

Real-time Information System (RTIS) Functional Specifications

Presented to:



Submitted by:

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and HNTB

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LIST OF ABBREVIATIONS AND ACRONYMS

ABD	As-Built Document
ADA	American with Disability Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AIL	Action Items List
ATP	Acceptance Test Procedures
BT	Burn-In Testing
AVL/CAD	Automatic Vehicle Location/Computer Aided Dispatch
DMS	Dynamic Message Signs
DRD	Design Review Documentation
GTFS	General Transit Feed Specifications
IDD	Installation Design Documentation
ITS	Intelligent Transportation Systems
LAN	Local Area Network
LED	Light Emitting Diode
MM	Maintenance Manuals
MTTA	Metropolitan Tulsa Transit Authority
NTCIP	National Transportation Communications Interface Protocols
NTP	Notice To Proceed
RM	Requirements Matrix
RR	Requirements Review
RTIS	Real-time Information System
SA	System Acceptance
SIP	System Implementation Plan
SM	Systems Manuals
ST	System Testing
TMS	The Master Scheduler
TP	Training Plan
TRD	Test Results Documentation
UM	User Manuals
WLAN	Wireless Local Area Network

1 Introduction

These specifications define the functional and performance; installation; and project management requirements for the implementation of a real-time information system (RTIS) for the Metropolitan Tulsa Transit Authority (MTTA) in Tulsa, OK. These requirements are not intended to be restrictive and are considered the minimum requirements of MTTA.

The Contractor is required to provide a complete functioning system that meets all requirements, inclusive of all hardware, software, communications connections, power connections, cabling, mounting hardware and other items required for the complete functioning system.

The Contractor will include in their proposal all costs required to design, provide, install, test, and maintain a complete RTIS in accordance with the requirements.

To ensure compatibility and uniform system operability, the RTIS must fully integrate with the existing Spatial Positioning on Transit (SPOT®) System from ETA Transit Systems. The selected Contractor will be responsible for maintaining the hardware and software systems required to achieve a reliable and consistent connection with the SPOT® platform, the data generated by SPOT®, and information feeds from SPOT®.

This document includes the following sections:

- Section 2 describes the existing system environment at the MTTA;
- Section 3 defines MTTA's information technology requirements for the RTIS;
- Section 4 defines the specifications for the dynamic message sign (DMS) hardware and software, DMS controller and central real time information system (RTIS);
- Section 5 defines the project management requirements;
- Section 6 defines the design review requirements;
- Section 7 defines the general installation requirements;
- Section 8 defines the acceptance testing requirements;
- Section 9 defines the documentation and training requirements;
- Section 10 defines the spares and warranty requirements;
- Appendix A includes information about DMS mounting at BRT stations;
- Appendix B contains the Price Proposal Form; and
- Appendix C contains the Compliance Matrix.

2 Background

2.1 Agency Profile

The MTTA, also known as Tulsa Transit, is the authority that provides a variety of public transportation services for the Tulsa metro area and beyond. Tulsa Transit operates fixed route and demand-response services for people with disabilities and those living outside the fixed-route service area. The MTTA operates a total of 62 vehicles (increasing to 67 with the new BRT service) on its 18 fixed routes and 47 paratransit vehicles. Annual trips provided on both of these services is approximately 3.12 million.

The MTTA is developing a bus rapid transit (BRT) line along Peoria Avenue, also known as the Peoria AERO BRT. A feature of this new service will be the display of real-time bus arrival predictions at BRT stations along the route. The BRT line is expected to begin revenue operations in September 2019.

The RTIS signs at BRT stations will be installed in 2019 as part of the development and construction of the BRT stations. Station construction is expected to be completed by July 1, 2019.

2.2 Existing System Environment

2.2.1 On-board System

Please note that this section is provided as background only for the Proposer.

MTTA is in the process of implementing an automatic vehicle location and computer-aided dispatch (AVL/CAD) system that will generate the basic information required to predict bus arrivals at each BRT station. MTTA has contracted with ETA Transit to implement their SPOT® program to provide the capability to make real-time bus arrival predictions. The ETA SPOT® system is expected to be implemented and operational in 2018.

The procured RTIS will enable MTTA customers to view scheduled and predicted arrival/departure information at 42 designated station locations and transit centers.

All MTTA fixed-route vehicles (62 now and 67 in the future when the Peoria BRT begins operation) will be installed with vehicle logic units (VLUs) provided by ETA. These VLUs shall report on current vehicle locations at an interval of 10 seconds to the ETA SPOT®. Also, these VLUs will provide schedule adherence reports to the central SPOT® system when crossing a timepoint. When a vehicle deviates from a pre-defined route, the central SPOT® system logs the off-route event and notifies the Dispatcher.

2.2.2 Fixed-end System

Please note that this section is provided as background only for the Proposer.

MTTA uses Trapeze FX provided by Trapeze for scheduling its fixed-route service. ETA's SPOT® system is NOT integrated with Trapeze FX to obtain route and schedule data. Rather, it uses the General Transit Feed Specification (GTFS) data which is generated by Trapeze FX to calculate route and schedule adherence (and in the future, the performance of other activities such as automated stop announcements).

2.3 RTIS Project Overview

The purpose of this project is to enhance the technologies being deployed at the MTTA to provide real-time information to Peoria BRT customers via DMS as defined in Table 1.

Table 1. RTIS Configuration

Information Category	DMS at BRT Stop Locations
Real-time information on next bus arrival/departure. (In general, the system will be required to display predicted next bus arrival information, which comes directly from the ETA SPOT® system.)	PD*
Real-time information on service disruption and alternatives	PD
Planned detour information	PD
Real-time information on transfer availability	PD
Real-time information alerts	PD
Current status of (availability of) real-time information	PD
Emergency information (e.g., AMBER alerts)	PD

* PD is pushed out based on system parameters

A high-level overview of the desired RTIS for the MTTA Peoria BRT is provided in Figure 1. As shown in Figure 1, the system will be required to obtain real-time predicted and/or schedule adherence (as required by the proposed solution) information from the new AVL/CAD system provided by ETA and shall be disseminated to MTTA BRT customers via DMS. Please note that Proposers shall describe in their proposals providing those elements on Figure 1 that are in yellow highlight.

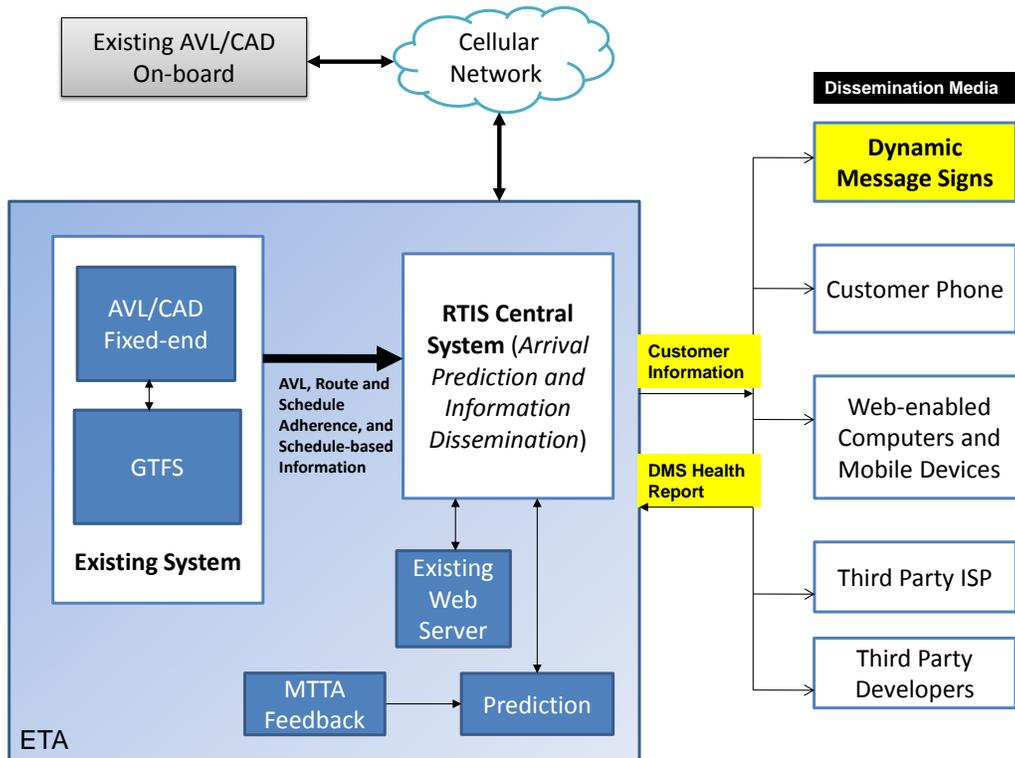


Figure 1. System Overview of the RTIS System

3 Information Technology and Data Communication Requirements

3.1 General

The proposed system shall follow an open architecture model, providing the capability for the agency to independently develop system interfaces or enable integration with other internal or third-party systems. The use of standard network communication protocols (e.g., transmission control protocol/internet protocol [TCP/IP]) and system interfaces (e.g., open database connectivity [ODBC] for databases) is required. The database structures and any proprietary interfaces shall be documented to the agency. The agency shall be allowed royalty-free access to the database tables, and royalty-free use of the data and interfaces. If necessary, the agency shall be allowed to extend such access and use to third parties for integration purposes.

The software application shall include context sensitive help capability.

All software applications must utilize the Microsoft Operating System consistent with current MTTA upgrades, patches and service packs on the servers and desktops.

The Contractor is required to notify MTTA when new releases of software applications become available, and when current releases and related systems are no longer supported.

The Contractor must comply with the MTTA's change management process when making any changes to supported systems; these changes must be reported to the MTTA project manager.

The Contractor shall implement a test environment, with all software components installed on parallel computer hardware at MTTA or the Contractor's hosted environment, where software updates and configuration changes can be tested prior to being implemented in the production system. Any future updates or upgrades must be tested in the test environment before being implemented on production servers.

3.2 Computer Hardware

Proposers shall describe all software and hardware components that comprise the proposed central system including the required number of licenses for all users. The capital and ongoing maintenance cost of each component shall be provided as per the instructions in the Price Proposal Form in the Request for Proposals (RFP).

MTTA expects that all software be installed on hardware that is in a hosted environment, so no hardware is installed at MTTA.

All software applications shall support and run on current shipping release of the hosted servers.

All servers that are part of the proposed solution shall be fully redundant and capable of automatic failover without administrator intervention. Proposers shall clearly describe the approach adopted to ensure fail-safe operation of their system in the event of a failure of the primary server(s), networks or network storage.

The RTIS server(s) shall be configured to perform the load balancing to account for variability in the number of information requests from MTTA customers.

3.3 Database

All data shall be the property of the MTTA and shall be immediately available to the MTTA.

Data generated by the AVL/CAD and RTIS shall be retained in a read-only historical database for use by management and other MTTA staff to plan and assess system performance, and to address inquiries, conflicts and related issues.

The system shall allow all such data to be retrieved, even if it has been archived.

In addition, the system shall include a means of archiving transaction data, or restoring data from an archive, while the system is in operation. It shall not be necessary to shut down the database to perform a successful backup operation.

The Proposer shall determine and describe the need and procedures for an incremental, daily or other time frame-based back up of the data generated by the AVL/CAD and RTIS. Other needs related to the archiving of this data, such hardware and software, shall also be determined and described by the Proposer.

The Contractor must provide the following:

- Scripts in order to recreate database schemas, stored procedures;
- Entity relationship diagrams;
- Database schema with a data dictionary detailing all database entities (e.g., tables, columns, and attributes); and
- Recommended practices document for support and maintenance of the database.

3.4 Information Security

Proposed software applications must run fully in the user context and shall not require elevated permissions or administrative permissions on the desktop.

The methods used for encrypting stored passwords must be disclosed. Industry standard encryption methods utilizing at least 256 bit encryption techniques are required. Applications may not store passwords in clear text.

Any vulnerabilities or exploits discovered by the Contractor or others for the proposed application must be reported to MTTA immediately with a proposed mitigation strategy.

The System Administrator (SA) account shall not be used. If it is, the solution must require MTTA staff to change the SA password on a periodic basis.

All software applications must support role-based security.

3.5 Data Communication System

The Proposer shall specify if communication infrastructure modifications are needed in the event that the current communication infrastructure is not adequate to facilitate two way data communication required between the central system and the DMS.

Proposers shall identify the specific hardware and software that will be required for both wired and wireless data communication alternatives to accomplish above data communication needs.

Proposers shall provide the price for each hardware or software component identified as part of the proposed alternatives.

4 Functional Specifications for the RTIS

4.1 General

The RTIS system shall interface with the ETA SPOT system (which will provide predictions of bus arrivals at each Peoria BRT station using procedures or an algorithm).

The Contractor is required to develop an interface with the ETA SPOT system to obtain real-time arrival prediction and schedule adherence data.

Predictions will be displayed on light emitting diode (LED) dynamic message signs (DMSs) which shall be mounted at each BRT station. All DMSs shall be double-sided displays.

The RTIS system shall have the capability of supporting larger or smaller DMSs including, but not limited to, multiple route arrivals, bus bay assignment messages and other custom messages created by MTTA dispatchers and managers.

Equipment components shall be replaceable as discrete units and identified by unique serial numbers. Each connector shall be keyed or otherwise configured so as to prevent inadvertent mis-wiring during equipment replacement.

Equipment modules, cables, mounting hardware and connectors shall be designed to withstand the full range of operating environments found in the areas in which they are to be installed, and shall not interfere with the operation of existing equipment.

Equipment inputs and outputs shall be protected, to absorb "routine" electrostatic discharges, over-voltages and reverse polarity conditions. In the event of "extraordinary" conditions, equipment shall be designed to sacrifice inexpensive and easily identifiable components when necessary to protect more expensive components or those less easy to troubleshoot.

Equipment shall operate in accordance with these specifications for ambient temperatures from -22°F (-30°C) to 144°F (+60°C).

Equipment shall withstand without damage being stored for extended periods in ambient temperatures from -40°F (-40°C) to 158°F (+70°C).

Equipment shall operate in accordance with these specifications for ambient humidity from 5% to 80%, non-condensing.

Equipment shall be sealed against dust and water intrusion, certified in compliance with the NEMA 4 or IP65 standard (or better).

Equipment shall be housed in enclosures that cannot be opened with standard hand tools, and resist damage from vandalism.

Equipment shall conform to FCC Part 15 Class A limits for conducted and radiated emissions of electromagnetic interference and radio frequency interference.

The system shall meet or exceed all American with Disability Act (ADA) requirements found in 49CFR Parts 37.167 and 38.35, as well as the requirements of the current version of the ADA Accessibility Guidelines (ADAAG) at the time of implementation. Compliance involving readability distance shall involve the selection of sign face and

character features, including background contrast, high character brightness, character font selection, number of pixels per character, character aspect ratio and number of pixels separating characters.

As described in detail below, arrival messages shall be updated in real-time based on data from the AVL/CAD system and displayed on the DMSs. Updates shall occur at least once per minute at a minimum.

DMSs shall be capable of:

- Providing both visual and audible information;
- Displaying the estimated arrival/departure time of AVL-equipped vehicles on multiple routes;
- Displaying the scheduled arrival/departure time of vehicles on multiple routes if real-time predictions are not available (e.g., because real-time vehicle locations are not available) or are below the accuracy threshold defined by MTTA;
- Two-way communication for diagnostic purposes and transmitting status and/or error messages to the central system; and
- Scrolling messages horizontally or vertically.

In addition, the format of the display shall be configurable by MTTA.

4.2 DMS

4.2.1 Display

4.2.1.1 Hardware

The Contractor shall install forty-two (42) double-sided LED DMS at the BRT stations along MTTA's Peoria BRT¹. MTTA will specify the locations of these bus stops at a later time. An overview of DMS units to be installed is provided in Table 2.

Table 2. Details of DMS

Type of DMS	Location	Location type	Character height	Number of Characters per line	Number of lines	Quantity
LED-double faced	Peoria BRT Stops	Outdoor	3"	30	4	42

The LED DMSs shall be capable of displaying information on four lines. The display shall be a maximum of 32" wide and no more than 12" deep. The DMS shall be capable of displaying 30 characters on each line and the character height should be 3" tall. The final DMS dimensions will be approved by MTTA.

DMS controllers shall be capable of being configured and maintained remotely via wired or wireless network and locally using a laptop computer or other portable programming device (e.g., via a USB port, an Ethernet port, or an

¹ Please refer to the description and drawing in Appendix A for further details on the layout of each Peoria BRT station

RS-232 console). Please note that wireless shall be the primary method of communication. These devices may also be used for performing routine diagnostic maintenance on the DMS.

Maximum DMS intensity shall be along the axis perpendicular to the sign face and at least 50% of this maximum intensity shall be maintained within a cone spanning 22 degrees in any direction from this axis.

DMS messages shall be readable by a person with 20/20 corrected vision within the cone of maximum intensity at up to 40 feet from the sign face per inch of character height, under the full range of ambient illumination conditions.

The LED half-life (time until light output has diminished by 50% from the original rated value) shall be a minimum of 100,000 hours.

The Proposer shall submit, for each DMS:

- Dimensions of display area;
- Enclosure dimensions and construction/material details;
- Recommended installation method;
- Requirements for and dimensions of all installation hardware;
- Weight of DMS and associated installation hardware;
- Power requirements (voltage, peak and average current draw);
- Communications method between DMS and control software;
- Available display colors; and
- Available enclosure colors.

4.2.1.2 Enclosure

DMS must be protected using vandal-resistant enclosures.

DMS electronics shall be contained within an enclosure providing a NEMA 4 level of protection from the ambient environment.

The exterior of the DMS enclosure shall be of a color and finish compatible with the marker (see Appendix A), and will be approved by MTTA.

The front face shall provide high contrast, low sunlight reflection in all weather and site conditions.

The enclosure shall be durable in extreme weather and site conditions as discussed in Section 4.1.

Displays shall be legible when sunlight is shining directly on the display face or when the sun is directly behind the display.

Specifically, LED DMSs shall incorporate photoelectric sensors for the purpose of varying the brightness of the LEDs to maintain the readability distance requirements under the following ambient illumination conditions:

- Dimming the LED brightness when the photocell indicates a drop in ambient light levels to a “night” condition.
- Increasing the LED brightness when the rear-mounted photocell indicates that the sun is facing the rear of the sign and creating a silhouette effect.

The display housing shall provide safe and convenient front service access for all modular assemblies, components, wiring, and other materials located within the housing.

All internal components shall be removable and replaceable by a single technician with basic hand tools.

Service access shall involve unlocking and opening one or more hinged front face panels.

Removal of a display module will not be required to access the internal components of the display.

4.2.2 Audio Announcement

Signs at stops shall include a manually-activated audio announcement system, which shall read out the sign text once successively in English and Spanish after a pushbutton has been pressed.

Audio sign messages shall be constructed in real-time by the DMS in a manner that avoids the need to send audio data over a cellular network, using either prerecorded announcements or text-to-speech generation of quality acceptable to MTTA.

The audio announcement system shall be made through speakers built-in to the DMS enclosure or installed nearby.

The pushbutton must be mounted no higher than 48 inches and no lower than 15 inches from the finished floor of the shelter or kiosk.

An unobstructed pathway no less than 36 inches wide connecting the pushbutton to an adjoining or overlapping accessible route must be provided. A clear floor space of no less than 30 inches wide by 48 inches long must exist at the device (wheelchair footprint).

The pushbutton must be operable with one hand; not require tight grasping, pinching, or twisting of the wrist; and the force required to activate the button shall not exceed 5 pounds-force (22 Newtons).

The pushbutton shall emit a brief low volume sound every few seconds (e.g., "chirp") to guide the visually impaired to the pushbutton location (optional requirement). The low volume sound shall be made only when a motion is detected near the push button. The installation location of the push-button shall be such that any unwarranted motion detection is avoided.

The audio volume shall be automatically adjusted based on the current ambient sound level in front of the DMS to ensure that it is only loud enough to be understandable within a configurable distance from the installation location of the DMS.

4.2.3 Controller

Each controller shall be connected to photoelectric sensor(s) sufficient to automatically adjust LED output to address the requirements for legibility under varying ambient illumination conditions.

The controller shall have a time of day clock and calendar. The time and date can be synced using a Network Time Protocol server or using the central software time at MTTA.

The controller shall incorporate a real-time clock capable of maintaining the current date/time for up to 14 days without external power supply. The controller shall be capable of receiving updated date/time data from the central software and using this data to update the real-time clock.

Public information messages/schedules and display configuration shall be stored in a minimum of 10MB or larger, as required by MTTA, of non-volatile memory, to enable the immediate restoration of these messages when power is restored after a power loss.

The controller shall be configurable with a unique name for the display. When powered on, the DMS shall present the following information at a minimum on the display:

- Name of the sign;
- Product name;
- Firmware version;
- Communication port configuration information;
- Hardware address of the controller; and
- Day, date, and time.

Next vehicle arrival prediction messages shall be generated by ETA and automatically input into the controller, incorporating the arrival time prediction data as it is received from the central prediction software (part of ETA's SPOT system).

The format of the message template shall be "(route#) (route/destination name) (countdown)" or an approved alternative format agreed with MTTA.

When the sign receives a message from the central software indicating that current prediction data is not available, the DMS shall display an alternate message approved by MTTA.

The controller shall be capable of displaying messages on multiple sequential "pages". For example, displaying a next vehicle arrival message, and a date and time message, each within a single row, would use an alternating sequence of two one row message "pages."

Hold times for each message display and the blanking interval between message displays shall be variable in at least one (1) second increments.

The DMS shall include ongoing self-diagnostics and shall send an alarm message to the central software in the event that a diagnostic fault is detected. Proposers shall describe the type of alarms that can be generated by the proposed DMS.

4.2.4 Data Communication Interface

The DMS controller shall be able to receive instructions from and provide information to central diagnostics/control software over the communication network infrastructure to be provided by MTTA. The proposed DMS shall be able to communicate over a cellular network via an RJ45 wired connection to an MTTA switch to the sign controller.

There will be one modem per station pair.

The network interface cards to be proposed with the sign shall be able to interface with MTTA network.

The DMS data communication equipment shall be housed within the sign case.

Interface with central system shall utilize National Transportation Communications Interface Protocols (NTCIP) standards, allowing additional signs to be added to the system without contractor support. An Interface Control Document (ICD) must be provided.

The controller shall be able to run independently from the central software allowing the DMS to operate even when the DMS is not in communication with the central software, including the ability to autonomously countdown the arrival predictions as time progresses even though not receiving further arrival prediction updates.

The DMS controller shall be able to receive instructions from and provide information to a local computer equipped with diagnostics/control software through a serial, RJ45 or USB port.

The data-link protocol will use a check summing technique to guarantee packet integrity. Packets must be discarded if the packet's check sum is not valid.

Each DMS on the network will be assigned a unique physical address.

The controller and other DMS equipment shall be located in the BRT station marker, as shown in Appendix A. An equipment shelf will be provided in the marker.

4.2.5 Power Consumption

Proposers shall describe the capabilities of their DMS solution in keeping the power consumption low (e.g., ability suspend or go into standby mode when no information is being disseminated at night).

The proposed DMS shall be powered from an electrical circuit contained in the BRT station.

4.2.6 Installation

The final installation locations of the DMS will be determined by MTTA.

The installation design of DMS, including the mounting of DMS, location of power conduits for DMS, push-button for audio announcement, and data modem antenna shall be approved by MTTA prior to installation.

The DMSs shall be installed by the shelter/marker fabricator, then the Contractor will prepare each DMS for operation, including power, communication and configuration. Close coordination is required between the shelter/marker fabricator and the Contractor.

The Contractor shall connect the signs to the local power supply and communication provided by MTTA at each sign location, including DMS and mounting hardware grounding as well as the provision of a power disconnect near the DMS that is accessible without need to touch the DMS enclosure.

4.3 Central RTIS Software

4.3.1 Information Prediction

The system shall use the real-time predicted and schedule adherence data directly from the ETA system to create continuously updated next vehicle arrival predictions for all stops.

4.3.2 Central Control Software

The system shall provide next vehicle prediction information from the SPOT® system to the DMS in countdown format through an automated process.

Multiple sign rows shall be used to display prediction messages when there are multiple routes at a stop or additional text messages are to be displayed.

The system shall allow an authorized user to construct and display one or more text messages (e.g., real-time information messages regarding service disruptions and snow emergencies) of 150 characters or less. These messages shall be displayed on the DMS on a separate row from the predicted arrival times. Also, an equivalent audio announcement of the displayed message shall be provided on-demand (e.g., through a push-button).

The system shall allow control software users to preview a message before it is transmitted to the DMS and other dissemination media for display.

The system shall allow users of the central control software to configure the amount of time that a message is shown on the DMS. This capability will enable users to display different messages for specific periods of time.

When information is not available or in the event of delays and emergencies, the system shall provide MTTA the ability to disseminate desired information. Proposers shall describe such capabilities in the proposed solution in their proposals.

The DMS shall have built-in health diagnostics and be able to indicate failure status to the RTIS. The central system shall notify the dispatcher in the event an alarm is received from the DMS.

The system shall be able to detect failures in communication link with an MTTA dissemination medium (DMS, web server) and notify that to authorized personnel.

4.3.3 Interface with the AVL/CAD System

The proposer shall interface with the existing AVL/CAD system, provided by ETA, to continuously obtain real-time prediction and/or schedule adherence information for the entire system through read-only access to the ETA AVL/CAD database or via an eXtensible Markup Language (XML)/JavaScript Object Notation (JSON) feed established for third party access.

The proposer shall identify a refresh interval for vehicle prediction and schedule adherence data such that the AVL/CAD system performance is not impacted due to querying of the AVL/CAD database by the RTIS system.

5 Project Management

5.1 General

The Contractor shall, for all deliverables, include the filename in the document footer and include in the filename the file release date.

The Contractor shall prepare all deliverables in both Microsoft Office (Word, Excel or PowerPoint) and Adobe PDF formats, with MTTA granted full rights to reprint as needed.

5.2 Project Status Tracking

The Contractor shall prepare a System Implementation Plan (SIP), including a detailed schedule of all implementation activities, including progress milestones and status, and assigned staff.

The Contractor shall also include a Safety Management Plan in their SIP, which shall detail their responsibilities and procedures for safety, including (1) conducting pre-installation surveys to identify potential project safety hazards; (2) identifying project hazard control procedures, including occupational (worker) and public hazards; (3) providing project safety orientation and training to its subcontractors and the transit agency staff who will be involved in the project; and (4) furnishing procedures and training for project accident reporting and investigations.

The initial draft of the SIP shall be provided to MTTA within two weeks from the Notice to Proceed (NTP).

A revised SIP, addressing comments from the first onsite meeting, shall be provided to MTTA within two weeks after this meeting.

The SIP must be approved and accepted by MTTA before it can become effective.

An updated SIP shall be submitted to MTTA at the beginning of each month.

The Contractor shall maintain an Action Items List (AIL), indicating for each item the following: (1) item number; (2) item priority (3) date generated; (4) brief item descriptive title; (5) assigned person with lead resolution responsibility; (6) date resolved; and (7) ongoing dated notes on resolution status.

The AIL shall be sorted, primarily by unresolved vs. resolved items and secondarily by the date the item was generated.

5.3 Minimum Required Onsite Work

At the first onsite meeting, the Contractor shall be prepared to discuss MTTA feedback on the draft SIP and conduct the Requirements Review.

At the second onsite meeting, the Contractor shall be prepared to discuss MTTA feedback on draft Design Review documentation.

During the third onsite and subsequent effort, the Contractor shall install the required software and conduct acceptance testing as specified in Section 8. These onsite installation and testing efforts will occur over an extended period, and will likely involve multiple onsite trips and a range of different Contractor staff.

5.4 Invoicing

The Contractor shall only submit an invoice once a fully-signed Acceptance Certificate is generated by MTTA indicating that a progress payment milestone has been achieved. MTTA will withhold 10% retainage on each invoice. Upon acceptance by MTTA, the total retainage for the project will be paid to the Contractor.

6 Design Review

The Contractor shall participate in the Requirements Review (RR) as part of the first onsite meeting. The RR meeting shall discuss, for each contract requirement, the following: (1) the MTTA design intent; (2) the intended Contractor design approach; and (3) the general Contractor approach to the demonstration through the acceptance testing process.

The Contractor shall submit draft Design Review Documentation (DRD) within four weeks of the RR meeting.

The DRD shall include the following materials: (1) an overview of the equipment, system and configuration proposed for implementation; (2) detailed technical documentation for each equipment item; (3) detailed technical documentation on all software, addressing the functions of each module, the format of all user interface screens, the format of all reports, the data fields to be included in all data exchange interfaces and any other software aspects warranting advance agreement with MTTA prior to system customization/configuration; and (4) a table detailing the approach taken in the design to address each individual contract requirement (subsequently referred to as the Requirements Matrix (RM)).

The Contractor shall prepare all deliverables in both Microsoft Office (Word, Excel or PowerPoint) and Adobe PDF formats, with MTTA granted full rights to reprint as needed.

The Contractor shall for all deliverables include the filename in the document footer and include in the filename the file release date.

The Contractor shall submit the updated DRD within two weeks of receiving the review comments on the draft DRD.

The DRD is intended only to reduce the chance of any misunderstandings on the design intent or interpretation of the contract requirements. The DRD shall not alter the need for the successful formal demonstration of each requirement through the Acceptance Testing process.

7 General Installation Requirements

These requirements cover all equipment and operational requirements to the maximum depth possible. It does not, however, in any way relieve the Contractor from its responsibility of providing a totally installed system including all integration and installation services that are necessary to provide a completely operational system.

As stated earlier, DMS installations shall be performed by the BRT station fabricator.

The Contractor shall configure DMS hardware. The integration of DMS hardware with central control software and the existing real-time information system (supplied by ETA) at MTTA shall be performed by the successful proposer.

The Contractor shall provide all necessary personnel, test equipment, transportation and supplies for the successful and complete installation of all software, and integration of the software with the ETA system.

The Contractor shall be responsible for their own and subcontractors' performance and safety.

Required installations shall be performed in accordance with all Federal, State and Local laws and regulations.

The Contractor shall use existing AC electrical power at shelters. If existing power arrangements are unsatisfactory, the Contractor must specify proposed alterations.

The Contractor shall submit Installation Design Documentation (IDD) for MTTA approval prior to the fabricator undertaking any installations.

The IDD shall provide text, drawings, illustrations and images using adequate detail to allow for quality installation by a fabricator's technician without further training in conjunction with other installation instructions provided by the vendors of individual equipment components.

The IDD shall be provided to the BRT station fabricator including details on (1) equipment installation locations/mounting; (2) routing, conductors, color-coding, labeling, and connectors for power and communications; (3) connections with, any required modifications to and restoration of existing infrastructure; (4) work area and equipment storage requirements (5) methods and quality standards; and (5) supervision and quality assurance procedures.

The Contractor shall be responsible for the security of equipment prior to installation by the BRT station fabricator. MTTA will provide space for the Contractor to establish secure storage facilities.

The Contractor shall prepare all deliverables in both Microsoft Office (Word, Excel or PowerPoint) and Adobe PDF formats, with MTTA granted full rights to reprint as needed.

The Contractor shall include the filename in the document footer and include in the filename the file release date for all deliverables.

8 Acceptance Testing

All requirements listed in Appendix C, the Compliance Matrix, must be tested.

The Contractor shall submit an Acceptance Test Procedures document (ATP) for MTTA approval prior to undertaking any testing.

Each ATP shall clearly address the following:

- Identification of all tests to be performed, the purpose of each test and the identification of the functional requirements being tested
- How each testable specification requirement will be demonstrated, including a description of the method/procedures for performing each test;
- How test results will be recorded
- The results that will constitute success for each test, including pass/fail criteria and/or measures of effectiveness;
- The responsibilities of both Contractor and MTTA representatives during each test;
- A cross-reference to which contractual requirements from the RM are being addressed by each test procedure;
- If the testing is re-testing because of a failure, a description of the corrective actions taken to remedy the failure and a description of the re-testing procedures, if they differ in any way from the original testing procedures; and
- The test schedule.

The ATP shall include an updated RM from the DRD, to include the test stage at which each contract requirement will be demonstrated; and a cross-reference to the test procedure(s) that serve to address each contract requirement.

The Contractor shall prepare all deliverables in both Microsoft Office (Word, Excel or PowerPoint) and Adobe PDF formats, with MTTA granted full rights to reprint as needed.

The Contractor shall, for all deliverables, include the filename in the document footer and include the file release date in the filename.

The ATP shall be submitted to MTTA at least three weeks in advance of any intended testing.

The ATP is subject to approval by MTTA.

MTTA reserves the right to witness any or all tests, without charge, and may include a check for compliance with all requirements set forth in the ATP, and the contract between MTTA and the successful proposer.

The ATP shall incorporate the following distinct testing stages for installation: (1) Factory Acceptance Testing (FAT); (2) Pilot Testing (PT); (3) System Testing (ST); and (4) Burn-In Testing (BT).

FAT shall be completed for DMSs at the Contractor's facility, and deficiencies shall be rectified before the initiation of DMS delivery to MTTA and before the initiation of PT.

FAT will be witnessed by MTTA representatives.

PT shall be completed for a subset of MTTA's fixed-route system (e.g., Peoria BRT route, three routes and three DMS units), and deficiencies shall be rectified before the initiation of ST.

PT shall include, but not be limited to, testing the integration of the central software with ETA's system, and display of information from the central system on the DMS.

PT will be witnessed by MTTA representatives.

ST shall be completed after the entire system for the deployment has been installed, and deficiencies shall be rectified before the initiation of BT.

ST shall be witnessed by MTTA representatives.

BT shall involve revenue service use of the system over a 30-day period after the completion of ST for the deployment, and deficiencies shall be rectified before MTTA will grant System Acceptance (SA) for the deployment.

Specific requirements regarding SA Testing are as follows. A thirty-day SA Testing period shall commence when the following minimum conditions are met:

1. The Contractor's proposed SA ATP shall have been received, reviewed and approved by MTTA.
2. The Contractor's proposed date for commencement of SA Testing shall be compatible with the schedules of MTTA staff who will be directly involved in such testing.
3. All hardware and system software shall be fully installed and operating without problem for a minimum of seven (7) business days after BT.

MTTA may authorize the Contractor to proceed to the next testing stage with certain deficiencies not yet resolved.

The Contractor shall provide written notice to MTTA at least five days in advance of any testing, indicating the specific tests to be completed as well as the date, time and location.

The Contractor shall be required to reschedule testing if MTTA witnessing representatives cannot be present or if other circumstances prevent testing from taking place.

The Contractor shall provide written Test Results Documentation (TRD) within one week of completing each stage of testing.

The TRD shall document the results of each ATP procedure and provide an updated RM that indicates which contract requirements have been demonstrated.

The TRD must be approved before MTTA will grant SA for the deployment.

SA will not be granted for the deployment until all contract requirements have formally demonstrated through AT.

The RM shall be used as a "punch list" to track which requirements have not yet been demonstrated at each stage of testing.

A requirement classified as having been "demonstrated" during a certain AT stage can be subsequently redefined as having been "not demonstrated" if compliance issues emerge prior to SA.

9 Documentation and Training

9.1 General

The Contractor shall prepare all deliverables in both Microsoft Office (Word, Excel or PowerPoint) and Adobe PDF formats, with MTTA granted full rights to reprint as needed.

The Contractor shall, for all deliverables, include the filename in the document footer and include the file release date in the filename.

All documentation described in this section shall be provided in hard copy and electronic formats. Three (3) hard copies of all manuals shall be delivered to MTTA. Electronic updates must be sent delivered to MTTA within 30 days of them becoming available.

Each type of maintenance manual shall contain, but not be limited to: (1) a description of operation; (2) installation procedures; (3) a complete parts identification diagram and list; (4) troubleshooting procedures; (5) inspection procedures; (6) preventive maintenance procedures and program; (7) repair procedures; (8) diagnostic procedures; (9) wiring diagrams; (10) electrical schematics with board and cable identification; and (11) adjustment procedures. All subcontractor's names and part numbers shall be cross-referenced with the Contractor's part numbers.

The manuals shall be complete, accurate, and up-to-date, and shall contain only that information which pertains to the system installed.

Preliminary drafts of manuals shall be supplied sixty (60) days prior to start of acceptance testing. The documents shall be as complete and as comprehensive as possible. Six (6) sets of each type of document, manual and drawings as described in this section shall be supplied. The preliminary documents shall be approved and comments furnished to the Contractor within thirty (30) calendar days of their receipt.

Complete final manuals in the quantities and quality as described in this section shall be supplied no more than thirty (30) days after comments have been furnished to the Contractor. Complete final manuals in the quantities and quality as described in this section shall be supplied no more than thirty (30) days after comments have been furnished to the Contractor.

The Contractor shall provide a list of all special or custom tools or instruments required to maintain or adjust any component within the system.

The Test Equipment Section shall include all information necessary to allow proper and full use of all test and calibration equipment furnished.

9.2 Training

The Contractor shall provide a comprehensive training program that enables MTTA employees to operate and maintain the RTIS System, including DMS hardware diagnostics, and hardware and software configuration settings. The training plan shall assume training for all MTTA Dispatchers, Maintenance personnel, Planning personnel and Information Technology (IT) personnel.

The Contractor shall provide all training materials in both Microsoft Office and Adobe PDF formats on universal serial bus (USB) flash drive, compact disc (CD) or digital videodisc (DVD) with a permission to reproduce copies later on.

The instructors shall demonstrate a thorough knowledge of the material covered in the courses, familiarity with the training materials used in the courses, and the ability to effectively lead students in a classroom setting. Course

instructors must have prior training experience and intimate familiarity with all aspects of the systems, training materials, and training aids.

If any instructor is considered unsuitable by MTTA, either before or during the training, the Contractor shall provide a suitable replacement within five business days of receiving such notice from MTTA.

The Contractor shall provide a detailed training plan in conjunction with the overall project schedule. The plan shall provide a description and duration of each course. All training will be conducted on-site at MTTA's facility.

9.3 Manuals

The Contractor shall provide an As-Built Document (ABD) to MTTA at the completion of the deployment.

The Contractor shall provide all manuals in both Microsoft Office and Adobe PDF formats on CD or DVD with a permission to reproduce copies later on.

The ABD shall include: (1) an inventory of all components supplied including supplier, model number, serial number and installation location; (2) an inventory of all spare parts supplied including supplier, model number, serial number and storage location; (3) all reference and user manuals for DMS system components, including those components supplied by third parties; (4) all warranties documentation, including that for components supplied by third parties; and (5) a diagram indicating the as-built interconnections between components.

The Contractor shall provide Maintenance Manuals (MM) documenting (1) how the system components were installed; (2) how to install and configure spare components; and (3) the schedule/procedures for preventative maintenance, inspection, fault diagnosis, component replacement and warranty administration on each system component.

The Contractor shall provide a Systems Manuals (SM), documenting (1) the configuration and topology of central systems hardware and software; (2) scheduled maintenance required for the central systems; and (3) database structure and data dictionary.

10 Spares and Warranty

10.1 Spare Components

The Contractor shall provide an initial supply of spare components to MTTA for all DMS, with a quantity of at least 10% of the installed quantity (with a minimum quantity of 1).

The proposal shall include a list of the spare components and quantities to be provided, including manufacturer and model numbers.

Storage provisions, such as shelving, bins or racks, for the spare components shall be included, and the components shall be delivered to MTTA already organized and labeled such that they can be readily identified and found. The storage provisions, organization and labeling must be approved by the MTTA Project Manager.

Spare components shall be packaged to protect their reliability, including providing for them to be identified, inspected, stored for long periods, and endure multiple inventories without damage or degradation.

At any time during the warranty period, MTTA shall have the option to purchase additional spare components. The price proposal shall include the price for MTTA optional purchase of each spare component.

These additional spare components shall be packaged, organized and labeled in the same manner as the original supply of spare components, although additional storage provisions will not need to be provided. These additional spare components will also be covered by the warranty.

10.2 Support

The Contractor shall arrange for support from one or more qualified firms to be available on a four-hour response basis when needed by MTTA to assist with fault diagnosis or component replacement.

The proposal shall include a list of the support firms, their support responsibilities and the response arrangements.

If a support firm does not respond within the agreed response timeframe, or when a support firm is not able to provide the needed support, the Contractor shall provide supplementary support in accordance with an agreed escalation procedure for the two-year warranty period (with three one-year extension options). The escalation procedure can initially involve telephone support, but must culminate in the Contractor providing on-site support if needed. The proposal must define the proposed support escalation procedure.

10.3 Warranty

The Contractor will provide a two (2) year service and warranty policy on all components of the RTIS including equipment, services, and software purchased under this contract, with an option to extend the warranty by one (1), two (2) or three (3) years. The warranty period will begin following final system acceptance (SA) by MTTA.

Proposers are required to identify their service facility in their proposals. MTTA reserves the right to approve or reject the service facility specified by the Proposer.

A complete copy of the Contractor's warranty shall be included in the proposal.

The Contractor shall provide any software updates and patches for the current version at no cost to MTTA during the warranty and support period.

Future upgrades to the software system will be made available to MTTA at no additional charge during the warranty and support period.

The Contractor shall provide ongoing user and technical support for the warranty period.

During the warranty period, the Contractor shall, at no cost to MTTA, furnish such materials, labor, equipment, software, documentation, services and incidentals as are necessary to maintain the system in accordance with the warranty.

During the warranty period, the Contractor shall, at no cost to MTTA, repair or replace any faulty components.

Proposers must indicate a quantity of spares for all equipment in their proposals along with the price of those spares. The number of spares for each type of equipment should be based upon past experience with the equipment.

Software support during the warranty period shall include technical support for all hardware and software, with a 24/7 support line, as well as providing, licensing, installing and integrating all released software patches and updates. The warranty period shall run concurrently for all system components, from their date of installation through to two (2) years from the date of SA with three one-year extension options.

The Contractor shall offer an option to extend the warranty period for the deployment for one, two or three additional years. The Proposer shall document any differences in the warranty terms for these option years in their proposal.

The Contractor shall warrant that it has reviewed and evaluated all information furnished by MTTA and has made all inquiries necessary such that the Contractor is fully aware of MTTA's business requirements and intended uses of system, as set forth or referenced in the Request for Proposals and any Addenda, Amendments or Final Proposal Requests, as well as in discussions during the Pre-proposal Conference.

The Contractor shall warrant that the system satisfies the foregoing requirements in all material respects and will be fit for such intended uses.

The Contractor shall warrant that the design, materials, construction, software and workmanship of the equipment shall reflect the intended use of the equipment as a component of the overall transit management system in the MTTA environment.

The Contractor shall warrant that equipment and software, including the initial supply of spare components, (1) are free from defects in design, material and workmanship, and shall remain in good working order, and (2) function properly and in conformity with this Contract.

The Contractor shall warrant that the documentation provided shall completely and accurately reflect the operation and maintenance of the equipment and software, and provide MTTA with all information necessary to maintain the system.

If there is a change in the production configuration of any equipment or software being installed prior to SA, MTTA may require that all previously installed equipment and software be upgraded to match the updated configuration.

The Contractor shall warrant compliance with all applicable laws and regulations relating to the project.

The Contractor shall warrant that its employees, agents and Subcontractors assigned to perform services under this contract shall have the proper skill, training and background to perform in a competent and professional manner and that all work will be so performed.

The Contractor shall provide any software upgrades, fixes, updates, or version changes at no cost to MTTA during the warranty period.

In addition to the foregoing warranties, the Contractor shall assign to MTTA, and MTTA shall have the benefit of, any and all Subcontractors', Suppliers', and Contractor' warranties and representations with respect to the deliverables provided.

In its agreements with Subcontractors, Suppliers and Contractor, the Contractor shall require that such parties (1) consent to the assignment of such warranties and representations to MTTA; (2) agree that such warranties and representations shall be enforceable by MTTA in its own name; and (3) furnish documentation on the applicable warranties to MTTA.

The Contractor shall provide a single point of contact for all warranty administration during the warranty period.

The Contractor shall warrant that MTTA shall acquire permanent title to all equipment and non-proprietary software provided under the Contract, free and clear of all liens and encumbrances.

10.4 Repair or Replacement of Faulty Components

During the warranty period, the Contractor shall repair or replace any faulty components, with the cost included in the warranty price. MTTA will ship each faulty component to the Contractor, who shall return a new or repaired component within one week of originally receiving it.

If the Contractor determines that a returned component is not faulty, MTTA shall receive the original component back in working order within two days of the Contractor originally receiving the returned component.

All components received back at MTTA from the Contractor will be tested in accordance with the original ATP, and returned to the Contractor if faulty accompanied by a certification.

The Contractor shall pay all shipping charges to and from MTTA, and any duties associated with the repair or replacement of faulty units.

Returned or replaced spare components shall be packaged, organized and labeled in the same manner as the original supply of spare components.

10.5 System-wide Replacement

If at least 25% of a given component requires repair or replacement within the two-year warranty period (with three one-year extension options), the component shall be deemed to warrant system-wide replacement.

System-wide replacement shall require the Contractor to replace all units of the suspect component throughout the system, whether or not they have exhibited any fault.

Even if the system-wide replacement activity extends beyond the end of the two-year warranty period (with three one-year extension options), the Contractor shall be obligated to complete it if the need was documented before the end of the warranty period.

Appendix A: DMS Mounting at BRT Station

It is intended that the RTIS sign will be affixed to a vertical station marker designed by MTTA's design team. The marker will be fabricated of 3/8" aluminum; dimensions are 20" wide and 12" deep. The marker will be fabricated and installed at BRT stations. Detailed design plans are available upon request.

The DMS will be mounted by the marker fabricator as shown in Figure 2. The DMS and the enclosure will be mounted using a bracket or other hardware as to allow the DMS to be positioned as a "flag" perpendicular to the adjacent roadway. The Contractor will cooperate with the marker fabricator in the design of the mounting system. The Contractor must ensure that the mounting does not affect the functioning of the sign or the RTIS system in any way.

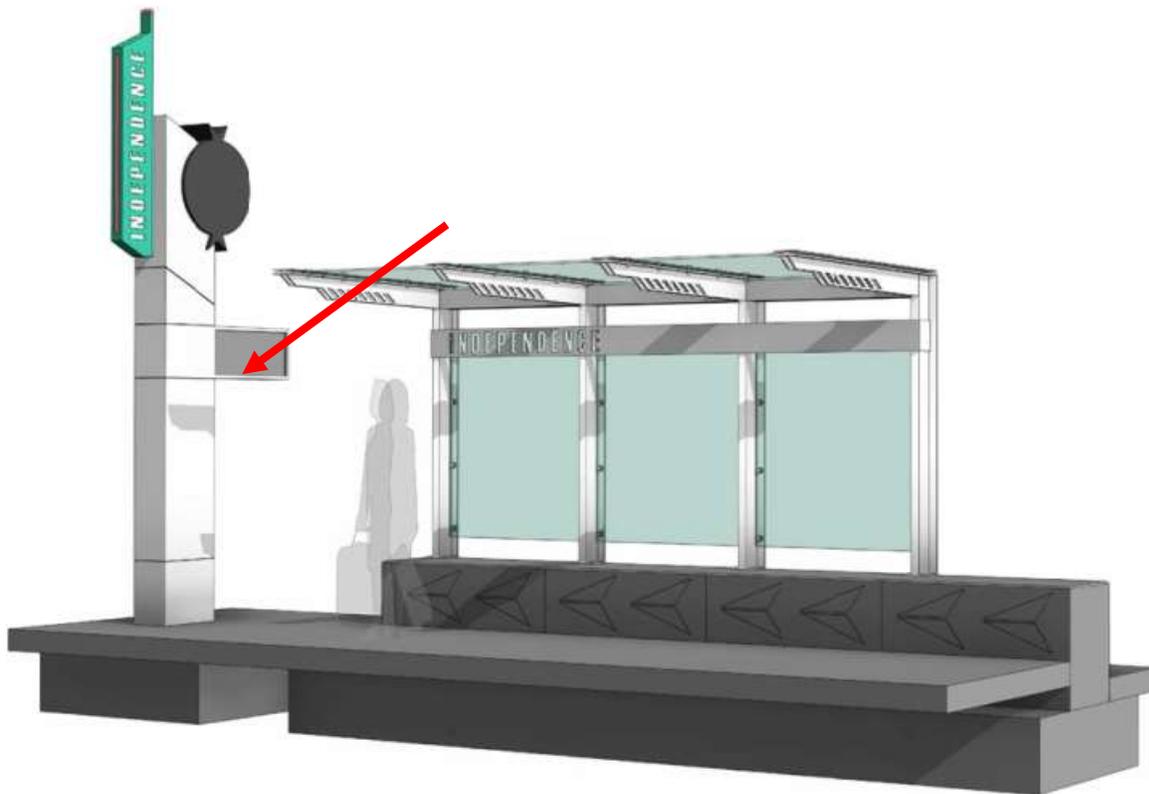


Figure 2. Conceptual Station Rendering

After the DMSs are mounted by the station marker fabricator, the Contractor will be responsible for making any adjustments, power connections and communication connections required to ensure the signs are fully functional.

Any required hardware or devices not in the DMS enclosure will be mounted inside the marker subject to space availability. A secure access panel allows access to the equipment space.

MTTA will be responsible for providing access to electrical power and digital communications at all sites. The method of communication has not been determined yet, but shall be cellular or wired (fiber or cable). DMSs must be capable of operating using cellular communications. The Contractor shall specify the DMS communications requirements. The Contractor is responsible for connections between MTTA-provided power and communications and the Contractor's hardware.

Appendix B: Price Proposal Form

See attached file entitled "Price Proposal Form.xlsx"

Appendix C: Compliance Matrix

See attached file entitled "RTIS_ComplianceMatrix.xlsx"