position. The required number of local users shall be as defined in Appendix C. In addition, simultaneous access by a minimum of 4 remote/shared users shall be supported by the Bus AVL system.

Proposals shall indicate the proposed design approach for supporting remote/shared users.

2.14.1 Event Handling

Bus AVL system users shall be permitted access to events to the extent permitted by their assigned data partition(s). Bus AVL system users with read-only access to specific events shall be able to view the

events, but they shall not be permitted to respond to (i.e., acknowledge, open incident, reply, log, etc.) the events. Bus AVL system users shall not be permitted to view events to which they do not have at least read-only access.

The Bus AVL system shall always ensure that emergency events are promptly presented to at least one active (i.e., logged on) Bus AVL system user. In this special case, the Bus AVL system user receiving the emergency event shall have full access to the event. Events not assigned to a data partition and events in data partitions without a current active user shall be routed to at least one active Bus AVL system user, regardless of the data partition assignment(s) of that user.

2.14.1.1 Event Presentation

The Bus AVL system shall enable Bus AVL system users to rapidly and efficiently detect and respond to events. Events shall be presented to Bus AVL system users in a manner that emphasizes the most urgent events requiring response. However, all events within a Bus AVL system user's data partition(s) shall be accessible.

Redundant events shall be eliminated in order to reduce the presentation of unnecessary events. In cases where multiple RTT, PRTT and EA events are present from the same vehicle, only the first-received, highest priority, unanswered (i.e., to which a Bus AVL system user has not responded) event shall be presented. However, a PRTT received from a vehicle after an EA has been answered shall be presented to allow the Bus AVL system user to respond to the PRTT. Where different mechanical alarms are being reported for the same vehicle, the most recent unacknowledged or return-to-normal alarm of each unique alarm subtype shall be presented. Where multiple RSA violations are being reported for the same vehicle, only the most recent event of each type shall be presented.

Bus AVL system users shall be able to inhibit or change the display reporting thresholds of selected events in order to reduce the volume of events being reported during peak operating periods and during service disruptions. In particular, Bus AVL system users shall be able to inhibit the display of RSA violations and to modify the display thresholds in order to control the number of RSA violation events displayed to the user.

All events, including redundant events, shall be stored in the historical log regardless of how they are filtered or otherwise handled for user presentation. For example, inhibiting and changing of display reporting thresholds by a user shall not affect the historical recording of the filtered events.

2.14.1.2 Event Selection

The Bus AVL system shall enable Bus AVL system users to quickly locate and select an event. A convenient mechanism shall be provided for the automatic selection of the oldest (first received) event in

the highest event priority level and the most recent (last received) event in the queue, regardless of the event's priority level.

Upon selection of an event by a Bus AVL system user, the Bus AVL system shall enable the following functions:

- a. View – examine all information concerning the event
- b. Edit – insert, delete and modify information concerning the event
- c. Remove – remove an event without responding to it
- d. Incident – create and edit an incident report for the event
- e. Answer – respond to an event requiring a response, including a request for voice communications, returning a text message, and acknowledging alarms
- f. Show Location – Show the current location of the vehicle associated with the event on the AVL map display
- g. Transfer – transfer control of the event to another authorized Bus AVL system user.

The Bus AVL system shall manage access to events by multiple Bus AVL system users in order to avoid conflicts and loss of data that may otherwise occur from multiple operations on the same event.

2.14.1.3 Event Removal

Authorized Bus AVL system users shall be able to remove events from display regardless of their current status. The ability to select multiple events for removal with a single command shall also be provided. Authorized Bus AVL system users shall also be able to specify that all events of a particular type be removed with a single command; for example, to remove all schedule adherence messages or all data messages of a particular type with a single command. Removal of emergency alarms shall require additional confirmation from the Bus AVL system user before the request is executed. Removal of events shall affect only their presentation to Bus AVL system users and shall not affect the historical log, which shall record and retain all events.

2.14.2 Map-Based Vehicle Location and Status

The Bus AVL system's AVL map capabilities shall provide Bus AVL system users with a detailed geographical map of the CCT service area showing the current locations and RSA status of all vehicles within a user's assigned data partition(s). This capability shall be provided at all workstations equipped for the display of the AVL map.

Vehicle positions on the AVL map shall be represented by vehicle symbols depicting CCT's various fleet vehicles. Vehicle positions shall be accurately located and aligned with the streets on which the vehicles are operating. There shall be no visible offsetting of vehicle positions from the displayed streets. If necessary, the Bus AVL system shall correct for map and positional inaccuracies and automatically position the displayed vehicle symbols onto the proper streets. Vehicle locations shall be updated on the map overlay each time valid vehicle position data is obtained from the vehicle.

When the on-board AVL equipment is not operational and when data communications is disrupted, vehicle locations shall remain at the last reported location. For such vehicles, the last reported location shall be depicted on displays with appropriate highlighting to indicate to a viewer that AVL data is not available and the vehicle location is the last known position.

Vehicle status information conveyed by this function shall include, but not be limited to, the following attributes:

- a. Schedule status (early, on-schedule, or late)
- b. Emergency alarm conditions
- c. Route status (on or off-route)
- d. Type of vehicle (e.g., fixed-route, paratransit, supervisor, service, or other non-revenue)
- e. Non-Scheduled - logged on (e.g., fill-in, tripper, special event vehicles)
- f. Not logged on
- g. Operator badge number and name
- h. Direction of travel
- i. AVL data not available.

Bus AVL system users shall be able to quickly and easily configure their map view to display all or selected attributes.

2.14.3 Service Status

The Bus AVL system shall provide tabular information to users for determining the status of specific routes, schedules, and vehicles within the users' assigned data partition(s) without the use of geographical maps. The Bus AVL system user shall be able to filter and sort the data presented using common selection criteria, such as date, time, vehicle, Operator, route, block, run, etc.

At a minimum, the following types of information shall be provided:

- a. A searchable listing of blocks that provides the scheduled times at timepoints and, if data is available, at bus stops
- b. A searchable listing of runs that provides the scheduled operator work piece(s)
- c. A searchable listing of routes that provides the scheduled times of vehicles at timepoints and, if data is available, at bus stops
- d. A listing of vehicles currently in violation of schedule adherence limits with the early/late status in terms of minutes, current route, block, and run assignment
- e. All blocks for the current service day and the current status of each block, including an indication of active blocks that are currently un-served (e.g., due to an overdue Operator log-on)
- f. A listing of the currently active (logged on) vehicle and vehicle Operator for each block
- g. All runs for the current service day and the current status of each run, including an indication of active runs that are currently un-served (e.g., due to an overdue Operator log-on)
- h. A listing of currently active (logged on) vehicle and vehicle Operator for each run
- i. All routes that currently have tripper and fill-in vehicles active and the number of tripper and fill-in vehicles on each of those routes.

2.14.4 Vehicle and Route Selection

The Bus AVL system shall enable users to quickly identify, through selection, a set of vehicles and routes for the purpose of data communications. Available vehicle and route selections shall be based on the Bus AVL system user's assigned data partition(s).

2.14.4.1 Basic Selection Methods

The basic methods of vehicle and route selection that shall be supported are as follows:

- a. Select one or more vehicles by specifying vehicle IDs
- b. Select one or more vehicles by specifying vehicle assignment attributes, including Operator badge numbers of the current vehicle Operators, currently assigned block numbers, and currently assigned run numbers. The Bus AVL system shall automatically

maintain the correlation between vehicles, vehicle Operator badge numbers, block numbers, and run numbers based on the current schedule and log-on data received when Operators log in.

- c. Select one or more specified routes by route numbers. Since the set of vehicles associated with a route may change frequently during the service day, the selection of routes shall resolve to the corresponding vehicles only at the time the selection is actually used and not during the selection process itself, which may have occurred at an earlier time. For example, route selections for the text message store and forward function shall pick up new vehicles as they log onto a route during the service day.
- d. Select all vehicles of a particular type (e.g., fixed-route revenue vehicles, paratransit vehicles, non-revenue vehicles).
- e. Select all vehicles. The Bus AVL system shall provide a dedicated command for executing this type of selection. Bus AVL system users shall not be required to make multiple selections to select all Bus AVL system-equipped vehicles.
- f. Re-use the selection with which the Bus AVL system user previously communicated, or tried to communicate. The Bus AVL system shall support this type of selection without requiring the Bus AVL system user to explicitly re-select the vehicles and routes involved. The Bus AVL system user shall be able to name and save selection criteria for re-use.

Any combination of the above selection methods shall be applicable interactively in order to construct the desired final list of vehicles and routes. The system shall automatically filter out duplicate vehicle entries that may occur as a result of the selection process.

2.14.4.2 Map-based Selection Methods

The following map-based selection methods shall be provided from the AVL map display:

- a. Select one or more vehicles and routes that are individually picked from the AVL map display.
- b. Select all displayed vehicles within a dynamically selected geographical area on the AVL map display. A "rubber-band" type of graphical selection shall be supported for defining the desired geographical area. The Bus AVL system shall generate a list of all vehicles that are currently located within the selected area. Vehicle IDs and block numbers shall identify the selected vehicles. Once a list of vehicles is generated, the Bus AVL system user shall be able to add, delete, and modify entries in the list prior to using it.

- c. Select all displayed routes within a dynamically selected geographical area on the AVL map display. A "rubber-band" type of graphical selection shall be supported for defining the desired geographical area. The Bus AVL system shall generate a list of all routes that pass through the selected area. Once a list of routes is generated, the Bus AVL system user shall be able to add, delete, or modify entries in the list prior to using it. Users viewing both revenue and non-revenue vehicles shall also be able to specify either or both types of vehicles to be part of the selection.

The Bus AVL system user shall be able to use a combination of both basic and map-based methods to make a selection.

2.14.5 Emergency Alarm

When a vehicle Operator generates an EA event, the Bus AVL system shall provide a subtle (i.e., not readily observable by passengers on the vehicle) and silent indication back to the initiating vehicle Operator's VCH that the emergency alarm has been initiated.

Initiation of this alarm shall result in an EA event being reported to all logged-in Bus AVL system users. Upon Bus AVL system user selection of an EA event in the event queue, the Bus AVL system shall provide a subtle and silent indication on the VCH display that the emergency alarm has been answered.

All attempts to initiate text messages with the vehicle from any source shall be inhibited during an emergency alarm. Data communications with all other vehicles not in an emergency alarm state shall continue to operate normally, except that any functions involving data communications with the vehicle in an emergency alarm state shall be inhibited.

The Bus AVL system shall terminate an emergency alarm if the initiating Operator subsequently issues a PRTT. The Bus AVL system user shall also have the capability to terminate an emergency alarm without communication from the vehicle Operator. However, the system shall issue a warning message and require a confirmation from the Bus AVL system user before the emergency alarm is actually terminated.

The Bus AVL system user selection of an emergency alarm shall automatically generate an incident report.

2.14.6 Text Messaging

A major goal of the Bus AVL system is to greatly reduce the need for voice communications and to streamline the dispatching function through the extensive use of text messaging between Operators and Dispatchers. To this end, the Bus AVL system shall be designed to efficiently support text messaging to and from the vehicle fleet.

The Bus AVL system shall enable authorized Bus AVL system users to send text messages to one or more selected vehicles and routes using any of the selection methods specified in Section 2.14.4. Free-form text messages and a set of pre-defined text messages shall be supported. Pre-defined text messages shall be configurable by authorized Bus AVL system users and shall be available for rapid selection. The Bus AVL system shall support at least 60 pre-defined messages. Text messages shall be up to 250 characters in length.

2.14.6.1 Text Messaging with Response (Option)

Bus AVL system users shall be able to specify a response requirement for each free-form text message that is issued. Response requirement options supported by the Bus AVL system shall include: “no response”, “acknowledgment of receipt”, and “yes/no”. For messages requiring a response, the Bus AVL system shall request a response from each vehicle to which the text message is directed. The default response requirement for free-form text messages shall be “no response”. Pre-defined text messages shall each have a pre-defined default response requirement.

The Bus AVL system shall track the status of responses to text messages that require a response. Responses shall not be displayed in the event queue. Rather, a separate display shall be used for displaying and managing these responses. The Bus AVL system user shall be able to display the status of all required responses grouped by message. For each message, a listing of the receiving vehicles shall be presented, along with the assigned block and run numbers, with an indication of those that have responded and the response received. Vehicles that have not responded shall be listed at the bottom of the list. The text of the original message and the time it was sent shall be displayed at the top of each list.

The Bus AVL system shall support situations where multiple messages requiring a response are active at the same time for the same Bus AVL system user. In this case, the Bus AVL system shall associate the responses with the proper message. The active messages and the status of responses for each shall be preserved when a Bus AVL system user logs off and automatically transferred to a new Bus AVL system user who logs on and takes over the responsibility of the Bus AVL system user who initiated the active messages. Alternately, a Bus AVL system user shall have the capability to manually initiate a transfer of the lists to another Bus AVL system user who may not be logged on yet or to whoever assumes the responsibility of the Bus AVL system user who initiated the messages.

Bus AVL system users shall be able to choose the message responses to be displayed from a list of active messages for which responses have been required. Bus AVL system users shall be able to delete a message from the active list even if all of the responses have not been received.

2.14.6.2 Text messaging — Store and Forward (Option)

The Bus AVL system shall enable authorized Bus AVL system users to send text messages that are designated as “store and forward” messages. Store and forward message capability shall also apply to messages that require a response.

Bus AVL system users shall be able to address “store and forward” messages to selected vehicles in a manner similar to normal text messaging and shall be able to designate a bounded (start/end) delivery time period within the service day. A “store and forward” message shall be delivered to the selected vehicles that are logged on and also to those that logon or interline to one of the addressed routes at any time during the user-designated delivery time period. In no case shall a store and forward message be delivered more than once to the same vehicle Operator while operating the same vehicle and block number.

A store and forward message shall remain available for delivery until the user-designated delivery time period has ended, until the message is deleted by the Bus AVL system user or until the end of the service day, whichever occurs first.

2.14.7 Route and Schedule Adherence (RSA) Status

The Bus AVL system shall monitor the RSA status of all fixed-route revenue vehicles. All vehicles that are off-route or off-schedule by more than pre-defined threshold values indicated below shall be presented to Bus AVL system users who are assigned to the corresponding data partition(s). RSA status data shall be presented in terms of minutes early or late and the distance off-route.

The threshold values for declaring a vehicle off-schedule and off-route shall be System Administrator-adjustable. Initially, vehicles that deviate from their schedules by one or more minutes early and more than five minutes late shall be treated as schedule adherence violations; and vehicles that deviate from their scheduled routes by more than 500 feet shall be treated as route adherence violations.

2.14.7.1 RSA Disable and Enable

Bus AVL system users shall be able to disable route and schedule adherence violation events for selected vehicles, for all vehicles on selected routes, for all vehicles while they are located within a specified geographic area, and for all vehicles. The objective of this capability is to minimize nuisance alarms presented to the Bus AVL system user; for example, when vehicles are forced to detour or are delayed due to a known traffic problem. These disabled conditions shall be identified in a list available to Bus AVL system users for review and for the re-enabling of the RSA violation events. All disabling and enabling of RSA violation events shall be logged.

2.14.8 Incident Forms

The Bus AVL system shall provide authorized Bus AVL system workstation users the ability to create, maintain, track, view, and distribute incident forms. The creation of incident forms shall be triggered automatically for some event types and sub-types (e.g., an emergency alarm), on user demand for all other event types and sub-types, and for incidents not linked to events. Bus AVL system workstation users shall be able to request a full menu listing of all open and closed incident forms for the current day for selection and display of the desired form.

Upon creation of an incident form, the Bus AVL system shall automatically fill in all data for the form that is available to the system, such as vehicle IDs, Operator name and badge number, block number, run number, route, RSA status, current date and time, and vehicle location. The automatically filled in location shall be a reverse geo-coded street address or, if applicable, transit location (e.g., timepoint or bus stop) based on the vehicle's reported lat/long position. Bus AVL system users shall be able to edit all data fields and fill out any additional data fields defined for the incident form. Bus AVL system users shall be able to edit incident form data until the incident form is closed. Incident form reports shall automatically be distributed to designated locations on CCT's LAN/WAN.

CCT prefers an approach to incident management that permits multiple events to be linked to a single incident form. *The Proposer shall describe in the proposal its implementation of this function.*

The Bus AVL system shall provide functions to enable the System Administrator to specify which events will automatically trigger incident forms and the incident form format to be used, create new incident form formats, edit existing form formats, and integrate new form formats into the system. These incident form maintenance functions shall be available on-line without interrupting current system operation.

2.14.9 Playback

The Bus AVL system shall include a playback capability that enables Bus AVL system users to quickly recreate and observe the exact conditions that existed within the system at a previous time for the purpose of analyzing incidents. The playback function shall permit users to rapidly and selectively retrieve data for any time period where online historical data is available without requiring the loading of archival data from removable media. A means shall be provided to restore data from removable media and play back data from time periods prior to the online history. All playbacks shall use the Information Server data. There shall be no limit to the duration of the playback period defined by the Bus AVL system users. *Proposals shall describe any limitations in the retrieval of data imposed by the proposed system (e.g., a maximum number of vehicles or timeframe for which data can be simultaneously retrieved).*

The playback shall recreate the exact conditions that existed during the particular time frame selected by the user. Observation of the conditions that were present at the time shall be supported and allow presentation of all displays, including AVL displays and production of all reports via the normal Bus

AVL system displays and reports at the requesting user's workstation. The actual displays that were originally present on each workstation monitor do not need to be recreated; only the system conditions need to be recreated. These system conditions shall include all:

- a. Application program generated outputs
- b. Alarms
- c. Events, including schedule and route adherence events
- d. Incidents
- e. Vehicle locations
- f. Information on reroutes in effect
- g. Data communications
- h. User-entered data and commands that initiate communications, initiate actions and modify the database.

The AVL presentation for playback shall include a means of determining the average speed of vehicles, if this is not already a capability of the normal displays.

The ability to play back the conditions that existed at a previous time shall be unaffected by database, display, and report changes that have occurred since that time. The normal online operation of the Bus AVL system at other user workstations shall not be affected by the playback function.

Playback functionality shall enable users to start a playback beginning at any selected date and time. Users shall not be required to play back data for an extended duration in order to properly initialize the system conditions at the beginning of the playback period specified by the user. Users shall be able to control the speed and execution of the playback and shall be able to start and stop the playback, fast forward, reverse, pause and resume, and play back in slow motion. While in pause mode, no further data updates shall occur, but users shall be able to view and move among all displays and produce all reports.

The same display formats and conventions shall be utilized for playback as for actual operations, except that a clear, distinguishing attribute such as a colored border or other means shall be provided to distinguish displays presented during playback from those presented during actual operations.

2.14.10 Paratransit Customer Locator (Option)

As an option, the Bus AVL system shall include a paratransit customer locator function that shall enable authorized users to quickly determine if a specific paratransit customer, based on the customer's ID, is currently riding on a vehicle and, if so, provide specific information on the current location and the status of the vehicle.

Proposals shall specifically describe in detail how the proposed system will perform this function, including the associated user displays and actions. Proposals shall also indicate if this function is currently supported by the proposed system or whether custom development is required.

2.15 System Administration Functions

Access to the following Bus AVL system user functions shall be restricted to System Administrators.

2.15.1 Schedule Data Maintenance

The Contractor shall supply all functions, software, scripts, procedures, and training necessary for the creation and maintenance of CCT fixed-route schedules within the Bus AVL system. CCT shall be able to create and maintain fixed-route service schedules and associated data without assistance from the Contractor. Schedule data shall include, but not be limited to, route definitions and shapes, timepoints, arrival and departure times, blocks, trips, runs, and other schedule-related definitions required for the proper operation of Bus AVL system functions, including route and schedule adherence monitoring.

Functions shall be provided to enable the validation, test, repair, and discarding of a schedule data set prior to its cutover to online operation if necessary. These functions shall be supported without interfering with online operation of the Bus AVL system using the currently active data set.

The cutover to online operation for a new and validated schedule data set shall be coordinated within the Bus AVL system to ensure schedule data is consistent between the fixed-end servers and the vehicles. The distribution of destination sign data to vehicles shall be according to the requirements specified for bulk data transfer. The cutover process shall minimize any interruption to online operations and in no event shall such an interruption exceed 10 minutes.

The Proposer shall describe the cutover process for a new set of data and shall define all impact to online operations, including whether system downtime is required. If system downtime is required, the description shall state the maximum downtime that will occur for the initial configuration of the Bus AVL system.

The Bus AVL system shall enable System Administrators to manually make adjustments and corrections to the Bus AVL system active schedule data for use on an interim basis. Adjustments and corrections

shall be visually distinguishable by users from the original data. All such manual changes shall be immediately available to all affected Bus AVL system functions. A means shall be provided to restore the schedule data to its original state without having to manually re-enter the data.

2.15.2 GIS Data Import and Maintenance

The Contractor shall supply all functions, software, scripts, procedures, and training necessary for successful import of the Cobb County base map GIS data into the Bus AVL system so that CCT can perform similar imports in the future without assistance from the Contractor. The Bus AVL system shall enable System Administrators to manually initiate the import of base map data, including addition of map layers and other spatial data without affecting current system operation and, once complete, shall permit a controlled and rapid switchover to the new data. The import process shall enable input, validation, and correction of new and updated map data without requiring extensive or complex manual operating procedures and without requiring significant manual data entry.

The Bus AVL system shall enable System Administrators to make corrections and additions to the map. The Bus AVL system shall store these corrections and additions so they can be re-applied on subsequent retrievals of newer versions of the base map without requiring re-entry of any of the changed data. A simple means of reverting to a prior map shall also be provided.

A means of switchover to new map data shall be provided that minimizes system disruption while updates are being distributed to all components of the system that require map data, including map-enabled workstations and MDTs. All distribution shall be automatic and shall not require the System Administrator to physically access each component.

Regardless of the method used, system downtime shall not exceed 10 minutes for incorporation of new GIS data. *The Proposer shall describe the cutover process for incorporation of new GIS data and shall define all impact to online operations, including whether system downtime is required. If system downtime is required, the description shall state the maximum downtime that will occur for the initial configuration of the Bus AVL system.*

2.15.3 Destination Sign Data Maintenance

The Bus AVL system shall enable System Administrators to create and maintain trigger location data and text message data for fixed-route vehicle exterior destination signs. CCT prefers that destination sign text messages be fully managed within the Bus AVL system, rather than using numeric codes that must be coordinated with separate, external sign programming facilities. The Contractor shall be responsible for determining whether the existing CCT destination signs can support this approach.

CCT prefers that destination sign changes be triggered based upon the starting and ending of user-specified trips, rather than require geographic location-based triggers. For systems that use location-based

triggers, the triggers shall be permitted at any location within the service area. The definition of location-based triggers shall not require manual entry of geo-coded locations. A means of easily defining, viewing, and modifying location-based triggers using a map of the service area with route overlays is strongly preferred. All location-based trigger designs shall utilize schedule data to determine if a trigger should occur when the vehicle passes through the trigger location.

All maintenance of destination sign data shall be possible without interrupting current online operations. A simple means of cutover to a new destination sign data set shall be provided that coordinates with other changes, such as schedule data changes that may also be pending. The distribution of destination sign data shall be according to the requirements specified for bulk data transfer.

2.15.4 System Configuration Monitoring and Control

The Bus AVL system shall provide System Administrators with the ability to review and modify the Bus AVL system configuration and parameters. The ability to monitor the status of all Bus AVL system components shall also be provided. Functions to control system performance monitoring, and to display and analyze server and workstation processor resource utilizations shall also be provided.

Control operations that shall be supported shall include, but not be limited to, failover switching, server and LAN administration, management of interfaces, and control of Bus AVL system components.

2.15.5 In-Vehicle Announcement Data Maintenance (Option)

This option applies only to the Proposer's own onboard audio and visual announcement system offering and shall be supplied in conjunction with the onboard system if that option is exercised by CCT (see Section 2.16.7).

The Bus AVL system shall enable authorized System Administrators to maintain data for all interior and exterior fixed-route vehicle audio announcements. The same maintenance functions shall also support visual announcements. Audio and visual announcement messages shall be fully managed within the Bus AVL system maintenance facilities. The use of numeric codes for messages that must then be manually coordinated with separate, external annunciator programming facilities is not acceptable. Capacity for at least 50 audio and 50 visual announcements per route shall be provided.

The maintenance facility shall include functions to create, edit and delete audio and visual announcements and their associated triggers and text descriptions. CCT strongly prefers software maintenance facilities that utilize rules-based trigger algorithms. For audio announcements, a method shall be provided for specifying output options of "interior", "exterior" and "both". A method for synchronizing an audio and visual message together via the same trigger or by other means such as or rule-based algorithm shall be provided. The maintenance facility shall enable prioritization of announcements, thereby enabling higher priority announcements to interrupt lower priority announcements when triggers overlap.

Triggering of automatic audio and visual announcements shall include, but not be limited to, the following methods:

- a. Approaches/departures to/from scheduled stops and timepoints – Triggers that occur at user-specified amounts of time or distance prior to arrivals at user-specified stops and timepoints within scheduled trips. CCT prefers and will favor the use of this type of trigger for next stop announcements rather than use of geographic area triggers
- b. Arrival within a defined geographic area – Triggers that occur upon vehicle entry into a user-specified physical area while operating on a user-specified trip. Support for triggers of this type without a trip association shall also be supported. Triggers of this type shall not require manual entry of geo-coded location data. A means of quickly identifying the trigger locations using a map of the service area with route overlays is strongly preferred
- c. Departure from a defined geographic area – Triggers that occur upon vehicle exit from a user-specified physical area while operating on a user-specified trip. Other requirements are the same as for (b), above
- d. Time of day
- e. Elapsed time – triggers that occur at a user-specified amount of time from the start of a user-specified trip
- f. Door open event
- g. Door close event.

Support for manual (i.e., Operator-triggered) announcements shall also be provided.

All maintenance of in-vehicle announcement data shall be possible without interrupting current online operations. A simple means of cutover to new announcement data sets shall be provided that coordinates with other changes, such as route changes, that may also be pending. The distribution of announcement data shall be according to the requirements specified for bulk data exchange.

2.16 Fixed-Route Revenue Vehicle Functions

The Bus AVL onboard system shall provide fixed-route revenue vehicle functions as specified in the following sections. Bus AVL system-equipped fixed-route revenue vehicles shall be capable of providing all required functions while operating anywhere within CCT's defined service area and without requiring manual reconfiguration of any kind.

2.16.1 Operator Support Functions

2.16.1.1 Operator Logon and Logoff

Operator logon data shall consist of the Operator badge number, block number, and vehicle ID. Operators shall not be required to enter the vehicle ID or be able to change the vehicle ID. The vehicle ID shall be programmed into and read from the IVCU.

A single logon at the VCH shall automatically logon all onboard system equipment, including destination signs and automatic passenger counters. However, the Bus AVL system shall verify that all logon data is valid before accepting the logon. The validity checks to be performed on each data field are as follows:

- a. **Operator badge number** - Verify that the Operator badge number entered is a valid number in the current employee list, that the employee is permitted to perform a vehicle logon, and that the same employee is not already logged onto another vehicle.
- b. **Vehicle ID** - Verify that the Vehicle ID is a valid number in the current vehicle list.
- c. **Block number** –Verify that the entered block number is valid for the current day and time, and that it is not already logged on to another vehicle.

Invalid logons shall be rejected. The Bus AVL system shall log an event after three consecutive invalid logon attempts that includes all relevant information about the invalid logon attempts, including the badge number used, the vehicle ID, block number, and date and time.

All valid logons and logoffs shall be logged as events that indicate all relevant information about the logon and logoff, including the Operator badge number, block number, vehicle ID, and date and time. A successful logon shall trigger the delivery of any relevant store and forward text messages to the vehicle.

If an Operator fails to log on prior to pull-out, the Bus AVL system shall issue an audible alarm to the Operator and shall prompt the Operator to log on. Dispatchers shall be immediately notified of this condition via an alarm event. A successful logon shall not be required in order to use any of the Bus AVL system vehicle communications functions.

The Bus AVL system shall retain an Operator's logon status during layovers and other temporary hold conditions for which the vehicle ignition may be turned off. The Operator's logon status shall not be affected by subsequently restarting the vehicle engine upon resumption of service.

2.16.1.2 Announcement System Logon (Option)

As an option, the Bus AVL system onboard logon function shall also automatically logon CCT's existing DRI-600 audio and visual announcement system.

2.16.1.3 Operator Changes

The Bus AVL system shall support enroute changes in the assigned Operators for cases such as mechanical breakdowns and Operator substitutions. The Operators shall be required to perform an Operator logon/logoff when the change takes place.

2.16.1.4 Text messaging

The Bus AVL onboard system shall enable Operators to send pre-defined text messages to Bus AVL system users with a minimum of interaction with the VCH. These messages shall be selected and transmitted by Operator selection. For each vehicle type (e.g., fixed-route, Supervisor, maintenance vehicle, etc.), the Bus AVL system on-board system shall support at least 30 pre-defined messages of at least 80 characters in length. Operator-initiated messages shall be handled as events and shall be subject to all of the requirements of events, including event priority and event data partitioning.

The Bus AVL system shall allow System Administrators to define and revise the set of pre-defined messages, and to schedule the automatic transfer of the revised messages to all vehicles via bulk data transfer.

Operators shall be able to review recently received messages at any time with a minimum of interaction with the VCH. The Bus AVL on-board system shall be capable of retaining at least the last eight received messages for Operator review. The received messages shall be ordered chronologically with the most recently received message presented first.

Messages requiring a response shall be clearly indicated to the Operators. Operators shall be able to respond by selecting the appropriate response on the VCH. Message responses shall be routed to the Dispatcher currently responsible for handling the responses.

2.16.2 RSA Status

The Bus AVL on-board system shall automatically display RSA (Route and Schedule Adherence) status to the Operator on fixed-route revenue vehicles. The Bus AVL on-board system shall display schedule adherence status to the Operator in units of minutes early. Display of late status shall be suppressed. The ability to turn the display of route and schedule adherence status on and off shall be configurable by the System Administrator.

2.16.3 Vehicle Location Reporting

Reporting of vehicle locations based upon on-board GPS equipment shall be provided by the Bus AVL system. Only valid GPS data received from the vehicle shall be processed by the Bus AVL system. Location data shall always be reported as part of all data messages.

When invalid GPS data is received and when the value of merit exceeds a System Administrator-adjustable threshold (e.g., 4 or 5) indicating less than desired accuracy of position solutions, the last location of the vehicle shall be maintained and an appropriate GPS status indication presented to Bus AVL system users for the vehicle. Normal vehicle position updates shall resume upon the receipt of valid GPS data and the desired value of merit is attained. *Proposals shall indicate what method is proposed to validate GPS location data and the proposed value of merit threshold for vehicle location reporting.*

A location reporting scheme that enhances the GPS-based location reporting based upon a combination of distance traveled and elapsed time is preferred. Additionally, data sources used to back up the GPS equipment when the GPS signal cannot be received (e.g., dead reckoning inputs), shall be supported.

Proposals shall indicate what methods are proposed to enhance and back up the GPS for vehicle location reporting.

Regardless of the reporting scheme used, vehicles shall report their location at least once every 90 seconds. Vehicles in an emergency alarm state shall report their location at least once every 30 seconds.

2.16.4 Destination Sign Control

The Bus AVL system shall provide for automatic control of all fixed-route vehicle destination signs that are equipped with external interfaces. The destination signs shall be automatically updated by the system at Operator logon and at pre-defined points along each route (e.g., at the end of a trip and interlines) based on the active schedule data. The pre-defined points at which destination sign messages are automatically changed shall be definable by the System Administrator.

For non-revenue portions of vehicle schedules (e.g., pull-outs, pull-ins, deadheads), destination sign text shall display “Out of Service” shall be displayed during all deadhead and other non-revenue service periods.

When an EA event is initiated by the Operator, the Bus AVL system shall display “Emergency – Call Police” on the destination sign of the affected vehicle. A means shall be provided to resume the normal operation of the destination sign after the emergency has ended.

Destination sign text shall be displayed in the same fonts, character heights, and wording that is currently in use.

2.16.5 Mechanical Alarms

The Bus AVL system shall detect certain fixed-route vehicle warning and failure conditions and generate an appropriate mechanical alarm event. The conditions that can be alarmed shall include any warning and failure condition that is detected by the vehicle’s onboard monitoring system (e.g., engine control

module), security camera system, and discreet status inputs. A J1939 interface, J1708 interface, and a minimum of 8 discreet status inputs shall be provided on each vehicle for detecting vehicle warning and failure conditions and generating mechanical alarm events. All displayed and recorded mechanical alarm events shall include an English text description of the alarm easily understood by Bus AVL system users. Manual lookup and interpretation of alarm codes to determine its meaning shall not be necessary.

When vehicle warning and failure conditions are detected from the vehicle's onboard monitoring system, data received in the form of a value shall only generate mechanical alarm events based on the value exceeding System Administrator-adjustable thresholds.

A means shall be provided to filter data from the vehicle's onboard monitoring system and from discrete status signals so that only specific System Administrator-defined mechanical alarm events are transmitted over the data communications infrastructure. All events not transmitted over the data communications infrastructure shall be transmitted to, and logged by, the Bus AVL system via the bulk data transfer function.

The Bus AVL system shall provide a means to inhibit unnecessary mechanical alarm events from being generated during vehicle startup, shutdown, or other such transient conditions.

The following specific mechanical alarms are desired by CCT:

- a. Check Engine Light
- b. Engine Coolant Temperature
- c. Low Engine Oil Pressure
- d. Transmission Oil Temperature
- e. Low Transmission Oil Level
- f. Low Turbo Boost Pressure.

In addition, the value (e.g., temperature) associated with the mechanical alarm is desired. The list of vehicle mechanical alarms to be implemented shall be finalized during the Bus AVL system design process.

2.16.6 Lift/Ramp Data

The Bus AVL system shall collect lift/ramp data indicating when the lift/ramp on a fixed-route vehicle is raised and lowered. The data collected shall enable generation of statistics for lift/ramp usage by location and the time it takes to board/de-board passengers using the lift/ramp.

2.16.7 Onboard Audio and Visual Announcements (Option)

CCT prefers that the Contractor continue to use the existing DRI-600 onboard announcement system for audio and visual announcements on fixed-route vehicles and optionally provide an interface for wirelessly transferring new announcement data to the DRI system. However, Proposers shall also offer as an option to supply and install their own onboard announcement system on fixed-route vehicles per requirements specified in the following sections.

Proposals shall clearly indicate how the offered system will implement audio and visual announcements.

2.16.7.1 On-Board Vehicle Audio Announcements

The Bus AVL system shall provide automatic audio announcements to passengers onboard fixed-route vehicles. This function shall support next stop announcements as well as annunciation of major intersections, key transfer points, promotional information, public service information, Operator-initiated messages and advertising. Written scripts for the initially required announcement messages and corresponding location names where announcements are to be made will be supplied by CCT for recording and implementation by the Contractor. The Contractor shall initialize the audio recordings and announcement trigger points to support CCT-provided locations and announcements.

Configuration of audio announcements shall permit triggering of specific messages based upon a variety of conditions, as specified for the data maintenance function (see Section 2.15.5). Additionally, the capability to randomize playing of timed announcements, such as advertising and public service announcements, is preferred. The Bus AVL system shall not issue next stop messages when the vehicle is off-route.

Next stop, major intersection and key transfer point announcement capacity shall be sufficient to support all of the routes in the CCT service area and all of the trips made by each vehicle during a service day, plus a 50% spare capacity for other types of announcements.

The Bus AVL system shall include facilities necessary to allow CCT to revise the initial, Contractor-supplied messages and to record additional messages as its services and routes change. All programming features of the supplied maintenance functions shall be fully supported by the in-vehicle announcement capabilities. A method for installing announcements on vehicles that does not require direct programming of each announcement device via memory cards and/or other manual methods shall be provided.

Audio levels shall be controllable by the Vehicle Operator within a usable audio range. The Operator shall have the capability of overriding the automatic initiation of audio announcements and instead manually select from a menu of predefined messages for announcements to passengers. The override shall be reported as an event.

2.16.7.2 On-Board Vehicle Visual Announcements

The Bus AVL system shall provide automatic visual announcements to passengers onboard fixed-route vehicles. This function shall support next stop announcements as well as annunciation of major intersections, key transfer points, promotional information, public service information, Operator messages, and advertising. Written scripts for the initially required announcement messages and corresponding location names where announcements are to be displayed will be supplied by CCT for display implementation by the Contractor. The Contractor shall initialize all messages and their associated trigger points to support CCT-provided locations and announcements.

Configuration, maintenance and capacity requirements shall be the same as for audio announcements. A means of coordinating visual announcements with corresponding audio announcements shall be supported. As with audio announcements, the Bus AVL system shall not display next stop messages when the vehicle is off-route.

The Operator shall have the capability of overriding the automatic initiation of visual announcements and instead manually select from a menu of predefined messages for display to passengers. The override shall be reported as an event.

2.16.7.3 Vehicle Exterior Audio Announcements

The Bus AVL system shall provide exterior announcements to passengers boarding vehicles. The exterior announcements shall be automatically activated by the system at predefined points along each route in order to announce route and destination information to boarding passengers. As a minimum, exterior announcements shall be coordinated with destination sign messages and shall be triggered by the opening of the vehicle doors.

Written scripts for the initially required announcement messages will be supplied by CCT for recording and implementation by the Contractor. The points at which exterior annunciator messages shall be automatically changed shall be definable by the System Administrator.

Audio levels shall be controllable by the Vehicle Operator within a usable audio range. The Operator shall have the capability of overriding the automatic initiation of exterior audio announcements and instead manually select from a menu of predefined messages for announcement to boarding passengers. The override shall be reported as an event.

2.16.8 Bus Excessive Idle Time Monitoring (Option)

As an option, the Bus AVL system shall monitor fixed-route buses for excessive idling, which is defined to be a contiguous period of time during which the bus engine is running and the vehicle has not moved.

When excessive idling is detected the Bus AVL system shall notify the Operator of the vehicle and also issue an alarm event to the fixed end.

The threshold time period for determining excessive idling shall be configurable by the System Administrator.

Proposals shall describe the method proposed for determining when a bus is in an idle state. Proposals shall indicate if this function is currently supported by the proposed system or whether custom development is required.

2.16.9 Safe MDT Usage Enforcement (Option)

As an option, the Bus AVL system shall limit permitted Operator interaction with the MDT while the vehicle is in motion. Functions that require significant Operator attention, such as text messaging, shall be inhibited while the vehicle is moving. This function shall not inhibit functions that do not require Operator interaction, such as a location reporting, automatic mechanical alarms, etc. This function also shall not inhibit emergency alarm functions or other static button functions of the MDT that do not require display interaction.

CCT prefers a design that enables the System Administrator to select from a set of specific functions to be inhibited during vehicle movement and also to set any applicable thresholds for determining when a vehicle is moving. Other possible configurable actions may also include designating a specific display to be shown whenever the vehicle has begun moving.

Proposals shall describe how the proposed system will perform this function, including the configuration capabilities and the specific functions that can be inhibited. Proposals shall indicate if this function is currently supported by the proposed system or whether custom development is required.

2.16.10 Traffic Signal Priority (Future)

The Bus AVL system shall support the future installation of traffic signal priority (TSP) functions and equipment on CCT's revenue vehicles. *Proposals shall describe the proposed system's capability of supporting TSP functionality and equipment at a future date, including a description of the Proposer's standard TSP offering.*

2.17 Paratransit Revenue Vehicle Functions

The Bus AVL onboard system shall provide paratransit revenue vehicle functions as specified in the following sections. Bus AVL system-equipped paratransit revenue vehicles shall be capable of providing all required functions while operating anywhere within CCT's defined service area and without requiring manual reconfiguration of any kind.

2.17.1 Vehicle Location Reporting

Reporting of vehicle locations based upon on-board GPS equipment shall be provided by the Bus AVL system. Specific requirements for this function are the same as for fixed-route (see Section 2.16.3).

2.17.2 Paratransit Online Manifests (Option)

The Bus AVL system shall include the paratransit manifest functions specified in this section and subsequent subsections. All manifest transactions between the paratransit vehicles and the paratransit scheduling system shall be verified by the Bus AVL system. Transactions where delivery is not able to be verified shall generate an appropriate manifest delivery failure event.

Operators shall have interactive access to their assigned manifest on the MDT while operating a Bus AVL system-equipped paratransit revenue vehicle. The manifest shall support and present to the Operator the manifest entries supplied by CCT's paratransit scheduling system, including pick-ups, drop-offs, breaks, and other entry types currently supported by the paratransit scheduling system.

The Bus AVL system shall keep track of manifest entries that are completed and shall display by default the next entry to be performed. Operators shall have a convenient means of scanning, selecting, and viewing details for all currently accessible manifest entries.

The vehicle manifest shall include, but not be limited to, the following data:

- a. Time
- b. Entry type: Pick-up, Drop-off, Break, etc.
- c. Customer Name
- d. Address
- e. Number of passengers by type (client, personal assistant, guests)
- f. Total fare amount to be collected
- g. Special instructions.

2.17.2.1 Operator Logon and Logoff

Operator logon shall determine the manifest to supply to the vehicle for the current service. Operator logon data shall consist of the Operator badge number, manifest/route number, and vehicle ID. Operators shall not be required to enter the vehicle ID or be able to change the vehicle ID. The vehicle ID shall be

programmed into and read from the IVCU. Verification of logon data shall be as defined for fixed-route logons (see Section 2.16.1.1).

2.17.2.2 Operator Changes

The Bus AVL system shall support enroute changes in the assigned Operators for cases such as mechanical breakdowns and Operator substitutions. The Operators shall be required to perform an Operator logon/logoff when the change takes place.

2.17.2.3 Text messaging

The Bus AVL onboard system shall enable Operators to send pre-defined text messages to Bus AVL system users with a minimum of interaction with the VCH. Functional requirements for text messaging shall be the same as for fixed-route (see Section 2.16.1.4). A unique set of canned messages shall be defined for paratransit service.

2.17.2.4 Manifest Entry Display Limit

Operators shall be able to view all data for manifest entries, but shall be limited in look-ahead to a System Administrator-adjustable number of future entries in their assigned manifest. The Contractor shall set the initial number of next entries that can be viewed to four entries. If manifest entry look-ahead is restricted then pick-ups that are displayed for passenger trips shall also have their corresponding drop-offs displayed regardless of where the drop-offs are located in the manifest list.

2.17.2.5 Manifest Schedule Changes

The Bus AVL system shall update vehicle manifests with trip insertions and deletions that may occur throughout the service day. All such updates shall be automatically distributed to all affected vehicles whenever manifest changes occur within the paratransit scheduling system. Manifest changes shall be possible at any time during the period from when the manifest is first assigned to the vehicle until the vehicle has pulled-in at the end of its scheduled service. Manifest changes shall be reflected on all affected vehicle MDTs within 1 minute of execution of the changes in the paratransit scheduling system.

For trip cancellations, the associated trip on the manifest shall be marked as “Cancelled” and made visually distinctive (e.g., grayed-out) from scheduled trips. Cancelled trips shall not be removed from the manifest.

2.17.2.6 Trip Status Reporting

The Bus AVL system shall enable Operators to quickly and easily report specific events relative to the status of their assigned manifest. All such status updates shall be automatically and promptly delivered to

the paratransit scheduling system, along with any other vehicle and trip information needed for the status update to be properly processed.

Trip status data that can be provided by the Bus AVL system, such as times and locations shall be “auto-filled” by the Bus AVL system and shall not require manual input of the data. Operator-initiated status updates that can be reported shall include, but not be limited to, the following:

- a. Arrive – arrival time at the current trip pick-up, drop-off, and break location, as appropriate. This status update, however, shall normally be automatically reported by the Bus AVL system (see Section 2.17.2.7)
- b. Perform – the time of successful completion of the current trip pick-up or drop-off. For pick-ups, the following additional information shall be collected:
 1. Mileage – field shall pre-fill with vehicle’s odometer mileage (see Section 2.17.2.8)
 2. Actual number of passengers by type – field shall pre-fill with scheduled number
 3. Actual fare collected (CCT paratransit vans have fareboxes, but an interface to them is NOT required) – field shall pre-fill with scheduled amounts
 4. Fare payment method.
- c. No Show – Operator is required to wait for approval to continue
- d. Cancel-at-Door.

2.17.2.7 Automatic Arrival Reporting

The Bus AVL system shall detect when a vehicle has arrived at its next scheduled location and automatically report an arrival event. The Operator shall also have a means to manually report an arrival in case an automatic arrival is not properly detected.

Proposals shall indicate whether automatic arrival reporting is supported as a standard function of the base offering, or whether custom development would be required.

2.17.2.8 Manifest Mileage Data

The Bus AVL system shall track, calculate, and report the actual paratransit vehicle mileage information associated with each trip on the vehicle’s assigned manifest. Trip mileage shall be calculated from the pick-up to the drop-off location. The total day’s service mileage (i.e., from pull-out to pull-in) shall also

be calculated and reported. The Operator shall also have a means to manually enter mileage data and correct erroneous data pre-filled by the Bus AVL system.

2.17.2.9 Manifest Navigation Aid

The Bus AVL system shall provide route navigation assistance to the paratransit Operator based on the vehicle's manifest schedule. Navigation assistance with the vehicle's route to the next scheduled location shall not require manual entry of starting and ending points; however, the ability to enter any starting and ending points shall also be supported. Operators shall be able to activate and deactivate this feature depending on whether they require assistance. Upon activation, the navigation aid shall automatically determine the optimal route from the vehicle's current location to the location of the next scheduled location on the manifest.

The manifest navigation aid function shall be geographic map-based and, when active, shall continuously and accurately depict the vehicle's current location on the map. The depicted vehicle shall always be centered on the map display and the direction of travel always be towards the top of the display. Streets and other information presented on the map shall always be correctly oriented to the vehicle's current direction of travel. The map display shall support a zoom capability that enables the user to see detailed street information and an area overview.

The manifest navigation aid function shall include a turn-by-turn function to provide audio and visual turning directions to the Operator. The Operator shall be able to enable and disable the turning directions as desired, as well as select audio, visual, and both forms of turning directions.

2.18 Non-Revenue Vehicle Functions

The Bus AVL system shall provide non-revenue vehicle functions as specified in the following sections. Bus AVL system-equipped non-revenue vehicles shall be capable of providing all required functions while operating anywhere within CCT's defined service area and without requiring manual reconfiguration of any kind.

2.18.1 Vehicle Operator Support Functions

The Bus AVL system shall provide the following vehicle Operator support functions for non-revenue vehicles:

- a. Operator Logon/Logoff -- as specified in Section 2.16.1.1. Non-revenue operators shall be able to enter a work code number in place of the revenue block number
- b. Text messaging – as specified in Section 2.16.1.4

2.18.2 Vehicle Location Reporting

The Bus AVL system shall perform non-revenue vehicle location reporting the same as specified in Section 2.16.3 for revenue vehicles.

2.18.3 Mobile Computer Terminal (Option)

As an option, the Bus AVL system shall support a Mobile Computer Terminal (MCT) with all required Bus AVL system application and utility software to provide Bus AVL system user functions in a vehicle in support of field supervision activities. The MCTs would support the following Bus AVL system user functions:

- a. CAD capabilities including text messaging to vehicles and event management. Data partitioning shall be supported in order to limit the amount of data required for this function.
- b. Display of current service schedules
- c. Incident Management functions, including opening, entering, updating and closing of incident forms
- d. Map-based AVL tracking and vehicle status monitoring functions. Data partitioning shall be supported in order to limit the amount of data required for this function.

Proposals shall describe the proposed system's capability of supporting the above MCT functionality and associated vehicle laptop equipment, including a description of the Proposer's standard MCT offering.

2.18.4 Paratransit Manifest Monitoring (Option)

The Bus AVL system shall include a paratransit manifest monitoring function enabling Supervisors to monitor the status of an active route (manifest) via the MDT of any Bus AVL system-equipped supervisor vehicle. The paratransit manifest monitoring function shall include selection of the desired paratransit manifest and subsequent display of the selected online manifest, information on the current Operator, current vehicle location, and the completion status of each entry on the manifest.

Proposals shall describe the proposed paratransit manifest monitoring function, including whether this functionality is currently supported by the Proposer's offering or if custom development is required.

2.19 Historical Data Storage Function

The Bus AVL system shall provide an historical data storage function to record and store all collected operational data for the purpose of later retrieval and analysis. The operational data to be recorded and

stored by the Bus AVL system shall include, but not be limited to, records of all events, all data messages to and from Operators and other personnel, all data transmitted from the vehicle fleet (e.g., Operator log-on data, communications requests, emergency alarms, mechanical alarms, data messages, text messages, RSA data, location data, timepoint collection data, data transmitted from other equipment on-board the vehicles, data collected from the vehicles via bulk data transfers), all user-entered data, all user log-ons/log-offs, and all reports generated by the Bus AVL system.

The stored data shall be time and date tagged and shall contain sufficient information to enable the selective retrieval and sorting of the data based on user-specified selection criteria. Stored historical data for each service day shall properly account for the service day exceeding 24 hours in duration and shall also properly handle the extra hour day and missing hour day resulting from Daylight Savings Time changes. Data latency between the time when real-time data is collected by the Bus AVL real-time functions and the time it is stored as historical data shall not exceed 5 minutes. All historical data shall be immediately accessible to authorized users.

The historical data storage function shall support storage of all data ranging from present time to at least the past 7 years. Data older than 7 years shall be periodically purged from the database via an automatically scheduled function. The system shall enable a System Administrator to manually archive selected data before it is purged.

2.20 Historical Data Retrieval Function

The Bus AVL system shall provide an historical data retrieval function that enables Bus AVL system users to selectively retrieve historical data for playback, reporting, export, and other analyses. The historical data retrieval function shall be designed to ensure that potentially large ad-hoc (i.e., unpredictable) data retrievals will not adversely affect the performance of online Bus AVL system functions.

The historical data retrieval function shall provide access security that is configurable by the System Administrator. The security features shall enable restriction of data access to view-only and shall permit further access restrictions to the data at both the table and field levels. The security provided for this function shall also support safeguards against unauthorized access to historical data by other outside users on the CCT LAN/WAN.

Selection criteria for data retrieval shall include text string matches on selected or all portions of fixed-format or free-format entries, or combinations of these criteria. Definition of selection criteria shall support the use of "wild card" and partial match entries. At a minimum, the following specific criteria shall be supported for accessing all historical data:

- a. Operator badge number

- b. Route number
- c. Block number
- d. Run number
- e. Trip number
- f. User ID
- g. Date and time
- h. Type of data, message, and event
- i. Vehicle ID
- j. Vehicle type
- k. Schedule adherence (exceptions)
- l. Service schedule elements, including route, direction, timepoint, and bus stop
- m. Five additional specific criteria to be defined later.

It shall be possible to combine any number of the above selection criteria with logical operands (“and” and “or”) such that all data meeting the combined criteria can be retrieved. Additional selection and sorting criteria for data shall include date and time ranges, status values, text string matches on selected data fields, and combinations of these criteria. Criteria for number fields shall not require the user to enter special alpha representations of the numbers, such as requiring leading zeros or blanks, in order to obtain correct sort order or to properly filter the data on numeric fields.

All data shall be retrievable in a fully decoded format. The user shall not be required to interpret coded messages in order to determine the meaning of the retrieved data.

Retrieved historical data for a service day shall properly account for the service day exceeding 24 hours in duration and shall also properly handle the extra hour days and missing hour days resulting from Daylight Savings Time changes. Retrieval of such data shall not require manual manipulation of the data in order for it to properly represent the chronological data for each service day.

2.21 Passenger Information Displays (Option)

The Bus AVL system shall provide real-time service status information to passengers at transit centers and optionally at selected bus stop locations. The specific locations to be equipped are identified in Appendix C. Refer also to Section 5 for information on equipment requirements.

2.21.1 Data Type Presentation Requirements

The Bus AVL system shall use fixed-route schedule data, schedule adherence and status, estimated arrival and departure times, headways, and other data as required to present service information to passengers at transit centers and specific stop locations. As a minimum, the following types of information shall be configurable for display to passengers:

- a. Descriptive headers for data columns (e.g., route, destination, direction, bay, ETA, etc.)
- b. Time and Date – the current coordinated Bus AVL system time and date.
- c. Route Identifiers
- d. Route Names
- e. Route Destinations
- f. Route Directions
- g. Scheduled Arrival/Departure times
- h. Predicted Arrival times – arrival predictions shall be accurate to within +1 minute and -5 minutes of actual arrival 90% of the time. Scheduled times shall be displayed if, for any reason, the system cannot accurately predict arrival or this capability has been disabled by an authorized user
- i. Schedule Adherence Early/Late Statuses – this information shall be suppressed if, for any reason, the system cannot accurately report adherence or this capability has been disabled by an authorized user
- j. Bus Bay Identifiers
- k. User-defined messages – authorized users shall be able to send alerts and other service information as free-form text and as pre-defined messages (see Section 2.21.4).

2.21.2 Transit Center Composite Presentation

Passenger information shall be displayable in a composite format at a transit center to provide complete information on all stops at the center in a composite and easily readable format. All routes servicing the location shall be presented. For this type of information, the simultaneous display of the next four departures for each destination/direction of each route servicing the location shall be supported.

The Bus AVL system shall enable System Administrators to configure the content of composite displays. Composite display capabilities at a specific location shall support at least 2 displays that can each support at least 4 distinct windows for presentation. Information presented on all displays and windows shall be individually configurable by the System Administrator.

In addition to the information identified in Section 2.20.1 composite displays shall also be configurable to support the following content:

- a. Web pages, such as for local weather, news, etc.
- b. Advertisements and public service announcements
- c. Audio/Video streams.

2.21.3 Bus Stop Presentation

Passenger information shall be displayable in a compact format for display at specific stops, including bus bays of a transit center. All routes servicing a particular stop shall be presented. For this type of information, the simultaneous display of the next arrival and departure for each destination/direction for each route servicing the bus bay shall be supported. Display paging/scrolling shall also be supported for those locations where the number of arrivals and departures exceeds the physical display area of the sign. The presentation shall be configurable by the System Administrator to contain any combination of data as defined in Section 2.20.1, above.

2.21.4 User-Defined Messages

The Bus AVL system shall provide authorized users the means to create, configure, save, select, edit, delete, and send pre-defined and ad-hoc messages (e.g., service alerts, service changes, fare information, special announcements, advertisements, etc.) to passenger information signs with a minimum of interaction. The Bus AVL system shall provide a convenient means for users to select one or more signs and locations to which the messages will be sent for presentation to customers. Users shall also be able to select a specific time and date range defining when the message will be presented.

The Bus AVL system shall support a minimum of 100 saved messages of up to 128 characters from which users shall be able to select, edit, and send the desired message. Scrolling shall be supported for the

uninterrupted presentation of the entire message should its length exceed the display area. Unused character space at the end of the message shall not be displayed or cause a delay to the presentation of the next message.

The Contractor shall work with CCT to develop an initial set of user-defined messages as part of the design process and initialize the Bus AVL system with these messages prior to formal system testing.

2.22 Web-based Passenger Information (Option)

The Bus AVL system shall include a passenger information web service that enables CCT customers to make informed decisions regarding travel within the CCT service territory. The web services shall provide accurate bus arrival and departure time predictions for transit centers and bus stops throughout CCT's service territory, bus location information for all fixed-route buses, general service information, and service alerts.

The web service shall utilize the Bus AVL system database as its source for all static and real-time service data. It shall not be necessary for CCT to perform any additional system administration tasks (e.g., re-import or conversion of schedule or GIS data) to support the RTPI functions for data that already exists in the Bus AVL system.

The Contractor shall integrate all hardware, software, and services necessary to accomplish the supply, design, testing, documentation, training, installation, and implementation of the web services in accordance with the associated requirements of this Specification, including scalability and expandability. The web server shall be configured outside of the Bus AVL system firewall and shall be fully secure to protect the Bus AVL system network resources, devices, functions, and data from unauthorized access by external users.

The Contractor shall be responsible for the initialization of web service parameters, imported data, and manually-entered data necessary for the proper operation of the service. This data shall include all data required by the web service, including but not limited to schedule data, revenue vehicle performance and location data, system parameter settings, user access privileges, network addresses, and GIS data. The Contractor shall integrate the web service (via links or other means) into CCT's existing website design.

The web service shall support common web browsers including, but not limited to, recent versions of Microsoft Internet Explorer, Google Chrome, Mozilla Firefox, Safari, and Netscape Navigator. In addition, web displays shall support web access via small mobile devices.

2.22.1 Web Services Performance Requirements

The initially delivered Bus AVL web service shall support the following capacities:

- a. Accommodate a minimum of 5,000 visitors per day
- b. Support a minimum of 5,000 automated notifications per day
- c. Support a minimum of 50,000 total customer registrations for notifications.

The web service shall not adversely impact the required minimum performance of other Bus AVL system functions regardless of loading on the web service.

2.22.2 Web Services Presentation Requirements

The supplied web services shall enable the public to easily and quickly navigate to the desired service information. The web service shall not require unnecessary and redundant data entry to perform functions. The presentation shall use a minimum of abbreviations and shall provide a glossary of all abbreviations and transit terms that are used.

The CCT service information presentation via the web shall include, but not be limited to, the following:

- a. Service data, including route information and schedule data
- b. Dynamic geographic map showing real-time locations of buses for user-selected routes in addition to static data showing route profiles, schedules, and bus stop locations. Users shall be able to select a transit location on the map and acquire the predicted arrival times for at least the next three buses that stop at that location, or the next three buses that stop at that location on a user-selected route
- c. Tabular bus arrival/departure prediction displays showing at least the next three arrivals/departures at a user-selected location, or the next three arrivals/departures at that location for a user-selected route
- d. User personal profile (customer registration) displays (see Section 2.22.3)
- e. Service announcement and alert displays
- f. Service alert notifications via email
- g. Search functions that enable customers to query information of interest based on one or more routes, destinations, bus stops, day of week, and time of day.
- h. User guidance messages
- i. Navigation links for users to access and download any software plug-ins or applications needed for the proper display of web services information (e.g., Adobe Acrobat Reader).

The Contractor shall also design and implement a “mobile” web site, similar to the full-featured public web site. The mobile site shall provide streamlined text-based content, suitable for presentation on a web-enabled handheld device. The dynamic map display is not required to be duplicated for the mobile web site. The system shall be able to automatically detect between a personal computer user and a mobile device user and route the user to the appropriate site. A means shall be provided for the handheld device user to access the full web site if desired.

2.22.3 Web Services Personal Profiles

The web service shall maintain personal profiles for public users who register via the web site. These profiles shall tailor the user’s web session such that certain user-entered information is retained and is used from one user session to the next. The information per user shall include customer name, personal PIN or password, up to six selected bus stops and routes, a minimum of 3 e-mail addresses, and a minimum of 3 telephone numbers.

As part of the personal profile, customers shall be able to subscribe to receive automatic notifications of service announcements, alerts, and the predicted arrival/departure times of buses for selected stops and routes at requested times during the day. Customers shall be able to specify up to six routes for which to receive service announcements and alerts. When announcement and alert messages are generated by the Bus AVL system then the messages shall be issued to customers as appropriate based upon their profile.

2.22.4 Web Services Operation and Administration

Web services functions shall be provided to enable authorized users to easily perform administrative and customer service functions required to operate and maintain the service. These functions shall include, but not be limited to, web service configuration and maintenance, customer profile maintenance, and generation of service alert and general (ad-hoc) messages. Authorization for administration functions shall be separate from operations functions so that operations personnel can issue alerts and messages, but do not have access to configuration and other administrative functions.

2.23 Interfaces with External Systems

The Bus AVL system shall support interfaces to external systems in order to provide all required functions of this Specification. It shall be the responsibility of the Contractor to determine each interface capability and to promptly report to CCT any deficiencies that may prevent full compliance with the functional requirements of this Specification.

The Contractor shall be responsible for the design and implementation of a highly secure means of data exchange for all interfaces to external systems that prevent access by unauthorized users to the Bus AVL system LAN. These interfaces shall utilize, to the fullest extent feasible, the capabilities already present in the external systems, so as to minimize the need for modifications to those systems.

External interfaces shall be fully designed and documented by the Contractor in sufficient detail for third parties to implement and/or modify the external side of the interface. Designs shall employ ODBC and support direct data access using SQL; and use standard file formats for file-based data exchange interfaces. Bus AVL system performance shall not be affected by the level of data transfer activity to and from external systems.

In addition to correctly developing the system interfaces, the Contractor shall be responsible for initializing the Bus AVL system with all data needed for the proper operation of the Bus AVL system in accordance with this Technical Specification. This shall include, but is not limited to, all GIS map and spatial data, Operator and Bus AVL system User IDs, vehicle IDs, service types, and destination sign data. As part of the system data initialization, the Contractor shall work with CCT in identifying any data-related issues that need to be resolved within the originating external systems.

Specific external interface requirements are contained in the following sections. Also identified are “future” external interface requirements for the Bus AVL system; these future interfaces shall be supported without major replacement of initial system components and software.

2.23.1 GIS System Interface

The Bus AVL system shall acquire any and all GIS map data from the Cobb County GIS system, including the base map and all associated layer data. GIS data to be made available to the Bus AVL system includes location and shape data for jurisdictional boundaries, major roads, all roads, street addresses, physical barriers (e.g., water), and landmarks.

Updates to the GIS data will occur in the future and shall be supported by the Bus AVL system on an as-required basis without requiring Contractor assistance.

2.23.2 Paratransit Scheduling System Interface (Option)

The Bus AVL system shall interface with CCT’s RouteMatch paratransit scheduling system for the automatic exchange of manifest service data between the scheduling system and CCT’s paratransit vehicles. The RouteMatch system server is located at CCT’s facility and is accessible via the CCT LAN/WAN.

The Bus AVL system shall acquire manifest data from the paratransit scheduling system interface for transmission to paratransit vehicles and acquire Operator-entered service status data for transmission back to the paratransit scheduling system. The capabilities of the interface shall be as necessary to support all Bus AVL system paratransit functions specified elsewhere in Section 2.

CCT prefers that the Bus AVL system utilize the standard RouteMatch interface protocol and format. The design and implementation of the interface shall be the sole responsibility of the Contractor. If the Bus

AVL system design will require modification to the standard RouteMatch interface, the Contractor shall be responsible for supplying all such modifications and any associated licenses. All Contractor modifications to the paratransit scheduling system interface shall fully comply with RouteMatch's warranty and maintenance contract terms.

It shall be the sole responsibility of the Bus AVL system Contractor to coordinate with the paratransit scheduling system vendor to obtain the information necessary to implement this function as specified, even if such coordination necessitates that the Bus AVL system Contractor enter into a separate sub-contractor agreement with the paratransit scheduling system vendor. CCT involvement for coordination and management of any agreement between the Bus AVL system Contractor and RouteMatch concerning the scheduling system interface shall not be required.

Proposals shall identify where an interface to RouteMatch has been implemented with the same generation CAD/AVL software proposed for the Bus AVL system, whether the standard RouteMatch interface format and protocol is supported, and any additions or modifications that may be required to support the Bus AVL system paratransit vehicle functions.

2.23.3 System Time Interface

The Bus AVL system shall include Universal Coordinated Time equipment to obtain accurate time from GPS. The Bus AVL system shall ensure that all Bus AVL system network, server, workstation, and vehicle functions utilizing time are synchronized with the time obtained from the GPS time reference equipment specified in Section 5.

2.23.4 External Access to Bus AVL System Historical Data

Historical data collected by the Bus AVL system is potentially of significant value to different departments within CCT, CCDOT, and Cobb County. Those users would typically not interact directly with the Bus AVL system, but would instead utilize Bus AVL system data for analysis and for integration with other available data. The Bus AVL system shall allow extraction of Bus AVL system historical data in common machine-readable formats that can be used by other external systems. All such access shall be via the Bus AVL system Information Database rather than requiring direct access to the Bus AVL system LAN.

2.23.5 Other Transit Operators (Future)

The Bus AVL system shall be able to add, in the future, external interfaces to other transit operator systems, such as MARTA, for such purposes as the exchange of service information and automatic coordination of transfers, where possible and such information is available.

Proposals shall describe the ability of the proposed Bus AVL system to be expanded to accommodate the future interface to other transit operator systems for the exchange of operational data.

2.23.6 Other External Interfaces (Future)

It is a goal of CCT that the Bus AVL system follow the guidelines and intent of the Regional ITS Architecture. While it is understood that some aspects of the architecture have not been fully designed or implemented by proposers of systems like the Bus AVL system, and that the Regional ITS Architecture may undergo change as National ITS needs become more clearly defined, CCT strongly desires that all elements that can be reasonably achieved be included in the Bus AVL system implementation.

In addition to the current and future external interfaces identified in previous sections, the Bus AVL system shall also be capable of being extended to permit information exchange with other systems in the future. It is anticipated that such future interfaces will require compliance with the Regional ITS Architecture NTCIP standards, including possible certification to those standards.

Proposers shall describe in their proposals their experience with supporting standard interfaces such as NTCIP, as well as plans and commitments to support interface standards in the future.

Section 3

USER INTERFACE

The Bus AVL system shall provide a modern, state-of-the-art User Interface (UI) for supporting all Bus AVL system fixed-end and mobile users. The class of Bus AVL system user, as defined in Section 2, shall determine the required access and capabilities of the UI. Regardless of the class of user, however, the UI shall be convenient to use and be responsive to user requests.

3.1 User Interface General Features

Rapid and reliable selection and performance of user actions is crucial to the successful implementation of the Bus AVL system and acceptance by its users. The Contractor's system and UI must be user-friendly and allow all user actions to be completed as quickly and conveniently as possible. Any user functions, especially frequently performed functions, requiring user actions that are confusing, awkward, or are too time-consuming will be deemed unacceptable and shall be corrected by the Contractor. To further avoid user confusion, the systems and functions accessible by users shall be integrated to minimize the number and diversity of system interfaces and discrete display devices that are presented to each class of user. The UI design shall be subject to CCT approval and shall be in conformance with accepted human-factors design criteria.

The following features shall be included in the Bus AVL system UI. Unless specified otherwise, these features shall apply to both fixed-end and mobile users. Alternatives may be offered, but should be functionally equivalent to the features specified.

3.1.1 Windows (Workstations)

The simultaneous display of at least eight windows on each screen of a workstation shall be supported. The windows shall be individually selectable by the user using the keyboard and mouse, with the currently selected window being the focus for all user input.

All windows shall be re-configurable by the user as follows:

- a. Quickly displayed in overlapping and tiled configurations at the user's option
- b. Easily resized to any dimension up to the full dimensions of the screen
- c. Easily moveable to any position on the screen, including across screens on a multi-screen workstation.

- d. Quickly reduced to an icon and subsequently restored to the previously configured size and position.
- e. Window configurations (including locations, sizes, and display configurations) shall be defined on a per-user basis, and shall be retained between user sessions. For multi-screen workstations, default window and dialog positions shall not be initially positioned across more than one screen. Default fixed locations for taskbars, time and date display, pop-up windows, and fixed windows shall be configured by the Contractor so that they are not obstructed by the boundaries between multiple screens.

3.1.2 Element Highlighting

Highlighting techniques shall direct the user to critical data on displays. The display attributes of color and intensity, blinking, background and character inversion, line texture, and appended symbols shall be provided. These attributes shall be used to highlight alarms, data entry locations, user selections, status conditions, and to convey other information to the user. The use of element highlighting shall be consistent throughout all displays of the Bus AVL system for each class of user.

3.1.3 User Guidance

The Bus AVL system shall respond to all user input actions indicating whether the action was accepted, was not accepted, or is pending. For multi-step procedures, the Bus AVL system shall provide feedback at each step. Indications such as text messages and element highlighting shall provide this feedback. User guidance messages shall not require the user to select, close, or move them in order to perform subsequent actions or read their contents.

User guidance messages shall be unabbreviated English text and shall not require the use of a reference document for interpretation. The use of mnemonics is prohibited.

User guidance messages for system errors that occur during normal system use shall not include diagnostic or other complex data or descriptions intended for maintenance personnel. This type of data shall instead be recorded in a log or in the Bus AVL system database for later retrieval by authorized users.

Critical actions initiated by a Bus AVL system user, such as a deletion, shall be performed only after a warning message and request for confirmation are issued to the initiating user and the confirmation of the intended action is received from the initiating user.

3.1.4 Cursor Positioning

Multiple methods of rapid and convenient cursor positioning shall be provided, including forward and backward tab keys, cursor control keys, touchscreen (optional on MDTs), and a mouse (on workstations). Tab stops shall be provided on displays at the first character of enterable data fields, at controllable devices, and at all other cursor targets. Cursor targets on displays shall be sufficiently sized to permit rapid selection of the target and shall be sufficiently spaced apart to minimize the possibility of incorrect target selections. Cursor positioning techniques shall be consistent for all displays for each class of user.

In addition to positioning the cursor on a screen, the Bus AVL system shall provide a means for continuously moving the cursor across screens on multiple-screen workstations and enable selection of a desired window within a specific screen.

3.1.5 Function and Display Selection

Bus AVL system users shall be able to rapidly initiate the most common functions and display requests at any time by a variety of means, depending on the user's preference. These means shall include the selection of items from menu bars, pop-up menus, tool bars, and function keys (if applicable) using cursor-positioning techniques specified in Section 3.1.4.

3.1.6 User Interface Configuration

To the greatest extent possible, reconfiguration of the Bus AVL system UI, such as changes to element highlighting techniques, user messages, and displays, shall not require reprogramming or recompilation of program code.

User-configurable settings and preferences of the workstation UI shall be retained between user sessions and shall be uniquely defined for each user and retrieved upon the user's logon to the Bus AVL system. Suitable defaults shall be provided for all settings and preferences. A means to restore all settings and preferences to the defaults shall be provided. A means to store multiple sets of settings and preferences for each user is considered a desirable feature.

3.1.7 Data Entry

The Bus AVL system shall determine if proper authorization exists for the user requesting data entry. All data fields where data entry is not authorized shall also be uniquely identified and shall not accept data entry. All enterable data fields shall be highlighted. Fields where data entry is mandatory shall be uniquely highlighted from fields where data entry is optional. The Bus AVL system shall validate all entered data. Invalid entries shall be detected and reported to the user as user guidance messages.

The Bus AVL system shall allow users to initiate data entry by selecting the desired data field in which the value is to be entered. Users shall be able to enter the desired data value anywhere within the data entry field. If only a portion of a data value needs to be changed, the Bus AVL system shall require only that portion of the value be changed. Full-display data entry shall be provided that allows users to make multiple data entries before requesting that the data be recorded in the database. All valid entries shall be recorded unless the Bus AVL system requires all entries be valid and an invalid entry is detected. In that case, the user shall only be required to correct the invalid entry and shall not be required to re-enter any valid entries.

The amount of data users are required to enter shall be minimized. The Bus AVL system shall automatically insert any data that is already known (e.g., date, time, user identification, vehicle identification, vehicle Operator). Default values shall also be inserted where defined. Users shall be able to override any Bus AVL system-inserted known and default values.

When data entry of a field is limited to a set of known values, the list of values shall be presented to the user in the form of a scrollable list from which the user shall be able to select the desired value. Where multiple values can be entered in a field, users shall be able to make multiple selections for subsequent entry.

Users shall be able to end data entry at any time by selecting a cancel function or requesting a different display or window. These actions shall cause the process to be terminated and any entered data discarded. Except for an explicit cancel request, user confirmation shall be requested in order to avoid accidental loss of data.

3.1.8 Context-Sensitive Help Facility

The Contractor shall provide a comprehensive, context-sensitive help facility to aid users in interpreting displayed information and to guide users, at their option, through all the control, data entry, selection, and other user action processes supported by the Bus AVL system. The help information displayed to users shall provide assistance and information pertaining to the particular actions being performed by the user at the time help was requested.

3.1.9 Time and Date

The Bus AVL system current time and date shall be displayed to users at a fixed location on the screen and not on a display basis. This information shall not be present on all displays.

3.2 User Displays

The Contractor shall provide all standard displays that are normally included with the base CAD/AVL system product. The Contractor shall also provide all displays and display features defined below. These

specific displays and display features are not intended to define the entire set of displays and display features necessary to meet the full functional requirements of this Specification. As such, the Contractor shall provide any additional displays necessary to support the Contractor's design approach and to meet all Bus AVL system functional requirements defined in Section 2 and elsewhere in this Specification.

Alternative approaches to the displays and display features defined below may be offered provided the functional requirements of the Specification are satisfied.

3.2.1 General Display Features

Each display shall have the general features described below.

3.2.1.1 Display Heading

Each display shall include a heading at the top of the display consisting of a title showing the unabbreviated name of the display. For multi-page displays, the current page number and the total number of pages shall be presented (e.g., Page 2 of 3).

3.2.1.2 Display Content

It shall be possible to present any item in the Bus AVL system database on a display. Tabular displays shall support the use of grouping, sorting, and filtering techniques to present displayed data in the manner desired by the user. Statuses of vehicles, devices, and other dynamic entities shall be displayable using combinations of symbols, colors, descriptions, and blinking.

3.2.1.3 User Guidance Message Area

A means for presenting Bus AVL system-generated user guidance messages on a display shall be provided. User guidance messages shall not obstruct the view of the display or prevent the user from performing additional actions within the display.

3.2.1.4 Display Scrolling

If the display is larger than the viewable area of the window, scroll bars shall be used to enable rapid viewing of all display content. Horizontal and vertical scroll bars shall include direction arrows indicating that additional data can be viewed by scrolling in the direction of the arrow.

For tabular displays, row and column headings shall be stationary so that these headings can be viewed regardless of the scroll position.

3.2.2 AVL Map Display

A geographical map display of CCT's service area shall be provided on Bus AVL system workstations and shall support all functional requirements for vehicle location status tracking, vehicle and route selection, and other supplied functions that require the use of a geographical map.

The Bus AVL system shall provide specific AVL map display features and capabilities defined below in order to enable Bus AVL system users to efficiently interact with the map.

3.2.2.1 Map Views

Bus AVL system users shall be able to set up a particular view of CCT's service area on the map display and store it for future selection and display. The ability to define, store, and retrieve up to 30 specific views of portions of the territory shall be supported. Each stored view shall include the defining parameters of the view including the area center point, scale/zoom level, map layers (themes) and routes to be displayed, and other parameters that define what and how the map view information is displayed.

Each stored view shall be uniquely identified and rapidly selected for display by the Bus AVL system user. When a stored view is selected, it shall be displayed as per the defining parameters for the particular view. All map functions, controls, and real-time vehicle updates shall be active when these stored views are being displayed.

3.2.2.2 Map Attributes

The AVL map shall be capable of supporting a variety of map attributes, including all roads, major roads, prominent geographical features (e.g., rivers, major bodies of water, mountains), important landmarks (bridges, airports, fire and police stations, shopping centers, schools, etc.), labels, CCT-specific spatial data (e.g., transit centers, timepoints, bus stops, etc.), and other map attributes required to meet the functional requirements of this specification.

3.2.2.3 Geographic Boundaries

The AVL map shall support defined boundaries within the CCT fixed-route and paratransit service areas that may be used to classify location-based data. Users shall be able to display defined boundary types on the map using overlays. Specific boundaries supported shall include, but not be limited to, Municipal boundaries.

3.2.2.4 Vehicle Overlays

The location of each Bus AVL system-equipped vehicle shall be indicated by a special symbol that is overlaid on the AVL map display. Up to six distinctive vehicle symbols shall be provided that represent each of CCT's vehicle types. Vehicle symbols shall also clearly show the vehicle state and status (see

Section 2) using combinations of symbol colors and shapes and, if necessary, text. The symbols shall be approved by CCT and shall be easily modified by the System Administrator.

Each vehicle symbol shall include the specific vehicle information for the vehicle represented by the symbol, which shall uniquely identify the vehicle. For revenue vehicles, the vehicle information shall include the vehicle number, run number, block number, and vehicle Operator badge number. For non-revenue vehicles, the vehicle information shall include the vehicle number, block number, and Operator badge number. The vehicle information to be displayed with the vehicle symbol shall be configurable by the user and initially set to display the vehicle block number. Bus AVL system users shall be able to call-up the additional information pertaining to a vehicle by selecting the vehicle's symbol on the map display. This additional vehicle information shall be displayed in a pop-up window.

When multiple vehicles cannot be displayed without overlapping at the selected zoom level, the Bus AVL system shall provide a means for the user to see the individual vehicle identities for the overlapped vehicles.

3.2.2.5 Map Navigation

The following navigation functions and features shall be provided to support Bus AVL system users when they are working with the AVL map:

- a. Rapidly select a specific map area for viewing by using a graphical map overview
- b. Locate and center a vehicle on the map by any combination of vehicle ID, Operator badge number, run number, block number, and route
- c. Locate and center a selected landmark on the map
- d. Center the map display on any selected point of the currently visible map
- e. Center the map display on a selected vehicle and automatically pan the display as the vehicle progresses to keep the vehicle centered on the map
- f. Calculate the distance between two selected points on the map and accumulate the distance along the path formed by a series of points
- g. Course and fine panning of the map display to bring any non-displayed portion of the map into view.

3.2.2.6 Map Scaling

Bus AVL system users shall be able to zoom in and out on the AVL map display to view specific areas of the service area at different levels of detail. The range of display capability shall extend from displaying CCT's entire service area at an overview level of detail to displaying a small portion of the area in fine detail. Bus AVL system users shall be able to zoom in to a map scale that allows at least four vehicles lined-up within a 200-foot distance to be clearly distinguished without overlap of the vehicle symbols.

Map attributes shall be automatically added and removed from the map display at specified zoom (scale) levels as the view is zoomed in and out, respectively. The System Administrator shall be able to specify the scale associated with each zoom level, as well as the map attribute information that will appear at each level. Map labels such as road names, vehicle identities, route names, and landmark names displayed at each zoom level shall be clearly readable. Road names shall be repeated along lengthy routes and streets. The Contractor shall provide an initial configuration of at least eight distinct zoom levels that satisfy the all AVL map requirements.

3.2.2.7 Map Attribute Filtering

In order to avoid unnecessary cluttering of the display, the Bus AVL system shall enable users to configure the AVL map display as desired by selecting specific attributes for display. All user configuration options for the map shall be unique to each Bus AVL system user and shall be retained for each user between sessions.

3.2.2.8 Vehicle Overlay Filtering

A Bus AVL system user shall be able to restrict the display of Bus AVL system-equipped vehicles on the AVL map to any combination of the following criteria:

- a. All vehicles of a transit provider
- b. All vehicles of a service type (e.g., fixed-route and paratransit)
- c. All revenue vehicles
- d. All revenue vehicles on selected routes
- e. All non-revenue vehicles
- f. Supervisor vehicles
- g. Maintenance/Service vehicles
- h. All vehicles

- i. A single vehicle.

The mechanism for selecting the routes (and the associated vehicles) to be displayed shall be convenient and shall not be solely dependent on the manual entry or individual selection of the specific route numbers. Other mechanisms, such as allowing Bus AVL system users to conveniently select one or more pre-defined groups of routes for display shall be supported.

Users shall be able to set filtering options that enable them to see vehicles outside of their assigned data partition(s). Vehicles reporting an emergency alarm shall always be visible on the AVL map display regardless of the user's current filtering criteria and data partition assignments.

3.2.2.9 Emergency Alarm Tracking

The generation of an EA by an Operator shall automatically display a separate EA tracking window on the AVL map display with the associated vehicle centered within the tracking window. The EA tracking window shall automatically pan such that the vehicle remains centered if and when the vehicle location changes. The EA tracking window attributes (e.g., title bar and colors) shall clearly distinguish the EA tracking window from other AVL windows, and the emergency state of the vehicle.

3.2.3 Event Queue Display

A tabular display shall be provided on Bus AVL system workstations that addresses the functional requirements of user event handling. The types and partitioning of events supported by this event queue display shall be as defined in Section 2, such that each user sees only those events that pertain to his/her area(s) of responsibility.

The following additional features of the event queue display shall be provided with the Bus AVL system.

- a. **Priority** - Color coding and spacing shall be used to distinguish events of different priority levels. The System Administrator shall be able to define the color to be used for each priority level. Events that are unanswered (i.e., those which a Bus AVL system user has not yet selected) shall be clearly distinguishable from all other events.
- b. **Event Ordering** - Events in the event queue display shall be ordered by decreasing priority, and ordered chronologically (oldest first) within each priority as the default mode of presentation. The Bus AVL system shall enable users to re-order the events in the event queue display by sorting on any displayed field. A means shall be provided to quickly return the display to the default ordering.

- c. **Scrolling** - Scrolling of the event queue display shall be supported as defined in Section 3.2.1.4 when there are more events in the queue than can be displayed in the viewing area.
- d. **Display Fields** - The fields (columns) to be presented for each event shall include the type of event, time of occurrence, block number, route number, run number, vehicle ID, vehicle Operator name and badge number, a text description of the event, event status (e.g., unanswered), and any important event attributes (e.g., schedule deviation amount). The System Administrator shall be able to define the order in which the event queue fields are displayed. The time of occurrence shall be displayed in a 24-hour format showing hours, minutes, and seconds. Clearly descriptive text and/or abbreviations shall be used for identifying each event type. The full set of attributes for an event shall be viewable by selecting the event.
- e. **Text Descriptions** - The text description shall uniquely describe each type of event such as emergency alarm, request to talk, schedule and route deviations, and text for pre-canned text messages received from vehicles. In the case of lengthy data messages, at least the first 20 characters of each data message shall be displayed in the event queue. For messages longer than 20 characters, the full text of the message shall be displayed to the user when the particular event is selected. Numeric and cryptic alphabetic codes shall not be used for the event descriptions.
- f. **Audible Annunciation** - An audible tone shall sound if a user's event queue contains no unanswered events and a new event is added to the user's event queue. This audible tone shall consist of a single short beep. When unanswered events already exist in the event queue, a new event added to the user's event queue shall not be audibly annunciated.
- g. For emergency alarm events, the above paragraph shall not apply. Instead, all emergency alarm events shall be audibly annunciated with a unique and distinctive tone when the emergency alarm is added to the event queue. This audible annunciation shall continue until all emergency alarm events are selected (answered) or otherwise acknowledged.
- h. **Event Selection** - The event queue display shall provide for the convenient selection of events in the queue and for initiating follow-up actions pertaining to the selected event(s) as described in Section 2. Once an event is selected, all information pertaining to that event and other pertinent data including the vehicle ID, vehicle Operator name, schedule adherence status, complete text of a data message, and fields for initiating follow-up actions shall be displayed. The ability to select multiple contiguous and non-contiguous events in the display shall be provided to support rapid event removal.

3.2.4 Service Performance Display

A tabular display, or integrated set of displays, shall be provided that enables Bus AVL system users to quickly monitor the current fixed-route service performance. In addition to basic identifying information, such as block number, route, vehicle ID, Operator badge number, run number, etc., the following specific types of information shall be presented:

- a. **Late logon** – The scheduled logon time shall be displayed for each block where the Operator is late logging on.
- b. **Off-route status** – The distance off route, the time that the vehicle went off route, and the next scheduled timepoint shall be displayed for each off route vehicle.
- c. **Off-schedule status** – The early or late schedule deviation and the next scheduled timepoint shall be displayed for each vehicle that is off schedule.
- d. **Late pull-out** – The scheduled pull-out time and the associated vehicle status, if logged in, shall be displayed for each block with a late pull-out.
- e. **Late pull-in** – The scheduled pull-in time and the associated vehicle status, if logged in, shall be displayed for each block that is late pulling in.

Status information shall be organized such that the most critical service issues are displayed first followed by less critical service issues and finally, if included in the display, all service that is within normal operating thresholds.

3.2.5 Reference Information Displays

The Bus AVL system shall provide reference information displays that present transit operations information routinely needed by the Dispatchers. The information displayed to Bus AVL system users shall be images or copies (e.g., Acrobat PDF) of existing CCT data obtained from various sources. Using this data as-is, the Contractor shall develop the Bus AVL system import procedures and software applications necessary to support these displays. CCT will not repackage, rework, or otherwise change its reference data to suit the needs of the Contractor's Bus AVL system input requirements. The Bus AVL system shall provide the capability for the System Administrator to create reference information displays as CCT uses the system and identifies other needs. The types of displays to be provided shall include:

- a. **Paddle Displays** – These displays shall present copies of the fixed-route Operator's schedules (paddles).

- b. **Headway Displays** – These displays shall present a list of buses by block number that service a particular route including time points along the route, the pull out/pull in times, and the departure times of each fixed-route vehicle.
- c. **Destination Sign Displays** – These displays shall present fixed-route destination sign messages and corresponding codes.
- d. **Phone Numbers Displays** – These displays shall present the telephone numbers needed by the Dispatchers.
- e. **Route Displays** – These displays shall provide detailed descriptions, including any notes, for each fixed service route.
- f. **Radio Assignments Display** – This display shall list the radio talkgroup assignments for each radio-equipped vehicle.
- g. **Vehicle Listing Display** – This display shall show a listing of all revenue and non-revenue vehicles. The information presented in this display shall include the vehicle number, vehicle type, manufacturer, license plate number, registration information, MDT serial number, and other pertinent vehicle-specific information. The finalization of the information to be included in this display shall be decided on by CCT as part of the FDR (Final Design Review) process.
- h. **Other Displays** – 3 additional displays to be defined later shall be provided.

3.2.6 Actual Versus Scheduled Headway (Option)

A display shall be provided that graphically and numerically compares the scheduled headways between vehicles on each fixed route with the actual headways. Bus AVL system users shall be able to specify the route whose headways are to be displayed. All vehicles operating on a route shall be displayed, separated according to the direction of travel along the route. In cases where the actual route topology includes a split or similar diversion, these features can be "compressed" into a simplified linear presentation format. The on-time performance of each vehicle shall also be displayed. The spacing displayed between vehicles shall be proportional to the scheduled and actual headways between the vehicles so that users may visually recognize bunching and excessive gap situations. The spacing used between vehicles on this display shall also be based on the travel time between the vehicles, not distance. Display selection buttons shall be provided on this display to allow users to directly request the desired headway displays and direction for the route.

3.2.7 Pull-Out Display

A display shall be provided that lists pull-out information for fixed-route revenue vehicles. The vehicles shall be listed chronologically and shall be identified according to block number. The scheduled pull-out time and actual pull-out time shall be displayed for each block number. In addition, for vehicles that are logged-in, the block number, vehicle ID, route, vehicle Operator badge number, and run number shall be displayed. Vehicles that are late pulling out shall be highlighted on the display along with the number of minutes late. The actual pull-out time shall be determined automatically by the Bus AVL system by tracking the vehicle location and determining when the vehicle actually leaves CCT's garage facility. The vehicles listed on this display shall be all those that are late in pulling-out, have pulled-out within the past 30 minutes, and those scheduled to pull-out within the next 60 minutes from the current time.

3.2.8 Pull-In Display

A display shall be provided that lists scheduled pull-in information for all fixed-route revenue vehicles. The vehicles shall be listed chronologically and shall be identified according to block numbers. The display shall list the time and location where each vehicle is scheduled to complete its revenue run before returning to the CCT bus garage facility, the block number, vehicle number, route number, run number, and Operator badge number. The vehicles listed on this display shall be all those late in pulling-in, have pulled-in within the past 30 minutes, and those scheduled to pull-in within the next 60 minutes from the current time.

3.2.9 System Configuration Monitoring and Control Displays

Bus AVL system configuration monitoring and control displays shall be provided that enable the System Administrator to review and manage the Bus AVL system configuration. These displays shall show the current configuration and status of the Bus AVL system servers and workstations, Bus AVL system LAN, communications links, and peripherals. The status of the data communications network shall also be included on this display to the extent that this equipment status is known to the Bus AVL system. The following control operations shall be supported on these displays:

- a. Failover, switching, and monitoring of each Bus AVL system server
- b. Monitoring of each Bus AVL system workstation, LAN, and device, including interfaces to the data communications facilities and other computer systems
- c. Controlling the performance monitoring function and displaying processor resource utilization.

3.2.10 System Parameter Displays

Many Bus AVL system functions defined in this Specification require System Administrator-adjustable parameters in order to allow the System Administrator to configure those functions to meet the specific needs of CCT and to best support the present operating conditions. The Bus AVL system shall provide convenient access to each of these adjustable parameters via system parameter displays.

System Administrators shall be able to display the current and default state or setting of each parameter and adjust the parameters as necessary, subject to the valid range of adjustability of the parameter. The parameters shall be logically grouped and clearly identified as to their function and purpose. All adjustable parameters shall be arranged on as few Bus AVL system displays as possible, rather than scattered among numerous Bus AVL system displays.

3.3 Reports

The Bus AVL system shall support production of pre-defined and ad-hoc (user defined) reports, which may be requested immediately and on user-defined schedules. Report schedules shall support one-time production of reports at specific dates and times, and recurring report production at user-defined intervals. Supported intervals shall include daily, weekly, monthly, quarterly, and yearly. In addition, the reporting function shall permit the definition of pre-defined collections of reports that can be conveniently referenced and produced as a group.

The destination of report output shall be user-selectable and shall include routing the output to the user's display (for immediate requests) and any user-selected printer(s) on CCT's LAN/WAN. Reports directed to the user display shall appear the same as the corresponding report when printed. Report production shall also support storage of report output into files at a user-designated location on any accessible network file server. Report output file formats shall include ASCII text format, HTML, and Acrobat PDF formats.

The Contractor shall provide all standard reports and standard report templates that are normally included with the Contractor's base product offering, as well as all reports required by the Contractor's design approach for meeting the functional requirements of this Specification. *Samples of all the Contractor's standard reports included in the base product offering shall be included in the Proposal.*

In addition to the above reports, the report features and specific reports defined in the following sections shall be provided. In general, the format of the reports specified below may be the Contractor's standard, provided that all required information is presented. If required information is not presented or not properly presented, the Contractor shall update the report(s) to satisfy the CCT required information.

3.3.1 General Report Features

3.3.1.1 Report Access and Distribution

Bus AVL system users shall be able to display and print any and all reports supported by the Bus AVL system. The Bus AVL system shall permit users to define the desired report content and configuration, including, but not limited to, defining the report content, changing the paper size, utilizing different printers, and reorienting the printed pages from landscape to portrait.

The ability to automatically generate and distribute reports electronically via email is considered a desirable feature.

3.3.1.2 Report Headings and Footers

All reports shall include headings and footers on each page that include at least the report title, page number, total number of pages, and the date and time that the report was generated.

Information displayed in columns shall have header labels. If a printed column length exceeds one page, successive pages shall have the column headers repeated. For displayed reports, columns and row headings shall remain locked and not scroll outside of the viewable window area.

3.3.1.3 Report Parameters

All reports shall support default and user-specified parameters that constrain the report content to CCT's fiscal year, year-to-date, month-to-date, specific calendar date/time periods, service date/time periods, vehicle types, etc. as appropriate to the purpose of the report. Report parameters shall also include appropriate pre-configured defaults that reflect current system parameters, where applicable, that are used to generate the report if the user does not otherwise specify different parameters.

All parameters, both default and user-specified, shall be printed with the report on a report cover page, or equivalent, that lists all parameter settings that were used to generate the report. Alternatively, the title and sub-title of the generated report may be used to indicate parameters used to generate the report; (e.g., a time period).

3.3.1.4 Report Content

Any report that includes a threshold value or a status condition based on a threshold value (e.g., a report including late schedule deviations, where the threshold is the definition of how many minutes behind schedule is defined as a "late" status) shall utilize the defined threshold value that was in effect at the time the data was collected, not the current threshold value.

The Contractor shall be responsible for assuring that each report contains the correct information and nomenclature regardless of the nomenclature used in their existing standard reports. Unless otherwise noted or instructed by CCT to keep existing wording, CCT's nomenclature shall be correctly used in all reports. CCT approval on the content and formatting of all report types shall be a requirement for the completion of the FDR payment milestone.

3.4 User Interface Performance Requirements

The following sections specify the performance required of the user interface. Performance requirements are specified separately for Bus AVL system workstation and MDT users. Averaged or other statistically processed response and update times will not be accepted as a measure of Contract conformance.

3.4.1 Workstation UI Performance Requirements

3.4.1.1 Display Response Time

When a new display is requested by the user, the new display complete with data values shall appear on the workstation screens within 2 seconds, under the peak load conditions defined in Appendix F. For this requirement, display response time is defined as the elapsed time required to show current database data on a display.

CCT realizes that a complex geographical map display may require a longer initial response time than other system displays. Due to the complex nature of geographical map displays, an additional 2 seconds shall be allowed to the response time listed in the above paragraph for the presentation of a new geographical map display. The additional 2 seconds shall not apply to the panning or zooming of a geographical map already displayed.

When data entry is performed on a display, the data entry operation shall be completed and the newly entered value(s) displayed on workstations within one second, under the peak load conditions defined in Appendix F.

3.4.1.2 Display Update Rate

Once a requested display containing dynamic data has been presented to the user, the display shall be updated to ensure a data latency of no more than one second. To achieve this, these display types shall be updated on a periodic basis of at least every one second or updated within one second of any change to the data. All displays containing dynamic data shall be updated within one second regardless of whether or not the display is presented in the currently active window.

3.4.1.3 Geographical Map Display Zoom Response Time

The level of detail presented on the Geographical Map Display shall be according to the zoom levels defined in Section 3.2.2.6. A user request to zoom the Geographical Map Display within a different zoom level shall update the display within 3 seconds.

3.4.1.4 Geographical Map Display Pan and Rotate Response Time

The Geographical Map Display shall support smooth panning and rotation. There shall be no user-discernable delay to refresh the display during map panning and rotation operations.

3.4.1.5 Report Response Time

Requests for reports shall be acknowledged immediately with an indication that the report is being processed. Printing of a report shall begin within one minute of its scheduled time or on-demand request, regardless of the level of Bus AVL system activity.

3.4.2 MDT UI Performance Requirements

3.4.2.1 Vehicle Operator Actions

All vehicle Operator actions performed via the MDT shall be completed within one second when entirely processed by the Bus AVL system on-board equipment.

3.4.2.2 Sent Data Messages

When a user enters a request on the MDT to send an event, the Bus AVL system shall provide immediate feedback to the user that the request has been accepted and is being processed, and when the message has been sent. The message shall be available at the fixed-end within the maximum event delay times specified in Section 2.

3.4.2.3 Received Data Messages

When the Bus AVL system on-board equipment receives a data message, the MDT user shall be notified by both visual and audible means, and the message available for display on the MDT within one second after it is received.

3.4.2.4 Geographical Map Display Zoom Response Time (Option)

If provided, the level of detail presented on the paratransit vehicle Geographical Map Display shall be according to the zoom levels specified in Section 3.2.2.6. A user request to zoom the Geographical Map Display within a different zoom level shall update the display within 2 seconds.

3.4.2.5 Geographical Map Display Pan and Rotate Response Time

If provided, the paratransit vehicle geographical map display shall support smooth panning and rotation. There shall be no user-discernable delay to refresh the display during map panning and rotation operations.

Section 4

SOFTWARE REQUIREMENTS

This section describes the required characteristics of the Bus AVL system fixed-end software. It is neither intended nor possible to list all software and all characteristics of the software required. The Contractor shall, however, provide all software necessary to satisfy the Bus AVL system functional requirements described in this Specification.

4.1 COTS Software Procurement (Option)

The base proposal shall include all software necessary to fully implement the Bus AVL system. As an option, Proposals shall include the price reduction offered for CCT to procure all commercial-off-the-shelf (COTS) software required to implement the Bus AVL system. CCT will decide whether to execute this option by no later than the end of the design phase of the implementation.

CCT expects that the COTS software will consist of server and workstation operating systems, database management software, backup software, and other 3rd-party software. Under this option, CCT will procure COTS software based on the Contractor's recommendations and specifications and deliver all procured software to the location designated by the Contractor. The Contractor shall continue to be responsible for installation, configuration, testing and other steps required to integrate the software into the Bus AVL system.

The Contractor shall retain responsibility for the proper operation and performance of the Bus AVL system using the CCT-procured COTS software provided that the Contractor's specifications for the COTS items have been met. The Contractor shall continue to provide all other software required for a complete and fully functional Bus AVL system.

Once delivered to the Contractor, and until installed at CCT's facilities, the Contractor shall be responsible for all CCT-provided materials including any necessary insurance, packaging, and shipment of the materials back to CCT following successful completion of the factory acceptance test (FAT).

Proposals shall include identification of all required COTS software items including quantities, provisioning, and other requirements necessary for CCT to independently procure the indicated COTS items. Price Proposals shall include a price deduction offered if CCT procures all COTS software.

4.2 General Characteristics

The Contractor shall provide standard, field-proven software products wherever possible. CCT will consider changes in the software requirements and characteristics if it can be shown that a proposed alternative approach using the Proposer's standard, field-proven software will meet the functional needs

of the Bus AVL system in a reliable and cost-effective manner. Newly developed software, or where software code modified and re-compiled to satisfy the requirements of this Specification, will be considered specially designed for this project and, as such “custom software”. CCT reserves the right to approve the design of such custom software without relieving the Contractor of the responsibility to meet the functional requirements of this Specification.

All operating system, database, utility, and network software shall be products that are commercially available, standard, unmodified, and off-the-shelf products produced by well-established and reputable suppliers. The most recent version of each product that is available at the time of the Factory Acceptance Test (FAT) shall be provided, subject to CCT approval. For all third-party software, the Contractor shall install all applicable vendor patches and service packs until final acceptance of the Bus AVL system by CCT. Local third-party support and training shall be available for all standard commercially available software.

The following subsections specify the required general characteristics applicable to all software provided with the Bus AVL system.

4.2.1 Conformance to Standards

The software provided with the Bus AVL system shall comply with Cobb County Information Systems standards, as specified in Appendix D. In addition, the software provided with the Bus AVL system shall comply with industry standards produced by national or international standards organizations, such as the IEEE, ISO, and OSF.

Application software shall use industry-standard programming languages and databases, and shall run under the provided operating systems using the standard and documented APIs of the operating system(s). Each programming language used within the Bus AVL system shall include libraries for accessing all operating system services.

4.2.2 Expandability

All software shall be easily expandable to accommodate the anticipated growth of the Bus AVL system in terms of users and vehicles as defined in this Specification. Reassembly, recompilation, or replacement of the software shall not be necessary to accommodate the specified growth. The size and configuration of the system shall be expanded by easily modified parameters contained in centralized system parameter files.

4.2.3 Modularity

All software shall be designed with sufficient modularity to minimize the time and complexity involved in making a change to any program. The modularity shall include the separation of hardware interface modules from other software modules.

4.3 Operating System Software

The system-level software provided shall include operating systems capable of supporting the functional, performance, and response requirements of the Bus AVL system. All servers shall use Windows Server 2003, or later. As a minimum, all workstations shall use Microsoft Windows XP Pro SP2, or later.

Proposals shall indicate whether MS Windows Server 2008 and/or Windows 7 are currently supported and, if not, the expected migration of the Proposer's offering to MS Windows Server 2008 and/or Windows 7. Proposers shall also indicate if they support server and/or workstation virtualization for their proposed system. If so, indicate the specific virtualization products supported. If not, note any future plans for supporting virtualization.

The provided operating systems shall not be modified or patched by the Contractor in a manner that is not approved by the operating system vendor.

4.3.1 Graphical User Interface

Operating systems supplied for the Bus AVL system workstations and servers shall utilize the Microsoft Windows graphical user interface. This graphical user interface shall be used to provide all user interaction within the Bus AVL system.

4.3.2 Time and Calendar Functions

The date and time of day shall be maintained for use by other Bus AVL system software, as specified in the following sections.

4.3.2.1 Daylight Savings Time

The time of the day shall be maintained in 24-hour format in hours, minutes, and seconds. The timekeeping function shall include the ability to correct for the local time zone, including adjustments to reflect Daylight Savings Time (DST) observance or the lack thereof. Orderly adjustments for time changeovers between standard and DST on event processing, historical files, system reports, and all other time-oriented functions shall be made. Adjustments shall automatically be made for both 23-hour and 25-hour days without disruption to any Bus AVL system function and without any data ambiguity. The System Administrator shall be able to pre-define the date and time when each of the time changeovers are to occur.

4.3.2.2 Date and Time Correction

The Bus AVL system shall use a time standard to keep all components of the Bus AVL system synchronized, including the time base used on all servers, workstations, passenger information signs, mobile devices, and other equipment hosting time-oriented functions. In the event of failure to communicate with the time standard, the Bus AVL system shall generate a system alarm. A Differential GPS receiver (see Section 5) is the preferred source of standard time for the system.

Devices installed in vehicles shall be synchronized to the Bus AVL System fixed-end time standard so that all fixed and mobile components of the system reflect the same standard time within a maximum error of 5 seconds.

The System Administrator shall be able to manually correct the Bus AVL system date and time in a single action that results in all components of the Bus AVL system being automatically synchronized with the new date and time. The alteration shall be immediately accepted by all system components and shall not corrupt data files, such as the historical logs, nor adversely affect the state of other currently running programs.

4.3.3 Network Software

The Bus AVL system shall include network software that supports the data communications within the Bus AVL system LAN and its connections to the CCT LAN/WAN network. Software for network communications, security, network services, and network management shall be provided. This software shall consist of standard off-the-shelf products, preferably included as part of the supplied operating system(s).

The network software shall support access by Bus AVL system users to printers and file servers on the CCT LAN/WAN. This network software, in conjunction with appropriate security software, shall also support controlled access to the Bus AVL system Information Server by users on the CCT LAN.

4.3.4 Diagnostic Port Access Security

Remote diagnostic ports shall be highly secure; use of encrypted VPN is preferred. The Bus AVL system Administrator shall be able to enable each port for either a single terminal session or until disabled by the System Administrator. The System Administrator shall have the option of being notified periodically by the Bus AVL system, via an alarm or event message, that the diagnostic port is enabled; and of being notified of each log-in and log-out on a diagnostic port.

4.3.5 System Performance Monitoring Software

Software shall be provided to continuously monitor hardware and software performance and gather performance statistics in real-time with a minimum of interference with the normal Bus AVL system

functions. The time period over which the statistics are gathered and saved shall be adjustable by the System Administrator, and the accumulated statistics, after storage in a save file, shall be reset at the start of each period.

The system performance monitoring function shall include processor resource usage monitoring, application program resource usage monitoring, and network resource usage monitoring. The Bus AVL system shall include on-line services that permit the System Administrator to individually enable, disable, and reinitialize each performance monitoring function.

The supplied performance monitoring software shall be suitable for evaluating the performance of the Bus AVL system against specified requirements during factory and field testing. Performance monitoring capabilities are not required for terminals that do not run application software.

4.3.6 Error Monitoring

The Bus AVL system servers shall employ on-line error monitoring. Bus AVL system devices shall be monitored for both recoverable and non-recoverable errors at all times, even if a backup device is available. The Bus AVL system shall monitor all devices and types of errors normally monitored by the operating system software. Error monitoring statistics shall not be lost upon device failover or restart.

The Bus AVL system shall enable the System Administrator to configure notification alarms for specific error events. The alarm notification shall provide an alarm message to the logged-in System Administrator(s). In addition, other notification options, including pager, SMS, and email notifications shall be supported by the error monitoring software.

Alarm notification shall be provided for, but not limited to, the following events:

- a. UPS alerts
- b. LAN/WAN failures and error conditions
- c. Application process failures
- d. Workstation and server failures
- e. Server failover and restarts.

4.4 Database Software

All supplied database management system software shall not be modified or patched by the Contractor in any manner that is not approved by the software's vendor. Microsoft SQL Server 2005 or Oracle 10G, or later, shall be used for the Bus AVL system databases.

The supplied database management system software shall support all functional, performance, and response requirements of the Bus AVL system at the ultimate user and fleet size requirements described in this Specification.

Additional database requirements for the Bus AVL system are contained in the following sections.

4.4.1 Online Database

The Bus AVL system shall include an online (i.e., continually updated and accessible) database that maintains comprehensive current and historical information on the Bus AVL system operating state, including, but not limited to, data on communications status, system status, route and schedule information, incidents, events, data required for displays and reports, data retrieved from the revenue and non-revenue fleets, data entered by Bus AVL system users, and data retrieved from other computer systems.

If a separate real-time (i.e., memory-resident) database is used, the Contractor shall provide all necessary API documentation and associated libraries for accessing this database from a program. All information maintained by a supplied real-time database shall also be accessible via the provided database facilities defined above, though possibly with greater latency.

The delivered Bus AVL system database software shall be sized to accommodate the ultimate user, fleet, and service area requirements described in this Specification, and shall be expandable so that data for future functions can be readily included.

4.4.2 Historical Information Database

The Bus AVL system shall provide a separate dedicated Historical Information database. The online database shall replicate all data to the Historical Information database in addition to any other data that may be required to satisfy Bus AVL system functional requirements for playback and reporting. The Bus AVL system shall monitor the replication process and ensure that the Historical Information database is synchronized with the online database. The Contractor shall provide all tools necessary, including documented procedures, to resynchronize the databases if a replication error is detected.

User access to the database via industry-standard SQL (ISO 9075 or later) and via third-party ODBC compliant front-end application software shall be supported. Facilities shall be provided to convert retrieved data to common export formats, including a comma-delimited ASCII and MS Excel file formats, for transfer and subsequent use in external office applications.

4.4.3 Historical Data Backup Database (Option)

The Bus AVL system shall provide a separate dedicated Historical Data Backup database. The backup database shall be hosted on a server at a Cobb County facility that is separate from the Bus AVL system installation at CCT, but that is accessible via the Cobb County WAN.

The Historical Information database shall replicate all historical data to the Historical Data Backup database in addition to saved reports and other data that may be required to satisfy all Bus AVL system requirements. The Bus AVL system shall monitor the replication process and ensure that the Historical Data Backup database is synchronized with the Historical Information database. The Contractor shall provide all tools necessary, including documented procedures, to resynchronize the databases if a replication error is detected.

All other database software requirements shall be the same as for the Historical Information database in Section 4.4.2, above.

4.4.4 GIS Map Database

The Bus AVL system shall include a Geographic Information System (GIS)-based database of the entire CCT service area. The GIS database shall support all of the functions and features required by this Specification, such as layering to permit separation of complex mapping information based on its type and/or function.

The GIS database shall be used by all map-related functions within the Bus AVL system. The programming APIs for interfacing with the GIS database shall be provided along with all relevant programming documentation on their use.

4.5 Software Maintenance Tools

The Contractor shall provide all software necessary for the continued maintenance of the Bus AVL system software following installation. One copy of all such software maintenance tools used by the Contractor during development shall be provided, regardless of whether all source and object code required by the tools has been supplied to CCT. Further, to ensure that CCT can maintain the software and firmware source and/or object code in escrow (see Section 9), all tools not otherwise required by CCT for continued maintenance of the Bus AVL system shall be placed in escrow along with the code.

Contractor-supplied updates to Bus AVL system software provided after initial installation shall also include any necessary updates to the software maintenance tools in order to keep the maintenance tools valid and usable for the currently installed version of the Bus AVL system software. This requirement shall apply regardless of whether the tools have been supplied to CCT or have been placed in escrow.

Access to maintenance software shall be password-protected to prevent unauthorized usage. All maintenance software shall execute without interfering with the online operation of the Bus AVL system. All updated objects, such as displays, reports, and programs, shall be capable of replacing the current copy of the object without significant interference with online system operation. It is desirable to be able to distribute updated objects on-demand to all affected workstations with a single command.

Requirements for specific types of software maintenance tools are contained in the following sections.

4.5.1 Display Generation/Editing Software

The Contractor shall provide means for generating new displays and editing existing displays. The Contractor's documentation shall describe the procedures required to build and integrate new displays and to modify existing displays. The Contractor shall use this same display generation software to construct all Contractor-provided displays.

4.5.2 Report Generation and Editing Software

The Bus AVL system shall provide authorized Bus AVL system users the ability to generate new report formats and edit existing report formats. Crystal Reports version 11, or later, software shall be used and provided with the Bus AVL system. The Contractor shall use this same report generation and editing software to develop all Contractor-provided Bus AVL system reports.

The report generator shall enable an authorized user at any workstation to develop ad-hoc queries and define reports for any Bus AVL system data via interactive procedures that do not require knowledge of SQL. The capability to format reports for both display monitors and printers shall be provided.

Executing the report generation and editing software shall not interfere with the on-line functions of the Bus AVL system.

4.5.3 Programming Languages

The Contractor shall provide the programming languages used for all software supplied with the Bus AVL system. CCT prefers a system that is written entirely in high-level languages conforming to industry-recognized standards. All languages shall include their associated compilers, assemblers, and loading facilities needed to add new programs written in the language. All libraries, class libraries, and individual classes shall be included, as used by the Contractor. Where feasible, the commercial software vendor's class libraries and development tool kits shall be used in preference to third-party tools.

All custom software shall be written using high-level languages conforming to industry-recognized standards and shall be easily transportable to other CCT-owned computer systems and workstations that

use the same standard language. Data access and data manipulation facilities in each language shall provide complete access to, and control of, the Bus AVL system data.

4.5.4 Source Editor

One or more source editors shall be provided for creation and modification of program source code. While a single source editor is preferred, multiple source editors are acceptable, provided that all editors are the same as used by the Contractor's programming staff for work on the Bus AVL system.

4.5.5 Code Management

A code management facility shall be used for documenting and controlling revisions to all Bus AVL system programs. This facility shall maintain a library of all Contractor-provided and CCT-developed source, object, and executable image code, and provide a controlled means for changing library files containing this code. It is desirable that the utility also supports revision management of system documentation.

The code management utility shall include inventory, version, and change control and reporting features. Program module inter-dependencies shall be included in the library for user reference. The description of inter-dependencies shall be compatible with the object code and program building facilities, such that dependent programs may be rebuilt automatically whenever a program, module, or library is changed. The code management facility shall retain a complete history of additions, deletions, and modifications for all programs, program modules, and program libraries.

4.5.6 Software Tester/Debugger

The software shall include one or more on-line, interactive software test and debugging utilities to assist in the testing of new and revised programs. Security checks shall be built into the software testing monitor to prevent the program under test from affecting the operation of the online Bus AVL system functions. The test/debug utility or utilities shall be the same as that used for the Contractor's work on the Bus AVL system.

4.5.7 Software Integration

Software integration services shall be provided for adding new programs to the set of active software after the programs have been tested. These services shall include commands to substitute one program for another, to set up or modify operating system tables, and to schedule and activate a new program with a minimum of interference with the normal running of the Bus AVL system. The capability to restore the Bus AVL system to its status prior to the new program integration shall be provided.

4.5.8 System Build

All required software elements and tools (including libraries, compilers, linkers, loaders, etc.) shall be provided with the Bus AVL system to enable CCT personnel to rebuild portions of the system, or the entire system, using only the elements supplied. CCT shall be able to perform all system build functions and generate an executable object of all software and database structures (excluding third-party software, such as operating systems and database systems) at CCT offices, without the necessity of returning to the Contractor's facility and without requiring Contractor engineering or programming support.

The procedures necessary to accomplish a complete system build on the Bus AVL system shall be provided as part of the system documentation.

4.5.9 Third-Party Software Libraries

All third-party source and/or object libraries required to build the Bus AVL system shall be provided, including the necessary documentation for programming with these libraries. All Contractor modifications to these libraries, if any, shall be clearly documented in the material supplied to CCT.

4.5.10 Database Maintenance

The Bus AVL system shall include all administrative and maintenance tools and facilities associated with the online, real-time, information, and historical backup databases. Tools of this type shall include, but not be limited to: performance monitoring and tuning; backup, restoration and recovery; and facilities for modifying, extending, documenting, and adding database structures.

4.5.11 GIS Database Maintenance

The Bus AVL system shall support GIS database updates made by importing externally supplied (external to the Bus AVL system) map data that will be supplied by CCT. Import capabilities shall enable import of new base map data acquired from external sources, while allowing the user to selectively retain existing map overlays (e.g., routes and bus stops) within the GIS database. Import capabilities shall support a variety of common GIS map interchange formats, including ESRI Shape file, ArcView, MapInfo and Enhanced TIGER formats. Cobb County uses ESRI GIS products.

4.6 Software Utilities

Efficient, reliable, well-documented, user-oriented software utilities shall be provided. All utilities shall be subject to a common design methodology and common standards in order to provide a similar look and feel among the utilities. All user-interactive utility software shall provide a graphical user interface.

The utility software shall operate without jeopardizing other Bus AVL system on-line functions running concurrently. Utility software shall be accessible from workstations and server terminals, and from

command files on mass storage. Multiple users shall have concurrent access to each utility program, provided there are no conflicts in the use of data files and peripheral devices.

All utility software required to maintain the Bus AVL system software shall be provided.

4.6.1 Text Editor

A general-purpose text editor shall be provided for the Bus AVL system that is the same as the text editor used by the Contractor's programming staff for work on the Bus AVL system. If necessary, servers and workstations may use separate text editors.

4.6.2 File Management

File management utilities shall be provided for the System Administrator and the Bus AVL system programs to allocate, create, modify, copy, search, list, compress, and delete program files and data files on mass storage and removable media storage devices supplied with the Bus AVL system.

The file management services shall maintain a record of the mass storage allocation of all programs and data. This record shall be available for display and printing upon request.

4.6.3 Copy Utility

A copy utility shall be provided that transfers files of any kind from any storage device to other storage and output devices, including any required format conversions.

4.6.4 Backup Software

A backup utility shall be provided that can backup and restore all mass storage, and selected portions thereof, from and to other storage and input/output media and verify the transfer. The backup utility shall support a full system restoration, including all operating system software. CCT currently uses Tivoli Storage Management for this purpose and requires that version 5.5, or later, of this specific software be provided and used with the Bus AVL system.

4.7 Contractor's Future Software Changes

CCT shall be placed on the Contractor's regular mailing list to receive all software announcements, including announcements of new software releases and other improvements that could be made to the software furnished with the Bus AVL system. Solutions to problems with Contractor-supplied software, whether discovered and corrected on the Bus AVL system or elsewhere, shall be documented and supplied to CCT without additional charge. This service shall include announcements and fixes pertaining to Contractor-produced software for ten (10) years after final system acceptance, and shall include

announcements pertaining to software produced by third-party suppliers for the life of the Bus AVL system warranty.

Section 5

HARDWARE CHARACTERISTICS

This section describes the hardware equipment characteristics for the Bus AVL system. Characteristics are discussed within the context of the design approach presented in these Specifications. *The Proposer may propose an alternative configuration better suited to the characteristics of the Proposer's standard products if it represents a superior compromise between performance and cost.* The purchase of a proposed configuration by CCT shall not release the Contractor from the contractual obligations to satisfy the functional, availability, capacity, expandability, and other requirements of this Specification. Where an alternative approach is proposed, the Contractor shall provide all necessary hardware, software, documentation, and services necessary to achieve the required functionality.

Unless explicitly stated otherwise, the requirements defined in this section apply to all Bus AVL system equipment. The quantities of individual devices to be provided by the Contractor and sizing information are presented in Appendix C and Appendix E.

5.1 COTS Hardware Procurement (Option)

The base proposal shall include all hardware necessary to fully implement the Bus AVL system. As an option, Proposals shall include the price reduction offered for CCT to procure all commercial-off-the-shelf (COTS) fixed-end hardware required to implement the Bus AVL system. CCT will decide whether to execute this option by no later than the end of the design phase of the implementation.

CCT expects that the COTS fixed-end hardware will consist of servers, workstations, UPS units, racks, and network devices. Under this option, CCT will procure COTS hardware based on the Contractor's recommendations and specifications and deliver all procured hardware to the location designated by the Contractor. The Contractor shall continue to be responsible for installation, configuration, testing and other steps required to integrate the hardware into the Bus AVL system.

The Contractor shall retain responsibility for the proper operation and performance of the Bus AVL system using the CCT-procured COTS hardware provided that the Contractor's specifications for the COTS items have been met or exceeded. The Contractor shall provide all other hardware required for a complete and fully functional Bus AVL system.

Once delivered to the Contractor, and until installed at CCT's facilities, the Contractor shall be responsible for all CCT-provided materials including any necessary insurance, packaging, and shipment of the materials back to CCT following successful completion of the factory acceptance test (FAT).

Proposals shall include identification of all recommended COTS hardware items including quantities, provisioning, and other requirements necessary for CCT to independently procure the indicated COTS items. Price Proposals shall include a price deduction offered if CCT procures all COTS hardware.

5.2 General Requirements

All hardware shall be manufactured, fabricated, assembled, finished, and documented with workmanship of the highest production quality and shall conform to all applicable quality control standards of the original manufacturer and the Contractor. All hardware components shall be new and suitable for the purposes specified. All hardware provided shall be commercially available, standard, off-the-shelf products manufactured by well-established and reputable manufacturers. Servers and workstations shall have remote management capabilities (e.g., HP's "Integrated Lights Out" option, or approved equal) and shall have simple network management protocol (SNMP) agents for network and device status monitoring and alarming.

Delivered hardware shall include all applicable engineering changes and field changes announced by the equipment manufacturer since it was produced. As part of the field performance test, the Contractor shall certify that all supplied equipment can be placed under a maintenance contract by the local service offices representing the equipment manufacturers.

5.3 Servers

The Contractor shall provide and install rack-mounted servers with redundant power supplies, plus all necessary racks, mounting hardware, cabling, and other components necessary for a complete and fully operating installation of the servers. Blade server technology may be proposed provided all Bus AVL system requirements are met, including redundancy and availability.

All servers shall be current models selected for efficient operation of a real-time system. CCT shall be able to replace or upgrade the servers with future server offerings to obtain increased computational power and system expansion with no required system or application software changes, and no software license modifications for Contractor-developed software.

Additional server requirements are contained in the following subsections.

5.3.1 Processors and Cache

The Bus AVL system servers shall support all functions described in this Specification utilizing no more than 40% of the total processing capability of each server under the peak loading conditions defined in Appendix F. Servers shall have Intel Pentium III Xeon processors, or faster, and shall have a minimum clock speed of 1 GHz. The servers shall have a minimum of 2 MB of L2 cache.

5.3.2 Main Memory

Each server shall be equipped with a minimum of 2 GB RAM main memory and shall have sufficient memory to meet all performance requirements of this Specification. The main memory of each supplied server shall be expandable in the field to at least 2 times the size of the delivered memory. This expansion shall be possible solely by the addition of memory modules and shall not require the replacement of any existing server components. The delivered memory shall include all memory installed in the server at the time of Final Acceptance, whether or not the memory is needed to meet the requirements of this Specification.

5.3.3 Server Terminals

The Contractor shall provide one or more shared server terminals for managing all supplied server equipment. Shared server terminals shall be quickly and conveniently switched among associated servers without unplugging or re-attachment of cables and without adversely affecting the operation of the servers. A server utilizing a shared terminal shall be capable of booting up without the shared terminal being switched to that server.

All server terminals shall be rack mounted in a location that is easily accessible by the System Administrator from a seated or standing position and within close proximity to the front panels of the associated servers. All server terminals shall consist of a color flat-panel monitor with at least a 17-inch diagonal screen, a QWERTY keyboard, and a mouse or trackball. The server terminals shall be packaged to utilize a minimum of rack space and shall be retractable for storage when not in use.

5.4 Workstations

All Contractor-supplied workstations shall consist of computer hardware that is compliant with Intel/Microsoft PC99, or later, design guidelines. Monitors, keyboards, and cursor-positioning devices supplied with workstations shall be connected via plug-detachable cords, and shall be manually interchangeable between all workstations. The Contractor shall provide all Bus AVL system workstations equipped as specified in Appendix C.

Additional workstation requirements are described in the following subsections.

5.4.1 Processors and Cache

The Bus AVL system workstations shall support all functions described in this Specification utilizing no more than 40% of the total processing capability of each workstation under the peak loading conditions defined in Appendix F. Workstations shall have Intel Core 2 Duo processors, or higher, and shall have a minimum clock speed of 2.3 GHz. The servers shall have a minimum of 2 MB of L2 cache.

5.4.2 Main Memory

Each workstation shall be equipped with a minimum of 2 GB RAM main memory and shall have sufficient memory to meet all performance requirements of this Specification. The main memory of each supplied workstation shall be expandable in the field to at least 2 times the size of the delivered memory. This expansion shall be possible solely by the addition of memory modules and shall not require the replacement of any existing workstation components. The delivered memory shall include all memory installed in the workstation at the time of Final Acceptance, whether or not the memory is needed to meet the requirements of this Specification.

5.4.3 Workstation LAN

Local Bus AVL system workstations shall be connected to servers and any other necessary external devices via the Contractor-supplied Bus AVL system LAN.

5.4.4 Workstation Human-Machine Interface

Each workstation shall be equipped with one keyboard and mouse. Where the Contractor's design requires multiple computers at a workstation position, a means shall be provided for the user to quickly and conveniently switch control among the workstation's computers.

5.4.4.1 Keyboard

Each workstation keyboard shall include a QWERTY key layout and a minimum of 12 function keys that initiate specific functions or display requests. The function keys shall be arranged in logical functional groupings. All workstation keyboards shall be identical.

5.4.4.2 Mouse

Each workstation mouse shall be equipped with at least two pushbuttons and a scroll device. The mouse shall produce cursor movement along any axis and at a speed proportional to the motion of the mouse. A means to adjust the proportionality of the mouse to cursor movement shall also be provided.

5.4.4.3 Monitors

All workstations shall include one or more identical, freestanding LCD monitors, each with at least a 22-inch diagonal viewing area. The number of monitors to be provided for each workstation position shall be as specified in Appendix C. Multiple monitor configurations shall be configured such that the combined display area of all monitors serves as a single, contiguous desktop under the operating system. Explicit user switching among monitors in a multiple monitor configuration shall not be required. On-screen menu operation for control of all monitor video tuning shall be provided.

Monitor native resolution shall be at least 1920 by 1200 pixels at 75 Hz vertical scan rate (non-interlaced) supporting at least 16.7 million colors, at a dot pitch of 0.26mm or less. The monitors shall be capable of accepting input signals within a scanning frequency range of 30 kHz to 80 kHz horizontal scan, and 50 Hz to 77 Hz vertical scan. The provided monitors shall support both standard VGA and DVI video inputs. Monitors shall be connected to the workstation video/graphics output utilizing the DVI port.

The contrast ratio shall be at least 700:1 and the backlight shall be equal to or better than 6 CCFT and provide 300 nit (cd/m²) brightness. All monitors shall be supplied with tilt and swivel stands with a tilt range of at least 5° downward (measured from a plane perpendicular to the face of the flat panel screen in relation to a horizontal plane) to 30° upward. The horizontal swivel shall range at least ±30° from a nominal centered position.

The nominal horizontal viewing angles shall be 160 degrees (80 degrees right/80 degrees left), and the nominal vertical viewing angles shall be 160 degrees (80 degrees up/80 degrees down). Minimum viewing angles shall be 140 degrees horizontal (70 degrees right/70 degrees left), and 140 degrees vertical (70 degrees up/70 degrees down). The monitor screen surface shall be abrasion resistant and anti-glare.

Monitors shall be designed for 24 hours per day, 7 days per week usage in a typical office environment. Nominal backlight life under these conditions shall be at least 50,000 hours. The monitors shall be capable of operating within a temperature range of 41 to 86 degrees F (5 to 35 degrees C), and humidity levels of up to a maximum of 80%. Power requirements shall be 100 to 120 VAC at 60 Hz. All monitors supplied must meet the following regulatory standards: UL 1950, C-UL, FCC Rules Part 15 Class B, CFR 21 DHHS, MPRIII (level B), TUV/GS, TCO, and VESA DPMS/Energy Star.

5.4.4 Audible Alarm

Workstations requiring audible alarms shall be equipped with Contractor-supplied audible alarm equipment that is capable of sounding repetitively for a System Administrator-adjustable time period. The audible level shall be adjustable by the user for each workstation, but be restricted to a minimum level so that the audio can always be heard (i.e., turned down at night but never off). At least four different audible alarm sounds shall be provided. The audible alarm shall not use the internal speaker of the workstation.

5.5 Printers

The Bus AVL system shall include at least one monochrome printer for use by the fixed-route and paratransit dispatchers. All supplied printers shall support a LAN/WAN interface for network printing and shall not require direct connection to a server or workstation.

The following sections describe specific printer requirements by printer type.

5.5.1 Monochrome Laser Printers

All monochrome laser printers shall have the following characteristics and features:

- a. A minimum resolution of 600 dots-per-inch
- b. Landscape and portrait output orientation
- c. Compatibility with the current versions of Microsoft Windows
- d. Paper input tray capacity of at least one ream
- e. Paper output tray capacity of at least 250 sheets
- f. Desk-top enclosures
- g. Use untreated paper and accommodate A-size (8.5" by 11") and legal (8.5" by 14") paper
- h. Postscript support
- i. Duplex (double-sided) print capability
- j. Minimum print speed of 17 pages per minute.

5.5.2 Color Laser Printers

Color laser printers shall produce an exact color copy of any Bus AVL system display and report. All color laser printers shall have the following characteristics and features:

- a. A minimum resolution of 600 dots-per-inch
- b. Landscape and portrait output orientation
- c. Paper input tray capacity of at least one ream
- d. Paper output tray capacity of at least 250 sheets
- e. Desk-top enclosure
- f. Use untreated paper and accommodate A-size (8.5" by 11") paper
- g. Postscript support
- h. Color calibration facilities

- i. Minimum print speed of 10 pages per minute for color prints.

5.6 Bus AVL System LAN

A LAN shall be supplied to interconnect Bus AVL system servers, workstations, and other local network devices. The supplied LAN shall be Ethernet conforming to the IEEE 802.3 series standards and shall support all Bus AVL system performance requirements. Wireless LAN technology shall not be used for this network.

The LAN design shall preclude LAN failure if a server, workstation, network device, or LAN interface fails. The LAN design shall also allow reconfiguration of the LAN and the attached devices without disrupting on-line operation of the Bus AVL system. All equipment, cabling, and installation required for the Bus AVL system LAN shall be the responsibility of the Contractor.

No more than 15% of the available access and transfer capacity of the supplied LAN shall be utilized under the peak loading conditions defined in Appendix F. The Bus AVL system LAN server backbone shall be at least one Gigabit Ethernet. Local workstation connections to the Bus AVL system LAN shall be at least 100Mbps.

The Bus AVL system LAN shall also provide network connectivity to the CCT LAN/WAN. The interconnection to the CCT LAN/WAN shall be secured with a Contractor-supplied firewall device that blocks all unauthorized users and systems on the CCT LAN/WAN from accessing Bus AVL system LAN resources. The Contractor shall integrate the firewall device(s). Cobb County Information Services will configure all supplied firewall devices to provide the County's required level of security.

The Contractor shall supply all necessary LAN segmentation and interconnection devices (e.g., hubs, routers, firewalls, switches, bridges, etc.) to provide secured connectivity among all supplied servers, workstations, and other supplied network devices. All such devices used in the Bus AVL system shall be products of Cisco Systems, Inc., which is the Cobb County standard for network equipment. All supplied devices shall be remotely manageable, shall be from the same scalable family of devices, and shall be comparable in quality to equipment currently in use by CCT and Cobb County.

5.6.1 Routers, Firewalls, and Switches

Router, firewall, and switch devices shall have simple network management protocol (SNMP) agents for network management and shall support remote terminal configuration of programmable filters.

5.6.1.1 Routers

Routers shall automatically build routing tables and shall include mechanisms (such as spanning tree algorithms) to prevent loops when multiple paths are possible.

Where multi-port routers are employed to interconnect more than two LANs, the multi-port routers shall be supplied with redundant power supplies and shall be configured such that no single failure of an interface card will result in the loss of communications with more than one LAN.

Router throughput shall be sufficient to take full advantage of the available channel bandwidth.

5.6.1.2 Firewalls

Firewalls shall limit access at the packet, circuit, and application levels. Firewalls shall provide the following features:

- a. Authentication – the firewall shall require authentication of the user. The firewall shall enforce password construction rules such as minimum length, inclusion of non-alphanumeric characters, and maximum validity period.
- b. Access Control – based on the identity of the user, different levels of access shall be provided, including none, read only, read/write, and execute. The types of access that users on the Bus AVL system LAN have to the external services, such as to the Internet, shall also be configured.
- c. IP Spoofing – the firewall shall guard against IP spoofing - an attack in which a would-be intruder outside the firewall configures its machine with IP addresses on the Bus AVL system LAN.
- d. Prevention of Denial of Service – The firewall shall protect against denial of service attacks. These attacks are characterized by attempts to deny service through overrunning buffers, filling the firewall disk, or overrunning the log files. Such attacks shall result in rejection of packets where they can be recognized. Where such packets are not recognized, the firewall shall respond by shutting down or denying external access when overruns occur rather than continuing to operate with partial capability. *The Contractor shall describe which types of denial of service attacks the proposed firewall can prevent.*
- e. Packet Filtering – packet filtering shall be provided by a screening router to restrict access based on both source and destination IP addresses.
- f. Stateful Inspection – each packet shall be inspected to determine which port numbers are used by which connections. When a connection closes, access to the port by that connection shall be shut down until another authorized user establishes a new connection.
- g. Proxy Servers – an application-layer proxy capability shall be provided to control access to the Internet to meet performance and security requirements. The firewall shall include

suitable application proxies, including at least HTTP, FTP, Gopher, Telnet, Mail, News, DNS, generic UDP and TCP, and other proxies needed for the Bus AVL system functions. Access to these services shall be customizable based on the user ID and IP address. Application-layer gateways for HTTP shall identify executable content downloaded from a Web site, including ActiveX and Java, and block transfer onto the Bus AVL system LAN.

- h. Network Address Translation – the firewall shall perform network address translation (NAT) to permit the hiding of IP addresses used on the Bus AVL system LAN from external view.
- i. Notification – all break-in attempts shall be recorded in a log file and notification issued to the System Administrator.

5.6.1.3 Switches

Switches shall support mechanisms (such as spanning tree algorithms) to provide path redundancy and to prevent loops when multiple paths are possible. One-second convergence shall also be supported to provide for the addition of new nodes to the network, switch failures, uplink failures, and indirect failures. The provided switches shall support all Layer 2, Layer 3, and security access control functions to meet the requirements of this Specification.

Switches shall be supplied with redundant hot-swappable power supplies and shall be configured such that no single failure will result in the loss of communications with more than one LAN.

Switch throughput shall be sufficient to take full advantage of the available channel bandwidth.

5.7 Mass Storage

The mass storage supplied with each server and workstation shall have sufficient storage capacity to satisfy the requirements of all Bus AVL system functions under the peak conditions of Appendix F. Fifty percent of the delivered mass storage for each server and workstation shall be spare capacity, completely free and available for CCT use. The delivered mass storage for each server and workstation shall also be expandable in the field within the provided enclosures to at least 2 times the delivered capacity, where the delivered capacity includes the spare capacity provided in accordance with this Specification and spare capacity in excess of specified requirements.

Historical Information and Historical Backup Database server mass storage units shall be sized to provide a minimum of 7 years of operational data. Where the data stored on mass storage is distributed among

multiple storage units, the requirements for mass storage spare capacity and expansion shall apply separately to each mass storage unit, or set of units allocated to one data type.

For servers, all mass storage units shall utilize Storage Area Network (SAN) and RAID 5 technology, be hot-swappable, and have dual power supplies. Mass storage access and transfer times must be sufficient to serve the current and future needs of CCT. No more than 60% of the available access and transfer capacity shall be utilized under the peak system loading conditions defined in Appendix F for both server and workstation mass storage units.

5.8 Backup Storage

The Bus AVL system shall include a high-density backup storage system that is configured for and capable of backing up all Bus AVL system servers and workstations. The backup storage system shall support backup of system software, applications, and data on a periodic basis. The backup system shall support full system recovery for each Bus AVL system server and workstation, including all operating system and application software. The backup storage device shall have sufficient capacity to allow unattended daily backup operations for a period of at least 7 contiguous days without requiring replacement of backup media. The backup media shall be rewriteable so that CCT may reuse the backup media. Sufficient media shall be provided to support a backup scheme incorporating multiple backup generations as well as offsite storage.

5.9 Remote Diagnostic Port

The Bus AVL system shall include a connection for use as a remote diagnostic port by the Contractor and by CCT. Diagnostic access shall be performed via a secured Internet connection utilizing VPN, rather than a separate, dedicated communications facility. The diagnostic port shall be protected by a name and password entry, and shall be enabled and disabled by the System Administrator as described in Section 4.

5.10 Differential GPS Reference Receiver (Option)

A differential GPS reference receiver and antenna shall be provided and installed by the Contractor to meet the AVL functionality and location accuracy requirements specified in Section 2. The receiver and associated equipment shall be installed at the CCT facility in Marietta. The Contractor shall provide all equipment and cabling necessary for interfacing the differential GPS reference receiver to the differential reference receiver antenna, to the power source, and to the Bus AVL system.

The pseudo-range and range-rate corrections for each GPS satellite in view of the reference receiver shall be calculated by the differential GPS reference receiver and transmitted to each GPS-equipped vehicle at least every 30 seconds.

The Contractor shall assist CCT in selecting the best location for installing the differential GPS receiver and antenna.

5.11 Time Facility and Displays

Digital LED or LCD time displays shall be provided and installed by the Contractor. The quantity and locations of required time displays are specified in Appendix C. The exact location of the displays in each area shall be mutually determined following Contract Award.

The displays shall be synchronized with the Bus AVL system time and shall be updated every second. The time shall be presented in a 24-hour format in hours, minutes, and seconds. Display characters shall be sufficiently large and bright to be clearly readable from a distance of 50 feet with ambient room lighting levels of 75 foot candles.

5.12 Communications Interfaces

5.12.1 Bulk Data Transfer Interface

The Contractor shall provide all equipment required to support the bulk data transfer functional requirements as defined in Section 2.6. This equipment shall include wireless communication processors and devices, associated antennas, cabling, mounting hardware, firewalls, routers/switches, and other network equipment as required by the Contractor's design.

The Contractor shall survey to determine Access Point (AP) locations and shall verify that the coverage between the wireless LAN access points overlaps such that the loss of a single wireless LAN access point does not cause a gap in the required coverage. The coverage area supported at bus garage, yard, and shop facilities shall be sufficient to meet the requirements for downloading and uploading data to and from the vehicles during normal operations and while the vehicles are parked in the bus yard³. It shall not be necessary to reposition vehicles in order to accomplish the necessary data transfers.

Potential interference between the Bus AVL system Bulk Data Transfer function and other CCT systems shall be considered in any design proposed by the Contractor. CCT is currently installing a Seon bus surveillance camera system on all buses that will include a new 802.11g WLAN. CCT also has a wireless fare collection system that operates at all of the fueling islands.

The Contractor shall insure that appropriate security measures are implemented to safeguard all wireless LAN interfaces from unauthorized access. The wireless LAN interface design and security measures shall be subject to CCT approval. Approval shall be based on the features provided below that are included in the Contractor's design.

³ Due to the long and narrow bus yard it is likely that remote Access Points will be required in the yard. CCT prefers that the remote APs be linked via a wireless bridge rather than using overhead or underground cables.

- a. Utilization of 802.11g (minimum) standards; 802.11n is preferred
- b. Encryption algorithms RC4, 3DES, and AES or newer with key length minimum of 256 bit or higher using WPA or newer protocol. WEP protocol shall NOT be used.
- c. Packet integrity utilizing CRC-32MIC, MD5-HMAC/SHA-HMAC or newer
- d. Device and user authentication
- e. FTP sessions utilizing SSH, SSL, or PGP encryption using secure FTP servers. Anonymous FTP shall not be used.

Proposals shall describe the specific security measures proposed for the bulk data transfer interface. Proposals shall also include recommendations on wireless LAN management hardware and software, and communication diagnostic tools to support network tracking, monitoring, and control.

5.12.2 CCT LAN/WAN Interface

The Bus AVL system shall be interfaced to the CCT LAN/WAN for exchanging data with other systems and for workstation access by some CCT Bus AVL System users. The Contractor shall provide all necessary hardware to interface to the CCT LAN/WAN. The Contractor shall provide all necessary security protection, including a firewall, to ensure that unauthorized personnel cannot access Bus AVL system LAN resources. The connection of the CCT LAN/WAN to the Bus AVL system shall be in a manner that isolates the Bus AVL system LAN from CCT LAN/WAN traffic and prevents failures or other disturbances on the CCT LAN/WAN from affecting the operation of the Bus AVL system.

The interface to the LAN/WAN shall support the following access and data exchange:

- a. Download revised GIS base maps to the Bus AVL system.
- b. Exchange manifest data and manifest updates between paratransit vehicles and CCT's RouteMatch paratransit scheduling system
- c. Access Bus AVL functions by CCT users with workstations on the CCDOT LAN
- d. Remote/Shared access by CCT users with workstations on the CCDOT LAN/WAN
- e. Provide Information Users on the WAN with read-only access to the Bus AVL system Historical Information Database, while otherwise restricting their access to the Bus AVL system
- f. Transfer of vehicle data to and from the bulk data transfer equipment at CCT's facilities.

The Contractor shall provide and configure all necessary hardware to complete the logical and physical connectivity to all specified LAN/WAN components. All such devices used in the Bus AVL system shall be from the same manufacturer, and if practical, from the same scalable family of devices.

5.13 Passenger Information Displays (Option)

The Contractor shall provide and install all passenger information displays and associated hardware at selected transit center waiting areas and bus bay locations. The Contractor shall provide all necessary software and equipment, including video displays, signs, communications cabling, and communications devices to support the display of service information at remote transit center locations.

The locations and numbers of displays to be supported are defined in Appendix C. Passenger information displays shall initially be installed at the transit locations and associated bus bay locations indicated in Appendix C, Figure C-4. The communications infrastructure at each location may be used for communications with the displays at the Contractor's option.

Proposers shall describe the proposed approach for communicating with display equipment at the designated locations.

All displays are to be located in a covered outdoor environment at the transit centers. Displays shall be made of non-corrosive material including enclosures, components, and fasteners and suitable for use in a covered outdoor environment. Displays shall be water-tight and capable of operating and presenting display information within a Winter/Summer temperature range consistent with the Marietta, GA area. Displays shall be easily viewable during daytime and nighttime lighting conditions.

Displays shall be of durable construction suitable for installation in a public environment with limited security. Displays shall be tamper and vandal-resistant or otherwise protected from vandalism, and shall be securely fastened in place.

The Contractor may assume that CCT will provide electrical power via a receptacle or junction box at each location where a display will be mounted. The Contractor shall be responsible for connecting the supplied equipment to the receptacle or junction box.

Proposals shall indicate the environmental operating specifications for the proposed signs including humidity and operating temperature ranges. Proposals shall also include information as to any CCT-provided facilities (e.g., commercial power source) needed for installation.

5.13.1 Video Displays

Video displays shall be provided at selected transit centers for the presentation of composite service information to passengers per functional requirements defined in Section 2. It is expected that the video

displays will be installed in a portrait orientation. However, details of the display configuration shall be determined and finalized during the design phase of the project. Each video display shall have a minimum diagonal display size of 40 inches and shall be rated for operation in a covered outdoor environment.

5.13.2 Bus Bay Displays

The Contractor shall supply and install bus bay displays at transit centers as indicated in Appendix C. Displays shall be securely mounted overhead at each bay so that they are clearly visible to waiting passengers at each bay. Bus bay displays shall support a minimum of 2 lines of text that shall be clearly readable at a distance of up to 30 feet. The display shall include scrolling options to support messages that exceed the width of the display.

5.14 Vehicle Equipment

The types of vehicle equipment to be provided and installed by the Contractor are identified in Appendix C, Figure C-3. The vehicle equipment shall be designed, built, and installed for the harsh environment in which this equipment is to operate, including conditions pertaining to temperature, humidity, power variations, shock, vibration, altitude, and EMI/RFI interference. All equipment housings shall be water proof and dust proof, and prevent damage from water directed on equipment while cleaning the inside of the revenue vehicles.

All vehicle equipment and displays provided by the Contractor shall be designed for, and operate properly under the following minimum conditions:

Operating Voltages	11-15 VDC, negative ground
Operating Temperature	-25 degrees C to +60 degrees C (vehicle storage includes outside areas)
Humidity	per SAE 1455
Shock	30g of 6 milliseconds
Vibration	Operating: 1.5g RMS, 5 to 150 Hz Endurance: 8g RMS, 100 to 1,100 Hz
EMI/RFI	FCC part 15 subpart J Class B

The Proposal shall identify the power and environmental specifications of the proposed vehicle equipment and the environmental tests and standards to which the proposed vehicle equipment conforms.

During engine startup, the voltage may drop to 0 VDC for several seconds, particularly in cold weather. *The Proposal shall define how the proposed vehicle equipment is designed to handle this situation, and any re-initialization, re-logins, and/or loss of data that will result when such a voltage drop occurs.*

Proposals shall also address situations where the engine is being re-started, yet the vehicle equipment is still powered-on (power-off delay timer has not expired). If internal batteries are used to support information stored in the vehicle equipment, these batteries shall provide an 8-year minimum life under normal operating conditions, shall be readily available, and shall have a low battery indicator included with the battery enclosure. Removal of all primary power to any or all of the vehicle equipment shall not cause any loss of stored information.

The installation details and placement of vehicle equipment shall be subject to CCT review and approval during the design phase of the Bus AVL system project. The availability and location of space for equipment installation will vary according to the various types of vehicles in the fleet.

In addition to the vehicle equipment that the Contractor is explicitly required to furnish by this Specification, the Contractor shall provide any other equipment that is required to install and operate the Contractor-provided equipment on CCT vehicles.

All Contractor-installed vehicle equipment shall be easily accessible, modular, and easily removable to facilitate maintenance and repair of the equipment. The vehicle equipment (e.g., MDT) shall be programmable using a personal computer and via a wireless link. All necessary field programming shall be possible without disassembly of the MDT enclosure. Programming and other routine maintenance shall not require removal or replacement of internal devices of any kind.

5.14.1 Mobile Data Terminals

The Contractor shall provide and install MDTs for all Bus AVL system-installed vehicles. Requirements for the MDT are described below in terms of two major MDT components; the VCH and the IVCU. MDTs that package the VCH and IVCU in a single device and MDTs that consist of two separately packaged devices are both acceptable.

For MDTs consisting of separately packaged devices, the VCH shall be the only device required to access all Bus AVL system vehicle Operator functions. All other devices of the MDT shall be securely mounted behind vehicle panels or in designated vehicle equipment compartments.

5.14.1.1 Vehicle Control Heads

The Contractor shall provide VCHs that shall serve as the interface between the vehicle Operators and the Bus AVL system. The VCHs shall be securely mounted on rigid Contractor-provided support brackets. The brackets shall be customized by the Contractor as needed for each type and variation of vehicle within the CCT fleet. CCT and the Contractor shall jointly decide the placement and mounting of each VCH. Each VCH shall be mounted and positioned within convenient reach of the vehicle Operator's seated position, where the vehicle Operator can easily read the VCH digital display and numeric/function

keys, where there will be no interference with the Operator's view through front and side windows, and where there will be not interference with the operation of the vehicle blinds and other equipment.

The VCH shall provide the following features and capabilities:

- a. The VCH shall be 100% solid state.
- b. The VCH housing shall be of rugged construction. CCT prefers that the VCH housings be of a light color to minimize heat absorption by the VCH when exposed to direct sunlight.
- c. For paratransit vehicles, VCHs shall provide a large, high resolution graphical color display suitable for viewing maps and other complex information.
- d. Provide a digital display that can display a minimum of 200 alphanumeric characters concurrently. For example, displays with 5 lines of 40 characters each, or similar configurations, would be acceptable. The display shall be easily read by the vehicle Operator in lighting conditions ranging from bright sunlight to darkness, and by vehicle Operators wearing conventional types of sunglasses, (e.g., polarized, un-polarized, "blue-block", etc.). The display shall be designed to minimize reflective glare from the front surface of the display. Operator-accessible controls for the display brightness and contrast shall be provided. Adjustment of the display brightness and contrast over the useful range of settings shall be possible. Adjustment of display brightness and contrast to settings where the display is unreadable shall be prevented.
- e. The VCH display characters shall be at least ¼" in height. Larger VCH display characters shall be utilized as necessary to meet accepted human factor design criteria for personnel with 20/20 vision at the distance and angle of the seated vehicle Operator from the mounted VCH. In the event the mounting location of the VCH varies between the types of vehicles in the CCT fleet, the character height shall meet these requirements for the most severe mounting location.
- f. Provide at least 16 backlit keys for vehicle Operator entry of data, selections, commands, and control functions. Alternatively, a fewer number of context sensitive soft keys shall be provided. If fixed keys are proposed, at least 10 shall be assigned to functions commonly required by the vehicle Operators. CCT shall be able to assign functions pertaining to their operations to these keys.
- g. The functions assigned to each key shall be listed or displayed immediately above, below, or adjacent to the key. If the text describing the key's function is placed on the key, it shall be in a manner that precludes the text from being worn-off by repeated use

by the vehicle Operators. The keys shall be durable, wear-resistant, and large enough for convenient selection. The keys shall be spaced sufficiently far apart to minimize inadvertent selection of adjacent keys. Color-coding of the keys and/or areas around the keys is preferred to help logically group keys according to their assigned functions. The backlighting of the keys shall be adjustable by the vehicle Operator. An audible tone or detent shall occur each time a button is pressed so that the Operator receives feedback that the action was successful.

- h. The VCHs shall produce audible tones when a voice call is received, and when a new text message has been received and is available for display on the VCH. The audible tones shall be capable of being heard over normal bus ambient noise levels. The audio output level shall be adjustable by the vehicle Operator within a restricted range that prevents audio output from being inaudible.
- i. The VCH shall display the current Bus AVL system time to the vehicle Operator.

5.14.1.1.1 Touch Screens (Option)

As an option for paratransit vehicles, VCHs shall utilize touch screen technology for Operator input. Touch screen input may be provided in lieu of, or in addition to, fixed hardware buttons. However, it shall not be necessary to use a combination of both touch screen and hardware button input to enter all required information to perform a given function.

Proposals shall describe, in detail, the proposed touch screen hardware characteristics and input methodology. Additionally, Proposers may offer providing touch screens for fixed route vehicles in addition to paratransit vehicles, as an alternative. If offered, Proposals shall include a description of the advantages and disadvantages of doing so, including maintenance and cost.

5.14.1.2 Intelligent Vehicle Control Units

The Contractor shall provide IVCUs to support the functional and device interface requirements defined in Section 2. The IVCU shall also interface to the Contractor's proposed industry-standard vehicle area network (VAN) for performing processing related to the on-board functions (e.g., mechanical alarms), and for interfacing to the vehicle's data communications equipment. IVCUs may be packaged as part of the VCH or as an independent device, and shall have sufficient spare resources and I/O ports to support CCT's future requirements.

The IVCUs shall store the vehicle ID and shall automatically transmit the vehicle ID as part of any data transmission, such as Operator logons. Encoding the vehicle ID shall not require manual programming of the MDT when the unit is replaced in a vehicle.

5.14.1.3 Other Device Interfaces

The MDT shall also be interfaced to a number of other on-board devices that do not reside on the VAN. The Contractor shall provide the input capabilities required to connect these devices to the Bus AVL system on-board equipment. The types of equipment to be interfaced shall include the following:

- a. Door sensors (status contacts)
- b. APC equipment and sensors (if not obtained via the VAN)
- c. Vehicle monitoring and diagnostic systems (if not obtained via the VAN)
- d. Wheelchair lifts/ramps (status contacts)
- e. Destination signs – where existing equipment has an RS232 interface
- f. Traffic signal priority equipment (status contacts) (Future)
- g. Spare RS232 and status contact inputs.

5.14.2 Vehicle Area Network

The Contractor shall provide and install a VAN on all installed vehicles. The VAN shall be based on the latest versions of the Society of Automotive Engineers (SAE) J1708 and J1587 standards.

On revenue vehicles, the Contractor shall provide and install the VAN wiring, connectors, and the device access boxes to the extent necessary to interface to the following devices:

- a. DRI audio/visual Announcement Equipment (Option)
- b. Destination signs (VAN capability for future equipment and destination sign upgrades that are J1708/J1587 compatible; for fixed-route only)
- c. Engine and transmission monitoring and diagnostic systems.

Proposals shall describe the types of wiring and connectors proposed for the J1708 VAN. The proposal shall also describe the Proposer's plans and commitments for on-board products that will meet NTCIP standards and how the proposed Bus AVL system equipment could be upgraded in the future to meet these standards.

5.14.3 Vehicle Wiring and Connectors

In addition to the J1708 VAN specified above, the Contractor shall provide and install all other vehicle wiring and connectors required for the Contractor-provided equipment and for interfacing to the existing vehicle equipment listed in these Specifications. All cables shall be sufficiently protected from damage within a harness covering and shall adhere to the guidelines and requirements of the SAE J1455 and SAE J2202 standards. All connectors and cables shall include appropriate environmental seals to ensure that they are water resistant. Cables shall be supported at least every five feet with insulated clamps. Maintenance service loops shall also be provided. Connectors shall be assembled according to the guidelines in SAE J2030 and J2202. All connections shall be securely crimped. Cable designs for the vehicles shall not have exposed cabling wherever possible. Cabling that must pass through the passenger area of the vehicle (e.g., cabling for APCs) shall be concealed behind panels. All vehicle wiring designs shall be submitted to CCT for approval prior to installations.

5.14.4 Power-Off Delay Timer

Unless the equipment is disconnected for maintenance purposes, the Bus AVL system vehicle equipment shall remain powered on for a defined time period after the vehicle has been powered off to allow the Bus AVL system to upload all collected data at the end of the day and to prevent Operators having to re-login during short layovers.

It shall be possible for the System Administrator to set and adjust the power off delay timer to a new time period without touching each vehicle. Time periods ranging up to 4 hours delay shall be supported and shall initially be set to power off the Bus AVL system vehicle equipment 45 minutes after the vehicle is powered off.

5.14.5 GPS Receivers and Antennas

The Contractor shall provide the GPS receivers, antennas, and all necessary connections required to monitor the location of Bus AVL system-equipped vehicles. The GPS receivers shall be parallel (dedicated channel) tracking receivers and shall be able to simultaneously track at least eight GPS satellites in the best geometry for a position fix. The GPS receivers shall report latitude, longitude, speed, time, direction of travel, and satellite tracking station to the IVCU. The provided receivers shall also provide date/time signals to all Contractor-provided and existing on-board equipment, as necessary to support the required Bus AVL system functions.

The GPS receivers shall support all Block I, Block II, and Block IIR GPS satellites that are operational at the time the GPS equipment is delivered. The accuracy of GPS location tracking functions shall be unaffected by GPS “week number rollover” events. Velocity measurements provided by the GPS equipment shall be accurate to within 0.1 meters/second when operating in the clear (non-selective availability) mode.

The GPS receivers shall have a cold start time to first fix (TTFF) solution time of two minutes or less and a signal reacquisition time of 15 seconds or less following the loss of the signal for at least one minute. The GPS equipment shall include multi-path rejection capabilities to eliminate spurious signals caused by reflections off of buildings and other structures.

The GPS receiver shall store the GPS almanac in non-volatile RAM.

The provided GPS antennas shall support the number of channels tracked by the GPS receivers and shall be low-profile units housed in rugged, weather tight, roof-mounted enclosures.

5.14.6 Additional Navigation Equipment

The Bus AVL system shall include and utilize any additional navigation equipment required to meet the Bus AVL system positional accuracy requirements. At a minimum, the dead reckoning methods shall be used to back-up the GPS-based navigation capability.

Proposals shall identify and describe all additional navigation equipment that is included in the offering as a supplement or backup to GPS. Proposers are reminded of the environment that the Bus AVL system must operate, which includes urban canyons located in the downtown Covington and Cincinnati areas.

5.14.7 Emergency Alarm Switches

The Contractor shall install new emergency alarm switches on Bus AVL system-equipped revenue vehicles. The emergency alarm button shall also trigger the onboard video surveillance system to tag the recording thereby eliminating the need for an Operator to press a separate button. All installed switches shall be identical. The switch configuration and location for new emergency alarm switches shall be subject to CCT approval.

5.14.8 Destination Sign Interface

The Bus AVL system shall provide interfaces to existing destination signs on all Bus AVL system-equipped fixed-route vehicles that have external control interfaces installed. The Contractor-provided interface shall enable the signs to be automatically controlled by the Bus AVL system. The destination sign interface shall also support the uploading of updated destination sign message data. CCT prefers that the interface approach not require permanently disabling the manual control panel functions of the destination signs.

The Contractor shall provide interfaces and control logic for the destination signs, regardless of whether the vehicle contains a controllable sign. For vehicles containing controllable destination signs, the Contractor shall install all required modifications and wiring necessary to control all of the signs. The Contractor shall be responsible for inspecting the fleet to ensure that the proposed system will correctly

interface to the existing equipment. As part of the design review process, the Contractor shall inform CCT of specific upgrades, if any, to existing signs that are needed to support the destination sign interface.

5.14.9 Odometer Interface

The Contractor shall interface to the odometer on all Bus AVL system-equipped vehicles. This interface shall support the collection of accurate mileage data for each vehicle, navigation, and other functions as necessary to meet the Contractor's design.

On vehicles where a J1939 interface is available, the Contractor shall obtain odometer data/pulses via the VAN. Where a J1939 interface is not available, the Contractor shall provide and install sensors as necessary to provide the output signals required by the Contractor's on-board equipment. Sensors provided by the Contractor shall measure distance to within $\pm 3\%$ of the actual distance traveled by the vehicle and shall include any additional hardware, software, and services required for implementation on all Bus AVL system-equipped vehicles.

5.14.10 Automatic Passenger Counting Equipment (Option)

The Bus AVL system shall support APC equipment on the number of revenue vehicles as indicated in Appendix C. The Contractor shall provide all onboard APC equipment including sensors, wiring, cabling, and installation required to make APC fully functional on the CCT-selected buses.

Sensors used to detect passenger boarding and de-boarding shall not use step-treadle technology, but shall use infrared or other similar sensors that have a high level of reliability and are easily serviced. The sensors shall have a demonstrated accuracy of 95% or better. The APCs shall include all equipment required to interface the subsystem with the rest of the vehicle equipment to allow the passenger counts to be correctly associated with the GPS-based location and correct bus stops. This interface equipment shall allow the Bus AVL system to offload accumulated passenger count data from the buses at the end of the service day, along with other data accumulated by the vehicle equipment.

5.15 Vehicle Operator Training Hardware (Option)

The Contractor shall provide 3 sets of training equipment, for training revenue and non-revenue vehicle Operators on the proper use and operation of the Bus AVL system on-board vehicle equipment in a classroom environment. Two sets of the training equipment shall be configured as a fixed-route vehicle, and one set as a paratransit vehicle.

Vehicle operator training will be held at CCT's facility. The training equipment shall be fully operational and identical to the equipment being provided and installed by the Contractor in CCT's revenue and non-revenue vehicles. At a minimum, the on-board vehicle devices to be provided for each set of equipment

shall include a MDT, CCT-provided mobile radio, emergency alarm switch, covert microphone, speaker, handset, and the ability to simulate various vehicle status inputs (e.g., mechanical alarms).

Each set of training equipment shall be mounted in a rigid frame that is portable and suitable for temporary placement on a desktop during training. The equipment sets shall be powered from the CCT-provided 120 VAC, 60 Hz power supply. *Proposals shall include the cost of each additional set of training equipment beyond the quantity specified above. CCT shall have the option of purchasing additional sets from the Contractor at that price through the warranty period.*

The Contractor shall provide all hardware, software, and cabling required to interface to all the devices in each set of training equipment and to provide a realistic simulation of all operations, functions, and features of the Bus AVL system on-board equipment. The training equipment shall allow vehicle Operators to be trained on the following functions:

- a. Logon and logoff sequences
- b. Requesting, conducting, and ending voice communications
- c. Use and meaning of all buttons, indicators/lights, menus, and any other information displayed on the VCH
- d. Sending, receiving, and responding to text messages including displaying and controlling all messages in the MDT's message queue
- e. Emergency alarm and covert monitoring scenarios
- f. Using route manifests, including all manifest interaction and update functions as defined in this Specification
- g. Understanding the meaning of and proper actions to be taken in response to all vehicle Operator prompts and error messages displayed on the VCH.

A dedicated Bus AVL system training workstation shall be provided to allow CCT training personnel to interact with the vehicle Operators in the same manner as actual operation. CCT training personnel shall be able to perform all Bus AVL system dispatch functions so that the training can be as realistic as possible.

One of each type of training equipment shall be tested as part of the factory testing. All sets of equipment shall be delivered to CCT in time for vehicle Operator instructor training.

5.16 Other Peripheral Devices

The Contractor shall supply any other peripheral devices or equipment required for the operation, software support, or maintenance of the proposed Bus AVL system.

5.17 Expandability

All expansion capacity defined in this Specification shall be satisfied within the existing enclosures by the addition of circuit boards only. All power supplies and chassis space for the expansion shall be supplied with the delivered system. Expansion requirements shall include, but not be limited to, main memory, mass storage, and the ultimate device quantities as described in Appendix C.

5.18 Overload and Surge Withstand Capability

The Contractor shall ensure that all communications facilities and interconnections among Bus AVL system components are adequately protected from voltage overload and surge conditions (e.g., static discharge). The Bus AVL system shall operate under minor overload conditions, recover to normal operation after other overload conditions, and limit damage caused by other, more severe, overload conditions. Facilities and interconnections requiring overload and surge protection at their interface to the system shall include telephone and T1 lines, antennas, and metallic cable runs.

The Contractor shall provide vehicle equipment that maintains normal operation under all operating conditions in which the equipment is installed, in accordance with the latest SAE J1455 guidance and requirements. The vehicle equipment shall be designed to withstand all transient voltage variations including load dump, inductive switching, and mutual coupling. For 24 VDC systems, the vehicle equipment shall be capable of operating in the presence of input voltage excursions of 38 VDC for up to 1.5 seconds. The Contractor shall provide the necessary cable and component shielding to prevent any inductive switching and mutual coupling errors from being introduced over I/O circuits and conductors.

5.19 Power Supply Requirements

The Bus AVL system shall operate with the following power inputs and the following conditions.

5.19.1 Facility Power Supply and Cabling

CCT will provide unconditioned, single phase 120 VAC, 60 Hz power to the Contractor-supplied UPS equipment that supports the Bus AVL system equipment. Power to the UPS equipment will be supplied from utility power sources. Input voltage may vary $\pm 10\%$ and frequency may vary $\pm 0.5\%$ from nominal.

Each circuit shall include a circuit breaker typed and sized in accordance with the equipment manufacturer's recommendation. The Contractor shall supply all power cabling to the equipment

locations, racks, workstations, enclosures, and other Bus AVL system equipment. Power supply connections shall be located within the enclosures. The Contractor shall distribute power within the system enclosures, peripherals, and other Bus AVL system components. The Contractor shall connect all equipment in accordance with the National Electric Code and applicable local electrical codes.

5.19.2 Uninterruptible Power Supplies (Option)

The Contractor shall provide uninterruptible power supply (UPS) units for all Contractor-installed servers, workstations, network equipment, and all other Bus AVL system equipment located at CCT's facilities, CCDOT offices, and other locations where Bus AVL system equipment is installed.

In the event of a power outage, the Contractor-supplied UPS equipment shall be sufficiently sized for the connected Bus AVL system components to remain fully functional for at least a 30-minute period without primary and backup power. As a minimum, UPS units shall be supplied as follows:

- a. The Bus AVL system shall include a managed UPS unit for the Bus AVL system equipment in the CCT Server Room. This unit shall be interfaced to all Bus AVL system servers, network devices, and other Bus AVL system equipment, including the DGPS receiver. The provided UPS shall provide for an orderly shutdown in the event that UPS battery power is depleted and both primary and backup power is not available.
- b. The Contractor-provided UPS unit shall provide redundant power protection with scalable power and runtime. The provided UPS unit shall be sufficiently sized to accommodate the Bus AVL system equipment, such that the total UPS load shall not exceed 60%.
- c. A UPS unit shall be provided for each of the fixed-route and paratransit Dispatcher positions. The UPS unit shall be sized to accommodate the Bus AVL system workstation and CCT's existing voice radio system equipment.
- d. A UPS unit shall be provided for each of the Contractor-supplied Bus AVL system workstations at the Customer Service, Maintenance Shop, System Administrator (if not located in the Server Room), Operation Manager, General Manager, and CCDOT workstation positions.
- e. Each Contractor-supplied UPS unit shall meet the following requirements:
- f. The load on each UPS unit shall not exceed 60% of unit's capacity.
- g. The minimum UPS battery discharge time upon loss of utility power shall be 30 minutes, calculated at the 60% capacity specified above.

- h. Batteries shall be sealed, maintenance free, hot-swappable, lead acid batteries; special ventilation arrangements shall not be required.
- i. The UPS units shall provide surge protection from public power source surges. Surge energy rating shall exceed 450 Joules.
- j. A means for detecting and reporting UPS status and alarms shall be provided for the Contractor-supplied UPS equipment.
- k. A means shall be provided to alert Bus AVL system users when primary power fails and, as a result, power is being provided by the Contractor-provided UPS battery sources.

5.19.3 Vehicle Equipment Power

The power supply on board CCT vehicles will be unconditioned 12 VDC. This voltage will normally vary between 11 VDC and 15 VDC; although larger voltage dips can be expected during engine startup. The voltage may drop effectively to zero for several seconds, under the most severe conditions. All Bus AVL system vehicle equipment shall be protected from restart (re-initialization), loss of data, and damage due to temporary voltage drops. All Bus AVL system vehicle equipment shall also be protected from damage resulting from power lead reversal and from over-voltage conditions (up to 200V) that could occur during maintenance operations or equipment failure (e.g., regulator failure).

The connection to the vehicle power supply shall be with a direct connection to the battery mains, via a dedicated circuit.

5.19.4 Hardware Protection

Excluding the AC power main circuit breakers to be provided by CCT, all fusing, switches, and surge protection necessary at all locations to protect the hardware supplied as part of this Specification shall be supplied by the Contractor.

5.20 Temperature/Humidity/Heat Load

All equipment provided under this Contract and located within the CCT server room and at workstation locations shall operate over an ambient temperature range of 50 degrees F to 110 degrees F, with a maximum rate of change of 15 degrees F per hour and with relative humidity ranging from 20% to 80% non-condensing.

5.21 Acoustic Noise Level

The noise level of any Bus AVL system equipment located in the server room shall not exceed 60 dbA three feet from the enclosure. The noise level of equipment located at other than the server room shall not

exceed 50 dbA three feet from the enclosure. Sound-deadening enclosures shall be provided where necessary to meet these requirements.

5.22 General Construction Requirements

All Bus AVL system equipment shall be constructed in accordance with the following requirements.

5.22.1 Enclosures

The Contractor shall provide enclosures for the Bus AVL system equipment located in the Server room. All equipment enclosures shall meet the following requirements:

5.22.1.1 Finish

The enclosures shall be finished inside and out. All cabinet metal shall be thoroughly cleaned and sanded, and welds chipped to obtain a clean, smooth finish. All surfaces shall be treated to resist rust and to form a bond between the metal and the paint. The finish colors of all enclosures shall be the Contractor's standard.

5.22.1.2 Accessibility

Floor mounted enclosures shall have front and rear access to hardware and wiring. Cabinet height shall not exceed 80 inches. All cabinet doors shall be secured with keyed locks with all locks being keyed alike. Keys shall be removable in both the locked and unlocked positions.

Moving assemblies within the enclosure, such as swing frames or extension slides, shall be designed such that full movement of the assembly is possible without bending or distortion of the enclosure or the moving assembly. Enclosures shall not require fastening to the floor to preclude tipping of the enclosure when the moving assembly is extended.

5.22.1.3 Cabling and Wiring

Cable entry shall be through the top, bottom, or back of the enclosure, such that no cables shall be visible from the front of the enclosure. All cables running above drop ceilings shall be rated as NEC Class 2 Plenum cable and tested to NFPA 262-1985 Test for Fire and Smoke Characteristics of Wires and Cables to a maximum peak optical density of 0.5, a maximum average optical density of 0.15, and a maximum allowable flame travel distance of five feet.

Wiring within enclosures shall be neatly arranged and securely fastened to the enclosure by non-conductive fasteners. Wiring between all stationary and moveable components, such as wiring across hinges or to components mounted on extension slides, shall allow for full movement of the component without binding or chafing of the wire.

Except for fiber-optic cables, all wiring shall use copper conductors. Conductors in multi-conductor cables shall be individually color-coded.

5.22.1.4 Cooling

Cooling air shall be drawn from the conditioned air within the room. Ducted or directed cooling air to the enclosures will not be supplied by CCT.

5.22.1.5 Construction Materials

All materials used in the enclosures, including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made of flame retardant material and shall not produce toxic gasses under fire conditions. Any use of PVC shall be allowed only with specific permission of CCT.

5.22.1.6 Anchoring

The Contractor shall ensure that the equipment, materials and installation comply with all local seismic requirements (Zone 1) for the area in which the equipment will be installed.

5.22.1.7 Grounding

A safety ground in accordance with the National Electrical code shall be provided within each enclosure and shall connect to the ground (green) wire of the AC power input. Enclosure grounding shall also be provided and shall be subject to CCT approval.

5.22.2 Assembly and Component Identification

Each assembly in the system, to the level of printed circuit cards, shall be clearly marked with the manufacturer's part number, serial number, and the revision level. Changes to assemblies shall be indicated by an unambiguous change to the marked revision level. All printed circuit card cages and all slots within the cages shall be clearly labeled.

5.22.3 Interconnections

The Contractor shall supply all signal cabling between component units of the Bus AVL system. The connectors shall be polarized to prevent improper assembly. Each end of each interconnection cable shall be marked with the cable number and the identifying number and location of each of the cable's terminations; this information shall agree with the drawings and be descriptive, so that maintenance personnel can easily identify which cables connect to which equipment. Each cable shall be continuous between components; no intermediate splices or connectors shall be used. Terminations shall be entirely within the enclosures.

5.23 Equipment Space

The Contractor shall provide a plan view of the locations where the Bus AVL system equipment is to be installed. Floor plans of the anticipated locations are provided in Appendix J. These floor plans shall be used to determine lengths of interconnecting cables. An additional 20 feet shall be provided for cables crossing room boundaries.

Proposals shall describe the space requirements for all Bus AVL system equipment to be installed in the CCT server room, in the Dispatch Room and other workstation locations, and at all other locations where Bus AVL system equipment is to be installed. The description shall include a proposed layout for the Bus AVL system equipment within the server room. Proposers are invited and encouraged to visit each location as part of the schedule pre-proposal meeting to be held at CCT's facility.

Section 6

CONFIGURATION CHARACTERISTICS AND AVAILABILITY

This section describes system configuration requirements, presents the functions required to monitor and manage the Bus AVL system hardware and software, and quantifies the Bus AVL system availability requirements. The ability of the Bus AVL system to perform its specified tasks under normal conditions and under conditions of hardware and software failure is of paramount importance to CCT.

6.1 System Configuration Requirements

The Bus AVL system shall accommodate the system configuration and network topology requirements described below and in other sections of this Specification. The required equipment quantities are listed in Appendix C.

Proposals shall include a detailed system block diagram illustrating the proposed system and equipment configuration.

6.1.1 Test Configuration

The Bus AVL system shall be designed to support a test configuration to support testing of new components, software, and schedule data prior to their use in production. To support this requirement, the Contractor shall supply sufficient fixed-end components to operate parallel production and test configurations. The test configuration shall also include a convenient means to transition the test configuration to production use with minimal effort.

Proposals shall describe in detail the proposed approach to fulfill this requirement.

6.1.2 System Configuration Major Elements

The Bus AVL system configuration shall include the following major elements:

- a. Redundant Bus AVL system application servers
- b. Redundant Bus AVL system on-line database servers
- c. Redundant data communication servers/devices
- d. Redundant RouteMatch paratransit scheduling system servers – Contractor shall supply, install, and configure new and/or replacement components as necessary to enhance the existing non-redundant paratransit scheduling system.

- e. A non-redundant, dedicated Information Server; however, if the Information Server is used to meet the Bus AVL system availability or long-term data functional and storage requirements, it too shall be redundant.
- f. A non-redundant, dedicated Historical Backup Server
- g. Dispatcher workstations located in the Dispatch Room
- h. All other users' workstations (e.g., System Administrator, Customer Service, Maintenance Shop, etc.)
- i. Differential GPS receiver
- j. Passenger information signs at the Marietta and Cumberland Transit Centers
- k. Interfaces to the following external systems:
 - l. RouteMatch Paratransit Scheduling System
 - m. CCT GIS
 - n. CCT LAN/WAN
 - o. RTPI Server/Provider.

All interfaces to the above external computer systems shall be secure and shall prevent unauthorized users and data traffic from impacting the performance or security of the real-time Bus AVL system functions.

6.1.3 Server/Device Interconnections

The Contractor-provided Bus AVL system LAN shall provide interconnections between the major system elements listed above, and other necessary server and device interconnections for:

- a. The exchange of data among servers and workstations for the purpose of executing all required Bus AVL system and user functions
- b. The exchange of data between servers for the purpose of populating and maintaining all Bus AVL system databases
- c. The exchange of server and device state information for the purpose of monitoring and controlling the Bus AVL system configuration

- d. The data communications between the Bus AVL system and the wide area wireless data communications provider
- e. Access to peripheral devices.

6.1.4 Backup Databases

A backup copy of all databases shall be maintained so that the Bus AVL system operation may continue in the event of server, workstation, device, or software failure. The backup databases shall be updated with the current contents of the primary databases, such that all changes to a primary database are replicated to the backup database.

6.1.5 Error Detection and Failure Determination

All Bus AVL system servers, workstations, devices, and on-line and background functions shall be monitored for fatal and recoverable errors. All errors shall be recorded for review by the System Administrator and shall be included in the error statistics displays and reports. Each type of error for each device (for example memory access violation, device reply time-out, or message checksum error) shall be recorded separately.

Configuration of errors and failures to also issue an alert to the System Administrator via pager, SMS, and email, etc., is considered a desirable feature by CCT.

6.1.6 Server Redundancy and Failure

Unless specifically identified as redundant in Section 6.1.2, servers may be configured as redundant or non-redundant, as necessary to meet availability requirements. Redundant servers shall be provided in a primary and backup server configuration, where the backup server is in a hot standby mode of operation.

When a failure of a primary server is detected, the Bus AVL system shall invoke the appropriate failover actions so that all functions assigned to the failed server are preserved and available. In the event of a primary server failure, the assigned backup server shall assume all functions performed by the primary server and take responsibility for the continued operation of the Bus AVL system. The transition of the backup server to the primary role shall take no longer than 60 seconds. This transition shall be considered complete when all system functions are completely operational on the new primary server.

Failures of servers operating in the backup state shall not initiate failover actions.

All server failures shall be annunciated by alarms. The alarms shall identify the failed server(s), all server state changes, and the success or failure of any restart and failover operations.

6.1.7 Device Redundancy and Failure

Unless specifically identified below as redundant, devices (including LANs and interfaces) may be configured as redundant or non-redundant, as necessary to meet the availability requirements of Section 6.4. In addition, the following device redundancy and failure recovery requirements shall be met:

- a. **LANs:** LAN components that represent a single point of failure shall be avoided. LAN components present in the Contractor's design shall be equipped with redundant power supplies and, at a minimum, shall allow immediate manual reconfiguration with a Contractor-supplied replacement component to correct the problem. Replacement components shall be installed in the same enclosure as the online device and shall be pre-wired for power. The routing and dressing of LAN cabling shall allow for the rapid rerouting of cables to the replacement component. Recovery from a LAN failure shall not require server failover.
- b. **Workstations:** When a Dispatcher workstation fails, the Bus AVL system shall assure that all of the partition assignments (e.g, route and fleet) of the user who was logged in at that workstation are assigned to at least one user logged in at another Dispatcher workstation. If one or more partition assignments are not covered, the partitions shall be assigned to the current user of another Dispatcher workstation and an alarm shall be generated at that workstation.
- c. **Backup storage:** Any function using a backup storage device shall be able to use any other backup storage device if the primary device is not available. Substitution of a backup storage device for a failed device shall be at the direction of the System Administrator.

When a failure of a redundant device is declared, the Bus AVL system shall automatically invoke the appropriate device failover actions so that functions assigned to the failed device are preserved. Backup devices may be identical to, or different from, the primary device provided that the functions of the failed device can be performed. The ability for the System Administrator to assign specific backup devices to replace failed primary devices shall be supported.

Except as specified above, server failover, as specified in Section 6.1.6, may be allowed as the means of recovering from the failure of a redundant device crucial to the Bus AVL system operation, and shall be subject to CCT approval.

When a failure of a non-redundant device is declared, the Bus AVL system shall not invoke failover or restart actions. Functions assigned to a failed, non-redundant device may be lost until the failed device is restored to service.

All device failures shall be annunciated by alarms. The alarms shall identify the failed device(s), all device state changes, and the success or failure of any failover operations.

6.2 Remote Site Communications

CCT will provide LAN/WAN connectivity to remote sites where Bus AVL system equipment is to be installed. The Contractor shall be responsible for verifying that the implementation of the communication facilities provided by CCT meets requirements of the proposed system. The Contractor shall demonstrate to CCT any problems encountered with the network communications implementation provided by CCT and shall assist CCT as necessary to resolve the problem(s).

The Contractor shall provide the necessary equipment for the Bus AVL system to interface to the existing communications equipment. The Contractor shall perform all interconnections and testing such that all Bus AVL system functions are provided and perform as specified.

6.3 Availability

The Bus AVL system shall have a total calculated availability, including functional availability (Section 6.3.1) and hardware availability (Section 6.3.2), of 99.98%. That is, the ratio of total time minus downtime to total time shall be equal to or greater than 0.9998.

The failure of any single Contractor-provided server, device, or other component shall not render the system unavailable.

The following subsections identify the functions and equipment required for the Bus AVL system to be considered available. Section 7.9, Availability Test, describes the requirements, responsibilities, and definitions for an availability test that shall demonstrate conformance with the availability criteria described in this section.

6.3.1 Functional Availability

All Bus AVL system functions shall execute as specified, without degradation in response times, for the system to be considered available.

Functional availability shall also include the execution of the Contractor-provided data communications interface and associated functions. For the purposes of the Availability Test, failure to meet this criterion due to failure of CCT-supplied communications circuits or components will not be measured as downtime, and will be considered Holdtime.

6.3.2 Hardware Availability

For the Bus AVL system hardware to be considered available, the fixed-end and vehicle hardware availability requirements defined below must be met. For purposes of the availability testing, software and firmware in the Contractor-provided data communications interface equipment and on-board vehicle equipment will be considered as part of the hardware.

6.3.2.1 Fixed-end Hardware Availability

The following minimum complement of fixed-end hardware must be operational for the Bus AVL system to be considered available:

- a. Sufficient servers, with all main memory, server interconnections, mass storage, and peripheral device access to execute all Bus AVL system functions at the scheduled periodicities and response times, including the interface to CCT's RouteMatch paratransit scheduling system and associated manifest download and update functions
- b. Sufficient LAN facilities to execute all Bus AVL system functions at the scheduled periodicities and response times
- c. At least 80% of the Bus AVL system workstations, System Administrator workstation excluded, shall be operational. A workstation shall be considered operational when the keyboard, mouse, all monitors, and computer are operational, and when it can support all required Bus AVL system functions while meeting all performance requirements. Additionally, each failure of the workstation application software that requires a program restart or reboot shall count as 15 minutes of downtime for that workstation.

6.3.2.2 Data Communications Availability

Sufficient Contractor-provided hardware to execute data communications must be operational for the Bus AVL system to be considered available. For the purposes of the Availability Test, failure to meet this criterion due to failure of CCT-supplied communications circuits or components will not be measured as downtime, and will be considered Holdtime.

6.3.2.3 Vehicle Equipment Availability

For the Bus AVL system to be considered available, 98% of the Bus AVL system-equipped vehicles in the CCT fleet shall have all Contractor-provided vehicle equipment fully operational. A Bus AVL system on-board system shall be considered operational when it can support all required vehicle functions while meeting all performance requirements.

For availability calculation purposes, a vehicle with a failure of Contractor-provided vehicle equipment shall be considered unavailable from the time the failure is noted by the vehicle Operator until the vehicle returns to the garage at the end of that vehicle's service day. An exception to this rule will be allowed in cases where the failure is intermittent and the failing operation is successfully performed in no more than two retries. In these cases, 15 minutes of unavailability shall be counted against each affected vehicle for each service day that the intermittent failure occurs.

6.3.3 Individual Device Availability

In addition to meeting the system hardware availability requirements, each Contractor-supplied device, including but not limited to servers, workstations, network and communications equipment, and vehicle equipment, shall individually exhibit a minimum calculated hardware availability of 99.5%.

For the purposes of the Availability Test, equipment consisting of an assembly of individual components shall be considered a single device (e.g., a server, MDT, router, etc.). Also, during the course of the Availability Test, each device shall experience no more than one hardware failure.

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Section 7

INSPECTION, TEST, AND AVAILABILITY

All materials furnished and all work performed under this Specification shall be inspected and tested. Deliverables shall not be shipped until all required inspections and tests have been completed, all deficiencies have been corrected as required and to the satisfaction of CCT, and the hardware and software have been approved for shipment by CCT.

Should any inspections or tests indicate that specific hardware, software, or documentation does not meet the Specification requirements, the appropriate items shall be replaced, repaired, upgraded, or added by the Contractor, as appropriate, to correct the noted deficiencies at no cost to CCT. After correction of a deficiency, all necessary retests shall be performed to verify the effectiveness of the corrective action.

For all testing specified in the following sections, no adjustments, modifications, or substitutions are to be made by the Contractor to the Bus AVL system software and equipment, except by approval of CCT.

7.1 Inspection

Access to the Contractor's facilities while system manufacturing and testing are taking place, including any facility where hardware or software is being produced for the Bus AVL system, shall be available to CCT representatives at any time.

In conjunction with scheduled project meetings at the Contractor's facilities, CCT representatives shall be allowed to review and verify the functional implementation of all operational Bus AVL system software in an informal, hands-on demonstration of the operation of each software function, even though software debug and integration activities may not have been completed. No special documentation is required to support these informal software demonstrations.

Inspections performed by CCT will include visual examination of hardware, cable dressings, and equipment and cable labeling. Contractor documentation may also be examined to verify that it adequately identifies and describes all hardware and software, and is in accordance with the documentation requirements in Section 9.

CCT shall have the right to inspect the Contractor's hardware and software quality assurance standards, procedures, and records that are applicable to the Bus AVL system. Documents identified in the Contractor's hardware and software quality assurance documentation shall also be available for inspection.

The inspection rights described above shall not apply to subcontractors supplying standard items, such as COTS computer or peripheral equipment and third-party software products. Standard COTS hardware

and software products shall be tested as part of the formal tests and activities specified elsewhere in Section 7. However, inspection rights shall apply to subcontractors that are developing new hardware or software for inclusion in the Bus AVL system.

7.2 Test Plans and Test Procedures

Test plans and test procedures for both factory and field tests shall be provided by the Contractor to ensure that each factory and field test is comprehensive and verifies all functions and devices to be delivered as part of the Bus AVL system. Test plans and test procedures for application software shall place special emphasis on comprehensively testing each function and feature, checking error conditions, and documenting and verifying the validity of all simulation techniques used. The test procedures shall be modular to allow individual test segments to be repeated as needed.

Together, test plans and test procedures shall provide a two-step description of each factory and field test. Test plans shall provide a high-level summary of the methods used for verifying each function and feature of the hardware, software, and firmware to be delivered. Test procedures shall include detailed, step-by-step procedures associated with each test segment. All test plans and test procedures shall be submitted to CCT for approval, subject to the review and approval process defined in Section 9. No factory and field testing shall commence without an approved test plan and the approved test procedures associated with each test.

7.2.1 Test Plans

The test plans for factory and field tests shall be submitted to CCT with sufficient time to allow for review and approval before Contractor submittal of the associated test procedures.

The following information shall be included in the test plans:

- a. Test schedule
- b. Responsibilities of CCT and Contractor personnel
- c. Record-keeping procedures and forms
- d. Procedures for monitoring, correcting, and retesting variances
- e. Procedures for controlling and documenting all changes made to the Bus AVL system after the start of testing
- f. Block diagram(s) of the hardware test configuration, including Contractor-supplied equipment, equipment supplied by CCT (if any), communications equipment, revenue

and non-revenue vehicle equipment, external communication channels, and any test or simulation hardware

- g. A list of individual tests to be performed, the purpose of each test segment, and references to the applicable sections of the Specification
- h. Identification of special hardware, software, tools, and test equipment to be used during the test
- i. Techniques and scenarios to be used to simulate ultimate system sizing, processor utilization, and performance, especially during the peak loading test
- j. Copies of any certified test data (e.g., environmental data) to be used in lieu of testing for certain approved equipment.

7.2.2 Test Procedures

Test procedures that are based upon, and consistent with, the approved test plan shall be submitted to CCT for review and approval. Test procedures shall be submitted only after the test plan has been approved by CCT. Testing shall not commence without approved test procedures. CCT will only approve test procedures if they are comprehensive and thoroughly test each Bus AVL system component, both independently and collectively.

Test procedures shall include the following items:

- a. Function or feature to be tested, with appropriate reference to the Specification section(s) that prescribes the requirement(s) being tested.
- b. Purpose of each test segment
- c. Set-up and conditions for testing
- d. Descriptions of all simulation tools and techniques used during the test
- e. Detailed, step-by-step procedures to be followed
- f. All inputs and expected results for each test segment.

7.3 Test Records

The Contractor shall maintain complete records of all factory and field test results. The records shall be keyed to the steps enumerated in the test procedures. A test report shall be provided by the Contractor upon completion of each test. The test reports shall include the following:

- a. Reference to the appropriate section of the test procedures
- b. Test results for each test segment, including a passed/failed indication and any modifications made to the procedures during the test
- c. Identification of the Contractor's test engineer and of the CCT representatives witnessing the test
- d. Date of the test
- e. Provision for comments by CCT representatives
- f. List of all variances generated and their status
- g. Copies of all variance forms generated
- h. System logs or printouts saved as part of the test.

7.3.1 Variance Forms

A variance form shall be prepared by either Contractor personnel or CCT representatives each time a deviation from Specification requirements, test procedures, or the Contractor's design is detected during any formal or informal Bus AVL system testing. The form shall include a complete description of the variance, including the following:

- a. A sequential identifying number assigned to the variance
- b. The date and time the variance was detected
- c. Variance priority (see below)
- d. Variance status (e.g., open, ready for retesting, closed)
- e. Appropriate references to the test procedures, Specification, or design documentation
- f. A description of the test conditions at the time the variance was detected

- g. Identification of Contractor and CCT witnesses
- h. A sign-off by both Contractor and CCT representatives when the correction of the variance has been verified.

Variance priorities shall be assigned by CCT. Each variance shall be assigned one of the following four priorities, depending on its severity:

- i. Priority 1: Critical – a failure or deficiency that results, or would result, in CCT being unable to use critical functions of the Bus AVL system to an extent that may affect the safety of the public and/or CCT personnel (e.g., a failure resulting in a complete loss of data communications and/or an extended inability to locate vehicles would be considered a Priority 1 variance).
- j. Priority 2: Major – a failure or deficiency of lesser severity than a Priority 1 that does not substantially reduce the capability of the Bus AVL system to accomplish its primary system functions, such as vehicle communications and AVL. Priority 2 variances indicate functional and/or performance deficiencies, but the Bus AVL system is still capable of accomplishing its primary system functions with a satisfactory degree of safety and effectiveness (e.g., deficiencies in performance, such as response times, may be considered Priority 2 variances). Also, Priority 1 variances for which an acceptable workaround has been established may also be reassigned to Priority 2.
- k. Priority 3: Minor – a failure or deficiency of a minor function, minor performance issues, and documentation errors. Priority 2 variances for which an acceptable workaround has been established may also be reassigned to Priority 3.
- l. Priority 4: System Enhancement – requests for functions, features, or devices not presently required or part of the Bus AVL system software or hardware suite.

7.3.2 Variance Tracking and Reporting

The Contractor shall track all variances and document actions taken to correct each variance. Sufficient information shall be provided to enable CCT representatives to determine the need for retesting the function, for testing interaction with any previously tested function, and for updating appropriate documentation as a result of the corrective action. Variance corrections that would result in a change to an approved document must be approved by CCT prior to their implementation by the Contractor.

Each variance shall be addressed by the Contractor and closed when a Contractor and CCT representative acknowledge, by signatures, correction of the variance. Variances shall be available to CCT at all times.

The Contractor shall maintain and periodically distribute (frequency of distribution based on testing activity) a variance summary that lists for each variance, the variance number, a brief description of the variance, date opened, priority, current status, date closed (if closed), and a brief description of the resolution of the variance. The Contractor shall distribute a current variance summary at the completion of each test, just before a new test, and when requested by CCT. The variance summary shall be distributed to CCT in both printed and Microsoft Access- or Excel-compatible electronic formats.

A closed variance shall be removed from the variance summary after the closed status and resolution of the variance has been reported on one version of the variance summary and distributed to CCT.

7.3.3 Disposition of Variances

All Priority 1 and 2 variances detected during factory testing shall be corrected and approved by CCT, and no more than fifteen Priority 3 variances shall remain open, prior to shipment of the Bus AVL system to CCT's facility.

All Priority 1 and 2 variances found during field testing shall be corrected and approved by CCT, and no more than ten Priority 3 variances shall remain open, prior to any portion of the Bus AVL system being phased-over to revenue operation.

Any Priority 1 variances that are detected during phase-over shall require the cessation of any revenue use of the Bus AVL system. CCT may choose to waive these restrictions in specific instances, depending on the nature of the variances.

All Priority 1, 2, and 3 variances shall be corrected before final acceptance of the Bus AVL system by CCT.

7.4 Wide Area Wireless Data Communications Coverage Test

Within one month of Contract Award, the Contractor shall perform a Coverage Test to demonstrate the coverage of the proposed wide area wireless data communications network. The Coverage Test shall be successfully completed and approved by CCT prior to any design and implementation activities for the Bus AVL system. All such activities that occur prior to CCT approval of the Coverage Test shall be at the Contractor's sole risk.

The Coverage Test shall involve a minimum of one test vehicle that shall traverse pre-defined routes covering the full range of the required service area. The chosen routes shall include a wide variety of terrain conditions, such as downtown city areas, areas of heavy foliage, and areas at the fringe of the required service area. The Coverage Test shall fully demonstrate and document to CCT that the proposed system offering will provide wide area wireless network coverage necessary to meet all requirements of this Specification.

Proposers shall include in their proposals a description of how the Coverage Test will be conducted and how test results will be collected and documented in order to fully demonstrate the required capabilities. Details of the test execution shall be determined by mutual agreement of both CCDOT/CCT and the Contractor following Contract Award.

7.5 Factory Acceptance Test

The Contractor shall perform a Factory Acceptance Test that shall demonstrate the required functional, software, and hardware operation of the fully integrated Bus AVL system. The FAT shall consist of a Contractor-performed dry run of the factory tests, which shall include a Functional Performance Test, unstructured testing by CCT, and a System Stability and Availability Test.

The Bus AVL system shall not be shipped to CCT until all factory acceptance tests are completed to the satisfaction of CCT. CCT is under no obligation to accept the Bus AVL system for shipment if any uncorrected functional, hardware, or software problems exist, except as provided for in Section 7.3.3.

The FAT configuration shall include all server, workstation, and network equipment; all communication equipment; one of each type of passenger information sign; and a complete set of on-board vehicle equipment for each type of revenue vehicle, one Supervisor vehicle, and one maintenance vehicle. Each set of vehicle equipment shall include all equipment and interfaces supplied by the Contractor under the Bus AVL system project, including any optional equipment selected by CCT for inclusion under this project. The FAT configuration shall also include all test equipment required to simulate system loading activity, vehicle movements, and data signals to and from devices supplied by others, such as wheelchair lift/ramps, destination signs, and vehicle mechanical alarm signals.

The Contractor-provided data communications equipment shall be used by the Contractor to simulate the data communications between the Bus AVL system fixed-end and vehicle equipment via the wide area wireless data communications provider. Common carrier interconnections between the Bus AVL system communications equipment and the wide area wireless data communications provider may also be simulated. Both individual and group data communications shall be tested.

All equipment that will be supplied by the Contractor, but not exercised as part of the factory test configuration, such as the remaining vehicle equipment, shall be tested using standard manufacturer's testing procedures and criteria. This testing may be conducted at another location, but the manufacturer's test results shall be supplied to and approved by CCT prior to the start of the FAT. CCT representatives shall have the opportunity to witness these tests.

The FAT shall include real-time testing of AVL functions by equipping a Contractor-supplied test vehicle with a set of revenue vehicle equipment and providing appropriate test map and route data to support comprehensive testing of conditions expected to be encountered by the actual vehicles on CCT routes. It

is recognized that local conditions may limit some aspects of this real-time testing. Such limitations shall be reviewed and approved by CCT prior to the start of the FAT.

As an alternative to the real-time AVL testing defined in the previous paragraph, a comprehensive simulation test of AVL functions shall be performed using the actual CCT service area base maps, including all route and map overlays. The simulation testing shall include playback of previously recorded AVL data associated with a minimum of two vehicles simultaneously traversing a set of actual routes. The previously recorded AVL test data shall include all patterns that a vehicle could expect to encounter to comprehensively test the Bus AVL system's AVL and RSA functions. CCT requires that the simulation test of AVL and RSA functions exercise vehicle subsystems in addition to the fixed-end components by simulating the GPS data feed to the vehicle subsystems that are being staged at the FAT.

Communications facilities for supporting communications between the Bus AVL system at the Contractor's factory and CCT local systems, if needed by the Contractor for implementation and testing, shall be supplied by the Contractor. Testing of data exchanges shall be conducted as part of the factory testing. Tests of data exchanges that are not required in real time (e.g., a new service schedule) may be conducted using suitable storage media for transport of the test data.

The following conditions shall be satisfied prior to the start of the FAT:

- a. Final design review completion and subsequent CCT approval of the Contractor's design.
- b. All applicable hardware and software engineering design changes shall be incorporated into the Bus AVL system.
- c. Bus AVL system documentation, including drawings, list of deliverables, software functional description document, factory test plans and test procedures, and all user manuals shall have been reviewed and approved by CCT.
- d. All action items related to approval documents, system performance, and test simulation techniques shall be resolved.

All test hardware, software, and special test and calibration equipment required to demonstrate the acceptable operation of the Bus AVL system shall be provided by the Contractor, including data communications with the vehicles, and the simulation of processor loading based on the ultimate system size and conditions defined in Appendix F. The Contractor shall not substitute any equipment and software during the entire factory test period without prior CCT authorization.

The FAT shall be considered successfully completed only when all tests have been performed, all variances have been resolved to the satisfaction of CCT, all required variances have been resolved, all test records have been issued to CCT, and CCT acknowledges, in writing, successful completion of the FAT.

7.5.1 Dry-Run Testing

Prior to the start of the Functional Performance Test, the Contractor shall conduct a complete and formal dry run of the entire Functional Performance Test and System Stability and Availability Test to verify that the Bus AVL system is ready to be tested by CCT. The Contractor shall follow the approved test plan and procedures, and record and correct all variances found during the dry run testing, including test procedure errors. Written certification that the dry run has been successfully completed and a report identifying the variances found and resolutions implemented shall be provided to CCT by the Contractor at least two weeks prior to the start of the Functional Performance Test. At the option of CCT, one or more CCT representatives may witness and participate in all, or portions of, the dry run testing.

7.5.2 Functional Performance Test

The Functional Performance Test shall completely verify that all the specified and Contractor-proposed features and functions of the Bus AVL system hardware, software, and firmware have been properly designed and implemented. CCT representatives will witness all tests and may perform hands-on actions of the test procedures, at CCT discretion. If CCT elects to perform hands-on actions of the test procedures, knowledgeable Contractor representatives shall be present at all times to assist the CCT representatives with the testing.

The following items, as a minimum, shall be included in the Functional Performance Test:

- a. Inspection of all equipment for conformance to drawings, specifications, and applicable standards, and for satisfactory appearance
- b. Testing of the proper functioning of all hardware by thoroughly exercising all devices, both individually and collectively
- c. Testing of the proper functioning of all software and firmware features and functions, including test cases with normal and exception data
- d. Testing of the proper functioning of all data communication features and facilities
- e. Testing of all revenue and non-revenue vehicle functions, using actual equipment items supplied as part of the Bus AVL system
- f. Input and output signals from devices supplied by others or already installed on the vehicles shall be simulated if CCT cannot provide actual devices for testing.
- g. Testing of AVL functions using a mobile test vehicle, or simulated vehicles, using the appropriate test map, schedule data, and geographic information for the routes that will be traversed

- h. Testing of all vehicle functions
- i. Testing of all bulk data transfer functions
- j. Testing of all passenger information sign functions and equipment
- k. Verification of all data transfers and interfaces with external systems, including CCT's GIS and RouteMatch systems
- l. Testing of all UI functions
- m. Simulation of hardware failures and failover of each Bus AVL system server and device that has a backup unit
- n. Simulation of data communications failure, including the subsequent transition to fallback mode of operation and the transition back to normal operation mode when data communications has been restored
- o. Verification that spare capacity and ultimate sizing requirements have been met, including all expansion requirements
- p. Verification of the accuracy of the system performance monitoring software
- q. Verification that the processor loading and system response time requirements have been met while performing functions as specified in Appendix F
- r. Verification of device and system recovery from AC power failures
- s. Verification of the accuracy of hardware and software documentation via random checks
- t. Testing of the display generator/editor, report generator/editor, and software and database maintenance functions
- u. Verification of all reports provided with the system, including ad hoc reports.

If CCT representatives believe the quantity and/or severity of the Bus AVL system variances warrant a restart of the Functional Performance Test, the test shall be halted, remedial work shall be performed by the Contractor, and the complete test shall be rerun at a time agreed upon between the Contractor and CCT.

7.5.3 Unstructured Testing

Periods of unstructured testing shall be permitted to allow CCT representatives to verify proper operation of the Bus AVL system under conditions not specifically included in the approved test procedures. Unstructured testing shall be conducted in compliance with the following conditions:

- a. A minimum of 25% of the time allotted testing shall be reserved for unstructured exercising of the Bus AVL system by one or more CCT representatives. Unstructured testing shall be allowed, at CCT's discretion, at the end of each structured test segment and at the end of the Functional Performance Test.
- b. The Contractor's test representative(s) shall be present and other Contractor's technical staff shall be available for consultation with CCT representatives during unstructured test periods.
- c. All simulation software and hardware, test cases, and other test facilities used during the structured portions of the FAT shall be made available for CCT use during unstructured testing.

7.5.4 System Stability Test

The stability of the Bus AVL system hardware and software shall be tested after the successful completion of the Functional Performance Test. All Bus AVL system functions shall run concurrently and all Contractor-supplied equipment shall operate for a continuous 48-hour period. All Priority 1 and 2 variances that have been detected must be corrected prior to the start of this test.

The System Stability Test shall assure CCT that the Bus AVL system is free of problems caused by interactions between software and hardware while the Bus AVL system is operating as an integrated whole. CCT will not accept the Bus AVL system for shipment if any unexplained restarts or failovers have occurred. The test will be extended by 24-hour increments until these requirements are satisfied.

The test procedures shall allow for both structured and unstructured testing under normal conditions according to procedures based in the approved Contractor documentation.

7.6 Field Tests

The Contractor shall perform field testing that shall demonstrate the required functional, software, and hardware operation of the fully integrated Bus AVL system under actual field conditions at CCT's facilities and on CCT's revenue and non-revenue vehicles. The field testing shall consist of a Field Installation Test and a Field Performance Test, and shall include unstructured testing by CCT in the same form and manner as with the FAT.

Before field testing begins, the capability of CCT to purchase maintenance contracts for all equipment shall be confirmed by the Contractor and certified to CCT. If any updates or maintenance is necessary for CCT to procure maintenance contracts, the Contractor shall immediately perform the necessary work.

7.6.1 Field Installation Test

The Field Installation Test shall be conducted after the Bus AVL system has been installed at all CCT sites and all of the Bus AVL system vehicle equipment is installed on the Mini-Fleet Test (Section 7.8) vehicles. All variances shall be corrected prior to the start of the test.

The purpose of the Field Installation Test is to ensure that the Bus AVL system, as installed in the field, works properly as a fully integrated and installed system. This testing shall include, but not be limited to, the verification of proper network (LAN and WAN) connectivity, hardware startup and operation, software startup and operation, interface connectivity between the Bus AVL system and other external CCT systems, interface connectivity between the Bus AVL system and the wide area wireless data communications provider, and other communication path connectivity.

The Contractor shall be responsible for conducting the Field Installation Test. CCT representatives will, at CCT's discretion, witness all or part of the installation testing.

7.6.2 Field Performance Test

Following the successful completion of the Field Installation Test and correction of all variances generated during the Field Installation Test, and CCT's acceptance of the mini-fleet test vehicle installations, a comprehensive test of the Bus AVL system shall be conducted with the mini-fleet test vehicles.

The purpose of the Field Performance Test is to ensure that the Bus AVL system functions properly as a fully installed and integrated system. This testing shall encompass the full range of Bus AVL system functionality; however, it shall concentrate on areas of Bus AVL system operation that were simulated or only partially tested in the factory, as well as on areas where variances were generated. Testing of other areas shall be repeated as necessary to ensure the proper functioning of the complete Bus AVL system.

The Contractor shall be responsible for conducting the Field Performance Test, including documenting and correcting any variances. CCT representatives will witness all tests and may perform the hands-on actions of some or all test procedures, and perform unstructured testing. Contractor representatives shall be present at all times to assist CCT representatives with such testing.

7.7 Mini-Fleet Test

A comprehensive Mini-Fleet Test (MFT) shall be conducted following the successful completion of the Field Performance Test and the correction of all variances. The MFT shall be conducted using one representative vehicle of each revenue vehicle type, one maintenance vehicle, and one Supervisor vehicle from the CCT fleet. The MFT vehicles shall be equipped with all of the vehicle equipment to be installed on each vehicle type, including all of the CCT-selected optional equipment.

The MFT vehicles shall all be simultaneously operated in actual and simulated revenue service to fully test service schedule and RSA, AVL, text messaging, emergency alarm processing, and the other Bus AVL system equipment and functions under actual service conditions. The MFT vehicles shall be operated on a subset of the service routes selected by CCT. These selected routes shall encompass the entire service area and allow testing under all of the operational and functional conditions expected to be encountered throughout the service day for each of CCT's service types.

The Contractor shall provide on-site support during the MFT to assist in testing, to help identify and document variances, and to correct any variances. The duration of the MFT will depend on the number of problems encountered and the need for additional testing. At a minimum, the MFT shall take place over a period of two weeks. The MFT shall continue until CCT is satisfied that the Bus AVL system is operating properly.

7.8 Phase-Over to Revenue Operations

Following successful completion of the MFT and correction of all variances, the Contractor shall begin the Bus AVL system vehicle equipment installation and gradual phase-over of the remainder of the fleet into revenue service, in accordance with the approved installation and phase-over plan. During the phase-over to revenue operations, CCT will monitor the performance of the Bus AVL system and notify the Contractor of any failure or degradation of the system and its components. Likewise, the Contractor shall notify CCT of any failure or degradation of the system discovered by the Contractor's representatives. Such failures or degradation shall be promptly corrected by the Contractor at no cost to CCT.

No adjustments, modifications, or substitutions are to be made by the Contractor to the Bus AVL system equipment and software during the phase-over to revenue operations, except by approval of CCT.

7.9 Availability Test

Following the phase-over of Bus AVL system-equipped vehicles to revenue operation, a 720-hour (30-day) test shall be conducted to verify the ability of the Bus AVL system to meet its availability requirements. Prior to the start of the test, all variances shall be corrected and all hardware and software documentation shall have been received and approved by CCT.

During this test, no adjustments, modifications, or substitutions shall be made to the Bus AVL system by the Contractor, except by approval of CCT.

7.9.1 Availability Requirements

The total Bus AVL system availability requirements specified in Section 6 shall be exhibited by the Bus AVL system in accordance with the specified availability criteria. Individual device availability shall also be measured over the Availability Test Period in accordance with the availability criteria, also specified in Section 6.

7.9.2 Test Responsibilities

CCT will be responsible for conducting the Availability Test. The test shall consist of normal Bus AVL system revenue operations without special test equipment or procedures. CCT will operate and maintain the Bus AVL system according to procedures in the approved Contractor documentation. Variance forms and test records defined in the Test Plan will be generated and maintained by CCT personnel, and submitted to the Contractor for subsequent correction. Corrected variances shall be promptly reported to CCT for verification and, if verified, closing of the variance forms.

The Contractor shall provide Bus AVL system maintenance on an on-call basis, as needed, via either consultation or on-site assistance. When on-site maintenance support is needed, qualified Contractor personnel shall arrive at the site within the time specified in Section 8.

7.9.3 Test Definitions

The following definitions of downtime and Holdtime shall apply to the Availability Test.

7.9.3.1 Downtime

Downtime occurs whenever the criteria for successful operation defined in Section 6 are not satisfied. Downtime shall be measured from the start of diagnostic procedures until full service is restored. In the event of multiple failures, the total elapsed time for repair of all problems shall be counted as downtime.

7.9.3.2 Holdtime

During a test of this nature, certain contingencies may occur that are beyond the control of the Contractor and of CCT. These contingencies may prevent successful operation of the Bus AVL system but, at the same time, are not considered to be downtime for the purpose of measuring Bus AVL system availability. Such periods of unsuccessful operation may be declared "Holdtime" by mutual agreement of CCT and the Contractor. These periods will not be considered in availability statistics for availability calculation purposes. Specific instances of Holdtime contingencies are as follows:

- a. **Scheduled Shutdown:** During scheduled shutdowns, or if an equipment failure occurs while its backup device is scheduled out-of-service, the resulting system outage shall be considered Holdtime, provided that service can be restored according to Contractor-specified procedures within 30 minutes.
- b. **Power Interruption and Environmental Excursion:** Loss of commercial power, or manual shutdown in the event of loss of environmental control, shall be considered Holdtime, provided the Bus AVL system is operated during periods of power or environmental conditions beyond those specified.
- c. **Service Response Time:** Holdtime will be allowed for the Contractor to respond to each call for maintenance support. This Holdtime will be limited to no more than the service response time specified in Section 8. The time between detection of a failure and the start of diagnostic procedures shall also be considered Holdtime when performed by CCT personnel.
- d. **Corrected Design Defect:** Holdtime may be declared by mutual agreement to ensure against similar future occurrences if a failure occurs due to a defect in the Bus AVL system design and the Contractor defines corrective measures. Holdtime may be declared while the Contractor is implementing and testing the corrective measures.

7.9.4 Test Satisfaction

After 720 hours of cumulative test time, test records shall be examined to determine conformance with availability criteria. If test objectives have not been met, the test shall continue until the specified availability is achieved, based on one of the following time periods:

- a. Total elapsed test time – required availability is achieved over an extended test period that exceeds 720 hours (the test window is extended)
- b. Consecutive 720-hour period of test time, exclusive of Holdtime – required availability is achieved over a 720-hour period different from the initial test period (the test window is moved).

In order to establish that all failures have been satisfactorily repaired prior to the end of the Availability Test, no downtime or any un-commanded restart or failover shall have occurred within 240 hours of the test's conclusion and no more than one un-commanded restart or failover shall have occurred during the entire 720-hour test period. The test shall be extended, if necessary, to satisfy this requirement.

After the 720-hour Availability Test period has been reached, the availability of each Bus AVL system device shall be evaluated and measured against the device availability criteria defined in Section 6. If one

or more Bus AVL system devices do not meet the defined criteria, or if any device failed more than one time during the Availability Test, CCT approval of the Availability Test shall be delayed until CCT representatives and the Contractor mutually agree that corrective action has been completed for those devices. Corrective action shall include performing all necessary procedures to test and verify proper operation to CCT satisfaction.

Section 8

TRAINING, SUPPORT SERVICES, AND MAINTENANCE

Requirements for Contractor-supplied training of CCT personnel, for Contractor-supplied support services, and for maintenance of the Bus AVL system are described in this section.

8.1 Training

The Contractor shall provide a comprehensive training program that prepares CCT personnel for operation, administration, and troubleshooting of the Bus AVL system. Training may be conducted by, and all training requirements shall apply to, the Contractor, the Contractor's subcontractors, third-party software suppliers, and original equipment manufacturers (OEMs). The Contractor shall provide to CCT all training credits supplied to the Contractor by the subcontractors, third parties, and OEMs and shall provide a list of subcontractor, third-party, and OEM training courses for which these credits can be used.

For the Preliminary Design Review (Section 9.5.2.1), the Contractor shall provide a list of training courses including the title of each course, a list of topics covered, duration, prerequisites, and training site.

The proposal shall identify the cost of each course and the duration of each course in hours.

8.1.1 Hardware Basic Maintenance Training

Bus AVL system hardware basic maintenance training courses shall be provided for all Contractor-provided Bus AVL system equipment. The hardware basic maintenance training shall provide CCT personnel with a working knowledge of the Bus AVL system hardware including its control, operation, interfaces with other CCT computer systems and devices, interfaces with data communications hardware, and the operation of diagnostic tools. The courses shall provide CCT support personnel with an overall knowledge of the installation, preventive maintenance, troubleshooting, repair, and expansion procedures. The courses shall provide sufficient understanding in the above topics so that trained CCT personnel may perform basic maintenance tasks and assist maintenance contractors with more detailed troubleshooting, as well as oversee the work performed by maintenance contractors.

8.1.2 Vehicle Equipment Advanced Maintenance Training (Option)

As an option, advanced vehicle equipment maintenance courses shall be provided that enable qualified CCT maintenance personnel to troubleshoot, replace, and configure Bus AVL system vehicle equipment at the replaceable module level. Removed equipment would be returned to the maintenance contractor for component level repair. Equipment covered by the courses shall include the vehicle MDT (VCH and IVCU), the Contractor-provided data communications equipment, vehicle wiring, and other associated equipment and sub-systems that are installed by the Contractor on the vehicles. The vehicle training

course shall include theory of operation, vehicle configuration, vehicle wiring and interfaces, diagnostics, and special procedures that must be observed, such as device/module replacement procedures and disconnection of power or fuses when other vehicle maintenance could affect the Bus AVL system vehicle hardware.

8.1.3 System Administration Training

The system administration training course shall provide training on the procedures necessary to configure, operate, and maintain the Bus AVL system in an efficient, controlled, well-documented manner. This training course shall include, but not be limited to, the following:

- a. The structure, interfaces, and functions of the Bus AVL system software and databases
- b. The configuration settings and maintenance of operating systems, third party software, and network devices using the operating system(s) and network administration facilities
- c. System backup and restoration procedures, including disaster recovery procedures
- d. Configuration and maintenance of all fixed-end hardware (e.g., servers, workstations, mass storage devices, etc.)
- e. Managing system security and user access
- f. Generating, deleting, modifying, and installing reports in the real-time environment, including the use of ad hoc queries
- g. Linkages to the database and application software shall be described. Generation and modification of typical reports shall be included in this course.
- h. Generating, deleting, modifying, and installing displays in the real-time environment
- i. Linkages to the database and application software shall be described. Generation and modification of typical displays shall be included in this course.
- j. Installing software updates provided by the Contractor and third-party software suppliers
- k. Using the software configuration management and administration tools
- l. Failing over to backup servers and devices, and restoration procedures
- m. Interpreting and responding to error and warning messages generated by system and device monitoring software

- n. Maintaining and tuning the databases using database management tools
- o. Data import and updating of fixed-route schedules and other data imported into the Bus AVL system
- p. Updating the AVL map database including base maps, routes, bus stops, etc.; and distributing these map updates to all map-equipped workstations
- q. Modifying application program configuration parameters
- r. Configuring and modifying the data set sent/received over links to external systems
- s. Performing maintenance of route, schedule, vehicle, bus stop, timepoint, and vehicle Operator data within the Bus AVL system
- t. Performing updates to the destination signs, including recommended guidelines for properly defining destination sign codes.
- u. System troubleshooting procedures
- v. Management of the passenger information signs
- w. Management, definition, and maintenance of data and text messages
- x. The steps necessary to create new messages, define the triggering conditions for each message, and to add, delete, modify, and download the messages to the vehicles shall be explained.

The System Administration course also shall include overview level training on the structure, organization, and functionality of the system software, application software, and database to allow CCT administrative and system administrator personnel to effectively support maintenance contracts for this software.

8.1.4 Dispatcher Training

The Contractor shall separately train CCT fixed-route and paratransit Dispatchers in the functional capabilities of the Bus AVL system and in the operation of the Bus AVL system workstations. Each course shall provide a thorough understanding of the UI and operation of all Bus AVL system functions, and shall familiarize the Dispatchers with general Bus AVL system design concepts and features. It shall include hands-on training using the actual hardware and software being delivered to CCT. Training aids for this course shall include the appropriate Dispatcher Manual.

8.1.5 Revenue Vehicle Operator Instructor Training

The Contractor shall train selected CCT personnel to be qualified instructors in the operation of the Bus AVL system fixed-route and paratransit revenue vehicle equipment supplied by the Contractor. This course shall provide a thorough and clear presentation of the UI of the vehicle equipment and shall include hands-on training using the actual vehicle hardware and software being delivered to CCT. This course shall also instruct CCT instructor personnel on the setup, operation, and configuring of the vehicle Operator training hardware and any simulation hardware and software provided for vehicle Operator training. Training aids for the course shall also include the appropriate Bus Operator Manual.

8.1.6 Non-Revenue Vehicle Operator Training

The Contractor shall train CCT non-revenue vehicle Operators in the operation of the non-revenue vehicle equipment supplied by the Contractor. This course shall provide a thorough and clear presentation of the UI of the vehicle equipment and shall include hands-on training using the actual vehicle hardware and software being delivered to CCT. Training aids for the course shall also include the non-revenue vehicle Operator Manual.

8.1.7 Management Training

The Contractor shall provide a high-level, half-day course for CCT management personnel. The course shall provide an overview of the Bus AVL system configuration, functions, UI and reports. The project schedule shall be presented, including a discussion of tasks that will be CCT's responsibility and the Contractor's advice/experience for best accomplishing these tasks. The course shall include a discussion of the types of data the Bus AVL system will acquire and store and the general accessibility of that data to CCT personnel.

8.1.8 Supplemental Training

The Contractor shall provide extended, duplicate, and additional training for the Bus AVL system as deemed necessary by CCT because of the following occurrences:

- a. Major modifications to Bus AVL system hardware and/or software that is implemented by the Contractor after completion of the scheduled training courses and that impacts the content of those courses
- b. Delays in placing the Bus AVL system into revenue service for which the Contractor is responsible and which result in more than two months elapsing between completion of one or more training courses and the placing of the Bus AVL system into revenue service.

Supplemental training shall be supplied at no cost to CCT. CCT will determine the time, location, and extent of any supplemental training in consultation with the Contractor.

8.1.9 Training Course Requirements

The following sections describe general requirements that apply to all training courses.

8.1.9.1 Class Size

The Contractor shall provide training for the following number of CCT personnel:

Section	Course Title	Number of CCT Participants	Number of Classes
8.1.1	Hardware Support	3	1
8.1.2	Vehicle Equipment Advanced Maintenance (Option)	3	1
8.1.3	System Administration ⁴	4	1
8.1.4	Fixed-route Dispatcher	6	2
8.1.4	Paratransit Dispatcher	4	2
8.1.5	Fixed-route Revenue Vehicle Operator Instructor	8	2
8.1.5	Paratransit Revenue Vehicle Operator Instructor	6	2
8.1.6	Non-Revenue Vehicle Operator	8	2
8.1.7	Management Training	4	1

8.1.9.2 Training Schedule

The Contractor shall conduct training in a timely manner that is appropriate to the overall Bus AVL system schedule. One session of the System Administrator, Fixed-route Dispatcher, and Paratransit Dispatcher training courses shall be conducted prior to the start of the Functional Performance Test so that these trained personnel may more effectively participate in the Bus AVL system FAT. The System Administrator and Dispatcher training courses shall be repeated, as necessary, so that the CCT-selected personnel receive training within 1 month prior to the start of the FAT. Fixed-route and paratransit

⁴ CCT anticipates other non-Administrator users attending report generation and audio/visual portions of the System Administrator training. The Contractor shall coordinate the scheduling of these portions with CCT such that these personnel need not attend the entire System Administrator course. As an alternative, the Contractor may provide separate training courses for these areas and personnel.

Revenue Vehicle Operator Instructor training shall be completed no later than 1 month prior to the start of the Field Performance Test. All other training shall be completed prior to the phase-over to revenue operations defined in Section 7. The Contractor shall finalize the training schedule in consultation with CCT after Contract Award.

8.1.9.3 Training Location and Classrooms

All training shall be conducted at CCT's facilities. CCT will provide classroom facilities for all training conducted at their facilities.

8.1.9.4 Instructors

The principal instructors provided by the Contractor, subcontractors, third-party software suppliers, and OEMs shall have had previous formal classroom instructor training and relevant experience with the Bus AVL system hardware and software. The instructors shall also demonstrate a thorough knowledge of the material covered in the courses and familiarity with the training documentation, tools, and training aids used in the courses.

When prerecorded lectures are part of a training course, the lecturer or a qualified substitute shall supplement the recorded material. All CCT-specific material shall be presented in person by a qualified instructor.

8.1.9.5 Training Documentation and Equipment

The Contractor shall provide training documentation and detailed agendas, including the training instructor for each training course, to CCT for review prior to the start of classroom instruction. CCT prefers that training materials specifically prepared for use as training aids be used as the primary training document; but system documentation such as reference manuals, maintenance manuals, and user manuals may also be used. Materials used for training shall be tailored to reflect all CCT hardware, software, terminology, and user requirements. If system documentation is used for training, the quantities of documentation provided for training shall be in addition to the quantities otherwise required in Section 9.

Upon completion of each course, instructor's manuals, training documentation, and training aids shall become the property of CCT. As part of the delivered system documentation and the final documentation, the Contractor shall supply CCT with all changes and revisions to the training documentation. CCT reserves the right to copy all training documentation and aids for use in CCT-conducted training courses.

The Contractor shall furnish for use during training courses all special tools, equipment, training aids, and any other materials required to train course participants. The number of special tools and other training equipment shall be adequate for the number of participants attending the course.

8.1.9.6 Video-Based and Computer-Based Training

The Contractor may use standard prerecorded lectures and workbooks and/or computer-based interactive courses as training material, subject to prior approval by CCT. All such courses shall be supported by the availability of qualified personnel to answer questions and provide in-depth discussion of difficult topics. The Contractor shall provide CCT with copies of all such training course material for retention and playback by CCT as reference documentation and training aids.

CCT reserves the right to videotape all training courses using its own recording equipment.

8.2 Support Services

Throughout the design, implementation, testing, and field installation phases of the Bus AVL system project, the Contractor shall supply engineering data and services, as required by CCT, regarding the necessary site preparations, communication facilities, field installation of equipment, and solutions to technical problems related to the Bus AVL system. These support services shall apply to Bus AVL system hardware, software, and operational needs.

8.2.1 Installation and Cutover Plan

During the design phase of the Bus AVL system, the Contractor shall meet with CCT personnel to discuss and develop the steps, procedures, and schedule for system installation and cutover. Based on the results of these discussions, the Contractor shall prepare a Bus AVL system Installation and Cutover Plan. The Installation and Cutover Plan shall be submitted to CCT sufficiently in advance for two review cycles and approval before shipment of the Bus AVL system to CCT.

The Installation and Cutover Plan shall describe a smooth and secure transition between the existing CAD/AVL equipment and the Bus AVL system, with no loss of control over dispatching operations. The Installation and Cutover Plan shall allow for parallel operation of current operations and operations using the Bus AVL system. The Contractor shall be responsible for implementing all software and hardware required to support system cutover.

The Installation and Cutover Plan shall describe in detail the design and procedures used to support the parallel operation, to test and verify the functionality of the Bus AVL system, and to transition between current operations and use of the Bus AVL system. The initial Bus AVL system installation, Field Installation Test, Field Performance Test, Mini-Fleet Test, and vehicle installations to be performed during the installation and cutover period shall be described in this plan.

The Installation and Cutover Plan shall provide detailed information concerning site preparation and equipment installation and shall be based on a clear understanding of CCT's existing communications equipment, computer system equipment, buildings and building facilities, building renovation plans,

operational requirements, Bus AVL system equipment, and schedule requirements. It shall be the responsibility of the Contractor to conduct any site visits that may be necessary to ensure a complete understanding of CCT facilities, existing equipment, and systems.

The Installation and Cutover Plan shall include detailed vehicle installation plans that define how the vehicle installation work will be performed, the sequence in which vehicle installation work will be performed, the schedule for installing equipment on the vehicles, installation forms and checklists, and the support and facilities expected from CCT.

8.2.2 System Setup

The Contractor shall be responsible for initially setting up the Bus AVL system and for entering and loading all required data into the system, which shall include, but not limited to, the following:

- a. Defining the hardware and software configuration
- b. Defining the user accounts and user functional partitions
- c. Defining all data required for the system databases
- d. Defining the routing of event queue entries
- e. Defining the pre-defined text messages
- f. Defining all CCT schedules in the Bus AVL system from the CCT schedule data
- g. Setting the initial values for all System Administrator- and user-adjustable parameters
- h. Setting the initial schedule and route deviation reporting thresholds
- i. Entering all communications parameters
- j. Configuring all network devices for the required security and accessibility
- k. Loading the AVL map, including all overlays and CCT GIS information
- l. Loading all information for Dispatcher reference information displays
- m. Programming for the control of destination signs
- n. Configuration of passenger information signs (Option).

8.2.3 System Preparation, Packing, and Shipment

The Contractor shall prepare, pack, and ship the Bus AVL system equipment in a manner that is consistent with OEM recommendations, and shall do nothing that invalidates any manufacturer's warranty or prevents the purchase or continuation of a commercially-available maintenance contract.

8.2.3.1 Preparation for Shipment

The Bus AVL system shall be prepared for shipment to avoid damage in transit and to facilitate installation. The equipment shall also be refurbished, as necessary, prior to shipment. All external surfaces shall be thoroughly cleaned, and all paint chips, broken parts, and other signs of use shall be repaired. The Bus AVL system equipment shall be shipped in an "as-new" condition.

8.2.3.2 Packing

All material and equipment shall be packed, crated, or otherwise suitably protected to withstand shipment to its destination. Equipment shall be shipped assembled and completely wired wherever possible.

Site accessibility and the size and nature of available doors, bays, and hallways needed for access to CCT control rooms, equipment rooms, offices, and any other locations where Bus AVL system equipment is to be installed shall be inspected by the Contractor. The Bus AVL system shall be shipped in modules that can be moved into place without requiring structural alteration of any CCT facility.

Each package, crate, and part shall be clearly marked with the name of the consignee, shipping destination, contract number and other such markings as appropriate. Complete packing lists shall be supplied showing the contents and identity of each package. One copy of the list shall be securely attached to the outside of each shipping unit.

8.2.3.3 Shipment

The components of the Bus AVL system shall be shipped, FOB destination, to the following address:

Cobb Community Transit
463 Commerce Park Drive, Suite 110
Marietta, GA 30060

The Contractor shall notify the CCT Project Manager two weeks prior to any shipment, and again 48 hours prior to arrival of equipment. The equipment shall be delivered Monday through Friday between 9:00 AM and 3:00 PM local time.

The Contractor shall be responsible for unloading the equipment, moving the equipment to its installation site, unpacking and uncrating the equipment, and verifying that no equipment was damaged during shipment.

Insurance on all deliverables shall be obtained and maintained by the Contractor during shipment and unloading at CCT.

8.2.4 Installation

The Contractor shall install all Contractor-provided equipment and the wiring required to properly connect all equipment to other new or existing equipment, and to power sources.

The logistics of the installation activities will be resolved between CCT and the Contractor in the course of developing the Installation and Phase-Over Plan.

8.2.4.1 Fixed-End Equipment Installation

The Contractor shall install all Contractor-provided fixed-end equipment at CCT's facilities, along with the wiring, antennas, mountings, connectors, and all hardware required to connect each device to other Contractor-provided equipment, existing equipment, and the power supplies.

The specific Contractor equipment includes, but is not limited to:

- a. CCT Server room – Rack-mounted application, database, and communications servers and associated peripherals, System Administrator console, network devices, and differential GPS receiver
- b. Bus AVL system workstation locations –Bus AVL system User workstation locations, as specified in Appendix C
- c. Bus Garage and Shop – Wireless bulk data transfer equipment and associated antennas, mounting hardware, and network equipment
- d. Passenger information Sign Locations (Option) – Passenger information signs and all associated communications equipment at the specified Transit Center locations. The Contractor shall be responsible for supply and installation required cabling, including power and communications cables.

8.2.4.2 Vehicle Equipment Installations

The Contractor shall install all Contractor-provided vehicle equipment on CCT revenue and non-revenue vehicles along with the wiring and connectors required to connect each device to other Contractor-

provided equipment, existing vehicle equipment, and the vehicle power supplies. The types and quantities of vehicles currently in the CCT fleet that will be equipped with Contractor-provided equipment are listed in Appendix E.

The final installation details for each type of vehicle will be determined after contract award, once the physical dimensions, mounting requirements, and other details of the Contractor-provided equipment are known. As a part of the Installation and Cutover Plan, the Contractor shall provide vehicle equipment installation procedures and checkout forms for each type of vehicle. Checkout forms for each vehicle shall be completed by the Contractor before and after installation of the Bus AVL system equipment to verify the condition of the vehicle and proper installation of the vehicle equipment. CCT personnel will work jointly with Contractor personnel to ensure that the vehicle installations are acceptable to CCT.

In order to allow for a smooth cutover from the existing vehicle equipment to the Bus AVL system, some or all of the Contractor-provided vehicle equipment and wiring may have to be installed on the CCT vehicles prior to the removal of the existing vehicle equipment and wiring. It may also be necessary to either temporarily or permanently move existing vehicle equipment and devices in order to properly install the Contractor-provided equipment and wiring. Any such parallel installations, relocations of equipment, and the eventual removal of the existing equipment that is being replaced shall be the responsibility of the Contractor.

The Contractor shall perform the vehicle installation work during nights and weekends, when vehicle availability will be the greatest. Specific vehicle installation requirements are as follows:

- a. All installations shall be completed in the same manner within a type of vehicle.
- b. Installation of vehicle equipment shall minimize the exposure to and possibility of damage due to abuse, vandalism, and theft. Theft-resistant fasteners and mountings shall be used. Cables shall be run in hidden and protected spaces to the degree possible.
- c. If new mounting trays are necessary, they shall be fabricated to use the same mounting holes as the existing trays, or otherwise attached so as to obviate the need to drill new holes.
- d. CCT reserves the right to require replacement of any Contractor and subcontractor installation personnel due to poor workmanship, excessive time spent in installation, and for unacceptable work.
- e. A qualified Contractor's engineer shall be present on site at CCT during the entire period of vehicle equipment installations to coordinate installation activities and needed resources with CCT and supervise the installation work. The Contractor's engineer shall

also coordinate with CCT management so as to be aware of the local safety plan and OSHA and CCT safety rules.

- f. The Contractor shall be responsible for providing and installing the interfaces between the Contractor-provided equipment and the following existing equipment:
 - 1. Passenger lift/paratransit indications
 - 2. Destination signs
 - 3. DRI-600 audio/visual announcement system (Option)
 - 4. Vehicle monitoring system (e.g., ECM)
 - 5. Mechanical alarm points
 - 6. Odometers
 - 7. Door sensors.

- g. To facilitate the installation of vehicle equipment, CCT will provide the following:
 - 1. Supervisory personnel to help the Contractor coordinate vehicle transfers and other logistics
 - 2. Delivery of all vehicles to the garages
 - 3. Limited, secure space at the garage locations for storing tools, parts and other equipment needed by the Contractor
 - 4. Work area for the Contractor's use at the garages (a minimum of two garage bays and additional space will be available).

8.2.4.3 General Installation Standards

- a. The workmanship and appearance of work throughout the Bus AVL system shall be of the best commercial quality and adhere to all applicable standards and codes. Work shall adhere to the highest standards of safety for personnel and property. Work shall be performed only by qualified personnel, and shall be supervised on-site at CCT by technically competent, trained, and experienced Contractor supervisory personnel. Installation shall comply with all Universal Building Code (UBC) and State seismic requirements for the Marietta area.

- b. Installation work shall exactly follow equipment manufacturers' instructions for grounding and all other installation details.
- c. All equipment racks shall be securely attached to the floor and/or wall. If applicable, the first rack in each row shall be securely anchored to the wall, and additional racks shall be bolted to the adjacent rack at the top of the rack. Racks and cabinets shall be shimmed to plumb alignment.
- d. The Contractor shall supply all necessary installation materials, such as fasteners, cable ties, bushings, and brackets.
- e. All equipment and components shall be easily accessible for adjustment and service.
- f. Equipment rack spacing shall allow not less than 3 feet clear working space. All equipment shall have full access front and rear, except that equipment mounted on swing-out racks is permissible.
- g. The Contractor shall be responsible for any damages caused by its negligence during installation, acceptance testing, and the Contractor's maintenance period.
- h. Cabling and equipment exposed to the weather shall be adequately protected from wind, rain, and dust. Seals, gaskets, packing, sheathing, finishes, mountings, and all other exposed items shall be designed for maintenance-free performance under long-term exposure to weather, including ultra-violet radiation.
- i. Equipment and cabling installed inside buses shall be adequately protected from water and dust, which are present during both normal operations and bus cleaning operations.
- j. Controls, adjustment points, displays, connectors, terminal strips, and circuit boards shall be labeled to indicate the function.
- k. Legends on control panels and other equipment shall be permanent and easily legible, resistant to fading or peeling, and capable of withstanding repeated cleaning without degradation or loss of legibility.
- l. Legends shall be applied to equipment by silk-screening, etching, engraving, or other approved method. Stencil transfer letters, hand-applied letters, or embossed plastic strips are not permitted.
- m. One original key and two copies shall be provided for each type of lock supplied. Each set of keys shall be assembled on a heavy-duty, double-loop key ring, and equipped with a permanent tag indicating the associated lock.

- n. All vehicle equipment shall be keyed alike.

8.2.4.4 Wiring Standards

Appendix D contains detailed low-voltage wiring standards that shall apply to the Bus AVL project. In general, wires and cables shall be installed in accordance with the following practices:

- a. Except for fiber optic cables, all conductors shall be copper of not less than 98% conductivity. Aluminum conductors are not acceptable.
- b. Conductors shall be continuous between terminals, without splices.
- c. Conductor gauge, insulation, and shielding shall be adequate for the intended purpose.
- d. Cable and wire shall be run neatly with adequate lacing or clamping.
- e. The manufacturer's minimum bending radius of cables shall not be exceeded at any point during installation.
- f. Consistent cable and wire color-coding shall be used throughout.
- g. All applications requiring physical movement and access shall use stranded conductors.
- h. Ring-type, crimped or soldered lugs shall be used with stranded wires terminated on screw-type terminals. Connections shall be made only with crimping tools that meet the connector manufacturer's specifications.
- i. Interfaces to carrier communication lines (e.g., telephone, T1, etc.) lines shall be terminated on industry-standard "66-type" punch blocks, with pre-wired telephone-type connectors.
- j. Shielded wiring, or other means of signal isolation, shall be used wherever necessary to avoid cross-talk, hum, pops, clicks, whine, and other forms of interference. The Contractor shall provide an interference-free system.
- k. Unless installed in conduit, wiring within cabinets, in ladder racks, beneath raised floors, and from outlet boxes to freestanding or desk-mounted equipment shall be neatly installed, bundled with appropriate tie-wrap devices, and tied to supports if practicable.
- l. Horizontal cable runs longer than the manufacturer's recommended self-support distance shall be tied to a rigid support, at intervals not greater than three feet. Vertical cable runs

shall be supported at intervals not greater than six feet. All cables shall be dressed appropriately, and run parallel to each other.

- m. Signal and control wiring, and connection of devices shall be installed beneath raised floor (where available), in conduits, or concealed, and shall be included as part of the work to be performed by the Contractor. Wiring shall be accessible for maintenance. At unattended sites and the server room, open cabling is permitted on cable racks provided the cables are neatly tied.
- n. Cables and wiring shall be “plenum” rated where required by the most restrictive applicable code.
- o. The insulation on interconnect cabling used in areas where the wiring will not be installed in metallic conduit, shall be of heat- resistant material to minimize pyrolysis and fire hazard.
- p. Cable and wiring penetrations through metal cabinets shall be protected with dielectric grommets.
- q. Cable and wiring installed in modular furniture shall be run in trays or channels designed for that purpose.
- r. Extra wiring necessary for equipment movement shall be neatly coiled, tied, and concealed.
- s. Wiring in dropped ceiling areas shall be mounted with J-hooks and shall not lie on top of light fixtures or ceiling tiles, nor be attached to existing cables, conduits, or ceiling wires.
- t. Cable penetrations through building outside walls shall be thoroughly packed and waterproofed.
- u. Cables, wiring forms, and terminals shall be identified by permanent labels, tags, or other appropriate means. Cables shall be identified at both ends with indications of the source and destination of that cable run. The cable identification shall agree with the wiring and interconnect diagrams.

8.2.4.5 Interference

As used in this section, “interference” means any interference from such causes as intermodulation, transmitter noise, etc. It includes interference either conducted or radiated to and from microprocessors, computers, and all associated equipment including, but not limited to, I/O devices, displays, terminals, printers, network devices, and protocol converters.

- a. The performance of Contractor-provided equipment shall not be degraded by radiated and conducted interference. Also, Bus AVL system equipment shall not cause interference that degrades the performance of existing devices.
- b. Synthesizer circuits used in mobile units shall not cause, or be affected by, interference to or from existing electronic and electrical systems in vehicles and other installations.
- c. Vehicle equipment installations shall be immune to ignition impulse, alternator, and other RF interference from on-board sources.

8.2.5 Decommissioned Equipment

At an appropriate time as determined by CCT, the Contractor shall remove all decommissioned equipment that was replaced by the Bus AVL system, both at fixed site locations and on-board vehicles. The Contractor shall inventory the removed equipment, prepare and package the equipment (i.e., palletize, pack in containers) for disposal according to federal requirements, and shall move it to a location to be specified by CCT on the Marietta premises.

8.2.6 Technical Support

The Contractor shall offer continuing technical support on an as-needed, per-diem basis for a minimum of 10 years after final acceptance. Consultation with knowledgeable Contractor technical support personnel and trained field service personnel shall be readily available to assist CCT personnel in maintaining, expanding, and enhancing the Bus AVL system. Technical support and consultation shall include cooperation with, and assistance to, CCT in implementing interfaces with other systems for the exchange of information between the systems.

8.2.7 Change Notification Service

CCT shall be informed of all alterations or improvements to the hardware, software, and documentation supplied under this Specification. CCT shall be placed on the Contractor's mailing list to receive announcements of the discovery, documentation, and solution of hardware and software problems, as well as other improvements that could be made to hardware and software provided with the Bus AVL system. The service shall begin at the time of contract award, and shall continue for 10 years following final acceptance. The Contractor shall also include a subscription to hardware and software subcontractors' change notification services from the time of contract award through the warranty period, with a CCT-renewable option for extended periods.

8.3 System Maintenance

In this section, system maintenance requirements prior to shipment and during installation, field testing, warranty and after warranty are described. All maintenance performed by the Contractor, subcontractors and OEMs shall be in accordance with procedures and schedules recommended by the equipment OEMs.

8.3.1 Maintenance Records

Software maintenance activities shall be recorded via the code management system (see Section 4) beginning with the start of software integration. Hardware preventive and corrective maintenance activities shall be recorded in a hardware maintenance log. The hardware maintenance log shall be submitted to CCT when the Field Performance Test is completed and shall be available for CCT inspection throughout the project.

8.3.2 Maintenance Prior to Shipment

The Contractor shall be responsible for performing repairs and preventive maintenance on all Contractor-provided equipment and software during development, integration, and factory testing of the Bus AVL system.

8.3.3 Maintenance During Installation, Field Test, and Warranty

The Contractor shall be responsible for maintenance and support of all Contractor-provided equipment and software, including all fixed-site and vehicle equipment, until successful completion of the warranty period. The warranty period shall be as specified in the RFP Terms and Conditions.

During the startup, field testing, and Warranty period, the Contractor shall provide the following maintenance and support for Contractor-supplied equipment and software:

- a. For critical system, hardware, and software failures, qualified Contractor maintenance personnel shall arrive on site within two hours of notification to begin troubleshooting activities, and remain on site until the problem is resolved. The two-hour response shall be provided twenty-four hours a day, seven days a week. Critical hardware and software failures shall include:
- b. Failure of critical CAD or AVL functions that affect the ability of the Dispatcher to communicate with, or track the location of, vehicles.
- c. Server hardware failures or server-resident software that cannot be corrected by a restart of the server. If after a successful restart, the failure re-occurs within twelve (12) hours, the second failure shall be considered a critical failure.

- d. Failures that affect the proper operation of Contractor-provided data communications equipment, including communications servers and communications interface equipment.
- e. Any other hardware or software failure that affects Bus AVL system functionality at more than one workstation or affects communications with more than one vehicle.
- f. For all other hardware and software failures, qualified Contractor maintenance personnel shall arrive on site within twelve hours of notification to begin troubleshooting activities, and remain on site until the problem is resolved. The twelve-hour response shall be provided eight hours a day, five days a week.

8.3.4 Maintenance After Warranty

After expiration of the warranty, CCT plans to maintain the Bus AVL system with a combination of CCT, Contactor, and third party services.

The Proposer shall propose the following Maintenance after Warranty options.

8.3.4.1 Base Maintenance Agreement (Option)

CCT shall have the option of purchasing a one-year, renewable maintenance contract for the Contractor-provided maintenance services described below. *The Proposer shall include in the base proposal separate maintenance contract pricing for this Base Maintenance Agreement per year for five (5) years beginning at the end of the warranty period. Where applicable, the pricing shall be based on equipment population, with total cost equal to a per-unit cost multiplied by the number of units under contract. Option pricing and per-unit cost for additional units shall be provided in the Pricing section of the proposal. The Contractor shall honor the provided option and unit pricing for the appropriate year. The Proposal shall also include a sample Maintenance Agreement contract for these services.*

- a. CCT Responsibilities:
- b. Procure spare parts for Contractor-supplied vehicle equipment and any unique fixed-site hardware that is generally not available as COTS computer system and network equipment.
- c. CCT, or a separate subcontractor hired by CCT, will perform first level maintenance activities for Contractor-supplied vehicle equipment, including troubleshooting, identification of the failed equipment at the replaceable module level (e.g., IVCU, VCH) and replacement and configuration of the failed module. CCT will return all removed Contractor-supplied vehicle equipment to the Contractor for repair. The Contractor shall permit participation of CCT's subcontractor personnel in vehicle maintenance training

classes purchased under this Contract, or purchased separately specifically for the purpose of supporting CCT's fleet maintenance.

- d. CCT, via third-party contracts, time and material, or via in-house maintenance, will maintain COTS computer, network, and peripheral equipment, and associated third-party off-the-shelf software.
- e. CCT personnel who are trained by the Contractor as Bus AVL system Administrators will perform system administration.
- f. Contractor Responsibilities: The Contractor shall provide hardware, system, and software maintenance services as defined below. System-level maintenance services shall include all system-level troubleshooting necessary to identify the failed hardware or software component, regardless of whether the Contractor or CCT is responsible for repairing the failed component that is identified:
- g. The Contractor shall repair or replace all Contractor-supplied vehicle equipment returned by CCT for repair. The Contractor shall be responsible for all shipping costs in both directions. Turn-around time for repairs shall not exceed 21 calendar days.
- h. The Contractor shall provide a contact phone number for CCT to notify the Contractor of any Bus AVL system problem. The contact phone number shall be staffed 24-hours a day, seven days a week.
- i. For critical system and software failures (as defined in Section 8.3.3.a), qualified Contractor maintenance personnel shall begin remote troubleshooting activities within two hours of notification by CCT and continue troubleshooting activities until the problem is resolved, a workaround has been identified that restores the Bus AVL system to full operation, or a hardware failure is identified in Bus AVL system equipment maintained by CCT (refer to item a above). The two-hour response shall be provided twenty-four hours a day, seven days a week.
- j. For all other system, hardware, and software failures, qualified Contractor maintenance personnel shall begin remote troubleshooting activities within twelve hours of notification, and continue troubleshooting activities during normal working hours until the problem is resolved, a workaround has been identified that restores the Bus AVL system to full operation, a hardware failure is identified in Bus AVL system equipment maintained by CCT (refer to Section 8.3.4.1.a above), or agreement is reached that the problem is a low priority issue and has minimal impact on operations. The twelve-hour response shall be provided eight hours a day, five days a week. Low priority problems shall be resolved within 31-calendar days.

- k. The Contractor shall coordinate with CCT's System Administrator prior to modifying or installing any software on the Bus AVL system. The Contractor shall inform CCT when a reported problem is resolved and what was done to resolve the problem.
- l. The Contractor shall provide monthly reports identifying the status of all unresolved problems and equipment that has been returned for repair.

8.3.4.2 Maintenance Agreement Alternatives (Option)

The Proposer shall propose optional maintenance contracts and alternative maintenance plans for review by CCT to maintain the Bus AVL system. Recommended maintenance contracts shall include contracts from the Contractor, the computer OEM and other equipment OEMs for maintenance of the Bus AVL system equipment. The Proposer shall also offer software maintenance and update services, as recommended by the Proposer.

8.4 Spare Parts and Test Equipment

The Contractor shall provide spare parts and test equipment for the Bus AVL system as required by Sections 8.4.1, and 8.4.2. If it becomes necessary at any time prior to acceptance of the Bus AVL system to modify the supplied hardware that is to be maintained by CCT (such as the use of a different type, size or configuration of equipment) to meet the requirements of this Specification, the Contractor shall provide all additional spare parts and test equipment that CCT needs to maintain the modified hardware at no cost to CCT.

8.4.1 Equipment Supported by Maintenance Contract

All spare parts, special test equipment, and other special devices necessary to troubleshoot and repair the equipment that is supported via maintenance contracts shall be the responsibility of the maintenance contractor.

8.4.2 Equipment Maintained by CCT

All spare parts, special test equipment and other special devices necessary to troubleshoot and repair the equipment to be maintained by CCT shall be delivered with the Bus AVL system. For multiple devices of the same type, such as MDTs, the quantities of spare parts and test equipment provided shall be sufficient to maintain the devices even if multiple failures occur simultaneously. In lieu of a kit of spare parts for each subsystem or component, fully assembled additional devices shall be supplied.

For the vehicle equipment supplied by the Contractor, the quantity of spare parts provided shall be sufficient to maintain the fleet for a period of one year following final acceptance of the system by CCT. In addition, fully assembled spare devices shall be supplied for the vehicle equipment provided by the

Contractor. The quantity of fully assembled spare vehicle devices supplied shall be sufficient to keep 100% of the installed fleet operational based on the Contractor's estimated failure rate and the Contractor's depot repair turnaround time for each spare device, or 10% of the required vehicle equipment quantities specified elsewhere in this Specification, whichever is greater.

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Section 9

PROJECT MANAGEMENT, SCHEDULE, AND DOCUMENTATION

This section describes the interface between CCT project personnel and the Contractor and the schedule, quality assurance, and documentation requirements for the Bus AVL system project.

9.1 Project Management

The Contractor's project manager assigned to the Bus AVL system project shall have the authority to make commitments and decisions that are binding on the Contractor. CCT will designate a project manager to coordinate all Bus AVL system project activities. All communications between CCT and the Contractor shall be coordinated through the project managers and shall include a copy to CCT's consultant.

The project shall be staffed from the list of project management, engineering, system analysis, software, and other personnel presented in the Contractor's proposal. The Contractor's key personnel shall have previous experience in a similar position on at least one other project similar in scope to the Bus AVL system project. The Contractor shall make every effort to maintain continuity of personnel assigned to the Bus AVL system project. The assignment and reassignment of key personnel to the Bus AVL system project by the Contractor shall be subject to CCT approval.

Each reporting period, the Contractor shall provide an updated project schedule (Section 9.2), a complete progress report (Section 9.3), and attend a progress review meeting (Section 9.5.1). The reporting period shall be six weeks. All references to reporting period in this section shall refer to this six-week time frame.

9.2 Project Schedule

The Bus AVL system project development shall be scheduled to meet the following requirements:

- a. The detailed project schedule, a list of training deliverables and a documentation status table (Section 9.11), shall be provided within one month after Contract Award.
- b. The Preliminary Design Review (PDR) (Section 9.5.2.1) shall be completed and the associated documents approved within 3 months after Contract Award.
- c. The Final Design Review (FDR) (Section 9.5.2.2) shall be completed and the associated documents approved within 5 months after Contract Award.

- d. The Factory Acceptance Test shall be successfully completed and the Bus AVL system shall be shipped within 10 months after Contract Award.
- e. The Field Installation Test, Field Performance Test, Mini-Fleet Test, and cut-over of all vehicles shall be successfully completed within 14 months after Contract Award.

The project schedule shall include all major project events, including those defined above, the payment milestones (see RFP Terms and Conditions), Contractor activities (Section 9.2.1), CCT activities (Section 9.2.2), documentation schedule (Section 9.2.3), and training schedule (Section 9.2.4).

The project schedule shall be an accurate representation of the progress and planned activities for the Bus AVL system project. The Contractor shall maintain the schedule using a commercially available project management software product with capabilities similar to those found in Microsoft Project, which is strongly preferred.

9.2.1 Contractor Activities

The project schedule shall include all Contractor and subcontractor activities related to the Bus AVL system project, including the following:

- a. CCT site survey(s)
- b. Preliminary Design and Review Meeting
- c. Vehicle surveys and prototyping
- d. Final Design and Review Meeting
- e. Hardware purchases, development, and integration
- f. Documentation preparation and submittal to CCT, including Bus AVL system site installation, and vehicle installation drawings
- g. Documentation revision and re-submittal following CCT comments
- h. Software design, coding, implementation, and integration
- i. System integration
- j. Training
- k. Progress Reports

- l. Meetings and conference calls
- m. Subcontractor contracts in place
- n. Pre-factory internal and dry-run testing
- o. Factory Acceptance Test, including variance resolution and retesting
- p. Bus AVL system shipment to CCT
- q. Mini-Fleet vehicle installations
- r. Field Installation and Field Performance Tests
- s. Mini-Fleet Test
- t. Fleet installation of the Bus AVL system vehicle equipment
- u. Availability Test
- v. Final Acceptance
- w. Expiration of warranty.

9.2.2 CCT Activities

The project schedule shall include all CCT activities required for the Contractor to complete the Bus AVL system project, including the following:

- a. Contract Award
- b. PDR and FDR review and approval
- c. Document review and approval
- d. Data submittals
- e. Meetings and conference calls
- f. Training
- g. Factory Acceptance Test approval
- h. Field Installation and Performance Test approvals

- i. Mini-Fleet Test approval
- j. Availability Test approval
- k. Final Acceptance.

9.2.3 Documentation Schedule

All Bus AVL system documentation to be provided during project implementation for CCT review or approval shall be included in the project schedule. The project schedule shall assume a minimum of two review cycles; one for the initial issue and one for a revised version of each document will be required prior to approval. Twenty working days shall be allotted in the schedule for the first CCT review of each submitted document and ten working days shall be allotted in the schedule for subsequent reviews of a revised document. Working days are defined as Monday through Friday, excluding CCT holidays.

The review and approval of documents and the impact on the start and finish of succeeding activities shall be consistent with other activities in the project schedule. For example, coding of a function should not be shown to start until after the finish date for approving the associated documents.

9.2.4 Training Schedule

A recommended schedule for all proposed training courses shall be included in the project schedule. Scheduling of courses shall be coordinated with other activities in the project schedule.

9.3 Progress Reports

The Contractor shall prepare a progress report for each reporting period. The report shall be made available to CCT at least one week prior to each progress meeting. The progress report shall include the following items:

- a. An updated project schedule with explanations of any deviations from the planned delivery schedule
- b. The explanations shall include the anticipated impact of any delays and a plan for returning to the target schedule. All delays shall be factored into the project schedule as soon as they are known to the Contractor. Also, all changes to the schedule since the last progress report shall be identified.
- c. An updated list of all correspondence transmitted and received

- d. An updated documentation status table showing the status of all documentation items and highlighting the documents to be transmitted for review during the next two reporting periods
- e. A summary of activities performed by the Contractor and CCT during the previous reporting period
- f. A summary of pending and upcoming Contractor and CCT activities during the next two reporting periods, along with required completion dates
- g. The status of unresolved contract questions and change requests
- h. A description of current and anticipated project problem areas and steps to be taken to resolve each problem.

9.4 Bi-weekly Conference Calls

The Contractor shall participate in bi-weekly conference calls with CCT representatives. The purpose of these conference calls shall be to discuss any technical, schedule, action item, deliverable, coordination, and project management issues that need to be resolved in order to help keep the project on schedule. These conference calls shall be scheduled at a mutually agreeable time, preferably the same day and time, every other week during the full course of the project. Although these conference calls will be conducted informally and both the Contractor and CCT may propose topics to be discussed during each call, a brief agenda shall be issued by the Contractor prior to each conference call. Brief notes concerning items discussed during the conference call will be generated and distributed by the Contractor for review by CCT and the incorporation of CCT comments. A scheduled conference call may be canceled if both the Contractor and CCT agree to do so.

9.5 Meetings

The Contractor shall attend progress review meetings and conduct project review presentations described in this section.

9.5.1 Progress Review

Progress meetings shall be scheduled and attended by the Contractor every reporting period to review progress of the project. Progress meetings shall be used to review the progress report, written correspondence exchanged since the last meeting, and open action items.

The Contractor shall also attend technical meetings as required to discuss technical aspects of the project and to review comments on documents submitted for approval. When appropriate, these technical meetings shall be conducted as extensions to the progress meetings.

Progress meetings and technical meetings shall be held at CCT offices; however, the Contractor may request a meeting be held at the Contractor's facility if technical resources or issues cannot be adequately presented at CCT's location. The Contractor shall record the minutes of each meeting and update the action item list. The meeting minutes and action item list will be forwarded to CCT for review and comment.

9.5.2 Technical Project Reviews

The Contractor shall conduct two major technical project review meetings in addition to the progress review meetings defined above. First, a PDR shall be conducted no later than the time specified above and when the system design has reached the level of completion described in Section 9.5.2.1. Secondly, a FDR shall be conducted no later than the time specified above and when the system design has further progressed as described in Section 9.5.2.2.

All submittals required for the PDR and FDR meetings, plus an agenda and presentation material (i.e., slides), shall be received by CCT at least ten working days prior to the meeting. The PDR and FDR presentations and discussions shall be conducted at CCT facilities and are expected to be two to three days in length, but shall continue until all issues are resolved. The PDR and FDR shall not be considered successfully completed until CCT is satisfied that the design has progressed to the appropriate level and that there are no significant unresolved issues. If CCT determines the design has not reached the appropriate level for the PDR and/or FDR, or if there are significant design issues, the Contractor shall correct the inadequacies and submit revised documentation reflecting the corrections. Portions of the review meeting shall be repeated as required by CCT and no schedule relief shall be granted to the Contractor.

9.5.2.1 Preliminary Design Review

For the PDR, the Contractor shall present the design approach for the Bus AVL system and all major subsystems, including room space layout, total system functional description, software system overview and preliminary design, workstation position layout, computer system configuration, communications interfaces, vehicle equipment design and functions, external system interfaces, and implementation approaches for future hardware and functions described in the Specification. All major subcontractors shall attend the presentation. The submittals that shall be provided for the PDR to support the design approach are as follows:

- a. System Functional Description

- b. Hardware configuration block diagrams showing all Bus AVL system equipment, including interfaces to other CCT systems and equipment
- c. Data communications design, including communications between the Bus AVL system and the wide area wireless data communications provider
- d. Layout plans for all equipment locations showing the dimensions and locations of the Bus AVL system equipment
- e. Workstation layout drawings showing the dimensions and locations of all Contractor and CCT-furnished equipment being installed at CCT
- f. Custom Hardware Design documents
- g. For each type of vehicle: equipment block diagrams, equipment layouts, equipment installation locations and mounting details, cable routing, sample units, VCH panel layouts, displays, and functional descriptions.
- h. Draft Fixed-route and Paratransit Dispatcher Manuals that describe the layout and content of all Bus AVL system displays and reports and the user actions required to perform each function available to the Dispatchers
- i. Draft Fixed-route and Paratransit Bus Operator Manuals that provide detailed operating instructions and procedures for each function available to the bus Operators, using the Contractor-provided vehicle equipment.
- j. Draft Non-Revenue Operator Manual that provides detailed operating instructions and procedures for each function available to operators of non-revenue vehicles (e.g., supervisor and maintenance vehicles) using the Contractor-provided vehicle equipment.
- k. Training Course List including the title of each course, a list of topics covered, duration, prerequisites, and training site(s)
- l. Draft Installation and Cutover Plan
- m. Interface Control Document(s).

9.5.2.2 Final Design Review

The FDR meeting shall include an update of all of the design activity to date. All major subcontractors shall attend the meeting. Approval of the FDR and associated documentation will allow the coding effort, integration, and other final designs to be formalized and completed. Any unapproved design and

implementation efforts conducted before the approval of the FDR shall be at the Contractor's own risk. In addition to the submission of previous documentation, updated to reflect the results of any design changes since the PDR, the submittals shall include the following:

- a. Detailed plans and schedule for the installation and commissioning of the Bus AVL system, including parallel operation procedures
- b. Copies of each Bus AVL system report
- c. Color copies of all Bus AVL system displays
- d. Database Documentation
- e. Confirmation of executed contracts with all major subcontractors.

9.6 Transmittals

Every written and electronic document, letter, progress report, change order, and other material exchanged between the Contractor and CCT shall be assigned a unique transmittal number. Discussions and phone calls where important information is exchanged will be documented by CCT or the Contractor (as mutually agreed in the conversation) in a transmittal. The Contractor shall maintain a correspondence index and assign transmittal numbers consecutively for all Contractor documents. CCT also will maintain a correspondence numbering scheme identifying documents and correspondence initiated by CCT.

All documentation identified above shall be issued to CCT with a copy to CCT's consultant.

9.7 Email Communications

The Contractor shall support electronic mail (email) correspondence between project participants for routine and informal correspondence. The use of email is intended to provide for timely communication and document distribution among Bus AVL system project personnel, but it is not to be a substitute for formal communications and submittals required by the Contract. All such contractual communications, correspondence, and submittals shall be provided in hardcopy, as required by the Specification and Contract, unless agreed otherwise between the Contractor and CCT. The Contractor and CCT will jointly develop any additional procedures or restrictions pertaining to the use of email.

9.8 Use of Consultants

No limitations shall be imposed on CCT's use of consultants in any activity related to the Bus AVL system project. The consultants, at the direction of the CCT Project Manager, shall be accorded the same access to facilities and participation in project activities as any member of the CCT project team.

Involvement of consultants may include, but shall not be limited to, progress and technical meetings, conference calls, document review, installation review, and system testing.

CCT shall have the option of adding consultants to the distribution list to receive all correspondence initiated by the Contractor. CCT shall also be able to add consultants to the distribution list to receive all or selected system documents. The consultants will be bound by the same confidentiality restrictions imposed on CCT personnel.

9.9 Quality Assurance

The definition, design, development, integration, testing, field installation, and documentation activities of the Bus AVL system project shall be conducted in accordance with the Contractor's hardware and software quality assurance plans presented in the proposal.

9.10 Document Review and Approval Rights

To ensure that the proposed Bus AVL system conforms to the specific provisions and general intent of the Specification, the Contractor shall submit documentation describing the Bus AVL system to CCT for review, comment, and approval.

CCT will respond with written comments to the Contractor within the number of days specified in Section 9.2.3 after receipt of the documents. The Contractor shall promptly resubmit to CCT for approval all documents requiring correction along with a written response to each CCT comment. All resubmitted documents shall include margin revision bars and/or text highlighting to clearly show where changes have been made in the documents to help expedite CCT's review of the resubmitted documents.

CCT will review the resubmitted documents and the Contractor's responses to the CCT comments, and will record its approval or submit additional comments to the Contractor within the number of days specified in Section 9.2.3 after receipt of the resubmitted documents. This review and update process shall be repeated for each document until the document is approved by CCT. No implementation schedule relief is to be implied for documents requiring further correction and resubmission to CCT.

To help CCT manage the review and turnaround of documents during any given period, the Contractor shall stagger the release of documents over the time allocated in the project schedule for document review. The number and size of documents shall be factored into the documentation schedule.

CCT shall have the right to require the Contractor to make any necessary documentation changes at no additional cost to CCT to achieve conformance with the Specification.

Any purchasing, manufacturing, or programming implementation initiated prior to written CCT approval of the relevant documents and drawings shall be at the Contractor's own risk. Review and approval by

CCT shall not relieve the Contractor of its overall responsibility to satisfy all functional requirements of the Specification.

9.10.1 Standard Document Review

Documentation of the Contractor's standard hardware, software, and firmware shall be furnished for CCT review, but approval shall be limited to the content of the document. Specifically, CCT reserves the right to determine that:

- a. All standard hardware, software, and firmware are in full conformance with the Specification.
- b. The documentation accurately and completely describes all features and options of the hardware, software, and firmware that pertain to the CCT Bus AVL system.

9.10.2 Modified and Custom Documents Approval

In some cases the Contractor's standard hardware, software, or firmware may need to be modified to fully conform to the requirements of this Specification. In other cases, selected portions of the hardware, software, or firmware may be completely custom. In both instances CCT shall have, in addition to the approval rights described above, full approval rights over the portions of the document's content and format pertaining to the modified or custom hardware, software, and firmware. The following conditions shall be satisfied for this approval:

- a. Hardware, software, and firmware shall be in full conformance with Contract requirements.
- b. Changes and modifications shall be documented in a complete and clear manner in accordance with the Contractor's established documentation standards.
- c. Features, equipment, and options pertaining to CCT shall be clearly distinguished from those that do not pertain.
- d. The Contractor shall follow its established quality assurance plan for design, implementation, and integration of the affected hardware, software, and firmware.

9.10.3 Functional Requirements and Test Document Approval

CCT shall retain full approval rights over all Software Functional Requirements, Test Plan, and Test Procedures documentation regardless of the standard, modified, or custom classification. In addition, CCT shall have full approval rights over the format of displays and the UI pertaining to Bus AVL system functions developed for CCT.

9.11 Documentation

Complete documentation of the Bus AVL system shall be provided. Documentation shall be prepared in accordance with the Contractor's documentation standard presented in the proposal. CCT reserves the right to reject documents not conforming to the standard. All documentation shall be clearly written in the English language. CCT reserves the right to reject any document that is not clear due to incorrect grammar, poor document or sentence structure, and/or significant spelling errors. All documents that are rejected by CCT shall be promptly corrected by the Contractor and shall be resubmitted to CCT for review and approval according to procedures outlined above.

All documentation shall exactly reflect the configuration of hardware and software supplied under this Contract. Any changes as a result of latent defects and design changes shall result in all affected documentation being updated within 30 calendar days of correction.

Each document shall be identified by a Contractor document number and the CCT project number. Where a document is revised for any reason, each such revision shall be indicated by a number, date, and subject in a revision block, along with an indication of official approval by the Contractor's project manager.

Table 9-1, below, summarizes the deliverable documentation requirements. The numbers of preliminary documentation and final documentation copies to be submitted for review is listed in Table 9-1, and are further defined in Sections 9.11.13 and 9.11.14.

Electronic copies of selected documents also shall be provided to CCT in Adobe Portable Document Format (PDF). For all documents, a PDF-format copy is required in addition to the specified number of printed copies for each submittal. PDF copies of each document shall be delivered or emailed to up to five CCT designated personnel.

The Contractor shall provide a Bus AVL system Documentation Index, identifying all documents to be provided with the system. The index shall describe each document and the document's purpose to help the user locate the appropriate document in the set of all Bus AVL system documentation.

The Contractor also shall provide an updated documentation status table for each Progress Report. The documentation status table shall include the following information for each document:

- a. Title
- b. Contractor's document number
- c. Scheduled and actual dates for initial submission, reviews by CCT, and resubmissions
- d. Revision number for each submission

- e. Indication of being preliminary or final document.

The documents in the documentation status table shall be grouped by type of document (hardware, software, user, etc.).

9.11.1 System Functional Description

A customized System Functional Description shall be provided that contains a high-level definition of the Bus AVL system hardware, software, and firmware, and the functions performed by each. The System Functional Description shall serve as a complete introduction to the Bus AVL system and to the more specific documents defined in the following Sections. The information to be provided in the System Functional Description shall include the following:

- a. An overview of the hardware configuration showing all major hardware subsystems
- b. The overview shall include block diagrams in sufficient detail to show the interrelationships of major hardware subsystems and the elements that comprise them.
- c. A description of the major hardware subsystems, the elements that comprise them, their interrelationships, and the functions they perform.
- d. System availability, processor performance, mass storage, and device redundancy, shall also be described.
- e. An overview of the major software subsystems, describing the software, the interrelationship of software within a subsystem, and the relationship between subsystems.
- f. High-level software subsystem block/flow diagrams shall be included to enhance CCT's understanding of the overall capability of the Bus AVL system. The subsystems to be described shall include: CAD software, AVL software, vehicle software, operating systems, network software, system interfaces, support utilities, database software, and display, map, and report generation software.
- g. A complete description of the software and the individual functions performed by the software
- h. Significant features, concepts, and algorithms pertaining to each function shall be described, with special emphasis on equipment, software, and features unique to the CCT Bus AVL system.
- i. System interfaces

- j. Over the air data protocols
- k. Communication modes
- l. Site connectivity
- m. List of all hardware to be acquired.

9.11.2 Hardware Documentation

Documentation for all Bus AVL system hardware shall be provided to CCT. Drawings shall be provided on standard 11x17 inch stock, and shall have borders and title blocks consistent with standard engineering practices. In addition to the documentation specifically identified below, the Contractor shall provide CCT with all documentation originally supplied with standard OEM hardware devices purchased from others.

9.11.2.1 Inventory, Floor Plans, Wiring, and Block Diagrams

The Contractor shall provide the following items:

- a. An inventory of all hardware to be supplied, including the manufacturer's name, model number, serial number, nameplate data, CCT identification tag number, overall dimensions, and quantities
- b. Floor plan drawings for each Bus AVL system equipment location, showing rack, cabinet, workstation position, and peripheral device locations and sizes
- c. Vehicle installation drawings detailing the on-board equipment installation to be provided by the Contractor. Drawings shall be provided for each type of vehicle and include general notes, installation notes, symbols and descriptions, part lists, on-board equipment block diagrams, equipment layouts, equipment installation locations and mounting details with labels and part/instruction references, cable routing, and detailed wiring diagrams.
- d. Proposals shall include examples of vehicle drawings of the type, quality, and content to be provided under this contract.
- e. Detailed installation wiring diagrams and cabling diagrams for fixed-site locations
- f. Any special precautions associated with cabling shall be clearly identified. All CCT cable and wiring terminations shall be shown on drawings, and all terminal markings, cable connector markings, and cable lengths shall be clearly indicated.

- g. Configuration block diagrams.

9.11.2.2 Site Preparation Manuals

Site preparation manuals shall be provided for all locations where Bus AVL system hardware is to be installed. The manuals shall contain:

- a. Drawings of all racks, cabinets, enclosures, power supply equipment, computer equipment, communications equipment, auxiliary and other equipment
- b. Mounting details, clearance requirements, and environmental restrictions
- c. Device installation requirements, including distance and clearance restrictions
- d. Electrical power supply and grounding requirements
- e. Heat dissipation specifications.

9.11.2.3 Enclosure Assembly Documentation

Enclosure assembly drawings shall be provided that show the location of all major subassemblies, such as power supplies, printed circuit card chassis, and components comprising the subassemblies to the level of printed circuit cards, in each enclosure, including, but not limited to, equipment racks, cabinets, and vehicle equipment enclosures.

The drawings shall identify each subassembly and component by part number and revision level. The drawings shall include interconnection wiring diagrams showing all interconnecting cables, including signal, grounding, antenna, and power distribution cables. Drawings shall be provided for each enclosure. A copy of the appropriate drawing(s) shall be stored inside each enclosure, preferably on the door of the enclosure.

9.11.2.4 Custom Hardware Design Documentation

The Contractor shall provide hardware design documentation for each hardware device that is built specifically for, or is highly customized for, the Bus AVL system. This documentation shall include, but not be limited to, functional description, specification data (e.g., features, capacity, performance parameters, power requirements, dimensions, weight, and environmental limits), physical drawings, mounting details, and schematics.

9.11.2.5 Reference Manuals and Instruction Books

Reference manuals and instruction books shall be provided for all hardware. These manuals shall include documentation relating to Bus AVL system hardware, including descriptions, specifications, theory of

operation, installation information, and drawings. The Contractor shall include an attachment to each document outlining those portions of the document, if any, that do not apply to the CCT hardware. Hardware user manuals also shall be provided where available.

9.11.2.6 Maintenance Manuals

Manuals and other descriptive material shall be provided for all Contractor-provided equipment, regardless of whether it is manufactured by the Contractor or another supplier. This documentation shall include descriptions, specifications, theory of operation, printed circuit module schematics and layout drawings (showing component types and positions), motherboard schematics (showing inter-module connections), backpanel and assembly wiring diagrams, pin lists, and other electrical, electronic, and mechanical hardware data.

Instructions shall be provided for preventive maintenance procedures that include examinations, tests, adjustments, and periodic cleaning. The manuals shall provide guidelines for isolating the causes of hardware malfunctions and for localizing faults.

Complete parts lists and breakdowns with sufficient descriptions to identify each field-replaceable component shall be provided.

9.11.2.7 Diagnostic Program Manuals

Diagnostic program user manuals shall be provided with complete instructions on the loading and operation of all hardware diagnostic programs required for the equipment to be maintained by CCT. The text shall include guides for locating faults, symptoms, possible causes of trouble, and suggested remedial action. Sample printouts from the diagnostic programs shall be included.

9.11.3 Software Documentation

Documentation for all Bus AVL system software shall be provided to CCT. In addition to the documentation specifically identified below, the Contractor shall provide CCT with all documentation originally supplied with standard OEM software purchased from others. The Contractor shall also provide an index listing all software to be supplied, along with version, status, and license information.

9.11.3.1 Standard Software Documentation

Existing documentation and user manuals for standard software shall be provided. Standard software is defined as field-proven software purchased from third-parties and software developed internally as a base for all projects that fully satisfies the requirements of this Specification without modification for the Bus AVL system. Typical examples include operating systems, compilers, software development utilities, software diagnostic programs, network managers, and window managers.

9.11.3.2 Interface Control Documents

An Interface Control Document (ICD) shall be provided for each required interface to an external system and computer. An ICD shall also be provided for each interface to an external vehicle system. The ICD shall contain sufficient detail to enable a third party to fully implement the external side of the interface. ICD content shall include, but not be limited to, detailed descriptions of protocols, message structures, and individual record and field formats. Contractor-provided ICDs shall include the following:

- a. Paratransit Scheduling System Interface
- b. GIS Interface
- c. Passenger information Sign Interface
- d. Vehicle Monitoring System Interface
- e. Destination Sign Interface
- f. Audio/Visual Announcement System Interface (Option)
- g. Signal Priority System Interface (Future).

9.11.4 Firmware Documentation

If the Contractor implements certain functions in firmware, that firmware shall be documented in conformance with the software documentation requirements.

9.11.5 Database Documentation

Database documentation shall be provided that describes each Bus AVL system database. Database documentation shall describe the configuration, individual elements (files, tables, fields, records, etc.), relationships, and security settings for each Bus AVL system database. Documentation content shall include, but not be limited to, an entity relationship diagram (ERD) and a complete listing of the data dictionary for each database. Portions of the databases developed, modified, or enhanced specifically for CCT shall be explicitly identified. Complete administration documentation for the database management system(s) utilized by the Bus AVL system shall also be supplied.

All data in the Bus AVL system databases that is supplied by CCT or generated from CCT operations shall be solely-owned by CCT. The Contractor shall have no ownership rights to this CCT-supplied or CCT operations-generated data. There shall be no restrictions on CCT's rights or ability to access and use its data.

9.11.6 Bus AVL system User Manuals

The Contractor shall provide user manuals that contain detailed operating instructions and procedures to be used by Bus AVL system users. Each user manual shall be customized for CCT and shall be based on the delivered Bus AVL system. It is not acceptable to describe the Contractor's standard system and then identify differences between the standard product and the delivered system; the user manuals shall not include standard or optional descriptions that do not apply to the Bus AVL system; the user manuals shall not include standard or optional descriptions that do not apply to the delivered equipment.

User manuals shall not be written as a programmer's document. Procedures shall be explained step-by-step with an explanation of how each step is performed, which parameters can be adjusted, and the effects obtained by varying each parameter. All user guidance and error messages shall be described, along with the steps necessary to recover from errors.

Information in each user manual shall be presented in terms that are meaningful to the specific CCT personnel for whom the manual is written.

Specific user manuals to be provided are described below.

9.11.6.1 Dispatcher Manuals

A fixed-route and a Paratransit Dispatcher Manual shall be provided that contains detailed operating instructions and procedures to be used by the associated Dispatchers. Each manual shall include a description of the operation of the Bus AVL system (hardware, software, and vehicle equipment) as it relates to the appropriate Dispatcher's tasks.

The Dispatcher Manuals shall describe each function defined in Section 2 of this Specification and all other functions accessible to each of the Dispatchers, and how it is used. The manuals shall also include a copy of each type of display and report used in the Bus AVL system, along with a description of each data field. User instructions for each display and report shall be provided.

The Dispatcher Manuals shall describe procedures to be followed as a result of computer system restarts, failures, failovers, and failures of elements of the vehicle equipment subsystem.

9.11.6.2 Bus Operator Manual

The Contractor shall provide a Fixed-route Bus Operator Manual and a Paratransit Bus Operator Manual that contain the related detailed operating instructions and procedures on all of the Contractor-provided vehicle equipment to be installed on CCT's buses.

The Bus Operator Manuals shall describe each related revenue vehicle function defined in Section 2 of this Specification and all other functions accessible to revenue Operators, and how it is used. The manuals

shall also include a copy of each type of display used in the related MDT, along with a description of display. User instructions for each function associated with the display shall be provided.

The Bus Operator Manuals shall describe all user guidance and error messages, along with the steps necessary to recover from errors. Procedures to be followed as a result of Bus AVL system vehicle equipment restarts and failures shall also be provided.

Proposals shall include a sample of a Bus Operator manual for the proposed system.

9.11.6.3 Non-Revenue Operator Manual

The Contractor shall provide a Non-Revenue User Manual that contains detailed operating instructions and procedures on all of the Contractor-provided non-revenue vehicle equipment, such as Supervisor and Maintenance vehicles.

The Non-Revenue Operator Manual shall describe each non-revenue vehicle function defined in Section 2 of this Specification and all other functions accessible to non-revenue Operators, and how it is used. The manual shall also include a copy of each type of display used in the MDT, along with a description of display. User instructions for each function associated with the display shall be provided.

The Non-Revenue Operator Manual shall describe all user guidance and error messages, along with the steps necessary to recover from errors. Procedures to be followed as a result of Bus AVL system vehicle equipment restarts and failures shall also be provided.

9.11.7 System Administrator Documentation

User-oriented documentation shall be provided to guide the CCT System Administrator in the operation and procedures required to maintain and update the Bus AVL system, including system software and firmware, database, application software, and other elements of the Bus AVL system. System Administrator documents shall be specifically geared to the delivered Bus AVL system and include, but not be limited to, the following items:

- a. Software code management
- b. Programming language compilers and assemblers
- c. Network communications management, including firewall and switch configuration, and system IP addresses
- d. Server configurations and build
- e. Workstation configurations and build

- f. System performance monitoring and tuning
- g. System restart and failover management
- h. Diagnostic programs and procedures
- i. System generation and management
- j. Database generation and management
- k. Display generation and management
- l. Report generation and management
- m. Base map interface/loading procedures
- n. Schedule data interface/loading procedures
- o. Audio/Visual Announcement management including definition, trigger points, and loading procedures
- p. Passenger information Signs management
- q. Traffic Signal Priority management (Future)
- r. Software utilities
- s. System and application software configuration
- t. System and data backup, restoration, and images
- u. System security
- v. GIS data importation management
- w. Other Contractor-supplied system software not included above.

9.11.8 Test Documentation

Documentation for all system factory, field, mini-fleet, and availability tests shall be provided in accordance with the requirements defined in Section 7.

9.11.9 Training Documentation

Training documentation shall be provided in accordance with the requirements defined in Section 8.

9.11.10 Program Code

The Contractor shall provide CCT with a machine-readable copy of all source code and other program files developed for CCT, including those developed for interfacing the Bus AVL system to external systems and for all displays and reports developed specifically for CCT. The machine-readable files provided shall contain all the data required to enable CCT to add, modify, and remove any CCT-specific displays, reports, and interfaces.

For the remainder of the Bus AVL system software and firmware, the Contractor shall provide an escrow agreement that guarantees CCT access to the source code and other files of the Bus AVL system software and firmware, should the Contractor be unwilling or unable to perform future system software/firmware maintenance or modifications required by CCT. The software and firmware retained in escrow shall be updated each time the Bus AVL system software or firmware is updated such that the version in escrow matches the version in use by the Bus AVL system.

9.11.11 Preliminary and Final Documentation

Review documents shall be submitted to CCT so that they may review and approve the Contractor's design. After reviewing a document, CCT will either submit comments for inclusion in the next update, or approve the document. If CCT submits comments for inclusion in the next update, the Contractor shall revise the document and submit the revised document as another review version. When CCT approves a document, the approved version shall be considered the preliminary document; and if the Contractor has not already submitted a quantity of copies greater than or equal to the number of preliminary copies shown in Table 9-1, the Contractor shall provide to CCT the requisite number of additional copies.

The preliminary documentation will be used by CCT personnel for system testing and for operating the Bus AVL system until Final Acceptance. All preliminary documentation shall be received by CCT at least 6 weeks prior to the start of factory tests unless specifically directed otherwise in this Specification.

Final documentation shall consist of preliminary documentation that is updated to include all subsequent changes made to the Bus AVL system up until Final Acceptance. Documentation revisions or changes necessitated by inaccuracies, installation requirements, omissions determined by usage, and design or production alterations to the Bus AVL system shall be supplied. All changes shall be issued in the form of replacements for the affected drawings, diagrams, charts, graphs, tables, lists, and written pages in the documentation. Where appropriate, the complete document shall be re-issued.

All Contractor-supplied final documentation shall be easily reproducible by CCT, and CCT shall be granted the rights to reproduce any document supplied under this contract for its own use.

In addition to properly bound and assembled hardcopies of all final documentation, CCT requires a copy of all final documentation produced by the Contractor on electronic media in commercially available word processing format and, where necessary, graphics formats. This media will be used by CCT to maintain the accuracy of the documentation as future changes to the system are implemented. Standard documentation produced by others is not required in an electronic format unless it is routinely available from the vendor as a standard or optional item for on-line accessibility. This standard OEM vendor documentation need not be editable by CCT.

9.11.12 Document Quantities

The quantities of documents to be supplied for review, preliminary, and final documents are enumerated in Table 9-1. All documents shall be provided to CCT in PDF format in addition to the specified number of printed copies for each submittal, including each time a review, preliminary, or final document is updated.

Table 9-1
DELIVERABLE DOCUMENTATION REQUIREMENTS

DOCUMENT	SECTION REFER- ENCE	REVIEW	PRELIM	FINAL
Hardware and Software Quality Assurance Documents	9.9	4	4	0
Documentation Index	9.11	4	4	3
System Functional Description	9.11.1	4	4	3
Hardware Documentation:				
Inventory of Hardware	9.11.2.1	4	4	3
Floor Plans	9.11.2.1	4	4	3
On-Board Equipment	9.11.2.1	4	4	3
Installation Drawings	9.11.2.1	4	4	3
Wiring and Cable Diagrams	9.11.2.1	4	4	3
Configuration Block Diagrams	9.11.2.1	4	4	3
Site Preparation Manuals	9.11.2.2	4	4	3
Enclosure Assembly Documentation	9.11.2.3	4	4	3
Custom Hardware Design Documentation	9.11.2.4	4	4	3
Reference Manuals	9.11.2.5	4	4	3
Users Manuals, Instruction Books	9.11.2.5	4	4	3
Maintenance Manuals	9.11.2.6	4	4	3
Diagnostic Program Manuals	9.11.2.7	4	4	3
Software Documentation:				
Software Inventory	9.11.3	4	4	3
Standard Software	9.11.3.1	4	4	3
Interface Control Document	9.11.3.2	4	4	3
Firmware Documentation	9.11.4	4	4	3
Database Documentation	9.11.5	4	4	3
Dispatcher Manuals:	9.11.6.1			
Fixed-route		4	6	6
Paratransit		4	4	4
Bus Operator Manuals:	9.11.6.2			
Fixed-route		4	12	12
Paratransit		4	12	12
Non-Revenue User Manual	9.11.6.3	4	3	3

DOCUMENT	SECTION REFERENCE	REVIEW	PRELIM	FINAL
System Administrator Documentation	9.11.7	3	3	2
Test Documentation:				
Test Plans	7.2.1	4	4	2
Test Procedures	7.2.2	4	4	2
Test Records	7.3	4	4	2
Dry Run Certification	7.5.1	0	1	0
Training Documents:				
Training Schedule	8.1.9.2	4	4	0
Training Manuals	8.1.9.5	4	4	4
Installation and Cut-Over Plan	8.2.1	4	4	2
Maintenance Record	8.3.1	4	4	1
Program Listings and Code	9.11.10	0	0	1 (escrow)

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Appendix A
ABBREVIATIONS AND ACRONYMS

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Appendix A

ABBREVIATIONS AND ACRONYMS

4GL	Fourth Generation Language
802.11	A family of wireless communications protocol standards used for short-range wireless local area networks
ADA	Americans with Disabilities Act; addresses federal requirements for facilities to accommodate individuals with disabilities.
ANSI	American National Standards Institute
APC	Automatic Passenger Counter
API	Application Program Interface
ASCII	American Standard Code for Information Interchange; a widely used binary code for text as well as communications and printer control.
ASTM	American Society for Testing and Materials
AVL	Automatic Vehicle Location
BPS	Bits per second; the rate of transfer of data over a communications link.
CAD	Computer-Aided Dispatch
CCDOT	Cobb County Department of Transportation
CCT	Cobb Community Transit
COTS	Commercial Off-The-Shelf
CPU	Central Processing Unit; the part of a computer that includes the circuits to interpret and execute program code.
DST	Daylight Savings time
EA	Emergency Alarm
ECM	Electronic Control Module
EMAIL	Electronic mail

EMI	Electromagnetic Interference; a naturally occurring phenomena when the electromagnetic field of one device disrupts, impedes or degrades the electromagnetic field of another device by coming into proximity with it, in computer technology, computer devices are susceptible to EMI because electromagnetic fields are a byproduct of passing electricity through a wire. Data lines that have not been properly shielded are susceptible to data corruption by EMI
EIA	Electronic Industries Association
ERD	Entity Relationship Diagram
FAT	Factory Acceptance Test; a series of tests at the Contractor's factory to demonstrate correct operation of all functions using the fully integrated Bus AVL system, including all fixed-end hardware and software, workstations and related equipment, all fixed-site radio equipment, and a subset of on-board vehicle equipment
FCC	Federal Communications Commission
FDR	Final Design Review
FTA	Federal Transit Administration
GIS	Geographic Information System; a system of computer hardware, software, and procedures designed to support the capture, management, manipulation, analysis, and display of spatially referenced data for solving complex planning and management problems.
GPS	Global Positioning System; a satellite-based system developed by the Department of Defense for determining geographic position.
GUI	Graphical User Interface
HVAC	Heating, Ventilation, and Air Conditioning equipment
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output; pertaining to all hardware and activity that transfers data into or out of a processor.
ICD	Interface Control Document; a formal, comprehensive, detailed document used to define an interface between two devices or systems.
ISA	Instrument Society of America
ISO	International Standards Organization
ITS	Intelligent Transportation Systems; refers to a wide range of advanced electronics, communications, control, computer, and other technologies designed to improve safety and productivity, reduce roadway congestion, and encourage transit use.

IVCU	Intelligent Vehicle Control Unit; a computer in a mobile installation that integrates, monitors and controls vehicle devices and functions. In some cases, the IVCU is integrated into a single package with the VCH.
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MARTA	Metropolitan Atlanta Rapid Transit Authority
MDT	Mobile Data Terminal; a display device (VCH) with integrated or separate computer processing capabilities (IVCU) that is used on-board revenue and non-revenue vehicles.
MFT	Mini-Fleet Test
MHz	Megahertz
MTBF	Mean Time Between Failure; failure rate of a repairable item of hardware computed from its design considerations, historical data, and from the failure of its parts for the intended conditions of use.
MTC	Marietta Transit Center
MTTR	Mean Time To Repair; repair rate of a repairable item of hardware computed from design considerations and historical data.
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association.
NTCIP	National Transportation Communications for ITS Protocol
ODBC	Open Database Connectivity
OEM	Original Equipment Manufacturer
OSF	Open Software Foundation
OSHA	Occupational Safety and Health Administration
PA	Public Address
PC	Personal Computer
PDR	Preliminary Design Review
PPM	Pages Per Minute.

PRTT	Priority-Request-to-Talk; a high-priority request for voice communications issued by an Operator or other mobile user to Dispatch. A PRTT is typically given the second highest priority in the CAD system following an Emergency Alarm.
PTT	Push-to-Talk
QA	Quality Assurance
QC	Quality Control
RAM	Random Access Memory
RFP	Request for Proposal
ROM	Read-Only Memory
RSA	Route and Schedule Adherence
RTPI	Real-Time Passenger Information
RTT	Request-to-Talk
SAE	Society of Automotive Engineers
SAN	Storage Area Network
SNMP	Simple Network Management Protocol
SQA	Software Quality Assurance
SQL	Structured Query Language
SWC	Surge Withstand Capability
TAN	Transport Area Network
TCIP	Transit Communications Interface Profiles
TCP/IP	Transmission Control Protocol/Internet Protocol
TIGER	Topologically Integrated Geographical Encoding and Referencing; a GIS map format
TSP	Traffic Signal Priority
TTF	Time To First Fix.
UBC	Universal Building Code
UHF	Ultra High Frequency (300 Megahertz - 3 Gigahertz)

UI	User Interface
UL	Underwriters Laboratories
UPS	Uninterruptible Power Supply
VAN	Vehicle Area Network
VCH	Vehicle Control Head
VLAN	Virtual Local Area Network
VPN	Virtual Private Network
WAN	Wide Area Network
WLAN	Wireless Local Area Network

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Appendix B
GLOSSARY OF TERMS

Appendix B

GLOSSARY OF TERMS

Administrator-adjustable	Modifiable via workstation displays accessible only by a System Administrator.
Alarm	A CAD/AVL system event that audibly and visually alerts one or more Bus AVL users to the presence of a condition that requires immediate attention.
Archive	To copy files to a long-term storage medium, typically offline. The System Administrator will archive files from online disk storage to a second offline storage device utilizing either, or both, hard and removable media.
Block	Work performed by a revenue vehicle between leaving and returning to a garage or other vehicle base
Bus	Revenue vehicles for providing the CCT fixed-route and paratransit service.
Bus AVL	The name of the system described in this Specification and to be supplied by the Contractor under this Contract.
Bus Operator	A person who operates a revenue transit vehicle
Central Site	Location of the Bus AVL servers and communications devices (e.g., CCT's Server Room).
Console	A dispatch operating position consisting of office, modular or customized furniture with one or more workstations and user interaction devices integrated into the furniture.
Contract	The complete agreement between the two parties regarding, in this case, the procurement of a complete Bus AVL system, including all equipment, services, warranties, etc.
Contractor	The party awarded the Contract to supply the Bus AVL system and related services.
Customer Service Agents	CCT personnel who provide information and other services to customers from the Information Center at CCT's facility, such as transit service information and trip planning.
Data Dictionary	A set of data descriptions and relationships depicting the database structure that can be utilized by the System Administrator for one or more applications.
Deadhead	Non-revenue movement of a revenue vehicle before, between, and after revenue trips.
Destination Sign(s)	Sign(s) located on the outside of a revenue vehicle denoting the route of that vehicle, typically the route number and name. Also referred to as a "headsign".
Detour	The act of rerouting one or more buses off of their regular route due to construction, accident, or other obstructions. Also referred to as a "reroute".

Dispatch	Centralized dispatch facility located at CCT's facility in Marietta, GA.
Dispatcher	Operations personnel who monitor and manage CCT's revenue service and non-revenue operations
Display	An organized presentation of data and display elements in a window intended to provide user access to specific functional capabilities and information
Display Elements	Basic elements that are used to construct all displays; such as fields, list boxes, scroll bars, radio buttons, text, graphics, etc.
Event	An occurrence that is detected, recorded, and possibly announced by the Bus AVL system. Examples include emergency alarms, RTTs, PRTTs, text and data messages, and Operator logon/logoff.
Extraboard	1.) The bus Operators who fill in for regularly assigned Operators who are absent for any reason, as well as driving open runs and trips (including vacation and regular days off) 2.) The daily list of assignments for these bus Operators
Extra Service	Refers to trips added for special events.
Fill-In	Covering lost service with another bus and Operator
Fixed-End	The location at which system equipment is permanently installed; as opposed to mobile
Function Key	A device, either a physical pushbutton, a function key on the keyboard, or a programmable function key or selection field on displays, that the user employs to interact with the computer system. The functionality of a function key may also be provided using a button on the Cursor Positioning Device.
Geocoding	The conversion of bus stops, street addresses, intersections, and landmarks to geographic coordinates
GIS	Geographic Information System, a system that contains spatially referenced data that can be analyzed and converted to information for a specific set of purposes and applications.
Headway	Scheduled or actual time between two consecutive trips at a time point
Hot	A bus running ahead of schedule (e.g., running hot)
Incident	An abnormal event that is documented by an Incident Report
Late	A revenue vehicle that is operating behind schedule by more than the defined late tolerance.
Layover	Time scheduled to be spent waiting between trips or waiting for transfers at a layover zone or transit center.
Layover Zone	Designated place for layovers to occur.
Leader	A bus of the same route immediately ahead of a given bus (the "Follower").
Local Workstation	A Bus AVL workstation that is connected directly to the Bus AVL LAN

Loop	A route or part of a route that is circular in nature providing overlapping service and served by buses traveling in one or both directions.
Lost Time	The time during which scheduled bus service does not occur. Lost time may be due to accident, equipment failure, lack of an Operator, illness, medical emergency, police action, or construction delays.
Manifest	A sequential listing of pick-ups and drop-offs, including associated information, indicating the day's scheduled work for a paratransit block/run.
Meet	Any arranged meeting of revenue vehicles at a particular location in order to facilitate the transfer of passengers.
Missed pullout	A bus missing its scheduled departure from the garage or vehicle storage facility due to either no Operator or no available vehicle.
Mobile Radio	A radio transmitter/receiver installed in a vehicle.
Mobile User	A user who interacts directly with the Bus AVL system via on-board vehicle equipment.
Monitor	A device used to display the GUI of a computer system to the user.
No Show	A paratransit customer that does not appear for the scheduled trip (within the pickup window).
Online Manifest	A system that provides paratransit operators with electronic access to their manifests in the vehicles. Capabilities typically include support for dynamic updates to the manifest during service and the ability for operators to provide immediate updates trip status during the course of service.
Operator	CCT personnel assigned the responsibility of operating the fixed-route and paratransit vehicles.
Operator ID	A unique identifier assigned to each Operator for logon purposes. The Operator ID is typically the same as the employee badge number.
Paddle	A description of a full day's service for an operator, including route description, scheduled times, and comments.
Pattern	The scheduled sequence of stops for one or more block trips. An ordered set of one or more patterns define a trip.
Peak	A period of time of increased transit service (i.e., the AM and/or PM commuter rush hour period).
Peak service	The transit service provided during the AM and PM peak.
Pullout	1.) A bus leaving its garage; 2.) The scheduled time of a pullout
Radio Console	A panel of switches and indicators, or a computer display that is used to directly monitor and control a radio system.
Radio System	The Cobb County system that includes the fixed-site and mobile radio equipment.
Relief Operator	An Operator who relieves another Operators. Primarily used for continuing service without taking the bus out of service.

Relief Point	A specified location at which an Operator relief has occurred or is scheduled to occur.
Remote Workstation	A Bus AVL workstation that must link to the Bus AVL LAN via the CCT WAN infrastructure.
Replacement Vehicle	The vehicle assigned to replace another vehicle on the road, typically due to mechanical problems or accident.
Report	A periodic or on-demand accumulation or summary of selected database and/or historical data that is compiled, sorted, formatted, and stored according to user and System Administrator specified directions and parameters. A report may be printed, displayed on a monitor, and/or stored as a file for subsequent access.
Revenue Service	Trips scheduled to carry fare paying passengers.
Road Call	Dispatching vehicle maintenance personnel with or without a replacement bus to a bus on the road that has had a mechanical failure or accident.
Route	A predefined path through the service area for which timepoints, bus stops, and a schedule are defined.
Run	A pre-defined daily work assignment for an Operator.
Running Time	The schedule time period for a revenue vehicle to operate between successive timepoints.
SAE J1587	A Society of Automotive Engineers standard for data interchanges between microcomputer systems in heavy-duty vehicle applications. It defines the format of messages, field descriptions, size, scale, internal data representation, and position within a message used to communicate on a vehicle area network. It also provides the frequency and circumstances in which a message is transmitted.
SAE J1708	A Society of Automotive Engineers standard for serial data communications between microcomputer systems in heavy-duty vehicle applications. It describes those parameters of a serial link that relate to electrical characteristics and hardware timing. It is used in conjunction with J1587 to define vehicle area network communications.
SAE J1939	A Society of Automotive Engineers standard used for communication and diagnostics among vehicle components, particularly the engine control units, and widely adopted by diesel engine manufacturers, including Gillig.
Schedule	A list of planned arrival and/or departure times for each timepoint on a route, along with associated information such as the route and time point names.
Screen	The full physical display area of a monitor or other display device.
Supervisors	Personnel assigned to monitor bus operations throughout the service area. Supervisors generally are located in the field operating from non-revenue support vehicles.
System Administrator	A privileged user who is ultimately responsible for overall administration and maintenance of the Bus AVL system, and for controlling access to the system by all other users.

Timepoint	A location on a route assigned a scheduled arrival and/or departure times.
Bus AVL User	A user who interacts directly with the Bus AVL system via a workstation on the Bus AVL domain.
Transfer	1.) A passenger getting off one transit vehicle and getting onto another; 2.) A slip of paper denoting proof of cash or ticket payment that is honored on another trip or route.
Transit Center	A facility for timed transfers, typically with assigned berthing locations for buses and shelter(s) for passengers.
Trip	One-way movement of a revenue vehicle from start to end terminus locations.
Tripper	Short-duration supplemental vehicle movement, typically operating during peak operating periods.
Turn-back	Revenue vehicle that skips the remaining portion of a trip and begins a subsequent trip at a point other than the terminus location.
User-adjustable	Modifiable by authorized Bus AVL users via workstation displays normally accessible to those users.
Vehicle ID	Unique numeric designation assigned to each revenue and nonrevenue vehicle.
Vehicle Operator	A generic term used to refer to the operator/driver of a vehicle.
Workstation	A computer platform, typically a networked personal computer, having one or more monitors, a mouse and keyboard, and associated operating system and Bus AVL application software.
Workstation Position	A seated location where a Bus AVL user performs their duties. Workstation positions typically consist of a computer, communications equipment, and other ancillary equipment. Workstation positions may or may not have console furniture.
Window	A defined display area on a screen.

Appendix C
EQUIPMENT QUANTITIES

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Appendix C

EQUIPMENT QUANTITIES

Figure C-1
BUS AVL SYSTEM EQUIPMENT LIST

Device	Delivered	Ultimate
Servers		
Application Servers	As required	As required
Communication Servers	As required	As required
Relational Database Servers	As required	As required
Server Terminals	(Note 1)	(Note 1)
System Administration Equip. (Note 2)	1	1
Backup Storage	1	2
Bus AVL Workstations	See Figure C-2	See Figure C-2
External System Communications Interfaces	As required	As required
On-Board Vehicle Equipment	See Figure C-3	See Figure C-3
Time Displays:		
Dispatch	1	1
Operator Area	1	1
Maintenance Shop	1	1
Transit Center Offices	0	2

Notes:

1. As required -- terminal sharing devices are acceptable as long as at least one terminal is provided for the set of primary servers and one for the set of backup servers.
2. The set of equipment, excluding the Bus AVL workstation, that is required for performing System Administration functions.

Legend:

- Delivered– Refers to the initially supplied system.
- Ultimate – Refers to the required expansion capability over the life of the system (without replacement of major components).

**Figure C-2
Bus AVL WORKSTATION REQUIREMENTS**

Workstation Purpose	Fixed-Route Dispatch	Paratransit Dispatch	Customer Service	Maintenance Supv.	General Manager	Operations Manager	CCDOT	System Admin.
Initial Location(s)	Dispatch	Dispatch	Customer Svc. Office	Maintenance Shop	Office	Office	Office	Sys. Admin. Office
Quantity Delivered	2	2	1	2	1	3	3	1
Ultimate Quantity	3	3	2	3	1	4	4	1
Workstation Equipment ¹								
<i>Furniture</i>	No	No	No	No	No	No	No	No
<i>Workstation Hardware</i> ²	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Monitors</i>	2	2	1	1	1	1	1	1
<i>Keyboard / Mouse</i>	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1
<i>PTT Switches</i>	0	0	0	0	0	0	0	0
<i>Headset Jacks</i>	0	0	0	0	0	0	0	0
<i>Radio Speakers</i>	0	0	0	0	0	0	0	0
<i>Audible Alarm</i>	1	1	0	0	0	0	0	0
<i>Voice Storage Unit</i>	0	0	0	0	0	0	0	0
<i>Radio Control Console</i>	0	0	0	0	0	0	0	0
<i>Control Station Radio</i>	0	0	0	0	0	0	0	0
Expected Usage ³								
<i>CAD</i>	Y	Y	Y	Y	Y	Y	Y	N
<i>Voice Communications</i> ⁴	Y	Y	N	Y	N	N	N	N
<i>Historical Data</i>	Y	Y	Y	Y	Y	Y	Y	Y
<i>Customer Service</i>	N	N	Y	N	N	N	N	N
<i>Map Displays</i>	Y	Y	Y	Y	Y	Y	Y	N
<i>Incident Reports</i>	Y	Y	N	Y	N	Y	N	N
<i>System Administration</i>	Y	N	N	N	N	N	N	Y

¹ Quantities are per workstation position.

² CCT may opt to supply workstation COTS hardware and software. Contractor shall supply all necessary Bus AVL software and other application software required for each identified workstation.

³ Expected usage is provided to aid the Contractor in selecting and configuring the workstation equipment and software.

⁴ This entry is for information only. Voice communications are not required to be integrated into, or supplied with, the proposed CAD/AVL system.

Figure C-3
REQUIRED ON-BOARD VEHICLE EQUIPMENT

DEVICE	QUANTITY Delivered <small>(Note 1)</small> / Ultimate <small>(Note 2)</small>
<u>Mobile Radios:</u>	0 (Note 3) / 0
<u>MDTs & GPS:</u>	
Fixed Route	101 / 115
Paratransit	31 / 86
Supervisor Vehicles	6 / 8
Maintenance/Support	0 / 5
<u>Alarm Switches:</u>	
Fixed Route	101 / 115
Paratransit	31 / 86
<u>Odometer/Dead Reckoning Equipment:</u>	
Fixed Route	101 / 115
Paratransit	31 / 86
<u>Destination Sign Interface</u>	
Fixed Route	101 / 115
Paratransit	0 / 0
<u>Mechanical Warnings, Alarms & Status Points</u>	
Fixed Route	101 / 115
Paratransit	31 / 86
<u>APC Equipment</u>	
Fixed Route	101 (Option) / 115
Paratransit	0 / 0
<u>Mobile Computer Terminals (Future)</u>	
Supervisor Vehicles	6(Option) / 7

Note 1: Delivered quantities specified here do not include required spares. Delivered quantity does not indicate ultimate fleet size. This quantity represents the current fleet size.

Note 2: Ultimate quantity is total, not additional. The Bus AVL system shall accommodate a minimum of 10% growth of the current fleet size over the lifetime of the system. **The ultimate paratransit fleet shall include a 10% growth plus an additional 50 vehicles that may be added to the system in the near future to accommodate a Senior Services fleet.**

Note 3: The existing Motorola mobile radios shall continue to operate independently of the supplied system for voice communications; no interface is required.

**Figure C-4
CUSTOMER INFORMATION DISPLAY REQUIREMENTS (OPTION)**

Location	Routes Served	Video Displays	Bus Bay Signs	Communications Available
Marietta Transit Center	12	2	8	LAN/WAN
Cumberland Transit Center	8	0	7	DSL Link

Appendix D

Cobb County Information Systems Standards

Page D1 – County IS (hardware/software) Standards

Page D2 – Low Voltage Wiring Standards

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County I. S. Standards

County standards for servers, communications, databases, desktops, laptops and tablet PC's.

No device shall require administrator rights to operate in production.

The County prohibits providing administrator or root privileges to servers for executing any software in the production environment.

The County Standards for server operating systems are:

- HP UX 11.11 and higher
- Solaris 10 and higher,
- AIX 5L version 5.2 and higher,
- Windows Server 2003 and higher.

The County standards for the desktop environment are:

- Microsoft Windows XP SP2 and higher
- Microsoft Office 2003
- Microsoft Outlook
- Microsoft Visio
- Internet Explorer 6.0 and higher (SP XPSP 2 and higher)
- ESRI GIS products

The County standards for ad-hoc reporting are:

- Oracle© Discoverer
- Crystal Reports
- MS SQL Server 2000 Reporting Services

The County standards for database management system are:

- Oracle 10g and higher ©
- SQL Server 2005 and higher

The County standards for network protocols communicating externally are:

- Port 80
- Port 443
- Any other ports must be approved by Cobb County Network Security

The County standards for network communication are:

- Ethernet
- Wireless 802.11g/n
- Wireless Cellular Broadband

The County standard for all communications devices is Cisco.

The County standard Telephony System is Cisco Call Manager v4.2.

The County Wiring Standard is published in, [StandarsCableSpecCAT6BLUE2009.document](#).

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CCT AVL RFP



I. Scope of Work

1. Low Voltage Data Wiring
 - a. Vendor is required to provide a Certified Category 6e Structured Wiring System for Data.
 - b. The vendor will provide Modular Relay Racks or Wall Mount Racks per design. All racks must include cable management. More than one Relay rack requires double sided wire troughs between each rack. Vendor is required to terminate the station end of the station cable into a RJ45 connector module. The vendor is required to use a faceplate on all wall locations, and a surface mount jack in the modular furniture. The Vendor is required to use Ivory faceplates with Blue RJ45 connector module inserts. Any faceplate that has an open insert position without a jack installed must be covered with the dust cover/blank cover.
 - c. The vendor will provide homerun cabling from modular jacks in the offices and work areas to modular patch panels in the wire closet. Vendor is required to provide patch panels. Vendor is required to mount the patch panels in the data rack and terminate the closet end of the station cables for data into the panels. The Vendor will allow for network equipment at the top of each rack to be specified per job. Each rack should start with one wire manager then patch panel.
 - d. Vendor will be required to install and homerun any tie cables that are required per job.
 - e. All cabling will be installed in compliance with all applicable national, state and local codes. Specifically, all cable-to-power source separation distances must be maintained. Cables will be securely attached to building structures and not to conduits containing power conductors or Fire sprinkler system.

II. Data Cabling Requirements

- a. Cable Specifications
All station cables will be Plenum rated Category 6e verified Unshielded Twisted Pair cable in Green Systemax part no. 760107219 Description 2091B Color: Green
- b. Contractor will provide patch cables for each drop installed with a Sysitmax patch cord part no. CPCSSX0-04F 007

III. Hardware Requirements

- a. Racks
Modular Relay Racks or Wall Mount Racks per design:
All racks must include cable management. More than one Relay rack requires double sided wire troughs between each rack.
 - Must provide at least 4 Wire managers per data rack

- Chatsworth Black Standard 7'x19" free standing rack 55053-703
- Chatsworth Black Double Vertical Cable through 11729-703
- Chatsworth Concrete floor mounting kit 40604-001
- Chatsworth Black line-up spacer kit 40702-700

b. Data Patch Panel

All data patch panels are required to be Category 6e certified 48 port patch panels.
Systimax Part no. 760051169

c. Data Jacks

All data jacks are required to be Green RJ45 CAT6e modular jacks.

Specified Part Numbers;	Systimax	Comscope Part#
Jack Inserts:	MGS600-226-Green	760092403

Faceplates:

Simplex	M10L-246	(Ivory)	108258419
Duplex	M12L-246	(Ivory)	108168477
Quad	M14L-246	(Ivory)	108168550

Surface Mount:

Duplex	M102SMB-246	(Ivory)	107984049
Quad	M104SMB-246	(Ivory)	107952442
Dust Cover	M20AP-246	(Ivory)	107067860

IV. Numbering

- D-X-X-XX
- Data-Building Letter-Floor-Jack number.
- More information can be given by the IS department of Cobb County.

V. Floor Plan Symbols

There are several different symbols on the floor plan.

- Solid Triangle = Data Outlet with 1 data cable as standard per triangle unless otherwise noted
- Split Triangle = Data Outlet with 2 data cables as standard per triangle unless otherwise noted
- Solid Triangle marked with a "W" = Wall mount data jack with AT&T Face plate
- Solid Triangle marked with a Circle around triangle = Ceiling height data jack with service loop
- Solid Triangle marked with a Box around triangle = Floor box with data jack

VI. Communications Closets

a. Closet Locations

Closets will be located during the design phase of any given project.

See Cobb County I.S. staff for internal room layout. These rooms are generally shared with the internal telephone service group, AT&T, and any other low voltage services like fire and security alarm systems.

b. Conduits

Building Contractor will provide the following:

- Provide 2 4-inch conduits between Main Distribution frame and the Intermediate Distribution Frame.
- Entry Conduits: Minimum of 3 4-inch conduits entering the building from outside utilities. 2 of which must contain 4 1-inch inter-ducts. These provide entry service for Telco and CATV services as well as any future services that may be needed.

c. Grounding

Building Contractor will provide the following:

- Provide Building Ground to each communications rack and the telephone switch location with #6 awg Solid Copper

VII. Miscellaneous Information

a. Fire Stop

Any penetration through firewalls or floor sleeves will have to be sealed with Fire Stop material.

b. Testing

All Data jacks and cable pairs of the station cables must be tested with the use of a TDR (Time Domain Reflectometer) or like tester, to 200 MHz.

- Required 100% usable results

c. Warranty

Submit warranty information with bid proposal. Any cable or component used in the installation must be covered in the warranty.

A minimum requirement for the warranty includes 24 hour, 7 days week coverage for repair or replacement of any component or cable used in the wiring system. Systimax certification is preferred.

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Appendix E
INVENTORY OF VEHICLES

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Figure E-1

INVENTORY OF VEHICLES

Vehicle Type	Current Full Fleet (Year 2010)		Ultimate Fleet (Year 2019)	
	Total (Note 1)	Peak (Note 2)	Total (Note 3)	Peak (Note 3)
Elmwood Facility				
Fixed-Route Vehicles	101	85	(Note 3)	(Note 3)
Paratransit Vehicles	31	20	(Note 3)	(Note 3)
Road Supv. Vehicles	6	6	(Note 3)	(Note 3)
Maintenance/Support Vehicles	3	3	(Note 3)	(Note 3)
FACILITY TOTAL	141	114	(Note 3)	(Note 3)

Notes:

1. The initially installed system shall be expandable to the ultimate fleet size totals solely through vehicle installations per additional fleet installation options and without requiring additional fixed-end components or software.
2. "Peak" indicates the estimated number of vehicles operating during the peak hour of the peak service day.
3. The ultimate fleet size totals represent the future expansion anticipated for the next ten years of service life of the Bus AVL system. CCT estimates a maximum of 10% expansion of its current fleet by the Year 2019.

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Figure E-2
Fleet Equipment Detail Forms

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Cobb Community Transit Fleet Equipment Details

Fixed Route and Express Bus Fleet

2002 Nova

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
15	82VW	40'	J1708	Yes	See Note 1

2002 Nova Bus IDs: 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283.

2004 New Flyer

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
20	DLF40	40'	J1708	Yes	See Note 1

2004 New Flyer Bus: IDs: 4001, 4002, 4003, 4004, 4005, 4006, 4007, 4008, 4009, 4010, 4011, 4012, 4013, 4014, 4015, 4016, 4017, 4018, 4019, 4020.

2005 New Flyer

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
9	DLF40	40'	J1708	Yes	See Note 1

2005 New Flyer Bus IDs: 5021, 5022, 5023, 5024, 5025, 5026, 5027, 5028, 5029.

2008 New Flyer

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
6	DLF40	40'	J1708	Yes	See Note 1

2008 New Flyer Bus IDs: 8030, 8031, 8032, 8033, 8034, 8035.

2010 New Flyer

# of Buses	Model	Length	HD Sign Interface	Farebox	Equip. Box
6	DLF40	40'	J1708	Yes	See Note 1

2010 New Flyer Bus IDs: 1001, 1002, 1003, 1004, 1005.

2003 MCI

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
11	D4500	45'	J1708	Yes	See Note 1

2003 MCI Bus IDS: 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347.

2006 MCI

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
34	D4500	45'	J1708	Yes	See Note 1

2006 MCI Bus IDs: 4039, 4040, 4041, 4042, 4043, 4044, 4045, 4046, 4047, 4048, 4049, 4050, 4051, 4052, 4053, 6069, 6070, 6071, 6072, 6073, 6074, 6075, 6076, 6077, 6078, 6079, 6080, 6081, 6082, 6083, 6084, 6085, 6086, 6087.

Note 1: *See CCT Personnel for AVL equipment locations*

Note 2: *All of the above buses have DR600s.*

Cobb Community Transit Fleet Equipment Details

Paratransit Bus Fleet

2007 Goshen

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
10	4500	25'	No headsign	Yes	See Note 1

2007 Goshen Bus IDs: 700, 701, 702, 703, 704, 705, 706, 707, 708, 709.

2008 Goshen

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
15	4500	25'	Headsign with no itnerface	Yes	See Note 1

2008 Goshen Bus IDs: 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814.

2009 Goshen

# of Buses	Model	Length	Hd Sign Interface	Farebox	Equip. Box
6	4500	25'	No headsign	Yes	See Note 1

2009 Goshen Bus IDs: 900, 901, 902, 903, 904, 905.

Note 1: See CCT Personnel for AVL equipment locations

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Appendix F

BUS AVL SYSTEM PERFORMANCE TESTS

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Appendix F

BUS AVL SYSTEM PERFORMANCE TESTS

This Appendix defines the one hour peak load performance testing conditions which shall be applied during the factory and field tests to prove that the Bus AVL system meets all specified processing utilization, spare capacity and timing requirements when it is supporting all Bus AVL functions and Bus AVL Users, and monitoring and communicating with the peak number of revenue and non-revenue vehicles that it will be required to support.

All specified timing requirements shall be met during this peak load testing including, but not limited to, the Bus AVL display response times, event message availability times, vehicle data reporting rates, Bus AVL display update times, and Bus AVL passenger sign update rates. The Bus AVL system processing load to be performed during the one-hour peak load performance tests is defined in Table F-1.

The peak load performance test conducted during FAT shall utilize all the Bus AVL hardware and software installed in the factory. The loading imposed by the Bus AVL hardware and software not installed in the factory shall be simulated.

The peak load performance test conducted during the Field Performance Test shall utilize all the Bus AVL hardware and software being implemented at that time. The loading imposed by the Bus AVL hardware and software not installed at that time shall be simulated using the same techniques used at FAT.

The peak load performance test shall include the loading of the maximum number of revenue and non-revenue vehicles that are to be supported by the configuration being tested. The loading associated with vehicles that have not been installed at the time of the testing shall be simulated.

Test Configuration

All peak load performance tests shall be conducted with all the Bus AVL hardware and software operational and all installed Bus AVL workstations connected and operational. The Bus AVL system shall be initialized as follows in preparation for the peak load performance test scenario:

- Verify that all equipment and all the Bus AVL functions are operational.
- Verify that the peak load performance testing correctly reflects the required configuration.
- Install all test hardware and software necessary to simulate loading for the required peak number of revenue and non-revenue vehicles.

- Install all test hardware and software necessary to simulate loading from all required data exchanges, system interfaces, and functions that are not yet implemented.
- Install all test hardware and software necessary to simulate Bus AVL workstations loading for the ultimate number of workstations.
- Provide all hardware and software required to measure update times of the Bus AVL displays, response times to the Bus AVL User actions such as display requests, times from detection of events to the availability of the events for display and storage, vehicle reporting periodicity, and other specified performance parameters.
- Define procedures, personnel assignments and associated activities required to conduct the peak load performance testing.

Display Requirements

The Bus AVL displays requested and actions performed throughout the peak load performance testing shall be a mixture of different displays and actions that will reflect actual workstation use. For multi-monitor workstations, the geographic map display shall be presented on one monitor and the remaining monitor(s) shall be used for requesting all other displays and performing any actions not requiring the use of the geographic map display.

**Table F-1
ONE HOUR PEAK LOAD PERFORMANCE TEST LOADING**

This table defines the peak level of Bus AVL system activity expected during a typical morning rush hour. This level of loading shall be executed during the one-hour peak load performance test to demonstrate that the Bus AVL system meets all specified performance, utilization, capacity, and timing requirements. The term “As Specified/Designed” means that the function listed shall be performed in accordance with the specified requirements and the approved design implemented by the Contractor. The term “As Required” means that the function listed shall be performed as necessary to accomplish all other actions or events that occur during the peak load performance tests.

TASK DESCRIPTION	Loading
Operating System	As Required
Restart/Failover	As Required
Interfaces	
Data Exchanges with all implemented computer systems	As required by application, but at least once
Dispatcher Initiated Actions and Communications	
Dispatcher Logout and Dispatcher Login	3 logins and 2 logouts
Data message transfer to individual vehicles and responses from these vehicles (the average data message length shall be 100 characters)	10
Data message transfer to a group of 25 vehicles and responses from these vehicles (the average data message length shall be 100 characters)	2
Reference data retrieval: route schedule lookup	5
Reference data retrieval: display an employee list	2
Bus Operator Initiated Communications	
Bus Operator Log-ins	108
Emergency Alarms	3
Bus Operator and Vehicle Equipment Initiated Data Communications	50

TASK DESCRIPTION	Loading
Other Bus AVL Functions and User Actions	
User Logins/Logoffs (other than Dispatchers)	3 / 3
Automatic Vehicle Location Monitoring	Track and report location and status of 125 revenue and 4 non-revenue vehicles at the required reporting interval. Ten percent of the revenue vehicles shall be off-schedule and two percent shall be off-route.
Bus AVL User Display Requests	30 per workstation
Geographic Map Display Scaling and Translation Operations	12 per workstation
Display Updates	As required for events, user actions and specification requirements
Supervisor initiated text messages	10 per Supervisor vehicle
Reporting	
Recording and entry of data required for reports.	As Required
Reports	Generate 1 report per workstation
Incident Reports	Open, complete the data entry for, and close 5 incident reports per Dispatcher workstation.
Data Storage and Retrieval	
Data Storage	Collect all historical data generated during the performance test.
User retrieval requests involving queries of 3 or more tables	3 total
Playback	Playback of a 15 minute segment of historical data for at least 4 vehicles using the Playback function.

Appendix G
TECHNICAL STANDARDS

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Appendix G

TECHNICAL STANDARDS

In general, the Contractor shall conform to the applicable standards published by the national, international, state, and local standards organizations named below:

AIA	American Insurance Association 1130 Connecticut Ave. NW Ste. 1000 Washington, DC 20336
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018 USA
ASTM	American Society for Testing and Materials International 100 Barr Harbor drive PO Box C700 West Conshohocken, PA 19428-2959
CCITT/ITU	The International Telegraph and Telephone Consultative Committee/International Telecommunication Union Place des Nations CH-1211 Geneva 20, Switzerland
EIA	Electronic Industries Alliance 2500 Wilson Blvd. Arlington, VA 22201
IEC	International Electrotechnical Commission 1 Rue de Varembe Geneva, Switzerland
IEEE	Institute of Electrical and Electronics Engineers 345 East 47th Street New York, NY 10017 USA
ISO	International Standards Organization Case Postale 56 CH-1211 Geneva, Switzerland
ITS	National and Regional ITS Architecture and Standards
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers Association
NTCIP	National Transportation Communications for ITS Protocol

ISA Instrument Society of America

SAE Society of Automotive Engineers, Inc.
400 Commonwealth Drive
Warrendale, PA 15096-0001

TCIP Transportation Communication Interface Profile

UL Underwriters Laboratories Inc.

Uniform Fire Prevention and Building Code

Energy Conservation Construction Code

National Electrical Code, and local code

Board of Standards and Appeals Standards

FCC Rules and Regulations

Factory Mutual Standards

Telcordia Technologies (Bellcore) Standards

Military Standards, as applicable.

The following standards and publications are incorporated herein by reference to the extent applicable. References to these standards shall imply the latest version of the standard, including revisions, in force at the RFP issue date.

<u>Standard</u>	<u>Standard Title</u>
ANSI X3.159 / ISO 9899	C Language Standard
ANSI X3.135 / ISO 9075	Structured Query Language
IEEE 829	Software Test Documentation
IEEE 830	Recommended Practice for Software Requirements Specifications
IEEE 1003 / ISO 9945	POSIX - Portable Operating System Interface
IEEE 1016	Recommended Practice for Software Design Descriptions and Guide to Software Design Descriptions
IEEE 1058	Software Project Management Plans
IEEE 1224	Open System Interconnection (OSI), Abstract Data Manipulation – Application Program Interface (API)
IEEE standard 12207	Software Life Cycle Processes
X Windows ICCCM	Inter-Client Communications Conventions Manual
AS 4802 / IEEE 802 / ISO 8802	Local Area Network Protocol
ANSI X3T9.5	Fiber Distributed Data Interface
21 CFR, Sub- chapter J	DHHS X-Radiation Safety Rules
ANSI C37.90a / IEC 255-4	Guide for Surge Withstand Capability Tests
AS 1469	Methods for the Determination of Noise Rating Numbers
NFPA 262	Test for Fire and Smoke Characteristics of Wires and Cables
ASCII	American Standard Code for Information Exchange
SAE J1455	Recommended Environmental Practices for Electronic Equipment Design (Heavy-Duty Trucks)
SAE J1587	Joint SAE/TMC Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications
SAE J1708	Serial Data Communications Between Microcomputer Systems in Heavy Duty Vehicle Applications (1990-10-05)
SAE J1939	Vehicle bus standard used for communication and diagnostics among vehicle components widely by diesel engine manufacturers
SAE J2030	Proposed Surface Vehicle Standard for Heavy-Duty Electrical Connector Performance Standard
SAE J2202	Heavy Duty Electrical Wiring Systems for Trucks (Draft)
SAE J2496	Transport Area Network Cabling
FCC Part 15	Technical Standard 50-745-01, Part 15, Subpart j, Requirements for a Class B computing device
ISO 9000	

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Appendix H
PROPOSER QUESTIONNAIRE

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Appendix H

PROPOSER QUESTIONNAIRE

To aid CCT in the evaluation of the proposed Bus AVL system, the Proposer shall answer the questions listed below and submit responses as part of the submitted proposal.

In responding to the following questions, the Proposer shall maintain the question numbers and shall repeat the question with the response. Technical Specification references are included with the questions, where applicable. A question may be answered by a specific reference (document title, volume, section, page, and paragraph number) to the proposal and/or by accompanying documentation.

1. **Functions** – Describe the applications proposed to fulfill each of the functional requirements in Section 2 of the Specification. For each application, categorize the software as one of the following:
 - a. **Standard:** For standard applications also indicate: (i) The date and project name of the initial release; and (ii) The programming language, operating system, and processor family of the initial release.
 - b. **Modified Standard:** For modified standard applications, indicate the extent of modification necessary to fully conform to the requirements of this Specification.
 - c. **Custom:** For custom applications, indicate: (i) New software is to be written by the Proposer; or (ii) A new third-party package is to be integrated with the Proposer's software.
2. **Standard Offering** – Describe your standard offering and highlight major differences between the standard offering and the Specification requirements, including those proposed features that exceed Specification requirements. (2.2.3)
3. **Security** – Describe mechanisms that will be applied to prevent unauthorized users from accessing the Bus AVL system and preventing unauthorized access to specific Bus AVL functions. (2.3)
4. **Bulk Data Transfer** – Describe the mechanisms proposed for bulk data transfer to/from revenue and non-revenue vehicles. (2.6)
5. **Remote/Shared Users** – Describe the method proposed for supporting remote and shared users (2.14).

6. **Incident Management** – Describe the proposed implementation of the incident forms function, including linking multiple events to an incident report. Describe any capabilities for defining new incident form types. (2.14.8)
7. **Paratransit Customer Locator (Option)** – Describe in detail how the proposed system will perform this function, including the associated user displays and actions. Also indicate if this function is currently supported by the proposed system or whether custom development is required. (2.14.10)
8. **Fixed-Route Schedule Data Maintenance** – Describe the functions to be provided to enter and maintain CCT's schedule data, including the service(s) to be provided for the initializing the data in the Bus AVL system. (2.15.1)
9. **GIS Data Import and Maintenance** – Describe the import and cutover process for incorporation of new GIS data for the AVL map data and define all impact to online operations, including whether system downtime is required. If system downtime is required, the description shall state the maximum downtime that will occur for the initial and ultimate configuration of the Bus AVL system. (2.15.2)
10. **Vehicle Location Reporting** – Describe the proposed method to validate and back up the GPS for vehicle location reporting. (2.16.3)
11. **Automatic Arrival Reporting (Option)** – Indicate whether automatic arrival reporting is supported as a standard function of the base offering, or whether custom development will be required. (2.17.2.7)
12. **Onboard Audio and Visual Announcements (Option)** – Describe how the offered system will implement audio and visual announcements and indicate whether the existing DRI equipment will be re-used. (2.16.7)
13. **Bus Excessive Idle Time Monitoring (Option)** – Describe the method proposed for determining when a bus is in an idle state. Indicate whether this is an existing or new feature of the proposed system. (2.16.8)
14. **Safe MDT Usage Enforcement (Option)** – Describe how the proposed system will perform the Safe MDT Usage function, including the configuration capabilities and the specific functions that can be inhibited. Indicate if this function is currently supported by the proposed system or whether custom development is required. (2.16.9)
15. **Traffic Signal Priority (Future)** – describe the proposed system's capability of supporting TSP functionality and equipment at a future date, including a description of the Proposer's standard TSP offering. (2.16.10)

16. **Mobile Computer Terminal (Option)** – describe the proposed system’s capability of supporting MCT functionality and associated vehicle laptop equipment, including a description of the Proposer’s standard MCT offering. (2.18.3)
17. **Paratransit Manifest Monitoring (Option)** – Describe the proposed paratransit manifest monitoring function, including whether this functionality is currently supported by the Proposer’s offering or if custom development is required. (2.18.4)
18. **Passenger Information Displays (Option)** – Describe, in detail, the proposed passenger information display system for each of the specified locations, and the ability to add signs and locations in the future, including the effort needed to do so. The discussion should include where the Proposer has implemented similar sign systems. (2.21, 5.13)
19. **Web-based Real-time Passenger Information (Option)** – Identify where web-based RTPI functions have been implemented that are similar to those proposed for the Bus AVL system. (2.22)
20. **Paratransit Scheduling System Interface (Option)** – Identify where an interface to a RouteMatch paratransit scheduling system has been implemented with the same generation CAD/AVL software proposed for the Bus AVL system, whether the standard RouteMatch interface format and protocol was used, and any additions or modifications to the scheduling system data that may be required to support the required paratransit scheduling system interface. Also indicate the features and capabilities of the proposed interface software to support future upgrades to the RouteMatch scheduling system software. (2.23.2)
21. **Other Transit Operators Interface (Future)** – Describe the ability of the proposed Bus AVL system to be expanded to accommodate the future interface to other transit operator systems for the exchange of operational data. (2.23.5)
22. **Other Scheduling System Data (Future)** – Describe the capability of the Bus AVL system to support future data exchanges with external systems that are in accordance with NTCIP standards, including plans and commitments to support interface standards in the future. (2.23.6)
23. **User Displays** – Provide a sample dispatching (CAD) display and AVL map display showing the header, symbols, labels, and color/flashing attributes proposed for the Bus AVL system. (3.2)
24. **Display Types** – Identify all standard displays that are normally included with the base CAD/AVL system product. (3.2)
25. **Reports** – Provide samples of standard reports included in the proposed system. (3.3)

26. **COTS Software Procurement (Option)** – provide a detailed list of all required COTS software items including quantities, provisioning, and other requirements necessary for CCT to independently procure the indicated COTS software items. (4.1)
27. **Operating System Software** – indicate whether MS Windows Server 2008 and/or Windows 7 are currently supported and, if not, the expected migration of the Proposer’s offering to MS Windows Server 2008 and/or Windows 7. (4.3)
28. **Virtualization** – does the proposed system support virtualization? If so, indicate the specific virtualization products supported. If not, note any future plans for supporting virtualization. (4.3)
29. **Hardware Characteristics** – Describe any alternative hardware configuration being proposed that is better suited to the characteristics of the Proposer's standard product(s) if it represents a superior compromise between performance and cost. (5.)
30. **COTS Hardware Procurement (Option)** – provide a detailed list of all required COTS hardware items including quantities, provisioning, and other requirements necessary for CCT to independently procure the indicated COTS hardware items. (5.1)
31. **Bulk Data Transfer Interface** – Describe the specific security measures proposed for the bulk data transfer interface. Also include recommendations on wireless LAN management hardware and software, and communication diagnostic tools to support network tracking, monitoring, and control. (5.12.1)
32. **Vehicle Equipment Specifications** – Provide the power and environmental specifications of the proposed vehicle equipment and identify the environmental tests and standards to which the proposed vehicle equipment conforms. (5.14)
33. **Touch Screens (Option)** – describe, in detail, the proposed touch screen hardware characteristics and technology. (5.14.1.1.1)
34. **Vehicle Area Network / Standards** – Describe plans and commitments for on-board products that will meet NTCIP standards and how the proposed Bus AVL equipment could be upgraded in the future to meet these standards. (5.14.2)
35. **Additional Navigation Equipment** – Identify and describe all navigation equipment that is included in the offering as a supplement or backup to GPS. (5.14.6)
36. **Vehicle Operator Training Hardware** – Include the cost of each additional set of training equipment beyond the quantity specified through the warranty period. (5.15)

37. **Power Requirements** – Furnish the maximum startup and surge load, the individual components and system steady-state kVA load, and the input power conditioning requirements. (5.19)
38. **Uninterruptible Power Supplies** – Describe the equipment and configuration proposed for the UPS equipment for all supplied equipment other than that installed in CCT’s server room, including a list of all Bus AVL devices to be supplied from the UPS equipment. (5.19.2)
39. **Heat Loads** – State the individual and total heat load of the equipment at each equipment location. (5.20)
40. **Equipment Space** – The Proposer shall describe in the proposal the space requirements for all Bus AVL equipment to be installed in the CCT server room, at each workstation location, and at other locations where equipment will be installed. The description shall include a proposed layout for the Bus AVL equipment within the server room. (5.23)
41. **System Configuration** – Provide a detailed system configuration block diagram illustrating the proposed Bus AVL equipment configuration, including the test system configuration. (6.1)
42. **Redundancy** – What servers and other devices are redundant in the proposed Bus AVL system? For each redundant device, list the types of failures that will result in device failover. (6.1.6, 6.1.7)
43. **Training** – Provide a list and descriptions of all training courses included in the proposed training program. (8.1)
44. **Base Maintenance Agreement (Option)** – Include in the base proposal separate maintenance contract pricing for this Base Maintenance Agreement per year for five (5) years. Where applicable, the pricing shall be based on equipment population, with total cost equal to a per-unit cost multiplied by the number of units under contract. The per-unit cost for additional units shall be provided in the Pricing section of the proposal. The Proposal shall also include a sample Maintenance Agreement contract for these services. (8.3.4.1)
45. **Maintenance Agreement Alternatives (Option)** – Propose maintenance contracts and alternative maintenance plans for review by CCT to maintain the Bus AVL system after the warranty period. Recommended maintenance contracts shall include contracts from the Contractor, the computer OEM, the mobile radio equipment OEM, and other equipment OEMs for maintenance of the Bus AVL equipment. The Proposer shall also offer software maintenance and update services, and upgrade services, as recommended by the Proposer. (8.3.4.2)
46. **Bus Operator Manual** – provide a sample of a Bus Operator manual for the proposed system. (9.11.6.2)

47. **General** – Identify any observed deficiencies in CCT fixed site facilities where proposed Bus AVL equipment is to be installed.

Appendix I
CCT SERVICE AREA MAPS

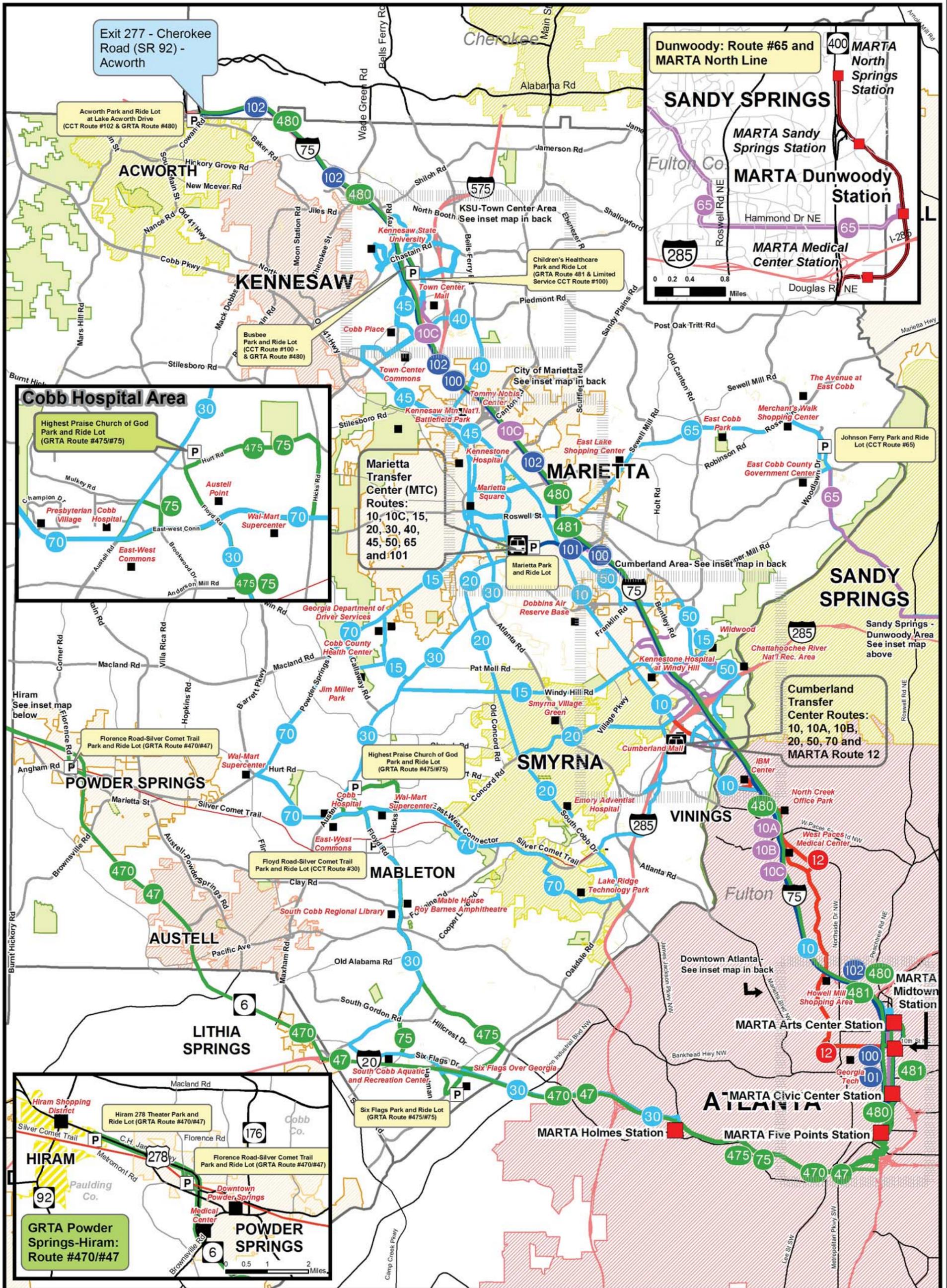
Page I1 – Fixed-route Service Area Map

Page I2 – Paratransit Service Area Map

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Cobb Community Transit (CCT) System Map

June 2007



Exit 277 - Cherokee Road (SR 92) - Acworth

Dunwoody: Route #65 and MARTA North Line

SANDY SPRINGS

MARTA Sandy Springs Station

MARTA Dunwoody Station

MARTA Medical Center Station

MARTA North Springs Station

0 0.2 0.4 0.8 Miles

Cobb Hospital Area

Highest Praise Church of God Park and Ride Lot (GRTA Route #475/#75)

Presbyterian Village

Cobb Hospital

Austell Point

Wal-Mart Supercenter

East-West Commons

0.5 1 2 Miles

Marietta Transfer Center (MTC)

Routes:

10, 10C, 15, 20, 30, 40, 45, 50, 65 and 101

Cumberland Transfer Center

Routes:

10, 10A, 10B, 20, 50, 70 and MARTA Route 12

Hiram Shopping District

Hiram 278 Theater Park and Ride Lot (GRTA Route #470/#47)

Florence Road-Silver Comet Trail Park and Ride Lot (GRTA Route #470/#47)

Downtown Powder Springs

Medical Center

HIRAM

POWDER SPRINGS

GRTA Powder Springs-Hiram: Route #470/#47

0.5 1 2 Miles

Legend

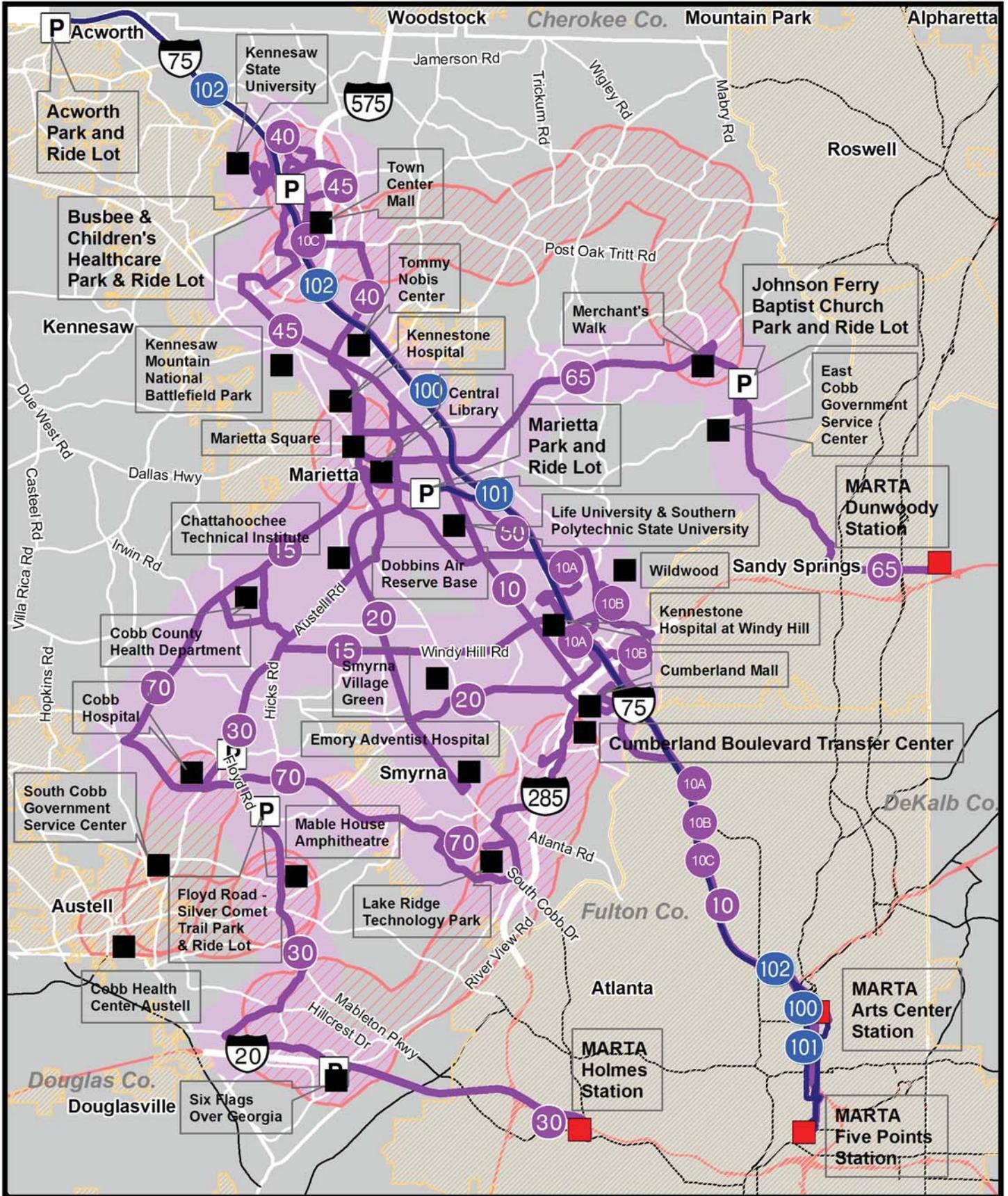
- Local Routes
- Local Route
- Peak-Hour Service Only
- Peak-Hour Express Route
- GRTA Xpress Route
- MARTA Bus Route
- MARTA Rail Station
- MARTA North Line
- CCT Park and Ride Lot
- CCT Transfer Center
- Points of Interest
- Municipality
- Park

Cobb County
Department of Transportation

0 1 2 4 Miles

LWS 6-1-07

Cobb Community Transit (CCT) System Map- Paratransit Service June 2008



	Legend	— CCT Service Routes	 CCT Paratransit Service Area
	P CCT Park and Ride Location	— CCT Express Routes	 CCT Grandfathered Area

Scale

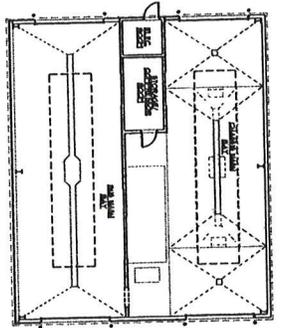


0 1 2 4
Miles

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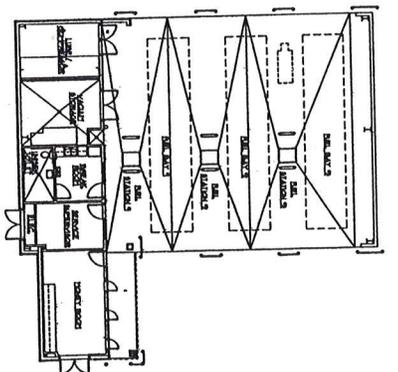
Appendix J
CCT FACILITY FLOOR PLAN

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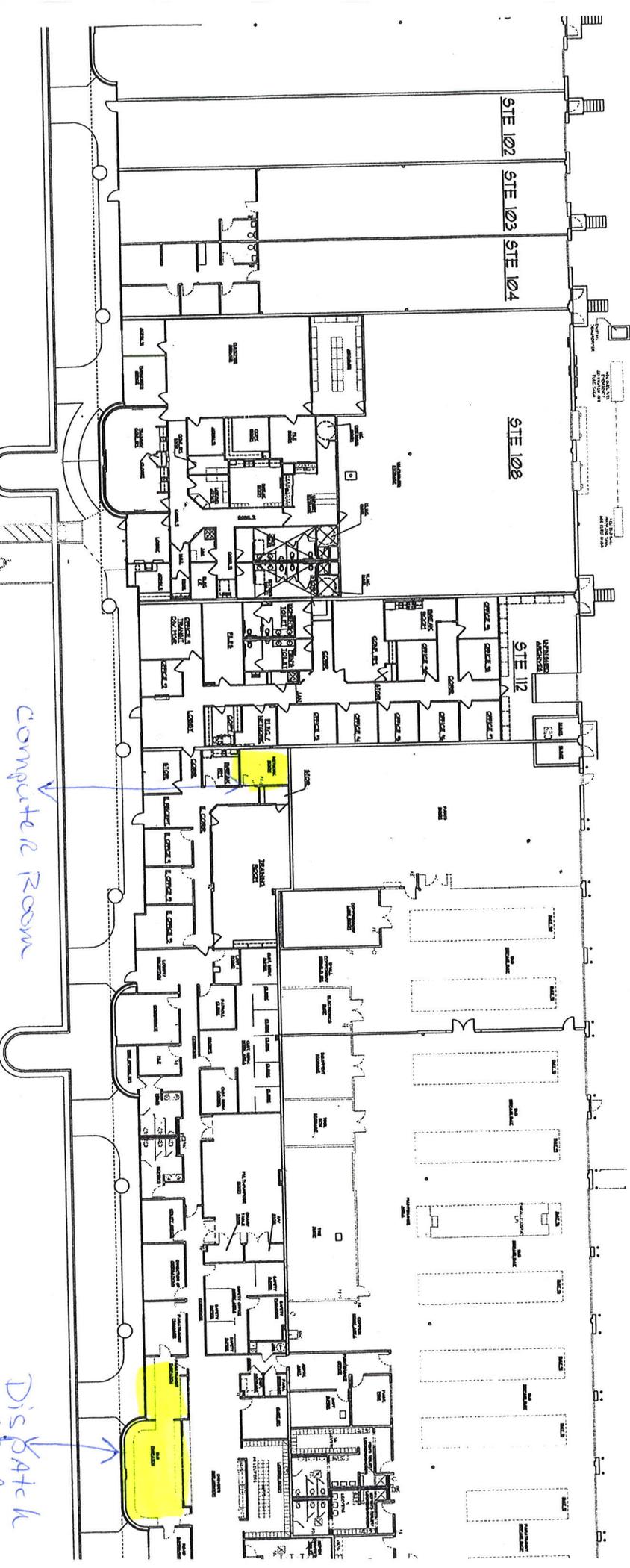
WASH BUILDING PLAN

SCALE: 1/8" = 1'-0"



FUEL BUILDING PLAN

SCALE: 1/8" = 1'-0"



Computer Room

Disk Rack