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Development of Performance-Based Specifications for Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)

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CALIFORNIA PATH PROGRAM
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**Development of Performance-Based
Specifications for Efficient Deployment of
Advanced Public Transportation Systems
(EDAPTS)**

Jeff Gerfen, Neil Hockaday, Xudong Jia

**California PATH Research Report
UCB-ITS-PRR-2008-12**

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation, and the United States Department of Transportation, Federal Highway Administration.

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California. This report does not constitute a standard, specification, or regulation.

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**Development of Performance-Based Specifications
for Efficient Deployment of Advanced Public
Transportation Systems (EDAPTS)**

Prepared for

**California Partners for Advanced Transit and Highways (PATH)
California Department of Transportation**

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Under PATH Contract TO-6402

DISCLAIMER

This work was performed as part of the California PATH Program of the University of California, in cooperation with the California Department of Transportation.

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ABSTRACT

Efficient Deployment of Advanced Public Transportation Systems (EDAPTS) Smart Transit System was developed by California Polytechnic State University, San Luis Obispo in a previous research effort from 1997 to 2007. California Partners for Advanced Transit and Highways (PATH) and the California Department of Transportation (Caltrans) have sponsored follow-on research to develop performance-based specifications for the EDAPTS system. These specifications are intended to facilitate industry adoption and widespread deployment of EDAPTS transit management system. The EDAPTS Performance Specification was developed by reviewing industry performance specification best practices, identifying all unique EDAPTS elements, determining appropriate performance metrics for each element, and determining these performance metrics. All EDAPTS elements and their associated performance metrics were organized and imported into a database for ease of analysis and automated performance specification report generation. An EDAPTS data-formatting standard was developed in conjunction with performance specification development efforts. The data-formatting standard is required to ensure that various parts of EDAPTS will be able to be procured from vendors as a commodity with ensured interoperability in the future. The non-proprietary EDAPTS performance specification and its supporting database program are available for general use by transit operators, service providers, and transit management system providers.

EXECUTIVE SUMMARY

Background

The Efficient Deployment of Advanced Public Transportation Systems (EDAPTS) Smart Transit System was developed by California Polytechnic State University, San Luis Obispo. Cal Poly researchers demonstrated that it is possible to construct a non-proprietary transit management system out of commercially available components during the San Luis Obispo Transit demonstration from 2001 to 2003. This system is constructed using off-the-shelf components whenever possible and is designed to maximize user benefits while minimizing initial and recurring costs. The EDAPTS Smart Transit System is nearly ready for commercialization and potential private industry partners require detailed performance specifications for EDAPTS system elements to justify the business case for this system. Such specifications would allow system integrators to supply, develop, or procure hardware and data communications subsystems to mate with existing open-source released EDAPTS software.

Methods

The goal of this project was to develop performance-based specifications for the EDAPTS Smart Transit System using a generalized method. Researchers began this project by documenting current best practices for determining performance specifications. Researchers then documented all EDAPTS system elements, developed a list of performance metrics applicable to EDAPTS, provided measures for these metrics on a per-element basis, and then documented the data format of all EDAPTS messages. A database-driven software program was then developed to provide an easy to use method for generating a performance specification document based on the aggregated information within the EDAPTS Performance Specification.

Results

A detailed set of tables containing all aspects of the performance specifications, including inter-table relationships were created and are referred to as the EDAPTS Performance Specification Tables (Appendix C). An EDAPTS specification software program was developed to simplify the cross-referencing and correlation of specifications within these tables and is available for interested parties to use. A sample output from this software program is provided in this report (Appendix B). An EDAPTS Performance Specification User's Guide for the EDAPTS performance specification tables and the software program was created and is also attached (Appendix A). An EDAPTS Data-Formatting Standard was created as a complement to the EDAPTS Performance Specification by defining low-level communications details of the system. Version 1.0 of the EDAPTS Data-Formatting Standard is being released to the transit industry for peer review and is also included in this report (Appendix D).

Conclusions & Recommendations

The EDAPTS Data Formatting Standard has the potential to facilitate future deployments and should become part of the definition of EDAPTS. This will allow EDAPTS components to be procured as commodities, i.e. components that may be obtained from any source and should drop

directly into the system by having commonality at the communications interface level. EDAPTS cost effectiveness will be maximized when system components have uniform interfaces as prescribed by the EDAPTS Data Formatting Standard. This standard provides a clean and unambiguous framework for EDAPTS development and deployment, and establishes the correct balance of interoperability and vendor commodity for EDAPTS. Although the EDAPTS Performance Specification comprehensively defines the required performance of all EDAPTS elements, including communications data-formatting at the component level, it does not define inter-element communications data formatting. Further work to define the data-formatting of various vehicle on-board elements, including automatic passenger counters, fare and media readers, and next-stop stop indicators and annunciators will help in the standardization and interoperability of these system elements.

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1. INTRODUCTION

The Efficient Deployment of Advanced Public Transportation Systems (EDAPTS) Smart Transit System was developed by California Polytechnic State University, San Luis Obispo (Cal Poly) as part of California Department of Transportation (Caltrans) grant #65A0061. The project's primary goal was to provide a low cost implementation of Intelligent Transportation System (ITS) technologies suitable for deployment by small, medium, and rural transit properties. Examples of these technologies are Automatic Vehicle Location (AVL), schedule adherence tracking, and passenger bus arrival notification.

The EDAPTS system was designed to be low cost, easily configurable, non-proprietary, and was constructed from the ground up based on the Federal Highway Administration National ITS Architecture and Transit Communications Interface Profiles (TCIP), both of which were emerging during the original research project. Cal Poly researchers demonstrated that it is possible to construct a non-proprietary transit management system out of commercially available components through a deployment of the prototype EDAPTS Smart Transit System on San Luis Obispo City Transit (SLO Transit) in 2001. The designs and source code for this system were licensed under the L-GPL open-source license.

The EDAPTS Smart Transit System utilizes vehicle on-board mobile data terminals (MDT) connected to dispatch via wireless data links, remotely controlled electronic message signs at bus stops, and central dispatch and server software. This system is designed to maximize user benefits while minimizing initial and recurring costs.

With this successful test deployment, the EDAPTS Smart Transit System is now ready for technology transfer and commercialization. Recognizing the potential benefits of the SLO Transit EDAPTS test, Caltrans initiated three additional research projects for the EDAPTS program in 2005. These three projects are 1) Benefit/Cost Evaluation of the EDAPTS system at San Luis Obispo Transit, 2) Development of Performance-Based Specifications for EDAPTS, and 3) Bronco Express Demonstration of EDAPTS. The collective goal of these projects is to solidify the business case for EDAPTS and demonstrate to the transit community that using the EDAPTS approach is just "smart business practice" for them.

Potential private industry partners require detailed performance specifications for the EDAPTS system elements to justify the business case for this system. Such specifications would allow system integrators to develop or procure hardware and data communications subsystems to mate with existing open-source released EDAPTS software. The goal of this project was to develop performance-based specifications for the EDAPTS Smart Transit System using a generalized method.

The overall approach to developing the EDAPTS Performance Specification began by understanding and documenting current best practices for determining performance specifications. From this effort, researchers documented all EDAPTS system elements, developed a list of performance metrics applicable to EDAPTS, determined the values of these metrics on a per-element basis, and documented the data format of all EDAPTS messages. A database-driven software program was then developed to provide an easy to use method for creating a system performance specification document based on the aggregated information collected.

Key results of this project are:

- A user’s guide for the EDAPTS performance specification tables and the software program. (Appendix A)
- The EDAPTS Performance Specification Generator software program with accompanying sample output in the form of an EDAPTS Performance Specification. (Appendix B)
- A detailed set of tables containing all aspects of the performance specifications, including inter-table relationships. These tables are referred to as the EDAPTS Performance Specification Tables. (Appendix C)
- Version 1.0 of the EDAPTS Data Formatting Standard. This document provides data-formatting details for all EDAPTS inter-component communications. (Appendix D)

These four project results, when taken as a whole, paint a comprehensive picture of the EDAPTS Performance Specification. The EDAPTS Performance Specification Generator allows the user to create a custom system performance specification document that can be used in the procurement of an EDAPTS Smart Transit System. The EDAPTS Performance Specification User’s Guide, the EDAPTS Performance Specification Tables, and the EDAPTS Data-Formatting Standard allow the user to comprehensively understand all details of the required performance of an EDAPTS system.

The following sections of this report will present the materials and methods utilized to develop the EDAPTS Performance Specification, report project results, discuss project efforts, and present conclusions and recommendations.

2. MATERIALS & METHODS

Literature Review

A literature search for performance-based specifications of Intelligent Transportation System (ITS) technologies, information and communications technologies, military/defense systems, and automotive technologies was conducted. Any other technologies for which performance specification material could be found were also pulled into this effort as they became apparent. The goals of the literature review were (1) to determine the current state and best practices of performance-based specifications, (2) to define the meaning of a performance specification for the scope of this project, (3) to locate any existing applicable ITS-based or other relevant performance-based specification documents, and (4) to determine and discover performance metrics potentially applicable to the EDAPTS system. The literature review was the first step in the development of the EDAPTS Performance Specification.

The first literature review effort was to determine the definition of a performance specification that would be used to refine the scope of the project. Various definitions were located and considered for use in describing an Intelligent Transportation System (ITS). Definitions from a variety of sources including state and Federal agencies, international agencies, and commercial entities were evaluated for incorporation or adoption. The definition of a performance specification selected for use in this project is:

“A performance specification states requirements in terms of the required results and provides criteria for verifying compliance, but it does not state methods for achieving results. It defines the functional requirements for the product, the environment in which it must operate, and the interface and interchangeability requirements.”

The next step in the literature review was initiated with a hypothesized set of performance metric categories that could be used to describe the EDAPTS transit management system. The following preliminary set of categories was determined:

- Communications
- Human Factors
- Installation and Maintenance
- Power Consumption
- Ruggedness
- Accuracy
- Computational Performance
- Privacy & Security

These categories were used as a baseline when looking for and examining example performance specifications. Various performance specifications and guideline documents were located based on their perceived relevance to Intelligent Transportation Systems. Each performance specification or guideline document was initially reviewed based on these performance metric categories. The initial category list proved to be incomplete and modifications to the list were made. The revised performance specification categories were determined to be:

- Communications & Electrical Interfaces
- Computational Hardware & Peripherals
- Design & Architecture
- Documentation
- Functional Performance
- Human Factors
- Installation & Maintenance
- Manufacturing
- Mechanical Interfacing
- Power
- Privacy & Security
- Ruggedness & Reliability
- Safety & Certification
- Standards & Practices
- System Accuracy

Although this list of performance metric categories seemed complete at the time of the literature review, it was further refined during the course of the development of the EDAPTS Performance Specification.

Identify EDAPTS Components, Elements & System Functions

The EDAPTS hardware design documentation, software code flow, and the EDAPTS final report for the original research effort done under Caltrans project #65A0061 (“EDAPTS Phase 2, A Smart Transit System for Small Transit Agencies”) were reviewed to determine an initial list of EDAPTS components and elements. **EDAPTS Components are considered to be any hardware or software portions of the EDAPTS system that are interchangeable with replacement components having the same performance specifications.** Components are made up of Elements. Elements are not necessarily interchangeable.

Once EDAPTS Components and their constituent Elements had been determined, the next step was to create a list of EDAPTS System Functions based on the existing functionality of the original San Luis Obispo Transit EDAPTS system as well as some functions anticipated by researchers to be desired in future EDAPTS systems. This initial list of system functions was then checked against all known EDAPTS Elements and Components. The process of cross-checking system functions to Elements and Components was iterative and led to creating more comprehensive lists of System Functions, Elements, and Components.

Develop the Performance Specification Tables

Researchers determined the organizational structure for all of the information in the EDAPTS Performance Specification during the checking of System Functions to Elements and Components. The research team observed that the quantity of information needing to be correlated was increasing rapidly and it was determined that all material would need to be imported into a database for ease of use. A set of EXCEL spreadsheet tables (worksheets) was then created to capture all EDAPTS Performance Specification information for development and later importation into the selected

database. These tables are formally known as the EDAPTS Performance Specification Tables and are attached to this report as a project result (see Appendix C). The tables were developed so that the content within them would be easily importable into the final database system. The content of each table was kept to be singular in nature and specific tables were created to capture the relationships between tables. The relationships and cross-referencing of these tables are described in the attached document “EDAPTS Performance Specification User’s Guide.”

Articulate Performance Metrics & Associate them with EDAPTS elements

The output of the literature review was reviewed to determine performance metrics applicable to EDAPTS. The general process followed was to evaluate each sample performance metric identified in the literature review for relevance and determine its suitability for inclusion in a particular performance specification category that was previously defined as part of the literature review. Any sample metrics deemed relevant were then crosschecked against the list of identified EDAPTS elements for applicability. Suitable metrics were then recorded as a potentially viable metric and given an appropriate metric category or inserted into an existing metric category. The process of checking any likely metric against the entire EDAPTS system frequently led to the discovery of new metrics that had not been previously considered.

The lists of metric categories and individual metrics were then checked and re-evaluated against all EDAPTS Elements. The goal was to look at a given metric or metric category and determine if there were any additional elements that it also seemed to fit. If the same metric could be reused for different Elements, it was re-applied to those Elements. If a metric was found to be applicable to an entire group of Elements, i.e. a Component, or the EDAPTS system as a whole, it was then associated with the higher level of system abstraction. Each performance metric was given a unique identifier that included the name of the metric and the Element or Component it is associated with. Metrics associated with the system level, meaning that they are associated with all Components and all Elements, have only the metric name in the identifier. The comprehensive list of performance metric categories and specific metrics resulting from this effort is in the attached EDAPTS Performance Specification Tables.

Determination of Performance Metrics

Each performance metric was then reviewed to determine its appropriate units of definition, which are essentially the requirements that should be used to define a metric. The verification method for the metric and the value of the metric were also determined. An EDAPTS integrator or potential procurer of EDAPTS will use these parameters to verify compliance with the specification. This information was obtained from sources including external specifications such as MIL specs from the Department of Defense, vehicular specs from the automobile industry, EDAPTS system functional requirements, system calculations, and the previous EDAPTS experience of the researchers.

It was also determined that some metrics would require the input of very specific information regarding the transit fleet for which the performance specification is to be developed. This information can include parameters such as fleet size, schedule size, etc. These performance metric values were flagged to allow incorporation of customized values specific to the individual transit property at the time of specification report generation using the EDAPTS Performance Specification Generator.

Compile the EDAPTS Data Formatting Standard

The EDAPTS Data Formatting Standard was compiled to document EDAPTS inter-component data communications. Extensible Markup Language (XML) was selected as a vehicle to represent EDAPTS data formats because of its widespread acceptability, its flexibility and ease of use, and its readiness to be directly converted into actual data objects. Transit Communications Interface Profiles (TCIP) is not recommended at this point, as the transit industry has been unable to unify behind it. If the industry were able to standardize on an interface protocol in the future, it would be appropriate to revisit this decision and consider adoption of the industry standard that evolves.

The EDAPTS Data Formatting Standard was created by manually tracing through all existing EDAPTS software and extracting messages transmitted between Components. New data objects were added to the EDAPTS Data Formatting Standard for functions and Components anticipated in future releases of EDAPTS.

It was decided to model the EDAPTS Data Formatting Standard on the original TCIP standard for several reasons. First, the original EDAPTS system in San Luis Obispo is based on TCIP and all existing internal EDAPTS data formats were based on TCIP. Second, the original TCIP standard was created through a broad-based transit property consensus among many transit properties. Third, TCIP has demonstrated itself to EDAPTS researchers over the life of EDAPTS to be comprehensive and well thought out, typically providing a structure that supports desired system modifications and extensions – a primary objective of EDAPTS. The EDAPTS Data Formatting Standard is included as a project deliverable.

Development of the EDAPTS Performance Specification Generator

An automated software tool that would allow any person desiring to generate EDAPTS Performance Specifications was developed as part of this project. This tool, called the EDAPTS Performance Specification Generator, allows a user to select the system functionality they desire for their EDAPTS system, input parameters specific to their transit system, and automatically generate a cleanly formatted performance specification document. This output is the EDAPTS Performance Specification deliverable from this project, and is attached to this document as an appendix.

Work on the EDAPTS Performance Specification Generator software commenced only after most of the development of the EDAPTS Performance Specification Tables was complete. This helped ensure that the software effort had a stable target. The EDAPTS Performance Specification Generator software program was developed using the Java programming language due to Java's powerful graphical user interface (GUI) programming and cross-platform portability attributes. Microsoft Access was selected as the database due to its widespread use and availability among future users of the EDAPTS Performance Specification Generator.

While, the EDAPTS Performance Specification Generator is sufficiently complete for researchers on this project to use to generate required performance specifications, the software still requires modest refinement prior to widespread distribution. These refinements will ensure that the software package is stable and simple to use and are expected to be largely accomplished during the EDAPTS Bronco Express Demonstration project.

Write the EDAPTS Performance Specification User's Guide

The EDAPTS Performance Specification User's Guide was written to tie all aspects of this project together. This guide contains documentation of the EDAPTS Performance Specification Tables and detailed instructions for using the EDAPTS Performance Specification Generator software application.

3. RESULTS

This project has four key results:

- The EDAPTS Performance Specification User's Guide (Appendix A)
- The Performance Specification Database, Software Program, & Output (Appendix B)
- The EDAPTS Performance Specification Tables (Appendix C)
- The EDAPTS Data Formatting Standard (Appendix D)

All results, except for the Performance Specification Software Database and Software Program are attached to this final report in printed form. The database program is included with this report on CD-ROM. It can also be downloaded from the following address:

http://itrans.calpoly.edu/EDAPTS/Performance_Specification/

EDAPTS Performance Specification Tables

The EDAPTS Performance Specification Tables are a set of tables in Microsoft Excel 2003 Workbook format. The tables in this workbook contain all of EDAPTS performance specification content in a form that is easy to peruse and edit. The EDAPTS Performance Specification Tables contain the following worksheets:

- Functional Groups
- System Functions
- Components
- Elements
- Market Packages
- Metric Categories
- Metrics
- Functions in Functional Groups
- Elements in Components
- Elements in Functions
- Functions in Market Packages

Details regarding contents and purpose of each of these individual worksheets are contained in the attached EDAPTS Performance Specification User's Guide.

EDAPTS Performance Specification User's Guide

The attached EDAPTS Performance Specification User's Guide provides detailed information regarding the EDAPTS Performance Specification Tables and their interrelationships. This handbook also provides instructions for using the EDAPTS Performance Specification Generator software application.

Performance Specification Database, Software Program, and Output

The EDAPTS Performance Specification Generator is an easy-to-use, portable application which interested parties can specify the performance in an EDAPTS system. This software application generates an output that is suitable for inclusion in procurement documents for an EDAPTS system. The output for a test deployment of EDAPTS is attached to this report as a deliverable.

EDAPTS Data Formatting Standard

The attached EDAPTS Data Formatting Standard provides low-level data formatting details regarding EDAPTS inter-component communications. Data formatting details are provided in the XML format.

4. DISCUSSION & CONCLUSIONS

Modification of Research Approach

The methodology initially envisioned for this project was to complete all tasks in a sequential fashion. These tasks were defined to be:

1. Literature Review
2. Identify EDAPTS Elements
3. Develop General List of Performance Metrics
4. Associate Performance Metrics with EDAPTS Elements
5. Measure / Determine Performance Metrics
6. Write Performance Specification

The reality of developing the performance specification dictated that all later tasks (Tasks 2 through 6) should be completed in a parallel, iterative fashion. The process of associating performance metrics developed in Task 3 with EDAPTS elements identified in Task 2 led to both the identification of new elements and new performance metrics. The new elements and new performance metrics were not simply items that had been forgotten, but typically more specific elements or metrics that had not been initially considered. Both the process of associating performance metrics with EDAPTS elements (Task 4) and the process of measuring and determining performance metrics (Task 5) led to further clarity in the identification of EDAPTS Elements. The process of writing the performance specification (Task 6) also had some bearing on the results from previous tasks; seeing the results of the output of the EDAPTS Performance Specification Generator resulted in changes to various aspects of EDAPTS Elements, adopted performance metrics, and the measurement of performance metrics. The end result of this iterative process is that collection of both EDAPTS Elements and performance metrics became more comprehensive, detailed, and specific as the specification grew into its final state and led to a better end product.

Performance Specification Applicability to ITS

The literature review uncovered many performance specifications for Information Technology and military projects or systems; however few existing ITS related performance specifications were identified. The EDAPTS performance-based specifications developed in this project could be the first case of a comprehensive performance specification for an Intelligent Transportation System.

As to the appropriate definition of a performance specification for ITS, it was determined that the definition should describe what a system should do, not how it should be constructed. The Department of Defense Standardization Program definition of a performance specification was determined to be the most appropriate for this project as it is succinct and complete. This definition is repeated here because of its importance to this project.

“A performance specification states requirements in terms of the required results and provides criteria for verifying compliance, but it does not state methods for achieving results. It defines the

functional requirements for the product, the environment in which it must operate, and the interface and interchangeability requirements.”

Project researchers came back to this definition periodically during the course of the project to ensure that all performance metrics being defined were proper and consistent.

It seems fair to conclude that the intelligent transportation system industry is early in the performance specification growth curve. Department of Defense entities are further evolved in this area. This is not unexpected, as the Department of Defense has been deploying large, complex, technology-based systems for decades using performance specifications.

EDAPTS Components & Elements

It was found to be necessary to group EDAPTS elements into Components for both organizational purposes and to provide an appropriate level of abstraction for specifying the performance of the EDAPTS system. Components and Elements were given the following definitions for use in the EDAPTS performance specification:

EDAPTS Component: A "swappable" piece of the EDAPTS system. The lowest level at which one piece can be replaced with another like piece and the system will still function properly.

EDAPTS Element: A subassembly or subsystem of a component. Does not need to be interchangeable with other like elements.

These definitions were selected to allow various Components to be procured from different vendors and/or contractors and to allow the internal workings of Components to be left to the discretion of the creator of the Component. This abstraction is coherent with the goals of the performance specification, which are to specify what the system should do, not how it should be constructed. It is worth noting that Components are subjected to EDAPTS data formatting metrics, but elements are not. This allows components to be purchased from any suitable supplier and work within the defined system, while giving the supplier the opportunity to design the internal workings of each Component as they see fit.

EDAPTS Performance Specification Tables in EXCEL Format

Building the EDAPTS Performance Specification Tables in Microsoft Excel proved to be an efficient scheme for development of the performance specification as whole. Researchers could view and edit any aspect of the performance specification, i.e. elements, in its entirety. This was helpful when making global decisions regarding the specification. Although the structure of these tables and hence the structure of the EDAPTS Performance Specification as a whole was carefully laid out at the beginning of the project, several changes to the structure proved to be necessary.

One example of this need for change was the need to associate system functions with National ITS Architecture Market Packages midway through the project. Another was the requirement to create groups of similar functions, which did not become apparent until near the end of development when EDAPTS Performance Specification Generator software program development was underway. Researchers were demonstrating the software package to the Caltrans Program manager when it

became apparent that the GUI would work better if functional groups of functions could be displayed. The spreadsheet implementation of the working performance specification allowed both of these new tables to be easily created and integrated into the EDAPTS Performance Specification as a whole.

Although an interested party can quickly and easily generate EDAPTS Performance Specifications from the software program, much insight can be gained about the requirements of the potential systems through a review of the raw performance specification tables. A method for viewing these tables in their original format should be included in any future release of the EDAPTS Performance Specification.

What is EDAPTS?

The question “What is EDAPTS?” arose when working on this performance specification. This question arose early and reappeared several times throughout this project, once where an external desire to have an “EDAPTS-like” system was expressed. After due consideration, project researchers came back to this early definition:

EDAPTS is a cost effective method for deploying transit management solutions to small and medium size transit properties. It is a framework for development and deployment that allows members of the transit community to leverage the efforts of each other to mutual advantage. EDAPTS is open source at its core and extensible. It may have proprietary extensions, allowing various entities to benefit from investment in it. It is flexible. It will grow with a transit property as their needs and resources grow. EDAPTS is consistent with the National ITS Architecture and conformant to TCIP.

Development of the EDAPTS Performance Specifications has provided the opportunity to cement various aspects of this definition through the creation of the EDAPTS Data-Formatting Standard. It is important to note that the EDAPTS Data-Formatting Standard is nothing new; rather it is merely the formalization of the data formatting which was central to the original EDAPTS system. Adherence to the EDAPTS Data-Formatting Standard allows all aspects of the above definition of EDAPTS to hold true:

- EDAPTS cost effectiveness will be maximized when system components have uniform interfaces, as prescribed by the EDAPTS Data-Formatting Standard.
- A uniform data-formatting standard provides a clean and unambiguous framework for development and deployment.
- EDAPTS will be extensible because all future data interfaces can be easily anticipated in early stages of deployment of a system.
- A uniform data-formatting standard enables system flexibility and extensibility.
- A uniform data-formatting standard ensures consistency with the National ITS Architecture and conformance to TCIP.

A meeting late in the project further reinforced this concept. Researchers were requested to draw a

detailed diagram for the architecture of an EDAPTS system to facilitate discussion. The drawing of this diagram forced researchers to demonstrate and consider which system interfaces should be documented and open and which could be proprietary. This diagram can be found in the attached EDAPTS Performance Specification User's Guide. The end result of this discussion was that requiring open interfaces at component boundaries and hence documented data formats for communications across these boundaries would provide the correct balance of interoperability and vendor commodity.

The EDAPTS Data Formatting Standard allows EDAPTS components to be procured as commodities, i.e. components can be obtained from any source and should drop directly into the system due to having commonality at the communications interface level. The EDAPTS Data Formatting Standard is central to all aspects of answering the question "What is EDAPTS?", by ensuring compatibility between EDAPTS Components. The intent is that this approach allows EDAPTS to be procured at the lowest possible cost. For this to be a viable outcome, EDAPTS must be defined at the data-formatting/interface level.

5. RECOMMENDATIONS

The EDAPTS performance specifications should be extended to cover various on-board elements, including automatic passenger counters, fare and media readers, and next-stop stop indicators and annunciators as they are developed and added. Vendors should be consulted during this process.

The EDAPTS Performance Specification Generator should be further polished and extended. Potential improvements include the ability for the program to:

- Differentiate between basic needs and optional system features.
- Allow direct export of EXCEL spread sheets of performance specification tables.
- Provide user interface forms that allow viewing and modification of any aspect of the EDAPTS Performance Specification.
- Provide for viewing and output of all individual tables from within the database.

The EDAPTS Data Formatting Standard should be maintained so that it:

- Tracks data formats used in future EDAPTS deployments and remains consistent with the industry.
- Tracks and merges with TCIP standard as TCIP reaches maturity.

6. APPENDICIES

Appendix A – EDAPTS Performance Specification User’s Guide

Appendix B – EDAPTS Performance Specification Output for a Test Deployment

Appendix C – EDAPTS Performance Specification Tables

Appendix D – EDAPTS Data-Formatting Standard

APPENDIX A

EDAPTS PERFORMANCE SPECIFICATION USER'S GUIDE

EDAPTS Performance Specification

User Guide

Prepared For:

California Partners for Advanced Transit and Highways (PATH)

California Department of Transportation

By:

California Polytechnic State University

San Luis Obispo, California

Under PATH Contract TO-6402

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1. INTRODUCTION

The EDAPTS Performance Specification User Guide provides an overview of the EDAPTS Performance Specification Generator and the Performance Specification Tables used in the creation of the Specification Generator, and instructions on how to generate an EDAPTS Performance Specification. Section two of this document provides detailed instructions for the EDAPTS Performance Specification Generator software package. These instructions will take the user through all stages of generating a performance specification. Section three then provides a detailed description of all aspects of the EDAPTS Performance Specification Tables. Information on the content of each table and the relationships between tables are provided. Lastly, this user guide provides a detailed example of how the EDAPTS Performance Specification Tables work, and how a user may use them to manually create an EDAPTS Performance Specification.

2. PERFORMANCE SPECIFICATION GENERATOR USER INSTRUCTIONS

2.1 Software Overview

The Efficient Deployment of Advanced Public Transportation Systems (EDAPTS) Performance Specification Generator allows the user, such as a transit owner, manager or planner, to develop tailored, transit-focused Intelligent Transportation System (ITS) performance specifications to aid in the procurement of an open-architecture EDAPTS transit management system. This software package creates a detailed performance specification based on the system functions selected and entered while using this software. System functions are actions that the system will do for a user of the system. In summary, the software will request the user to select functions desired for the EDAPTS system, indicate parameters specific to the user's transit operation (e.g. number of buses, numbers of routes) and then automatically generate a performance specification for an applicable EDAPTS system. The following sections provide step-by-step instructions for generating an EDAPTS performance specification.

2.2 Operating Instructions

The latest version of the EDAPTS Performance Specification Software Database and Software Program may be downloaded from:

http://itrans.calpoly.edu/EDAPTS/Performance_Specification/

Several other software tools are required to use the Performance Specification Software Database and Software Program. All of these programs are commonly installed on most desktop computers, but if you are uncertain about your computer please check with your system administrator.

Required Software:

1. Java Runtime Environment (v1.6.0 or higher). The Java Runtime Environment (JRE) is free, and the latest version can be obtained from:

<http://java.sun.com/javase/downloads/>

2. A PDF viewer such as Adobe Acrobat Reader. The Adobe reader is free, and can be obtained from:

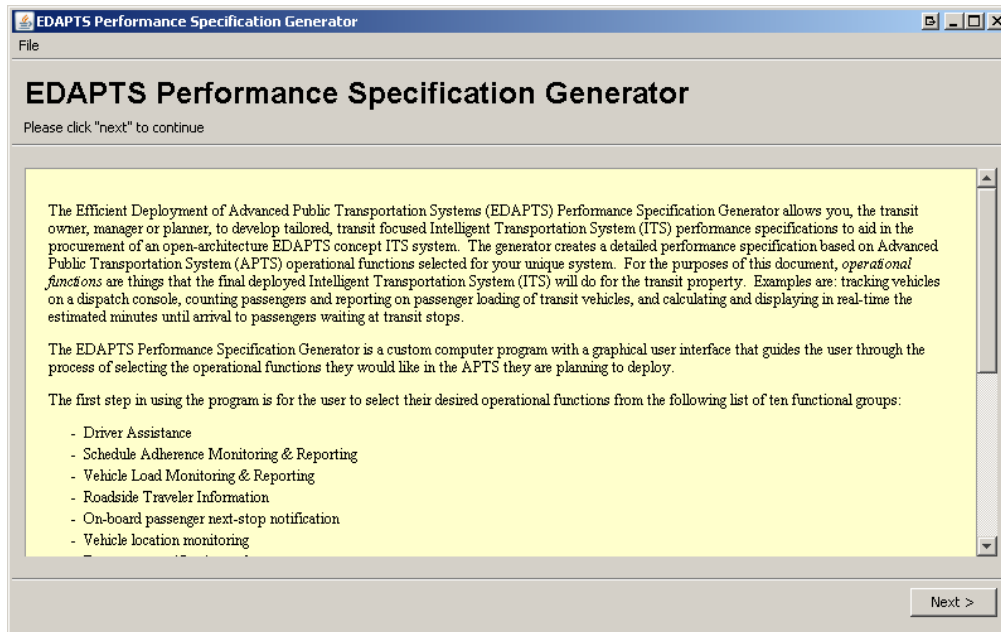
<http://www.adobe.com/products/reader/>

3. An unzip program such as WinZip or 7-Zip is required to extract the Performance Specification Software zip file. 7-Zip is free, and can be obtained from:

<http://www.7-zip.org/>

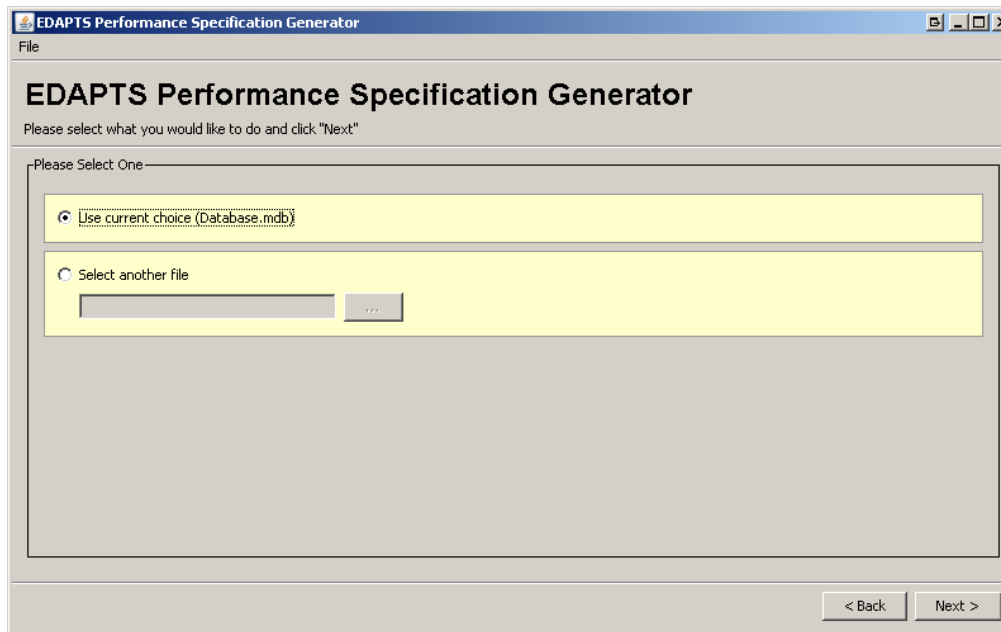
Using the Performance Specification Generator

1. Start the Specification Generator program by double-clicking the 'EDAPTS Performance Specification Generator.jar' file. Upon opening the program you will be presented with the introduction screen.



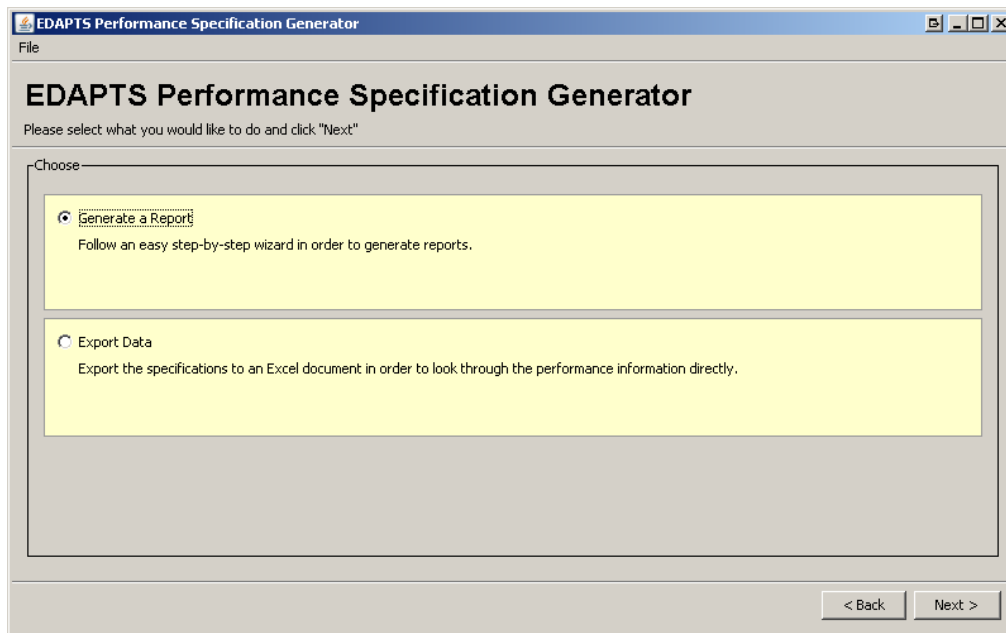
This introduction provides a brief overview of the Specification Generator and how it can be utilized. Once you have read the introduction, click 'Next'.

2. The Specification Generator then prompts for selection of a database to use to generate the specification.



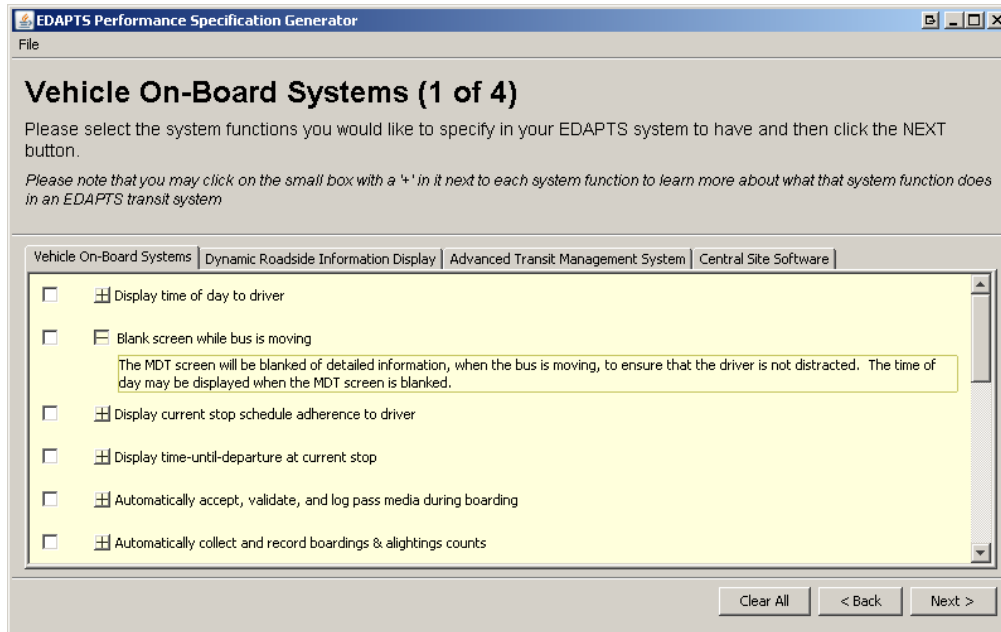
The included database is pre-selected by the Specification Generator. If you wish to use the included database, click 'Next'. If you have another database you wish to use, click the 'Select another file' radio button, click the '...' button to select the file, and then click 'Next'.

3. The Specification Generator will then prompt you to choose whether to generate a Specification report, or export the database data to a set of Excel spreadsheets for examination.



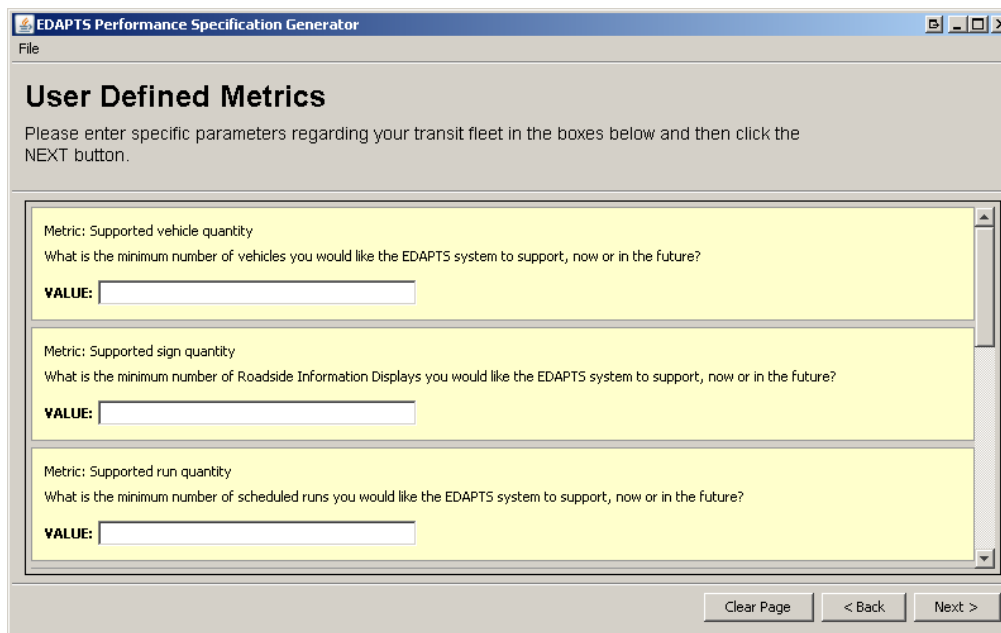
The 'Generate a Report' option is pre-selected and is the output normally desired for procurement document use. Click the 'Next' button to continue.

4. The Specification Generator then prompts you to select the desired system functions you desire in your EDAPTS transit system. These system functions are grouped by EDAPTS component, and are available by clicking any of the tabs above the listed functions. Clicking the '+' symbol next to each system function displays a brief description of the function.



Select the desired functions for your EDAPTS transit system by clicking the checkbox to the left of the function name. Clicking 'Next' will display the next tab in the sequence, but you may skip to any tab as required by simply clicking on the tab itself. Click 'Next' from the last tab when all desired functions have been selected and you are finished with the function selection process.

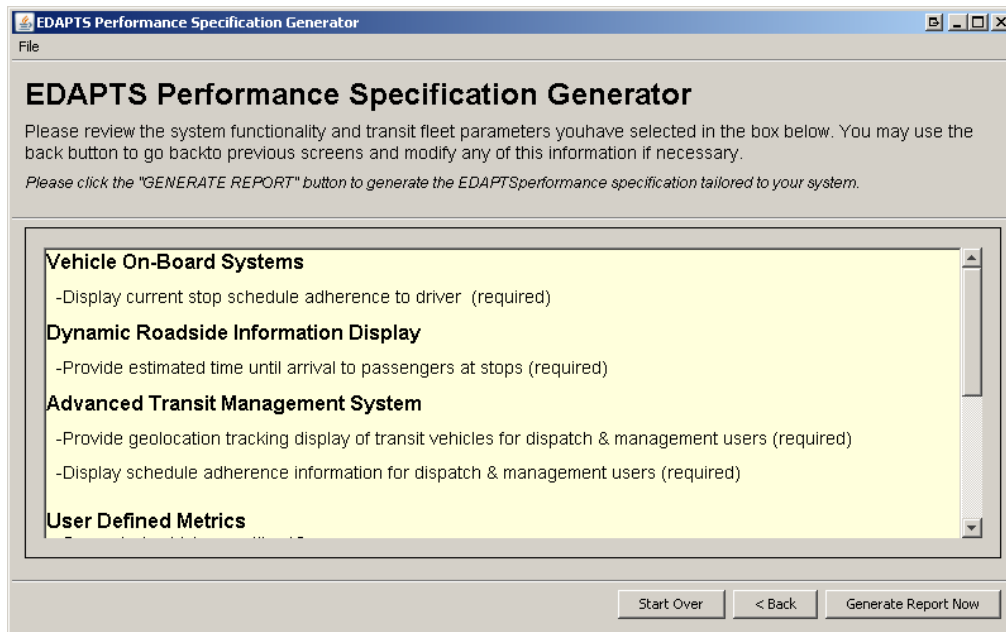
5. The Specification Generator will then prompt for entry of parameters that are specific to your EDAPTS installation, such as the number of vehicles you wish the system to support.



Values may be left blank, but it is highly recommended that all questions be given an

answer to avoid ambiguity in the Specification Report. Fill in (answer) the questions, and then click 'Next'.

6. The Specification Generator will then display a summary of the selected EDAPTS system functionality and entered parameters.



Review the summary to ensure all desired functions are selected and that the entered parameters are correct. If you want to make changes to your initial selections, click the 'Back' button until the desired specification page is displayed, make the desired change to the functionality and then go to the last tab and click the "Next" button again. When you are satisfied that the summary is accurate, click the "Generate Report Now" button to create an EDAPTS Performance Specification Report.

The Specification Generator will prompt you to select a name for the report, and a location for it to be saved. Choose a name and location, then click the 'Save' button. The Specification Generator will create a report, and the 'Generate Report Now' button will change to a 'Close' button that you can click to exit the program. You are done with the generation of a full performance specification for your EDAPTS transit ITS procurement.

7. Using your PDF viewer, open the EDAPTS Performance Specification Report from the location you saved it in the step above..

3. PERFORMANCE SPECIFICATION TABLE DETAILS

3.1 Table Descriptions & Details

There are eleven tables in the Excel version of the Performance Specification. These tables are:

- Elements
- Components
- System functions
- Metric categories
- Metrics
- Functional groups
- Elements in components
- Elements in functions
- Functions in functional groups
- Market packages
- Functions in market packages

An overview of each table is provided below, along with a sample from each table.

Elements

EDAPTS Elements are defined as a subassembly or subsystem of a Component (please see the next section for an overview of Components). Elements comprise the lowest level of abstraction in the Performance Specification, and consist of parts or small groups of parts necessary to implement EDAPTS functionality. Elements are not required to be interchangeable with other like Elements of same or different manufacture.

As shown below, the Element table (worksheet) is organized in rows. Elements are listed with a unique identifier, an Element name, the name of the Component it is a member of, that Component's unique identifier, a description of the Element, and any applicable notes.

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-101	Mobile Data Terminal (MDT)	Vehicle On-Board Systems	C-1	A device that provides the driver access to various functions such as schedule adherence status, passenger boarding status, time of day, time of day, route being driven. The MDT provides driver input and output functions and is likely connected to other on-board elements.	

Components

EDAPTS Components are comprised of Elements. Components are defined as the “swappable” pieces of the EDAPTS system, and are the lowest level at which one piece can be replaced by another like Component of same or different manufacture.

As shown below, the Component table (worksheet) is organized in rows. Components are listed with a unique identifier, a Component name, and a description of the Component.

component_ID	component_name	component_description
C-1	Vehicle On-Board Systems	The equipment and software installed in a transit vehicle to perform transit management functions. On-Board systems will typically include a Mobile Data Terminal and associated peripherals such as magnetic stripe card readers, on-board annunciators and electronic message signs, and driver's emergency button.

System Functions

System Functions are defined as an action the system does for a system user. When used as part of the EDAPTS Performance Specification Generator they provide an end-user interface to the Performance Specification, allowing the creator of an EDAPTS Specification to easily select desired functionality.

As shown below, the System Function table (worksheet) is organized in rows. System Functions are listed with a unique identifier, a Function name, a description of the functionality the Function will implement, and the Component the Function is primarily associated with.

function_ID	function_name	function_description	part_of_component
F-101	Display time of day to driver	The current time of day in hours and minutes will be displayed to the driver via the MDT screen in large-format, easy-to-read numbers.	C-1

Functional Groups

As a shortcut to defining an EDAPTS functional solution, fully populated sets of System Functions are assembled together into Functional Groups. This higher level feature-set can then be easily selected by the creator of an EDAPTS Performance Specification, avoiding the need to individually select all individual functions independently. They provide the procurer a simple set of packages allowing the selection of EDAPTS features.

As shown below, the Functional Group table (worksheet) is organized in rows. Functional Groups are listed with a unique group identifier, the group name, and a description of the group and the functionality it implements.

functional_group_ID	functional_group_name	functional_group_description
FG-03	Vehicle Load Monitoring & Reporting	The vehicle load monitoring & reporting group will provide dispatchers and transit managers with real-time and post-processed information regarding transit vehicle loading. Real-time vehicle loading of all vehicles on route as well as after-the-fact reports indicating average loading will be available. All vehicle loading reports will be selectable by route, time, or date.

Metric Categories

Metrics (see next section) are grouped into general areas or Metric Categories, allowing similar Metrics to be viewed together in the Specification. This facilitates the viewing of requirements in the Performance Specification by both the procurer of an EDAPTS system and any potential bidders or implementers of the system.

As shown below, the Metric Category table (worksheet) is organized in rows. Metric Categories are listed with a unique identifier, a Category name, and a description of the Metric Category along with general topic areas for that category.

category_ID	category_name	category_description
MCAT-01	Communications & Electrical Interfacing	Communications and Electrical Interfacing performance metrics define required data communications latency, reliability, and throughput, and electrical interfacing standards.

Metrics

Metrics comprise the heart of the Performance Specification, and list all of the requirements necessary for construction of an EDAPTS system. Metrics are defined as individual performance measures for an Element, Component, or the system as a whole.

As shown below, the Metric table (worksheet) is organized in rows. The Metrics are listed with a unique identifier, the Metric name, the specific requirements for the Metric, the units (if applicable), the method of verifying compliance with the Metric’s requirements, the value of the Metric (if applicable), the question the Performance Specification Generator should prompt with for entry of custom values (if applicable), the unique identifier and name of the Metric

Category the Metric is associated with, and the unique identifier and name of the Element or Component the Metric should be applied to.

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method
M-01004	latency_OBS_Wireless_Communications	Maximum time for vehicle-update messages sent from the On-Board System to be received by the CSS under typical system load conditions.	Seconds	Test by measuring time delay

metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component_ID	element_name or component_name
15 seconds		MCAT-01	Communications & Electrical Interfacing	E-202	On-board Wide-Area Communications Infrastructure / Repeaters

Elements in Components

Elements in Components is a relational table that provides a list of all Elements in a Component. It is used by the Performance Specification Generator to link Components with their member Elements. The table links each Component identifier and name with an Element identifier and name.

component_ID	component_name	element_ID	element_name
C-1	Vehicle On-Board Systems	E-101	Mobile Data Terminal (MDT)

Elements In Functions

Elements in Functions is a relational table that lists all Elements required to implement a given System Function. It provides the link between the higher-level functionality selected by a user of the Performance Specification and the lower-level pieces of an EDAPTS system. The table links each Function identifier and name with an Element identifier and name.

function_ID	function_name	element_ID	element_name
F-104	Display current stop schedule adherence to driver	E-101	Mobile Data Terminal (MDT)

Functions in Functional Groups

This relational table lists all System Functions contained within a Functional Group. It is used by the Performance Specification Generator to link Functional Groups with their member Functions. The table links each Functional Group identifier and name with a Function identifier and name.

functional_group_ID	functional_group_name	member_function_ID	member_function_name
FG-01	Driver Assistance	F-101	Display time of day to driver

Market Packages

Market Packages represent slices of the National ITS Architecture. Packages collect together different subsystems, equipment packages, terminators, and architecture flows that provide the desired service. Definitions for the packages are provided by the U.S. Department of Transportation.

As shown below, the Market Package table (worksheet) is organized in rows. Each Market Package is listed with a unique EDAPTS identifier, the USDOT identifier, the package service area, the package name, and a description of the focus of the package.

market_package_ID	market_package_number	market_package_service_area	market_package_name	market_package_description
MPKG-01	AD1	Archived Data Management	ITS Data Mart	This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.

Functions in Market Packages

Functions in Market Packages is a relational table that lists which System Functions have been implemented for a given Market Package. It provides the link between EDAPTS functionality and the National ITS Architecture. The table links each Market Package EDAPTS identifier with its USDOT identifier, its package service area and its Function identifier and name.

market_package_ID	market_package_number	market_package_service_area	function_ID	function_name
MPKG-01	AD1	ITS Data Mart	F-301	Provide API for transit traveler information

3.2 Using the Tables

All tables described above are included in the Excel spreadsheet file titled “TO-6402 Performance Specification Tables” as individual worksheets within the file. While these tables can be used to manually create a system specification, they are intended to be imported into the EDAPTS Performance Specification Generator program that allows automated specification generation based on a users individually selected set of required functions. This section provides instruction on how to **manually** use the tables, and uses examples from the tables to assist the readers understanding of the specification generation process.

Understanding the performance requirements for a System Function

1. Select a System Function.

Ex. F-101, Display time of day to driver.

2. Determine which Elements are required for that System Function with the “Elements in Functions” table”, using the Function ID as the key.

Ex. F-101 requires Elements E-101 and E-107.

3. Use the “Elements in Components” table to determine which Components are required, using the Element ID as the key. Make sure to address all Elements identified in the list of required Elements determined in Step 2.

Ex. Elements E-101 and E-107 require Component C-1.

4. Search through the Metrics table for Metrics that apply to the list of Elements determined in Step 2 using the “Element or Component ID” column. If any Metrics you identify contain the Metric value ‘[USER DETERMINED DATA]’, replace it with the value required for your specific EDAPTS installation.

Ex. Metrics M-01001, M-02001 through M-02009, M-03001 and M-03002, M-05009 through

M-05031, M-06003 through M-06007, M-10002 through M-10004, M-12018, M-13001, M-14004, M-16001 through M-16003 are applicable to Elements E-101 and E-107.

5. Search through the Metrics table for Metrics that apply to the list of Components determined in Step 3 using the “Element or Component ID” column. If any Metrics contain the Metric value ‘[USER DETERMINED DATA]’, replace it with the value required for your specific EDAPTS installation.

Ex. Metrics M-06002, M-07003 and M-07004, M-09001 and M-09002, M-10001, M-12013 through M-12017, and M-14001 through M-14003 are applicable to Component C-1.

6. Search through the Metrics table for Metrics that apply to **all** Elements and Components. The Metrics are marked as applicable to ‘ALL’ in the “Element or Component name” column. If any Metrics contain the Metric value ‘[USER DETERMINED DATA]’, replace it with the value required for your specific EDAPTS installation.

Ex. Metrics M-04001 through M-04015, M-05001 through M-05008, M-06001, M-07001 and M-07002, M-08001 through M-08008, M-11001 through M-11004, M-12001 through M-12012, M-15001 through M-15013 are applicable to all Components and Elements.

7. The Metrics determined from steps 4, 5, & 6 are the requirements for the selected function.

Understanding how Market Packages are implemented by System Functions

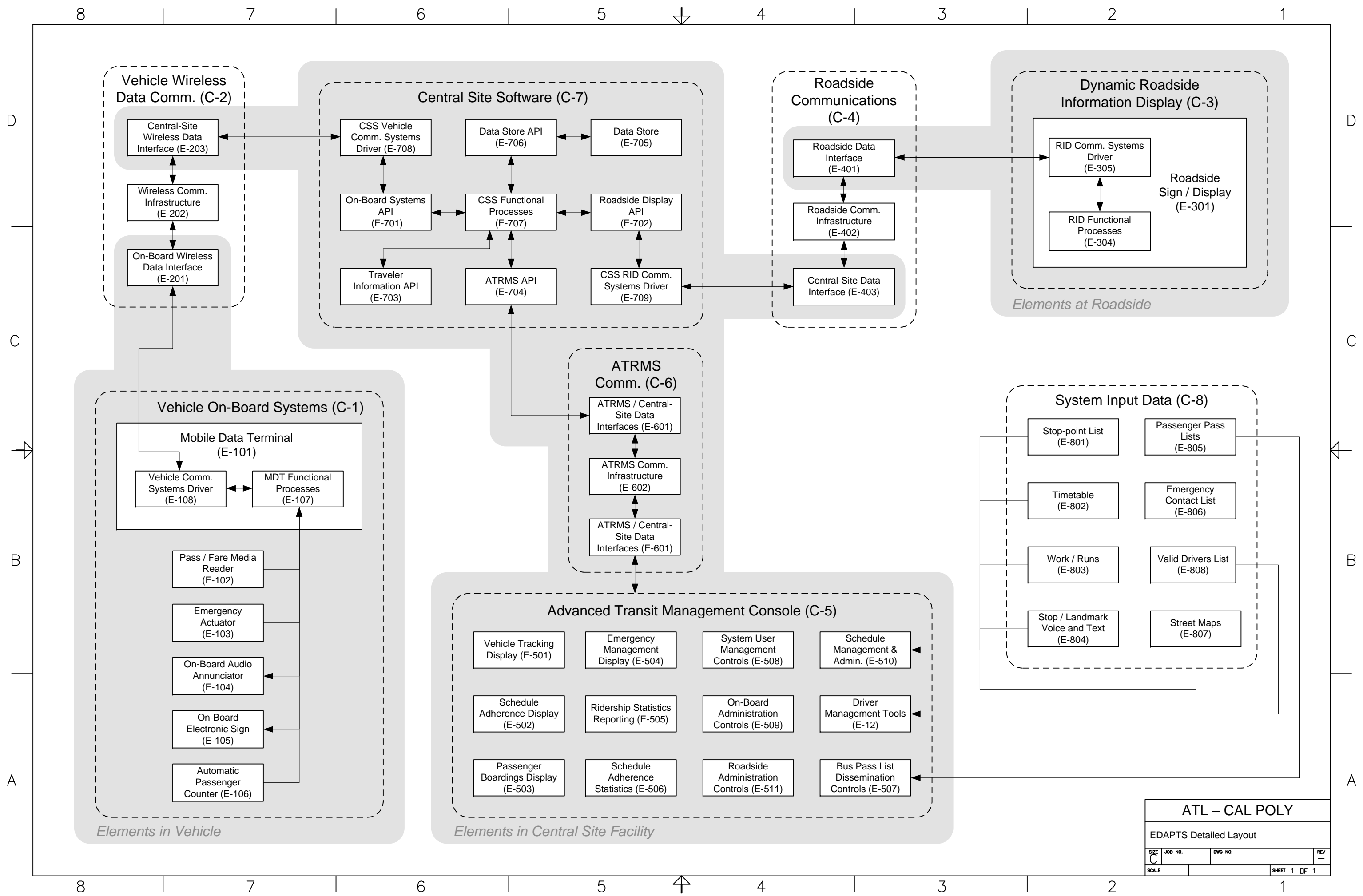
1. Select a System Function.

Ex. F-401, Provide geolocation tracking display of transit vehicles for dispatch and management users.

2. Search through the “Functions in Market Packages” table to determine which Market Packages are associated with the System Function selected in Step 1 using the “Function ID” as the key.

Ex. Market Packages APTS1, APTS2, and EM10 are associated with Function F-401.

APPENDIX A - EDAPTS LAYOUT DIAGRAM



APPENDIX B

EDAPTS PERFORMANCE SPECIFICATION OUTPUT FOR A TEST DEPLOYMENT

EDAPTS Performance Specification

A. Report Summary

1. Selected System Functionality

Vehicle On-Board Systems: The equipment and software installed in a transit vehicle to perform transit management functions. On-Board systems will typically include a Mobile Data Terminal and associated peripherals such as magnetic stripe card readers, on-board annunciators and electronic message signs, and driver's emergency button.

- Display time of day to driver
- Display current stop schedule adherence to driver
- Automatically collect and record boardings & alightings counts
- Provide notification of stop arrivals and departures to driver
- Collect route number during login
- Provide real-time vehicle updates (location, schedule adherence, etc)
- Survey stop locations
- Blank screen while bus is moving
- Display time-until-departure at current stop
- Receive, store, and transfer bus stop data from peripheral on-board devices
- Collect driver ID during login
- Change driver's work assignment during the day
- Declare on board emergency
- Manually collect and record passenger boarding counts.

Dynamic Roadside Information Display: An electronic, remotely controlled display that presents information regarding estimated time of arrival of buses to passengers waiting at bus stops. These displays typically provide "real-time" information based upon bus progress along route.

- Provide estimated time until arrival to passengers at stops
- Provide dynamic public service information to passengers at stops

Advanced Transit Management System: The software application that will run at locations such as the dispatch center and other management offices, typically providing personnel with information such as vehicle position and location, schedule adherence data, boarding and ridership data, and statistical analysis and reporting of the above functions.

- Provide geolocation tracking display of transit vehicles for dispatch & management users
- Display passenger boarding / alighting information for dispatch & management users
- Provide statistical ridership reports for dispatch & management users
- Display schedule adherence information for dispatch & management users
- Handle driver emergency button alarms for dispatch and management users
- Provide statistical schedule adherence reports for dispatch & management users

- Provide controls for roadside banner message display
- Provide system user administration

Central Site Software: The software that will run at a fixed, central location to receive, transmit, store, and facilitate the exchange of data between other components. Such software typically provides an interface to communicate with On-Board and Roadside components, stores and retrieves collected system data, and provides Application Programming Interfaces (APIs) to both ATRMS and Traveler Information systems.

- Provide API for transit traveler information

2. Required Components and Elements

Vehicle On-Board Systems

- **Mobile Data Terminal (MDT)**: A device that provides the driver access to various functions such as schedule adherence status, passenger boarding status, time of day, time of day, route being driven. The MDT provides driver input and output functions and is likely connected to other on-board elements.
- **MDT Functional Processes**: Software that executes on the MDT to perform functions such as detecting bus stops, accepting data from devices such as an Automatic Passenger Counter or a media reader, or controlling on-board devices such as annunciators and electronic display signs.
- **MDT Vehicle Wireless Data Communications System Driver**: Software that executes on the MDT interface to the Vehicle Wireless Data Communications System. This software may perform data encoding/decoding.
- **APC (Automatic Passenger Counter)**: Devices mounted at all bus entry and exit locations that detect passengers embarking and disembarking from the bus. APCs typically keep track of the total number of people riding on the bus at any given time. Data may be downloaded at the end of the day or may be transferred to another on-board devices such as the MDT as it is determined.
- **Emergency Actuator**: A device that drivers will utilize to send an emergency notification or "Mayday" message to the dispatcher indicating they have a situation on their bus which poses a physical threat to themselves or any of the passengers. The Emergency Actuator would typically be installed in the driver's compartment so that the driver could actuate it unbeknownst to anyone else on the bus.

Vehicle Wireless Data Communications System

- **On-Board High-Speed Data Interface**: An on-board device, such as a modem or data communications card, that allows the on-board computational equipment (the MDT) to make a high-speed data communications connection to the central site from within the transit facility.
- **On-board High-Speed Communications Infrastructure / Repeaters**: Equipment located on the transit facility that serves as a relay station for high-speed bi-directional wireless data communications transmissions between the central site and transit vehicle on-board systems in the transit facility.
- **Central-Site High-Speed Data Interface**: A device such as a modem, data communications card, or network access card that allows the central site communications servers to make a high-speed wireless data connection to transit On-Board Systems of transit vehicles within the transit facility.

- On-Board Wide-Area Wireless Data Interface: An on-board device, such as a modem or data communications card, that allows the on-board computational equipment (the MDT) to make a data communications connection to the central site from anywhere in the transit service area.
- On-board Wide-Area Communications Infrastructure / Repeaters: Equipment located on mountaintops, buildings, poles, etc. that serves as a relay station for bi-directional wireless data communications transmissions between the central site and buses anywhere in the transit service area.
- Central-Site Wide-Area Wireless Data Interface: A device such as a modem, data communications card, or network access card that allows the central site communications servers to make a connection to transit vehicle on-board systems anywhere in the transit service area via the Wireless Communications system.

Dynamic Roadside Information Display

- Roadside Sign / Display: A device (typically installed on a post or pole) that presents "live" data regarding estimated time of arrival or minutes until arrival for transit vehicles arriving at a stop. This sign/display may display information for more than one route at a given stop and also may display other messages such as public service announcements or system status information.
- Roadside Post: A post or pole that supports the Roadside Information Display.
- Roadside Post Foundation: The foundation for the Roadside Post.
- RID Functional Processes: Software that executes on the RID and receives messages from the central site and performs functions such as calculating estimated minutes for arrival for buses, formatting public service messages for display.
- RID Communications System Driver: Software that executes on the RID and interfaces to the RID Data Communications System. This software may perform data encoding/decoding.

Roadside Data Communications System

- Roadside Data Interface: A device, such as a modem, data communications card, or network access card that allows the Dynamic Roadside Information Display to make a data communications connection to the central site.
- Roadside Communications Infrastructure / Repeaters: Equipment located on mountaintops, buildings, poles, etc. that is serves a relay station for uni-directional or bi-directional wireless data communications transmissions between Roadside Information Displays and the central site.
- Central-Site Data Interface: A device such as a modem, data communications card, or network access card that allows the central site communications servers to make a data communications connection to buses via the On-Board Wireless Communications system.

Advanced Transit Management System

- On-Board Equipment Administration Controls: A GUI screen with controls that allows a management user to administer the MDT computer and its operating system remotely from the central site. Administration capabilities include loading new configuration files, software executables, system schedules / timetables, and retrieving log files of various system functions. These administration tools give the remote administrator the same tools they would have if they were connected into the MDT's operating system via a hard-wire connection.

- Schedule Management & Administration Tools & Controls: A GUI screen with controls that allows a management user to build, modify, or delete system schedules on a per time period, per route, or per system basis.
- ATRMS Data Communications System Driver: Software that executes on the ATRMS interface to the ATRMS Communications System. This software may perform data encoding/decoding.
- Driver Management Controls: A GUI screen with controls that allows the addition, removal, and editing of drivers and driver information within the system.
- Emergency Management Display: A GUI screen that alerts a dispatch and/or management user when a driver has depressed his or her emergency actuator. This screen creates audible and visible indications of the emergency conditions and does not allow any other activity on any ATRMS console until the emergency has been acknowledged and coordination responsibility is assumed by a dispatch or management user. It enables continuous "live" tracking of the vehicle reporting the emergency and allows the emergency to be closed out and automatically logged when it is over.
- Roadside Information Display Controls: A GUI screen with controls that allows a management user to reconfigure Roadside Information Displays to serve different stops, update their schedules, or update them with public service or system status banner messages.
- Vehicle Tracking Display: A GUI screen with controls that allows a dispatch and/or management user to observe real-time vehicle positions. The screen may display information in a map-based or tabular form, depending upon specific user requirements.
- Schedule Adherence Display: A GUI screen with controls that allows a dispatch or management user to observe vehicle schedule adherence on a user-defined per stop, per trip, per route, per hour, or per day basis.
- Passenger Boardings Display: A GUI screen with controls that allows a dispatch and/or management user to observe passenger boardings on a user-defined per stop, per trip, per route, per hour, or per day basis.
- Ridership Statistics Reporting Controls: A GUI screen with controls that allows a dispatch or management user to generate reports regarding ridership statistics on a user-defined per stop, per trip, per route, per hour, or per day basis.
- Schedule Adherence Statistics Reporting Controls: A GUI screen with controls that allows a dispatch or management user to generate reports regarding vehicle schedule adherence on a user-defined per stop, per trip, per route, per hour, or per day basis. Reports generated may be either statistical or exception based in nature.
- System User Management Controls: A GUI screen with controls that allows a management user to create new system users, modify the permissions of existing users, or delete users.

ATRMS Communications

- ATRMS / Central-Site Data Interfaces: The local area networking (LAN) cards installed in central-site workstations and servers.
- ATRMS Communications Infrastructure / Repeaters: The local area networking (LAN) equipment used to connect central-site workstations and servers to each other and to remote ATRMS clients via the Internet.

Central Site Software

- On-Board Systems API: A software application that runs at the central site and communicates with all Mobile Data Terminals (MDTs) in the fleet via the Central Site Wireless Data Interface and the On-Board Communications Infrastructure and Repeaters. This communications server provides all access to Mobile Data Terminals in vehicles for the central site.
- ATRMS API: A software application that runs at the central site and provides a set of functions that return information to support all ATRMS GUI screens.
- Data Store: A software application or function (most likely a dbms) that provides short term and long term storage of all system data received from transit vehicles and system schedules.
- Data Store API: An application programmers interface that provides read-write access to the Data Store for software applications such as the Central Site Software and the ATRMS.
- CSS Functional Processes: Software that executes at the central site to perform functions such as calculating schedule adherence, processing driver emergencies, generating reports, managing schedules, etc.
- CSS Vehicle Wireless Data Communications Systems Driver: Software that executes at the central site and interfaces to the Vehicle Wireless Data Communications System. This software may perform data encoding/decoding.
- CSS ATRMS Data Communications System Driver: Software that executes at the central site and interfaces to the ATRMS Communications System. This software may perform data encoding/decoding.
- Roadside Information Display API: A software application that runs at the central site and communicates with all Roadside Information Displays via the Central Site Data Interface and the Roadside Communications Infrastructure and Repeaters. This communications server provides all access to Roadside Information Displays for the central site.
- CSS RID Data Communications System Driver: Software that executes at the central site and interfaces to the RID Communications System. This software may perform data encoding/decoding.
- Traveler Information API: A software application that runs at the central site and provides a set of functions that return information regarding vehicle location on route, schedule adherence, and vehicle seat availability to applications that will provide this information the public through various communications and display schemes.

System Input Data

- Stop-Point List: The master list of all stops in the transit system. Each stop has a unique identifier number or designation as well as latitude, longitude, and direction of travel for the stop. It may also include other identification information such as common street names, intersection and/or stop name.
- Timetable: The master schedule for the transit system, indicating all routes, trips, and stops on trips in the system.
- Work / Runs List: The master list of all runs in the system.
- Valid Drivers List: A list of valid transit fleet drivers.

3. Market Packages

- ITS Data Mart: This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.
- Transit Vehicle Tracking : This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider.
- Transit Fixed-Route Operations : This market package performs vehicle routing and scheduling, as well as automatic operator assignment and system monitoring for fixed-route and flexible-route transit services. This service determines current schedule performance using AVL data and provides information displays at the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.
- Transit Passenger and Fare Management : This market package manages passenger loading and fare payments on-board transit vehicles using electronic means. It allows transit users to use a traveler card or other electronic payment device. Sensors mounted on the vehicle permit the operator and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem. Two other market packages, ATMS10: Electronic Toll Collection and ATMS16: Parking Facility Management also provide electronic payment services. These three market packages in combination provide an integrated electronic payment system for transportation services.

- Transit Security : This market package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment is deployed to perform surveillance and sensor monitoring in order to warn of potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this market package provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring).

The surveillance and sensor information is transmitted to the Emergency Management Subsystem, as are transit user activated alarms in public secure areas. On-board alarms, activated by transit users or transit vehicle operators are transmitted to both the Emergency Management Subsystem and the Transit Management Subsystem, indicating two possible approaches to implementing this market package.

In addition the market package supports remote transit vehicle disabling by the Transit Management Subsystem and transit vehicle operator authentication.

- Transit Traveler Information: This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.
- Mayday and Alarms Support : This market package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user, gather information about the incident, and determine the appropriate response. The request for assistance may be manually initiated or automated and linked to vehicle sensors. This market package also includes general surveillance capabilities that enable the Emergency Management Subsystem to remotely monitor public areas (e.g., rest stops, parking lots) to improve security in these areas. The Emergency Management Subsystem may be operated by the public sector or by a private sector telematics service provider.

- Evacuation and Reentry Management : This market package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The market package addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning.

This market package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times.

Evacuations are also supported by EM10, the "Disaster Traveler Information" market package, which keeps the public informed during evacuations. See that market package for more information.

- Disaster Traveler Information: This market package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This market package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems.

A disaster will stress the surface transportation system since it may damage transportation facilities at the same time that it places unique demands on these facilities to support public evacuation and provide access for emergency responders. Similarly, a disaster may interrupt or degrade the operation of many traveler information systems at the same time that safety-critical information must be provided to the traveling public. This market package keeps the public informed in these scenarios, using all available means to provide information about the disaster area including damage to the transportation system, detours and closures in effect, special traffic restrictions and allowances, special transit schedules, and real-time information on traffic conditions and transit system performance in and around the disaster.

This market package also provides emergency information to assist the public with evacuations when necessary. Information on mandatory and voluntary evacuation zones, evacuation times, and instructions are provided. Available evacuation routes and destinations and current and anticipated travel conditions along those routes are provided so evacuees are prepared and know their destination and preferred evacuation route. Information on available transit services and traveler services (shelters, medical services, hotels, restaurants, gas stations, etc.) is also provided. In addition to general evacuation information, this market package provides specific evacuation trip planning information that is tailored for the evacuee based on origin, selected destination, and evacuee-specified evacuation requirements and route parameters.

This market package augments the ATIS market packages that provide traveler information on a day-to-day basis for the surface transportation system. This market package provides focus on the special requirements for traveler information dissemination in disaster situations.

B. Specification Details

1. System-Wide Requirements

1.1.1. Documentation

1.1.1.1. Document writing level

Metric Requirement: All documents shall be presented clearly and concisely, and reflect writing of at least a 12th grade level.

Verification Method: Verify writing level.

1.1.1.2. Document reading comprehension level

Metric Requirement: All documents shall be clearly understandable by audiences with 12th grade reading comprehension level.

Verification Method: Inspect deliverable documents to ensure compliance.

1.1.1.3. Document clarity

Metric Requirement: All documents shall conform to the MIL-STD-962D documentation standard, section 4.7 for clarity.

Verification Method: Verify conformance with standard.

1.1.1.4. Document style

Metric Requirement: All documents shall conform to the U.S. Government Printing Office Style Manual for style and grammar.

Verification Method: Verify conformance with standard.

1.1.1.5. Document wiring diagrams identifiers

Metric Requirement: All cables and wires on wiring diagrams shall utilize unique identifiers which match physical labels on cables.

Verification Method: Inspect deliverables to ensure compliance.

1.1.1.6. Document wiring diagrams inter page connections

Metric Requirement: All wiring diagram inter-page connections shall be clearly marked at the left or right hand side of the page with the wire or cable's unique identifier.

Verification Method: Inspect deliverables to ensure compliance.

1.1.1.7. Document wiring diagram individual signals

Metric Requirement: All wiring diagrams shall reflect individual signal levels for multi-conductor cables.

Verification Method: Inspect deliverables to ensure compliance.

1.1.1.8. Document wiring diagrams standard connections

Metric Requirement: System wiring diagrams shall indicate all individual conductors/signals by unique identifier

Verification Method: Inspect deliverables to ensure compliance.

1.1.1.9. System manual theory

Metric Requirement: The System Manual shall include a Theory of Operation outlining the operation of the system and how it functions.

Verification Method: Verify conformance with standard.

1.1.1.10. System manual comprehensiveness

Metric Requirement: The System Manual shall be comprehensive and cover all system-operation scenarios in clear step-by-step detail.

Verification Method: Verify document comprehensiveness.

1.1.1.11. System manual troubleshooting

Metric Requirement: The System Manual shall include clear step-by-step instructions for troubleshooting any potential system problems.

Verification Method: Verify troubleshooting procedures and completeness.

1.1.1.12. System manual installation documentation

Metric Requirement: The System Manual shall include clear step-by-step instructions for installing the EDAPTS system.

Verification Method: Verify troubleshooting procedures and completeness.

1.1.1.13. System manual maintenance instructions

Metric Requirement: The System Manual shall include clear step-by-step instructions for all necessary routine or scheduled maintenance procedures.

Verification Method: Verify troubleshooting procedures and completeness.

1.1.1.14. Operator manual comprehensiveness

Metric Requirement: The User Manual shall be comprehensive and cover all user-operation scenarios in clear step-by-step detail.

Verification Method: Verify document comprehensiveness.

1.1.1.15. Operator manual troubleshooting

Metric Requirement: The User Manual shall include clear step-by-step instructions for troubleshooting common potential problems.
Verification Method: Verify troubleshooting procedures and completeness.

1.1.2. Functional Performance

1.1.2.1. Supported vehicle quantity

Metric Requirement: The minimum number of vehicles supported by the system shall be the specified number plus 50%.
Units of Measurement: Vehicles
Value: 8
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.2.2. Supported sign quantity

Metric Requirement: The minimum number of Dynamic Roadside Information Displays supported by the system shall be the specified number plus 50%.
Units of Measurement: Signs
Value: 4
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.2.3. Supported run quantity

Metric Requirement: The minimum number of scheduled runs supported by the system shall be the specified number plus 50%.
Units of Measurement: Runs
Value: 12
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.2.4. Supported route quantity

Metric Requirement: The minimum number of scheduled routes supported by the system shall be the specified number plus 50%.
Units of Measurement: Routes
Value: 3
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.2.5. Supported trip quantity

Metric Requirement: The minimum number of scheduled trips supported by the system shall be the specified number plus 50%.
Units of Measurement: Trips

Value: 225
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.2.6. Supported stop quantity

Metric Requirement: The minimum number of stops supported by the system shall be the specified number plus 50%.
Units of Measurement: Stops
Value: 33
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.2.7. Supported driver quantity

Metric Requirement: The minimum number of drivers supported by the system shall be the specified number plus 50%.
Units of Measurement: Drivers
Value: 30
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.2.8. Supported farecard quantity

Metric Requirement: The minimum number of passenger farecards supported by the system shall be the specified number plus 50%.
Units of Measurement: Fare Cards
Value: 50000
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.3. Human Factors

1.1.3.1. Ease of use ALL

Metric Requirement: All devices displaying information to or requiring information from a user shall be easy to use and display clear operational usage instructions to the user
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.4. Installation & Maintenance

1.1.4.1. Element installability

Metric Requirement: All system elements shall be installable by qualified transit property personnel.
Verification Method: Test installation to ensure compliance.

1.1.4.2. Element part availability

- Metric Requirement: The transit property shall have the ability to self-maintain all system Elements due to the availability of spare parts and the capability to retain a supply of spares.
- Verification Method: Verify in vendor's contract documents.

1.1.5. Manufacturing

1.1.5.1. Part edge trueness

- Metric Requirement: Any non-radiused external part edges shall be smooth, straight, and true.
- Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.5.2. Part corners

- Metric Requirement: All installed physical parts shall have smoothed (radiused / non-sharp) corners.
- Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.5.3. Part physical tolerances

- Metric Requirement: All physical parts shall be manufactured to within the given tolerance of their specified dimensions.
- Units of Measurement: Inches
- Value: 0.005
- Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.5.4. Part interchangeability

- Metric Requirement: All parts having the same manufacturer's part number are functionally and physically interchangeable.
- Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.5.5. Part availability

- Metric Requirement: All system elements and their associated parts shall have a reasonable expectation of being available for a minimum period of five years.
- Verification Method: Verify availability in supply contract.

1.1.5.6. Part corrosion resistance

Metric Requirement: All external metal parts and exposed fasteners shall be corrosion resistant.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.5.7. Part emi transmission

Metric Requirement: All installed parts shall meet FCC guidelines and licensing as appropriate and shall meet MIL-STD-461 tolerances for radiated emissions.

Units of Measurement: Specifications

Value: TRUE

Verification Method: Inspect supplied certifications.

1.1.5.8. Abrasion resistance OBS

Metric Requirement: All installed cables shall utilize cable clamps, split loom, cable raceways, or other similar methods to minimize cable abrasion along the length of the cable.

Verification Method: Inspect deliverables to ensure compliance.

1.1.6. Privacy & Security

1.1.6.1. Rider ID privacy

Metric Requirement: Raw passenger fare or pass identification numbers or strings that directly identify a specific rider may not be stored anywhere in the EDAPTS system or transmitted across any EDAPTS communications link. Any obfuscation method of these numbers must be one-way and non-reversible, preventing the transformation back to a raw ID number or string.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

1.1.6.2. Driver ID privacy

Metric Requirement: Driver's identification numbers or strings containing sensitive personal information such as social security numbers shall not be stored anywhere in the EDAPTS system or transmitted across any EDAPTS communications link.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

1.1.6.3. Network attack resistance

Metric Requirement: All EDAPTS components utilizing a TCP/IP connection for communication shall be resistant to compromise by common network attacks such as spoofing and packet flooding (DDOS).

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.6.4. Communications link attack resistance

Metric Requirement: ALL EDAPTS components utilizing a wireless communications link shall encode, encrypt, or otherwise protect communications against snooping or unauthorized use. Such protection shall meet or exceed common industry best practices.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.7. Ruggedness & Reliability

1.1.7.1. Operational lifecycle

Metric Requirement: The expected lifecycle of EDAPTS system elements shall exceed the specified number of years.

Units of Measurement: Years

Value: 7

Verification Method: Inspect manufacturer certification

1.1.7.2. Mayday message reliability

Metric Requirement: Mayday messages initiated by the driver shall be received with the specified percent reliability.

Units of Measurement: Percent

Value: 100

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

1.1.7.3. Weather resistance

Metric Requirement: All EDAPTS elements installed in an outdoor environment shall be weather resistant to the installed environment.

Verification Method: Inspect manufacturer certification

1.1.7.4. Data corruption resistance

Metric Requirement: All EDAPTS elements shall be resistant to corruption of data due to power loss, shock, or other external forces.

Verification Method: Inspect manufacturer certification

1.1.7.5. Data retention

Metric Requirement: On-Board System elements shall maintain configuration and calibration information in memory for a minimum number of days while powered off.
Units of Measurement: Days
Value: 180
Verification Method: Inspect manufacturer certification

1.1.7.6. Power loss recovery

Metric Requirement: All EDAPTS elements shall be able to recover from a power loss and resume normal operations without requiring specialized technical interaction.
Verification Method: Inspect manufacturer certification

1.1.7.7. Operating environment max ambient temperature

Metric Requirement: All outdoor or vehicle-installed EDAPTS elements shall operate in ambient temperatures up to the specified maximum.
Units of Measurement: Degrees Farenheit
Value: 120
Verification Method: Inspect manufacturer certification

1.1.7.8. Operating environment max induced temperature

Metric Requirement: All outdoor or vehicle-installed EDAPTS elements shall operate in induced temperatures (include allowances for the effects of solar heating) up to the specified maximum.
Units of Measurement: Degrees Farenheit
Value: 160
Verification Method: Inspect manufacturer certification

1.1.7.9. Operating environment min temperature

Metric Requirement: All outdoor or vehicle installed EDAPTS elements shall operate in temperatures down to the specified minimum.
Units of Measurement: Degrees Farenheit
Value: -24
Verification Method: Inspect manufacturer certification

1.1.7.10. Operating environment max humidity

Metric Requirement: All outdoor or vehicle-installed EDAPTS elements shall operate at relative humidity levels up to the specified maximum.
Units of Measurement: Percent
Value: 100
Verification Method: Inspect manufacturer certification

1.1.7.11. Contaminant protection

Metric Requirement: All outdoor or vehicle-installed EDAPTS elements shall protect against external contaminants such as dust, salt air, and fog as necessary to prevent interruption of operation.

Verification Method: Inspect manufacturer certification

1.1.7.12. Operational lifetime

Metric Requirement: All EDAPTS elements shall operate for a minimum number of years before expected replacement.

Units of Measurement: Years

Value: 7

Verification Method: Inspect manufacturer certification

1.1.8. Standards & Practices

1.1.8.1. Product marking

Metric Requirement: All installed parts shall bear a manufacturer's nameplate or sticker, containing the manufacturer's name, product part number and revision as applicable, and serial number.

Verification Method: Inspect deliverables to ensure compliance.

1.1.8.2. Cable standards

Metric Requirement: All field-installed interface wires and cables shall use suitable gauge, shielding, and color for the application in conformance with applicable SAE and state and federal DOT standards.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.8.3. Cable marking

Metric Requirement: All installed interconnect cables shall bear a cable marker at six inches from each end of the cable, and at regular intervals along the cable.

Verification Method: Inspect deliverables to ensure compliance.

1.1.8.4. Null values

Metric Requirement: Null values shall be used when initializing or creating any data or data types, or recording an out-of-range value.

Verification Method: Verify in system design document or specifications. Test deliverables to ensure compliance.

1.1.8.5. Workmanship

Metric Requirement: All equipment and accessories shall be a product of good workmanship and shall be free from any defects that will affect their appearance or serviceability.

Verification Method: Inspect deliverables to ensure compliance.

1.1.8.6. Equipment commonality

Metric Requirement: All installed equipment shall share Component-level part commonality, allowing for ease of swappage or replacement with minimal reconfiguration.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.8.7. Hardware commonality

Metric Requirement: All user or maintenance accessible hardware (including mounting hardware) shall share Component-level part commonality, and also at the system-wide level where possible.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

1.1.8.8. Specification conflicts

Metric Requirement: In case of conflict between regulatory body, classification and international regulations and requirements, and this specification, the more stringent requirement shall take precedence.

Verification Method: Verify in system design document or specifications.

1.1.8.9. Data transparency

Metric Requirement: All data transferred between subsystems or components shall be left in an uncompressed, unencoded, or unencrypted form, except as needed for reasons such as security or passage through low-throughput communications links. In instances where compression, encoding, or encryption is deemed necessary, documentation shall be provided describing the compression / encoding / encryption algorithms required and fully detailing the implementation used.

Verification Method: Verify in system design document or specifications and upon system delivery.

1.1.8.10. Data validation

Metric Requirement: All transferred data between elements or components shall be validated upon receipt and before use to eliminate out-of-range and non-sensical values.

Verification Method: Verify in system design document or specifications or inspect supplied certifications

1.1.8.11. Data corruption

Metric Requirement: All transferred data between EDAPTS Components shall include a checksum or other similar method to test for data corruption, and shall be tested for such corruption upon receipt.

Verification Method: Verify in system design document or specifications or inspect supplied certifications

1.1.8.12. Data structure extensibility

Metric Requirement: If extension of an EDAPTS protocol is deemed necessary, it shall be done in a manner that does not interfere or break compatibility with existing data elements, and shall not duplicate or otherwise repeat existing functionality.

Verification Method: Verify in system design document or specifications or inspect supplied certifications

1.1.8.13. Software programming languages

Metric Requirement: All vendor-developed software shall be written in an industry standard, high level, non-proprietary language.

Verification Method: Verify in system design document or specifications or inspect supplied certifications

2. Vehicle On-Board Systems

2.1. General Requirements

2.1.1. Human Factors

2.1.1.1. Inobtrusiveness OBS

Metric Requirement: On-board devices shall not impede driver's view of the road, normal driver operations, movement in the driver's or passenger compartments, nor entry or egress from the vehicle.

Verification Method: Test installation to ensure compliance.

2.1.2. Installation & Maintenance

2.1.2.1. Removal and replacement OBS

Metric Requirement: The maximum amount of time required to remove and replace an On-Board system element.

Units of Measurement: Minutes

Value: 10 minutes

Verification Method: Test installation to ensure compliance.

2.1.2.2. Self diagnostics OBS

Metric Requirement: The On-Board systems shall provided self-test diagnostics to aid in fault isolation.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.1.3. Mechanical Interfacing

2.1.3.1. Mounting hole pattern tolerances OBS

Metric Requirement: All On-Board System element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

2.1.3.2. Mounting hole size tolerances OBS

Metric Requirement: All On-Board System element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

2.1.4. Power

2.1.4.1. Over current protection OBS

Metric Requirement: All power connections shall be fused or circuit breaker protected at the source connection.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

2.1.5. Ruggedness & Reliability

2.1.5.1. Emi resistance OBS

Metric Requirement: On-Board System elements shall be resistant to levels of EMI present in a commercial environment.

Verification Method: Inspect manufacturer certification

2.1.5.2. Mtbf OBS

Metric Requirement: The expected MTBF of On-Board system elements shall exceed the specified number of hours.

Units of Measurement: Hours

Value: 7,500

Verification Method: Inspect manufacturer certification

2.1.5.3. Physical shock resistance OBS

Metric Requirement: On-Board System elements shall not be negatively affected by physical shocks and impacts present in a commercial transit environment.

Verification Method: Inspect manufacturer certification

2.1.5.4. Vibration resistance OBS

Metric Requirement: On-Board System elements shall not be negatively affected by the vibrations in a commercial transit environment.

Verification Method: Inspect manufacturer certification

2.1.5.5. Contaminant protection OBS

Metric Requirement: On-Board System elements shall be resistant to external contaminants such as dust, salt air, and fog to prevent interruption of operation.

Verification Method: Inspect manufacturer certification

2.1.6. Safety & Certification

2.1.6.1. Dot certification OBS

Metric Requirement: All On-Board Systems elements shall meet all applicable state and federal DOT standards.

Verification Method: Inspect supplied certifications

2.1.6.2. Fcc licensing OBS

Metric Requirement: All On-Board Systems elements utilizing wireless transmission for inter-element data transfer shall be provided with necessary FCC licenses for operation in the transit system.

Verification Method: Inspect supplied certifications

2.1.6.3. Ewra compliance OBS

Metric Requirement: All On-Board Systems elements shall be compliant with the California Electronic Waste Recycling Act of 2003.

Verification Method: Inspect supplied certifications

2.2. Mobile Data Terminal (MDT)

2.2.1. Communications & Electrical Interfacing

2.2.1.1. Interfacing MDT

Metric Requirement: For its wired electrical control/data interfaces, the MDT shall be able to connect to other on-board peripherals and other equipment using easy to remove connectors or terminals.

The MDT control/data signal interfaces shall be interference-tolerant in a production bus environment. Control/data interface signal levels shall be fully defined, non-proprietary and easily accessible to other connecting on-board peripherals and equipment. Control/data signal interfaces shall utilize commonly accepted standards and protocols such as SAE J1708, RS232, TCIP, IEEE, etc. Signal structures used (levels, timing, etc.) shall be compatible with data needs.

Verification Method: Verify in vendor's specifications

2.2.2. Computational Hardware

2.2.2.1. User input responsiveness MDT

Metric Requirement: The maximum amount of time the MDT shall take to respond to driver or passenger input for normal (non-emergency) operations.

Units of Measurement: Seconds

Value: 1

Verification Method: Test by timing user operations.

2.2.2.2. Memory capacity MDT

Metric Requirement: The MDT shall have sufficient memory capacity to handle transit system operational parameters as given in this specification.

Verification Method: Verify in vendor specifications.

2.2.2.3. Storage capacity MDT

Metric Requirement: The MDT shall have necessary non-volatile storage capacity to sustain operations with all necessary transit system operation parameter maximums as given in this specification.

Verification Method: Verify in vendor specifications.

2.2.2.4. Logging capacity MDT

Metric Requirement: The MDT shall have the necessary non-volatile storage capacity to store all collected stop data for the minimum specified period.

Units of Measurement: Days

Value: 30

Verification Method: Verify in vendor specifications.

2.2.2.5. Logging capacity CSS

Metric Requirement: The Central Site Software shall have the necessary non-volatile storage capacity to store all collected data for the greater of either the specified value or given transit provider requirement.

Units of Measurement: Years

Value: 1

Verification Method: Verify in vendor specifications.

2.2.2.6. Processing capacity media reader MDT

Metric Requirement: The Mobile Data Terminal shall be capable of validating, logging, and forwarding to the central site the specified number of pass-card media reads per minute.

Units of Measurement: Pass-card reads per minute

Value: 50

Verification Method: Verify in vendor specifications and inspect deliverables to ensure compliance

2.2.2.7. Processing capacity APC MDT

Metric Requirement: The Mobile Data Terminal shall be capable of logging and forwarding to the central site the specified number of counts per minute.

Units of Measurement: APC counts per minute

Value: 50

Verification Method: Verify in vendor specifications and inspect deliverables to ensure compliance

2.2.2.8. Latency emergency actuator MDT

Metric Requirement: The Mobile Data Terminal shall be capable of detecting an emergency actuator signal from the driver and transmitting the message to the central dispatch site within the specified number of seconds.

Units of Measurement: Seconds

Value: 2 seconds

Verification Method: Verify in vendor specifications.

2.2.2.9. Processing capacity MDT

Metric Requirement: The Mobile Data Terminal shall be capable of validating, logging, and forwarding to the central site the specified number of vehicle location and status per minute.

Units of Measurement: Location updates per minute

Value: 2

Verification Method: Verify in vendor specifications and inspect deliverables to ensure compliance

2.2.3. Design & Architecture

2.2.3.1. Extensibility MDT

Metric Requirement: The MDT shall support additional on-board APTS applications in software and hardware.

Units of Measurement: Applications

Value: 2

Verification Method: Verify in vendor specifications.

2.2.3.2. Extensibility OBS API

Metric Requirement: Future modifications to the OBS API shall be possible and shall not affect existing functionality.

Verification Method: Verify in API documentation.

2.2.4. Functional Performance

2.2.4.1. Power switch MDT

Metric Requirement: The MDT shall have an accessible power switch in the driver's compartment.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

2.2.4.2. Time of day clock MDT

Metric Requirement: The MDT shall have a large format clock to display time to the driver when the coach is in motion

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.3. Stop arrival display MDT

Metric Requirement: The MDT shall display bus stop name to the driver upon arrival at a stop.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.4. Schedule adherence display MDT

Metric Requirement: The MDT shall display bus stop arrival schedule adherence information to the driver when at a stop

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.5. Departure countdown display MDT

Metric Requirement: The MDT shall display countdown until departure in minutes to a driver while at a stop or on break.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.6. Bus pass validation MDT

Metric Requirement: The MDT shall validate bus pass data presented by the Pass / Fare media reader, validate the data, and indicate if it is valid or invalid to the driver and the rider who presented the pass to the media reader.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.7. Process APC counts MDT

Metric Requirement: The MDT shall receive APC boarding and alighting data from the APC, display a cumulative count to the driver, associate this data with stops during the day, and incorporate the data into the stop record transmitted to the central site for each stop.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.8. Receive undetermined data MDT

Metric Requirement: The MDT shall have the capability to receive data from yet to be determined on-board devices, associate this data with stops, and transmit it to the central site upon departure from a stop.

Verification Method: Verify in system design document or specifications.

2.2.4.9. Control annunciator MDT

Metric Requirement: The MDT shall have the capability to control an on-board annunciator to notify passengers upon arrival at a stop, departure from a stop, and when travelling between stops.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.10. Control electronic sign MDT

Metric Requirement: The MDT shall have the capability to control an on-board electronic sign to notify passengers upon arrival at a stop, departure from a stop, and when travelling between stops.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.11. Detect arrivals & departures MDT

Metric Requirement: The MDT shall have the capability to detect arrivals and departures from stops, when at a stop, and when between stops based on the transit schedule and master stop list.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.12. Prompt for driver MDT

Metric Requirement: The MDT shall have the capability to prompt a driver for their ID number upon login, and then associate the ID number with an ID number / name cross reference in the MDT.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.13. Prompt for route number MDT

Metric Requirement: The MDT shall have the capability to prompt a driver for route number upon login.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.14. Route change MDT

Metric Requirement: The MDT shall have the capability to prompt the driver for a route number during a route change during the day.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.15. Log boarding data MDT

Metric Requirement: The MDT shall have the capability to log boarding and alighting data for retrieval and post processing.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.16. System administration MDT

Metric Requirement: The MDT shall have the capability to be remotely administered from the central site.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.17. Log arrival departure data MDT

Metric Requirement: The MDT shall have the capability to log stop departure and arrival data for retrieval and post processing.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.18. Declare on board emergency MDT

Metric Requirement: The MDT shall have the capability to declare on-board emergencies to central dispatch and then send regular position updates to the central site.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.19. Survey stops MDT

Metric Requirement: The MDT shall have the capability to survey route stops for latitude, longitude, and direction (heading).

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.20. Admin data comm MDT

Metric Requirement: The MDT shall have the capability to communicate with the central site to support administrative functions such as software updates, schedule downloads, and retrieval of data logged on the MDT.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.21. Self test MDT

Metric Requirement: The MDT shall have the capability to perform a comprehensive self-test upon power up.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.22. Commanded diagnostics MDT

Metric Requirement: The MDT shall have the capability to perform self-test and diagnostics of other on-board devices upon a command from the MDT front panel (user interface).

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.4.23. Receive vehicle faults MDT

Metric Requirement: The MDT shall have the capability to receive mechanical malfunction reporting from the driver for a bus.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.5. Human Factors

2.2.5.1. Ergonomics accessibility MDT

Metric Requirement: The MDT controls and interface shall be easily operable by the driver without requiring a significant shift from driving position.

Verification Method: Test installation to ensure compliance.

2.2.5.2. Ergonomics readability MDT

Metric Requirement: The MDT display shall be clearly readable by the driver from its installation location as he or she conducts normal operations. The MDT display shall maintain clear readability under both day and night-time conditions.

Verification Method: Test installation to ensure compliance.

2.2.5.3. Ergonomics audibility MDT

Metric Requirement: All sounds, tones, or other audible feedback generated by the MDT shall be of sufficient volume to be audible in the driver's compartment above background vehicle noise.

Verification Method: Test installation to ensure compliance.

2.2.5.4. Ergonomics ease of use MDT

Metric Requirement: The MDT shall provide a simple, easy to use, uncluttered interface to the driver. All commonly used actions such as log-in, log-out, and route-change shall be easily accessible and provide integrated step-by-step instructions. Buttons and screen controls shall be easily used and activated.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.5.5. Ergonomics driver interaction MDT

Metric Requirement: The MDT shall require minimal interaction by the driver as during normal driver operations.

Verification Method: Verify in vendor specifications.

2.2.6. Power

2.2.6.1. Supply power dissipation maximum MDT

Metric Requirement: Maximum power dissipation allowable by the device.

Units of Measurement: Watts

Value: 30

Verification Method: Verify in vendor's specifications

2.2.6.2. Supply voltage range MDT

Metric Requirement: Voltage ranges the device must be able to operate under.

Units of Measurement: Volts DC

Value: 9 to 32

Verification Method: Verify in vendor's specifications

2.2.6.3. Supply allowable noise MDT

Metric Requirement: The Mobile Data Terminal shall conform to the SAE J1455 standard, section 4.11.2 for transients and noise ranges the device must be able to operate under.

Verification Method: Verify conformance with standard.

2.2.7. Ruggedness & Reliability

2.2.7.1. Stop detection reliability MDT

Metric Requirement: The MDT shall detect stops with the specified percent reliability when GPS is available.

Units of Measurement: Percent

Value: 99.5

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.2.8. Safety & Certification

2.2.8.1. Coach in motion MDT

Metric Requirement: The Mobile Data Terminal shall detect when the vehicle is in motion, and shall blank its screen to prevent driver distraction. Display of the time in large characters is acceptable.

Verification Method: Verify in system design document or specifications. Test deliverables to ensure compliance.

2.2.9. System Accuracy

2.2.9.1. Georeference accuracy MDT

Metric Requirement: Latitude and longitude estimates shall be accurate to within the specified number of meters.

Units of Measurement: Meters

Value: 10

Verification Method: Inspect supplied certifications

2.2.9.2. Time reporting accuracy MDT

Metric Requirement: Time estimates shall be accurate within the specified number of seconds.

Units of Measurement: Seconds

Value: 1

Verification Method: Test deliverables to ensure compliance or inspect supplied certifications

2.2.9.3. Time synchronization MDT

Metric Requirement: If any time measurement is utilized, it shall be synchronized with Coordinated Universal Time (UTC), and maintain accuracy within the specified number of seconds

Units of Measurement: Seconds

Value: 1

Verification Method: Inspect supplied certifications

2.3. MDT Functional Processes

2.3.10. Data Formatting

2.3.10.1. Data format MDT functional processes

Metric Requirement: The MDT functional processes shall transfer data to and from the MDT Vehicle Wireless Data Communications System Driver in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

2.4. MDT Vehicle Wireless Data Communications System Driver

2.4.11. Documentation

2.4.11.1. Interface documentation MDT comm driver

- Metric Requirement: Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT wireless data-communications system driver and the on-board wireless data interface shall be provided by the vendor upon delivery.
- Verification Method: Inspect documentation deliverables to ensure compliance.

2.4.12. Data Formatting

2.4.12.1. Data format MDT vehicle wireless data communications system driver

- Metric Requirement: The MDT Vehicle Wireless Data Communications System Driver shall receive data from the MDT Functional Processes in accordance with the EDAPTS Data Formatting Standard. Any MDT Vehicle Wireless Data Communications System Driver internal data formatting and compression methods used shall be documented and provided to the transit property.
- Verification Method: Verify documented data formats in system design documents or specifications.

2.5. APC (Automatic Passenger Counter)

2.5.13. Documentation

2.5.13.1. Interface documentation APC MDT

- Metric Requirement: Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT and the automatic passenger counter shall be provided by the vendor upon delivery.
- Verification Method: Inspect documentation deliverables to ensure compliance.

2.5.14. Functional Performance

2.5.14.1. Command and control APC

- Metric Requirement: The APC shall be able to have collected data retrieved remotely
- Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.5.14.2. Count passengers APC

- Metric Requirement: The APC unit shall count boardings and alightings and provide data to the MDT.
- Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

2.6. Emergency Actuator

2.6.15. Communications & Electrical Interfacing

2.6.15.1. Interfacing E Actuator

Metric Requirement: For its wired electrical control/data interfaces, the Emergency Actuator shall be able to connect to the MDT, or other on-board peripherals and other equipment.

Signal levels shall be compatible with MDT signal input specifications. Signal structure (protocol, timing, etc.) shall be compatible with MDT signal structure needs.

Verification Method: Verify in vendor's specifications

2.6.16. Documentation

2.6.16.1. Interface documentation emergency actuator MDT

Metric Requirement: Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT and the emergency actuator shall be provided by the vendor upon delivery.

Verification Method: Inspect documentation deliverables to ensure compliance.

2.6.17. Human Factors

2.6.17.1. Accessibility E-Actuator

Metric Requirement: The Emergency Actuator shall be operable from the driver's position, and shall be able to unobtrusively activated in the event of an emergency. The actuator shall be resistant to accidental activation due to normal movement in the driver's compartment.

Verification Method: Test installation to ensure compliance.

2.6.17.2. Inobtrusiveness E-Actuator

Metric Requirement: The Emergency Actuator shall be hidden from passenger view.

Verification Method: Test installation to ensure compliance.

2.6.18. Ruggedness & Reliability

2.6.18.1. Noise resistance E-Actuator

Metric Requirement: The Emergency Actuator's control/data signal interface to the MDT shall be resistant to noise generated in a production bus environment.

Verification Method: Inspect manufacturer certification

2.6.19. System Accuracy

2.6.19.1. Emergency signaling accuracy OBS

Metric Requirement: The emergency actuator shall not allow false signaling of an emergency.

Verification Method: Test deliverables to ensure compliance or inspect supplied certifications

3. Vehicle Wireless Data Communications System

3.1. General Requirements

3.1.1. Installation & Maintenance

3.1.1.1. Removal and replacement OBS Comm

Metric Requirement: On-Board System elements shall be able to be removed and replaced within the specified amount of time.

Units of Measurement: Minutes

Value: 10 minutes

Verification Method: Test installation to ensure compliance.

3.1.1.2. Self diagnostics OBS Comm

Metric Requirement: The On-Board Wireless Communications system shall provide self-test diagnostics to aid in fault isolation.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

3.1.2. Mechanical Interfacing

3.1.2.1. Mounting hole pattern tolerances OBS Comm

Metric Requirement: All On-Board Communications element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

3.1.2.2. Mounting hole size tolerances OBS Comm

Metric Requirement: All On-Board Communications element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

3.1.3. Power

3.1.3.1. Over current protection OBS Comm

Metric Requirement: All power connections shall be fused or breakered at the source connection.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

3.1.3.2. Over current protection RID Comm

Metric Requirement: Any required external power connection shall be fused or breakered at the source connection.
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

3.1.3.3. Backup power OBS Comm emergency management

Metric Requirement: Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.
Units of Measurement: Hours
Value: 1
Verification Method: Test by measuring time delay

3.1.4. Ruggedness & Reliability

3.1.4.1. Emi resistance OBS Comm

Metric Requirement: Shall be resistant to levels of EMI present in a commercial environment.
Verification Method: Inspect manufacturer certification

3.1.4.2. Mtbf OBS Comm

Metric Requirement: Expected mean time between failures.
Units of Measurement: Hours
Value: 15,000
Verification Method: Inspect manufacturer certification

3.1.4.3. Availability OBS Comm

Metric Requirement: Acceptable levels of minimum uptime / maximum downtime in a normal operating environment
Units of Measurement: Percent
Value: 99.9
Verification Method: Inspect manufacturer certification

3.1.5. Safety & Certification

3.1.5.1. Fcc licensing OBS Comm

Metric Requirement: All On-Board Systems Wireless Communications elements shall be provided with necessary FCC licenses for operation in the transit system.
Verification Method: Inspect supplied certifications

3.1.5.2. Ewra compliance OBS Comm

Metric Requirement: All On-Board Systems elements shall be compliant with the California Electronic Waste Recycling Act of 2003.

Verification Method: Inspect supplied certifications

3.2. On-Board Wide-Area Wireless Data Interface

3.2.1. Ruggedness & Reliability

3.2.1.1. Physical shock resistance OBS Comm

Metric Requirement: On-Board Wireless Communications elements shall not be negatively affected by physical shocks and impacts present in a commercial transit environment.

Verification Method: Inspect manufacturer certification

3.2.1.2. Vibration resistance OBS Comm

Metric Requirement: On-Board Wireless Communications elements shall not be negatively affected by the vibrations in a commercial transit environment.

Verification Method: Inspect manufacturer certification

3.2.2. Safety & Certification

3.2.2.1. Dot certification OBS Comm

Metric Requirement: All On-Board Systems Wireless Communications elements shall meet all applicable state and federal DOT standards.

Verification Method: Inspect supplied certifications

3.3. On-board Wide-Area Communications Infrastructure / Repeaters

3.3.3. Communications & Electrical Interfacing

3.3.3.1. Latency OBS Wireless Communications

Metric Requirement: Maximum time for vehicle-update messages sent from the On-Board System to be received by the CSS under typical system load conditions.

Units of Measurement: Seconds

Value: 15 seconds

Verification Method: Test by measuring time delay

3.3.3.2. Reliability OBS Wireless Communications

Metric Requirement: The On-Board Wireless Communications system shall have a specified successful rate (in percentage) in transporting vehicle updates between vehicles and the central site.

Units of Measurement: %
Value: 99.900%
Verification Method: Test by measuring delivery rate

3.3.3.3. Throughput OBS Wireless Communications

Metric Requirement: The On-Board Wireless Communications system shall have a sufficient data-communications throughput rate to ensure that all vehicles in the fleet with the specified update frequency,

Units of Measurement: Vehicle updates per minute

Value: 1

Verification Method: Test by measuring throughput

4. Dynamic Roadside Information Display

4.1. General Requirements

4.1.1. Installation & Maintenance

4.1.1.1. Removal and replacement RID

Metric Requirement: Roadside Information Display elements shall be able to be removed and replaced within the specified amount of time.

Units of Measurement: Minutes

Value: 30 minutes

Verification Method: Test installation to ensure compliance.

4.1.1.2. Self diagnostics RID

Metric Requirement: The Roadside Information Display shall provided self-test diagnostics to aid in fault isolation.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

4.1.2. Mechanical Interfacing

4.1.2.1. Mounting hole pattern tolerances RID

Metric Requirement: All Roadside Information Display element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

4.1.2.2. Mounting hole size tolerances RID

Metric Requirement: All Roadside Information Display element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

4.1.3. Ruggedness & Reliability

4.1.3.1. Emi resistance RID

Metric Requirement: Shall be resistant to levels of EMI present in a commercial environment.

Verification Method: Inspect manufacturer certification

4.1.3.2. Mtbf RID

Metric Requirement: Expected mean time between failures.
Units of Measurement: Hours
Value: 7,500
Verification Method: Inspect manufacturer certification

4.1.3.3. Vandalism resistance RID

Metric Requirement: Shall be resistant to displacement or damage by vandalism.
Verification Method: Inspect manufacturer certification

4.1.4. Safety & Certification

4.1.4.1. Fcc licensing RID

Metric Requirement: All Roadside Information Display elements shall be provided with necessary FCC licenses for operation in the transit system.
Verification Method: Inspect supplied certifications

4.1.4.2. Ewra compliance RID

Metric Requirement: All Roadside Information Display elements shall be compliant with the California Electronic Waste Recycling Act of 2003.
Verification Method: Inspect supplied certifications

4.2. Roadside Sign / Display

4.2.1. Computational Hardware

4.2.1.1. Update message responsiveness RID

Metric Requirement: The maximum amount of time the RID shall take to calculate and make available a received update message for display.
Units of Measurement: Seconds
Value: 1
Verification Method: Verify in vendor specifications.

4.2.1.2. Memory capacity RID

Metric Requirement: The Roadside Information Display shall have the necessary memory capacity to handle transit system operational parameter maximums as given in this specification.
Verification Method: Verify in vendor specifications.

4.2.1.3. Storage capacity RID

Metric Requirement: The Roadside Information Display shall have the necessary non-volatile storage capacity to sustain operations with all necessary transit system operation parameter maximums as given in this specification.

Verification Method: Verify in vendor specifications.

4.2.2. Design & Architecture

4.2.2.1. Extensibility RID API

Metric Requirement: Future modifications to the RID API shall be possible and shall not affect existing functionality.

Verification Method: Verify in API documentation.

4.2.3. Functional Performance

4.2.3.1. Command and control RID

Metric Requirement: The RID shall be able to have configuration and system schedule information downloaded to it remotely from the central site.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

4.2.3.2. Banner message size RID

Metric Requirement: The Dynamic Roadside Information Display shall be capable of receiving and then displaying banner messages up to the given character limit.

Units of Measurement: Characters

Value: 40

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

4.2.3.3. Banner message quantity RID

Metric Requirement: The Dynamic Roadside Information Display shall be capable of storing and then displaying at least the given number of individual public service banner messages..

Units of Measurement: Messages

Value: 25

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

4.2.3.4. Provide ETA RID

Metric Requirement: The Dynamic Roadside Information Display shall have the capability to present minutes until arrival for buses arriving at a stop based on real-time bus trajectory.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

4.2.3.5. Out of service info RID

Metric Requirement: The Dynamic Roadside Information Display shall have the capability to indicate when it is out of service to passengers waiting at a stop.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

4.2.3.6. ADA RID

Metric Requirement: The Dynamic Roadside Information Display shall be capable of supporting the optional dissemination of information to riders with hearing and sight disabilities in accordance with the Americans with Disabilities Act (ADA).

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

4.2.4. Human Factors

4.2.4.1. ADA accessibility RID

Metric Requirement: The Roadside Information display shall be conformant to ADA Standards for Accessible Design, 28 CFR Part 36, Chapter 10.

Verification Method: Inspect supplied ADA certification

4.2.5. Power

4.2.5.1. AC supply voltage range RID

Metric Requirement: Voltage range the device must be able to operate within if powered by direct current.

Units of Measurement: VAC

Value: 110 - 125

Verification Method: Verify in vendor's specifications

4.2.5.2. Autonomous power inclement weather RID

Metric Requirement: The Roadside Information Display shall have the specified number of days of solar autonomy if no external power source is part of the system. Any internal batteries shall not be discharged below 50% capacity in order to reach this autonomy.

Units of Measurement: Days

Value: 14

Verification Method: Test by measuring autonomy

4.2.5.3. Autonomous power system recovery RID

Metric Requirement: If no external power source is part of the system, the Roadside Information Display shall recover from a 50% discharge level to a 90% charge level within the specified maximum number of days of normal solar operation.

Units of Measurement: Days

Value: 5

Verification Method: Test by measuring time

4.2.5.4. Over current protection RID

Metric Requirement: All power connections shall be fused or breakered at the source connection.

Verification Method: Verify in vendor's specifications

4.2.6. Safety & Certification

4.2.6.1. UI certification RID

Metric Requirement: The Roadside Information Display shall be listed with Underwriters Laboratories if externally AC powered.

Verification Method: Inspect supplied certifications

4.2.7. System Accuracy

4.2.7.1. Time reporting accuracy Sign

Metric Requirement: Estimated minutes until arrival shall be accurate to within the specified number of seconds.

Units of Measurement: Seconds

Value: 60

Verification Method: Test deliverables to ensure compliance or inspect supplied certifications

4.2.7.2. Time synchronization RID

Metric Requirement: If any time measurement is utilized, it shall be synchronized with Coordinated Universal Time (UTC), and maintain accuracy within the specified limit.

Units of Measurement: Seconds

Value: 1

Verification Method: Inspect supplied certifications

4.3. Roadside Post

4.3.8. Safety & Certification

4.3.8.1. Rigidity RID Mounting

Metric Requirement: Roadside Information Display post shall meet applicable state and federal DOT standards for crash safety.

Verification Method: Perform design analysis or inspect supplied certifications.

4.4. Roadside Post Foundation

4.4.9. Safety & Certification

4.4.9.1. Wind resistance RID Mounting

Metric Requirement: Roadside Information Display foundations and posts shall comply with the Uniform Building Code with regard to wind resistance.

Verification Method: Perform design analysis or inspect supplied certifications.

4.4.9.2. Earthquake resistance RID Mounting

Metric Requirement: Roadside Information Display foundations and posts shall be earthquake resistant when installed in earthquake-prone areas.

Verification Method: Perform design analysis or inspect supplied certifications.

4.5. RID Functional Processes

4.5.10. Data Formatting

4.5.10.1. Data format RID functional processes

Metric Requirement: The RID functional processes shall transfer data to the RID Data Communications System Driver in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

4.5.10.2. Data format RID functional processes

Metric Requirement: The RID functional processes shall transfer data to and from the RID Communications System Driver in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

4.6. RID Communications System Driver

4.6.11. Data Formatting

4.6.11.1. Data format RID vehicle wireless data communications system driver

Metric Requirement: The RID Communications System Driver shall receive data from the RID Functional Processes in accordance with the EDAPTS Data Formatting Standard. Any RID Communications System Driver internal data formatting and compression methods used shall be documented and provided to the transit property.

Verification Method: Verify documented data formats in system design documents or specifications.

4.6.11.2. Data format RID data communications system driver

- Metric Requirement:** The RID Data Communications System Driver shall receive data from the RID Functional Processes in accordance with the EDAPTS Data Formatting Standard. Any RID Data Communications System Driver internal data formatting and compression methods used shall be documented and provided to the transit property.
- Verification Method:** Verify documented data formats in system design documents or specifications.

5. Roadside Data Communications System

5.1. General Requirements

5.1.1. Installation & Maintenance

5.1.1.1. Removal and replacement RID Comm

Metric Requirement: Roadside Information Display elements shall be able to be removed and replaced within the specified amount of time.

Units of Measurement: Minutes

Value: 30 minutes

Verification Method: Test installation to ensure compliance.

5.1.2. Mechanical Interfacing

5.1.2.1. Mounting hole pattern tolerances RID Comm

Metric Requirement: All Roadside Communications element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

5.1.2.2. Mounting hole size tolerances RID Comm

Metric Requirement: All Roadside Communications element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.

Units of Measurement: Inches

Value: 0.005

Verification Method: Inspect deliverables to ensure compliance.

5.1.3. Ruggedness & Reliability

5.1.3.1. Emi resistance RID Comm

Metric Requirement: Shall be resistant to levels of EMI present in a commercial environment.

Verification Method: Inspect manufacturer certification

5.1.3.2. Mtbf RID Comm

Metric Requirement: Expected mean time between failures.

Units of Measurement: Hours

Value: 15,000

Verification Method: Inspect manufacturer certification

5.1.3.3. Availability RID Comm

Metric Requirement: Acceptable levels of minimum uptime / maximum downtime in a normal operating environment
Units of Measurement: Percent
Value: 99.9
Verification Method: Inspect manufacturer certification

5.1.4. Safety & Certification

5.1.4.1. Fcc licensing RID Comm

Metric Requirement: All Roadside Information Display elements shall be provided with necessary FCC licenses for operation in the transit system.
Verification Method: Inspect supplied certifications

5.1.4.2. Ewra compliance RID Comm

Metric Requirement: All Roadside Information Display elements shall be compliant with the California Electronic Waste Recycling Act of 2003.
Verification Method: Inspect supplied certifications

5.2. Roadside Communications Infrastructure / Repeaters

5.2.1. Communications & Electrical Interfacing

5.2.1.1. Latency RID Communications

Metric Requirement: Maximum time for vehicle-update messages sent from the CSS to be received by the RID under typical system load conditions.
Units of Measurement: Seconds
Value: 15 seconds
Verification Method: Test by measuring time delay

5.2.1.2. Reliability RID Communications

Metric Requirement: The Roadside Information Display (RID) communications system shall meet or exceed the specified successful delivery rate (in percentage) for all vehicle updates transported between vehicles and the central site.
Units of Measurement: %
Value: 99.900%
Verification Method: Test by measuring delivery rate

5.2.1.3. Throughput RID Communications

Metric Requirement: The Roadside Information Display Communications system shall have a sufficient throughput rate to ensure that all vehicles in the fleet with the specified update frequency.

Units of Measurement: RID updates per minute

Value: 2

Verification Method: Test by measuring throughput

6. Advanced Transit Management System

6.1. General Requirements

6.1.1. Computational Hardware

6.1.1.1. User input responsiveness ATRMS

Metric Requirement: The maximum amount of time the ATRMS shall take to respond to operator input for vehicle tracking operations.

Units of Measurement: Seconds

Value: 1

Verification Method: Test by timing user operations.

6.1.1.2. Memory capacity ATRMS

Metric Requirement: The ATRMS shall have the necessary memory capacity to handle transit system operational parameter maximums as given in this specification.

Verification Method: Verify in vendor specifications.

6.1.2. Functional Performance

6.1.2.1. ATRMS client quantity CSS

Metric Requirement: The central software shall be capable of supporting at least the given number of simultaneously running ATRMS clients.

Units of Measurement: Clients

Value: 5

Verification Method: Verify system design document or specifications.

6.1.2.2. Emergency handling quantity CSS

Metric Requirement: The central software shall be capable of supporting at least the given number of simultaneous emergency conditions.

Units of Measurement: Emergencies

Value: 5

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.1.3. Human Factors

6.1.3.1. GUI readability ATRMS

Metric Requirement: The ATRMS GUI shall be readable by employees of varying visual capabilities.

Verification Method: Test installation to ensure compliance.

6.1.3.2. Font scalability ATRMS

Metric Requirement: ATRMS display fonts shall be scalable from small to large.
Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.1.4. Power

6.1.4.1. Backup power ATRMS emergency management

Metric Requirement: Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.

Units of Measurement: Hours

Value: 1

Verification Method: Test by measuring time

6.1.5. System Accuracy

6.1.5.1. Time synchronization ATRMS

Metric Requirement: If any time measurement is utilized, it shall be synchronized with Coordinated Universal Time (UTC), and maintain accuracy within the specified limit.

Units of Measurement: Seconds

Value: 1

Verification Method: Inspect supplied certifications

6.2. On-Board Equipment Administration Controls

6.2.1. Functional Performance

6.2.1.1. OBS administration ATRMS

Metric Requirement: The ATRMS consoles shall have the capability to allow the user to remotely administer the On-Board Systems aboard each vehicle.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.2.2. Data Formatting

6.2.2.1. Data format on board equipment administration controls

Metric Requirement: The On-Board Equipment Administration Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.3. Schedule Management & Administration Tools & Controls

6.3.3. Functional Performance

6.3.3.1. Schedule builder ATRMS

Metric Requirement: The ATRMS consoles shall have the capability to allow the user to build a schedule, disseminate it to the fleet, and track the schedule version on each vehicle in the fleet.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.3.4. Data Formatting

6.3.4.1. Data format schedule management & administration tools & controls

Metric Requirement: The Schedule Management & Administration Tools & Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.4. Driver Management Controls

6.4.5. Data Formatting

6.4.5.1. Data format driver management controls

Metric Requirement: The Driver Management Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.5. Emergency Management Display

6.5.6. Functional Performance

6.5.6.1. Emergency alarm handling ATRMS

Metric Requirement: The ATRMS consoles shall have the capability to receive vehicle emergency alarms, track vehicles with alarms, and log actions taken.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.5.6.2. Emergency planning ATRMS

Metric Requirement: The ATMS consoles shall have the capability to guide users through the process of creating an emergency plan for handling driver's emergency alarms. This plan shall include procedures for interacting with local law enforcement and forms for developing an emergency callout list.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.5.7. Human Factors

6.5.7.1. Audibility emergency ATRMS

Metric Requirement: The ATRMS shall sound an audio alarm of at least the specified volume at 1 meter.

Units of Measurement: DB

Value: 85

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.5.7.2. Visibility emergency ATRMS

Metric Requirement: The ATRMS shall have a visual emergency indicator that flashes and attracts the attention of any employee within the room the ATRMS is installed in.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.5.8. Data Formatting

6.5.8.1. Data format emergency management display

Metric Requirement: The Emergency Management Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.6. Roadside Information Display Controls

6.6.9. Functional Performance

6.6.9.1. RID administration ATRMS

Metric Requirement: The ATRMS consoles shall have the capability to allow the user to administer each Dynamic Roadside Information Display in the system, including downloading schedules and executables, operational status, and tracking file versions on each sign.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.6.10. Data Formatting

6.6.10.1. Data format roadside information display controls

Metric Requirement: The Roadside Information Display Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.7. Vehicle Tracking Display

6.7.11. Functional Performance

6.7.11.1. Track transit fleet ATRMS

Metric Requirement: The ATRMS consoles shall have the capability to track transit vehicles via map-based and tabular display.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

6.7.12. Data Formatting

6.7.12.1. Data format vehicle tracking display

Metric Requirement: The Vehicle Tracking Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.8. Schedule Adherence Display

6.8.13. Functional Performance

6.8.13.1. Schedule adherence display ATRMS

Metric Requirement: The ATRMS consoles shall have the capability to track transit vehicle schedule information and display it to the user.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.8.14. Data Formatting

6.8.14.1. Data format schedule adherence display

Metric Requirement: The Schedule Adherence Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.8.15. System Accuracy

6.8.15.1. Time reporting accuracy ATRMS display

Metric Requirement: Time estimates shall be accurate within the specified number of seconds.

Units of Measurement: Seconds

Value: 30

Verification Method: Test deliverables to ensure compliance or inspect supplied certifications

6.9. Passenger Boardings Display

6.9.16. Functional Performance

6.9.16.1. Vehicle loading info ATRMS

- Metric Requirement: The ATRMS consoles shall have the capability to track transit vehicle loading information and display it to the user.
- Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

6.9.17. Data Formatting

6.9.17.1. Data format passenger boardings display

- Metric Requirement: The Passenger Boardings Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.
- Verification Method: Verify documented data formats in system design documents or specifications.

6.10. Ridership Statistics Reporting Controls

6.10.18. Functional Performance

6.10.18. Ridership reports ATRMS

1.

- Metric Requirement: The ATRMS consoles shall have the capability to compile and present ridership reports for the user.
- Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

6.10.19. Data Formatting

6.10.19. Data format ridership statistics reporting

1.

- Metric Requirement: The Ridership Statistics Reporting Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.
- Verification Method: Verify documented data formats in system design documents or specifications.

6.11. Schedule Adherence Statistics Reporting Controls

6.11.20. Functional Performance

6.11.20. Schedule adherence reports ATRMS

1.

- Metric Requirement: The ATRMS consoles shall have the capability to compile and present schedule adherence reports for the user.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

6.11.21. Data Formatting

6.11.21. Data format schedule adherence statistics reporting

1.

Metric Requirement: The Schedule Adherence Statistics Reporting Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

6.11.22. System Accuracy

6.11.22. Time reporting accuracy ATRMS statistics

1.

Metric Requirement: Time estimates shall be accurate within the specified number of seconds.

Units of Measurement: Seconds

Value: 30

Verification Method: Test deliverables to ensure compliance or inspect supplied certifications

6.12. System User Management Controls

6.12.23. Functional Performance

6.12.23. ATRMS user admin ATRMS

1.

Metric Requirement: The ATRMS consoles shall have the capability to allow the user to administer all system users and their permissions.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

6.12.24. Data Formatting

6.12.24. Data format system user management controls

1.

Metric Requirement: The System User Management Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

7. ATRMS Communications

7.1. General Requirements

7.1.1. Power

7.1.1.1. Backup power ATRMS Comm emergency management

Metric Requirement: Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.

Units of Measurement: Hours

Value: 1

Verification Method: Test by measuring time

7.1.2. Ruggedness & Reliability

7.1.2.1. Mtbf ATRMS Comm

Metric Requirement: Expected mean time between failures.

Units of Measurement: Hours

Value: 15,000

Verification Method: Inspect manufacturer certification

7.1.2.2. Availability ATRMS Comm

Metric Requirement: Acceptable levels of minimum uptime / maximum downtime in a normal operating environment

Units of Measurement: Percent

Value: 99.9

Verification Method: Inspect manufacturer certification

7.2. ATRMS / Central-Site Data Interfaces

7.2.1. Functional Performance

7.2.1.1. Network connectivity central site

Metric Requirement: If utilizing TCP/IP communication, ATRMS clients shall function from within a Network Address Translation (NAT) network.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

7.3. ATRMS Communications Infrastructure / Repeaters

7.3.2. Communications & Electrical Interfacing

7.3.2.1. Reliability ATRMS Comm

Metric Requirement: The ATRMS Communications System shall meet or exceed the specified successful delivery percentage rate for all data transported between the ATRMS and the ATRMS API.
Units of Measurement: %
Value: 99.99%
Verification Method: Test by measuring delivery rate

7.3.2.2. Latency ATRMS Comm

Metric Requirement: Maximum time for a message and response between the ATRMS and the CSS.
Units of Measurement: Seconds
Value: 5
Verification Method: Test by measuring time delay

8. Central Site Software

8.1. General Requirements

8.1.1. Computational Hardware

8.1.1.1. Responsiveness CSS

Metric Requirement: The maximum amount of time the Central Site Software shall take to respond to user or system-driven input for vehicle tracking operations

Units of Measurement: Seconds

Value: 1

Verification Method: Time system operations.

8.1.1.2. Memory capacity CSS

Metric Requirement: The Central Site Software shall have the necessary memory capacity to handle transit system operational parameter maximums as given in this specification, and the required number of field elements as specified by the transit provider.

Verification Method: Verify in vendor specifications.

8.1.1.3. Storage capacity CSS

Metric Requirement: The Central Site Software shall have the necessary non-volatile storage capacity to sustain operations with all necessary transit system operation parameter maximums as given in this specification.

Verification Method: Verify in vendor specifications.

8.1.2. Functional Performance

8.1.2.1. Provide data store CSS

Metric Requirement: The central site software shall have a data store for all system configuration, schedule, and collected data.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

8.1.3. Installation & Maintenance

8.1.3.1. Self diagnostics RID Comm

Metric Requirement: The Roadside Information Display Communications system shall provided self-test diagnostics to aid in fault isolation.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

8.1.3.2. Self diagnostics RID Comm

Metric Requirement: The Central Site Software shall provide self-test diagnostics to aid in fault isolation.
Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

8.1.4. Power

8.1.4.1. Backup power CSS emergency management

Metric Requirement: Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.
Units of Measurement: Hours
Value: 1
Verification Method: Test by measuring time

8.1.5. Ruggedness & Reliability

8.1.5.1. Availability CSS

Metric Requirement: Acceptable levels of minimum uptime / maximum downtime in a normal operating environment
Units of Measurement: Percent
Value: 99.99
Verification Method: Inspect manufacturer certification

8.1.6. System Accuracy

8.1.6.1. Time synchronization CSS

Metric Requirement: If any time measurement is utilized, it shall be synchronized with Coordinated Universal Time (UTC), and maintain accuracy within the specified limit.
Units of Measurement: Seconds
Value: 1
Verification Method: Inspect supplied certifications

8.2. On-Board Systems API

8.2.1. Functional Performance

8.2.1.1. MDT wireless data interface CSS

Metric Requirement: The central site software shall have an interface to the on-board systems wireless data communications system.
Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

8.2.2. Data Formatting

8.2.2.1. Data format OBS API

Metric Requirement: The CSS On-Board Systems API shall transfer from the CSS Vehicle Wireless Data Communications Driver in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

8.3. ATRMS API

8.3.3. Design & Architecture

8.3.3.1. Extensibility ATRMS API

Metric Requirement: Future modifications to the ATRMS API shall be possible shall not affect existing functionality.

Verification Method: Verify in API documentation.

8.3.4. Functional Performance

8.3.4.1. ATRMS API CSS

Metric Requirement: The central site software shall have the capability to provide system data to other system functions via electronic computer calls over a network.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

8.3.5. Data Formatting

8.3.5.1. Data format ATRMS API

Metric Requirement: The ATRMS API shall transfer data to and from all ATRMS displays in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

8.4. Data Store

8.4.6. Design & Architecture

8.4.6.1. Open data storage facility

Metric Requirement: Direct, unfiltered, read-only access shall be provided to the data store.

Verification Method: Verify in vendor documentation and specifications.

8.4.7. Documentation

8.4.7.1. Open data storage documentation

Metric Requirement: The open data-storage-facility documentation shall be comprehensive and cover all aspects of the data-store including providing a complete data-dictionary, table definitions and relationships as necessary, and all data structure information necessary to query the data-store from an external interface.

Verification Method: Verify document comprehensiveness.

8.4.8. Functional Performance

8.4.8.1. Capacity datastore

Metric Requirement: The capacity required to store all entered and recorded data for a minimum period of time before expungment or other such maintenance is required.

Units of Measurement: Months

Value: 60

Verification Method: Verify in system design document or specifications.

8.4.8.2. Backup interval datastore

Metric Requirement: The minimum allowable intervals between backups of the data store.

Units of Measurement: Days

Value: 7

Verification Method: Verify in system design document or specifications.

8.4.8.3. Export capability datastore

Metric Requirement: The data storage facility shall have the capability to export data in whole or in part for given ranges, to be used for other functions.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

8.4.8.4. Expunge capability datastore

Metric Requirement: The data storage facility shall have the capability to expunge all entered or recorded data for a given date range.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

8.4.8.5. Backup capability datastore

Metric Requirement: The data storage facility shall have the capability to back up or archive all entered and recorded data in whole or in part (given data range). Mechanisms shall be available for both user-initiated and scheduled automatic backups.

Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

8.4.9. Ruggedness & Reliability

8.4.9.1. Operational lifecycle data backup

Metric Requirement: Maximum time between backups of data-storage facility

Units of Measurement: Days

Value: 30

Verification Method: Inspect manufacturer certification

8.5. CSS Vehicle Wireless Data Communications Systems Driver

8.5.10. Documentation

8.5.10.1. Interface documentation CSS comm driver

Metric Requirement: Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the CSS vehicle communications system driver and the central-site wireless data interface shall be provided by the vendor upon delivery.

Verification Method: Inspect documentation deliverables to ensure compliance.

8.5.11. Data Formatting

8.5.11.1. Data format CSS vehicle wireless data communications system driver

Metric Requirement: The CSS Vehicle Wireless Data Communications System Driver shall transfer data to the CSS On-Board Systems API in accordance with the EDAPTS Data Formatting Standard. Any CSS Vehicle Wireless Data Communications System Driver internal data formatting and compression methods used over the communications link shall be documented and provided to the transit property.

Verification Method: Verify documented data formats in system design documents or specifications.

8.6. Roadside Information Display API

8.6.12. Functional Performance

8.6.12.1. RID data interface CSS

Metric Requirement: The central site software shall have an interface to the Dynamic Roadside Information Display data communications system.

Verification Method: Verify in system design document or specifications. Inspect deliverables to ensure compliance.

8.6.13. Data Formatting

8.6.13.1. Data format CSS RID API

- Metric Requirement: The CSS RID API shall receive data from the CSS RID Data Communications System Driver in accordance with the EDAPTS Data Formatting Standard.
- Verification Method: Verify documented data formats in system design documents or specifications.

8.7. CSS RID Data Communications System Driver

8.7.14. Data Formatting

8.7.14.1. Data format CSS roadside communications system driver

- Metric Requirement: The CSS RID Communications System Driver shall transfer data to the CSS Roadside Display API in accordance with the EDAPTS Data Formatting Standard. Any CSS RID Communications System Driver internal data formatting and compression methods used over the communications link shall be documented and provided to the transit property.
- Verification Method: Verify documented data formats in system design documents or specifications.

8.8. Traveler Information API

8.8.15. Design & Architecture

8.8.15.1. Extensibility Traveler Information API

- Metric Requirement: Future modifications to the Traveler Information API shall be possible shall not affect existing functionality.
- Verification Method: Verify in API documentation.

8.8.16. Functional Performance

8.8.16.1. Traveler Information API CSS

- Metric Requirement: The central site software shall have the capability to provide system data to outside system functions via electronic computer calls over a network.
- Verification Method: Verify in system design document or specifications. Test installation to ensure compliance.

8.8.17. Data Formatting

8.8.17.1. Data format traveler information API

- Metric Requirement: The Traveler Information API shall transfer data to and from all external traveler information using entities in accordance with the EDAPTS Data Formatting Standard.
- Verification Method: Verify documented data formats in system design documents or specifications.

8.8.18. System Accuracy

8.8.18.1. Time reporting accuracy Traveler API

Metric Requirement: Time estimates shall be accurate within the specified number of seconds.

Units of Measurement: Seconds

Value: 30

Verification Method: Test deliverables to ensure compliance or inspect supplied certifications

9. System Input Data

9.1. General Requirements

9.2. Stop-Point List

9.2.1. Data Formatting

9.2.1.1. Data format stop point list

Metric Requirement: The Stop-Point List shall be formatted in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

9.2.2. System Accuracy

9.2.2.1. Georeference stop-point accuracy

Metric Requirement: Latitude and longitude estimates shall be accurate to within the specified number of minutes.

Units of Measurement: Meters

Value: 10

Verification Method: Inspect supplied certifications

9.3. Timetable

9.3.3. Data Formatting

9.3.3.1. Data format timetable

Metric Requirement: The Timetable shall be formatted in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

9.4. Work / Runs List

9.4.4. Data Formatting

9.4.4.1. Data format work runs list

Metric Requirement: The Work/Runs List shall be formatted in accordance with the EDAPTS Data Formatting Standard.

Verification Method: Verify documented data formats in system design documents or specifications.

APPENDIX C

EDAPTS PERFORMANCE SPECIFICATION TABLES

Functional Groups Definition: Groups of System Functions assembled together as a higher level feature-set for selection by the creator of an EDAPTS Specification.

functional_group_ID	functional_group_name	functional_group_description
FG-01	Driver Assistance	The driver assistance functional group will aid drivers in driving their route. Drivers will be notified of stop name and number when they arrive and are at a stop. Drivers will also be provided with a large-digit clock on their MDT when bus is moving.
FG-02	Schedule Adherence Monitoring & Reporting	The schedule adherence functional group will provide drivers, dispatchers, and transit managers with real-time and post-processed information regarding transit vehicle schedule adherence status & performance. Drivers will be provided with their schedule adherence status when they arrive at a stop as well as be given a countdown until departure while they are at a stop or on break. Dispatchers and transit managers will be provided with the real-time schedule adherence status of all vehicles on route as well as after-the-fact reports indicating average deviations from schedule adherence requirements and exception reports listing all out of tolerance schedule adherence events for the system. All schedule adherence reports provided to dispatchers and managers will be selectable by route, time, or date.
FG-03	Vehicle Load Monitoring & Reporting	The vehicle load monitoring & reporting group will provide dispatchers and transit managers with real-time and post-processed information regarding transit vehicle loading. Real-time vehicle loading of all vehicles on route as well as after-the-fact reports indicating average loading will be available. All vehicle loading reports will be selectable by route, time, or date.
FG-04	Roadside Traveler Information	The roadside traveler information functional group will provide passengers waiting at bus stops with timely estimates of minutes until arrival for all transit vehicles scheduled to arrive at a transit stop as well as public information messages composed in the transit management or dispatch center.
FG-05	On-Board Passenger Next-Stop Notification	The on-board passenger next-stop notification functional group will notify passengers of the expected next stop and key landmarks. Notification to passengers will be made by audio annunciator via the bus public address system, by an electronic sign installed within view of all passengers, or both.
FG-06	Vehicle Location Monitoring	The vehicle location monitoring functional group will provide dispatchers with real-time information about where all buses in their fleet are. Specific information that will be provided includes last stop on route, current location, and route number.
FG-07	Emergency Notification & Management	The emergency notification and management functional group will provide drivers with the ability to declare an on-board emergency that will be detected by dispatchers so that they can coordinate a law enforcement response.
FG-08	Boarding Pass Validation & Reporting	The boarding pass validation & reporting functional group will allow transit vehicles to be loaded with lists of valid boarding pass identifiers. Transit riders will swipe their pass upon boarding where the pass will be validated and recorded. Transit managers will then be able to later look at boarding pass reports.

Function Definition: An action the system does for a system user.

function_ID	function_name	function_description	part_of_component
Vehicle On-Board Systems			
F-101	Display time of day to driver	The current time of day in hours and minutes will be displayed to the driver via the MDT screen in large-format, easy-to-read numbers.	C-1
F-102	Blank screen while bus is moving	The MDT screen will be blanked of detailed information, when the bus is moving, to ensure that the driver is not distracted. The time of day may be displayed when the MDT screen is blanked.	C-1
F-104	Display current stop schedule adherence to driver	The current schedule adherence status, i.e. the number of minutes the bus is early or late will be displayed to a driver via the MDT screen while they are at a scheduled stop.	C-1
F-105	Display time-until-departure at current stop	The minutes until the scheduled departure time will be displayed to the driver via the MDT screen while the bus is at stop or the bus out of service is on a scheduled break.	C-1
F-106	Automatically accept, validate, and log pass media during boarding	Passenger fare media will be read via card swipe or proximity scan as passengers board the bus. Read pass media will be validated and the success or failure of the pass-media validation will be indicated to the driver and to the boarding passenger allowing boarding to be completed as appropriate. The result of the pass-media validation will then be logged for later transfer to the central site.	C-1
F-107	Automatically collect and record boardings & alightings counts	Automatic passenger counter (APC) boarding and alighting counts from all passenger entry and exit doors are collected at each stop. This passenger count data is then associated with the route, trip, stop, date, and time, and is recorded for later transfer to the central site.	C-1
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	Stop-based data calculated and received from onboard peripherals will be stored electronically for later transfer to the central site. The transfer to the the central site may be immediate or completed during a scheduled manual or automatic download of data from the bus. The association between the data to be transferred and the stop, trip, route, time, and date will be maintained during this transfer.	C-1
F-109	Provide on-board stop annunciation	The next scheduled stop and other pertinent information such as local landmarks, bus route number, etc. will be automatically announced to passengers as the bus departs each stop and progresses on route.	C-1

function_ID	function_name	function_description	part_of_component
F-110	Provide on-board stop signage	The next scheduled stop and other pertinent information such as local landmarks, bus route number, etc. will be automatically indicated to passengers via electronic sign as the bus departs each stop and progresses on route.	C-1
F-111	Collect vehicle odometer data	Vehicle odometer data will be collected from the driver at various times such as driver login, fueling, and shift changes. The odometer data will be manually read by the driver from the bus speedometer and then entered into the MDT via the keypad/display.	C-1
F-112	Provide notification of stop arrivals and departures to driver	The driver will be notified via the MDT screen when their bus arrives at a stop on route and departs a stop. This notification will include route number and stop name.	C-1
F-113	Collect driver ID during login	The driver's employee identification number will be entered by the driver via the MDT keypad when they log in to the MDT at the beginning of their shift.	C-1
F-114	Collect route number during login	The route number and name will be entered by the driver via the MDT at the beginning of their shift, when they change route, etc. The driver will be able to select the route number from a list of possible route numbers.	C-1
F-115	Change driver's work assignment during the day	The driver will enter a new work assignment, such as Block #, via the MDT keypad when they switch to a new driving assignment.	C-1
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	The MDT will create updates including information such as location, last stop visited, time, schedule adherence, and passenger loading, and transmit them to the central site via wireless communications link. These updates will provided at appropriate times such as departing a stop or at a regularly scheduled intervals.	C-1
F-118	Declare on board emergency	The driver will depress a hidden button in the driver's compartment to declare an on-board emergency such as a dangerous person on-board their vehicle. An emergency message will be relayed to the dispatch center, where a dispatcher will have the opportunity to acknowledge the message. The driver will receive notification via the MDT display upon a dispatcher acknowledging the emergency. The MDT will provide periodic vehicle position updates to the central site until the emergency is over.	C-1
F-119	Survey stop locations	Transit stop location and street direction information will be collected by a transit employee using the MDT in stop survey mode. Survey data will be stored in the MDT for later downloading and use in the transit system schedule.	C-1

function_ID	function_name	function_description	part_of_component
F-120	Manually collect and record passenger boarding counts.	The driver will press a button, either on the MDT or on a separate keypad, that indicates a certain fair classification rider has boarded.	C-1
Dynamic Roadside Information Display			
F-201	Provide estimated time until arrival to passengers at stops	The estimated number of minutes until arrival for all buses scheduled to arrive at a stop will be displayed to passengers waiting at the stop via electronic message signs.	C-3
F-202	Provide dynamic public service information to passengers at stops	Public service messages will be displayed to passengers waiting at bus stops. These messages may include transit system updates, emergency preparedness and evacuation advice, and other general information suitable for public consumption.	C-3
Central Site Software			
F-301	Provide API for transit traveler information	Transit fleet operating data including vehicle locations on route, schedule adherence, and transit system timetables will be provided to outside entities and systems so that they might provide 'live' transit system information, system timetables, and trip planing help to the public through various electronic means.	C-7
Advanced Transit Management System			
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	Vehicle location on route will be presented on a map-based and/or tabular display to dispatch and management personnel via their computer console. Vehicles & routes will be color coded, making them easily discernable to all users. Both vehicles and routes will be selectable for display on a per-route basis, with information including vehicle number, current stop, next stop, etc.	C-5
F-402	Display schedule adherence information for dispatch & management users	Transit vehicle schedule adherence information will be presented to dispatch and management personnel via their computer console. Schedule adherence information will be able to be sorted and displayed on a per route/per day basis with information presented for all stops on all runs on a route during the day. The schedule adherence information will include information such as stop location, scheduled arrival and/or departure time, and deviation from the schedule.	C-5

function_ID	function_name	function_description	part_of_component
F-403	Display passenger boarding / alighting information for dispatch & management users	Passenger boarding, alighting, and passenger load counts will be presented to dispatch and management personnel via their computer console. This boarding, alighting, and load information will be able to be sorted and displayed on a per route/per day basis with information presented for all stops on all runs on a route during the day.	C-5
F-404	Handle driver emergency button alarms for dispatch and management users	Transit fleet dispatchers will be notified via visual and audible alarms when a driver initiates a transit vehicle emergency. The dispatcher will be required to initiate communications with the driver and acknowledge the emergency. The location of the vehicle with the emergency alarm will be continuously displayed to dispatchers during the course of the emergency.	C-5
F-405	Provide statistical ridership reports for dispatch & management users	Transit fleet dispatchers and managers will be provided with written reports that provide: system ridership as a distribution of number of rides/passenger/month and ridership statistics on a per route per time period basis. Ridership data for these reports will be based on various rider populations that can be differentiated based on data collected at boarding, such as rider type from electronic pass card, rider type discerned by the driver and entered on the MDT. Reports will be provided in various computer file formats such as pdf or comma separated variable (csv) formats. All reports will be directly viewable on the computer console after they are generated.	C-5
F-406	Provide statistical schedule adherence reports for dispatch & management users	Transit fleet dispatchers and managers will be provided with written reports that provide a statistical summary of out-of-tolerance stop arrivals and list all out of tolerance stop arrivals with day, route, time, scheduled arrival time, actual arrival time, deviation, and vehicle ID identified. An indication of report accuracy/sample size will be provided by indicating the percentage of stops reporting data on a per trip/per route basis. Reports will be provided in various computer file formats such as pdf or comma separated variable (csv) formats. All reports will be directly viewable on the computer console after they are generated.	C-5

function_ID	function_name	function_description	part_of_component
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	Transit fleet managers and administrators will use controls for manual and automatic dissemination of bus-pass lists to on-board equipment on buses. The controls will allow the bus-pass lists to be disseminated on a per bus or fleet basis. The bus-pass lists will be able to be disseminated in whole or as additions to an existing version of a list. Bus-pass version numbers will be maintained at the central site and on each bus and viewable from the controls. Bus-pass distribution will utilize methods to verify accurate and complete distribution to selected buses.	C-5
F-411	Provide controls for roadside banner message display	Transit fleet managers will use controls to post free-form and/or pre-defined banner messages on roadside information displays on a per-sign or system basis.	C-5
F-412	Provide system user administration	Transit fleet managers will add, edit, and delete ATRMS console users, and set the ATRMS functions they will have access to.	C-5
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	Transit fleet dispatchers and managers will be provided with written reports that provide a statistical summary boarding, alighting, and passenger load counts. Reports will be provided in various computer file formats such as pdf or comma separated variable (csv) formats. All reports will be directly viewable on the computer console after they are generated.	C-5

Component Definition: "Swappable" pieces of the EDAPTS system. The lowest level at which one piece can be replaced with another like piece, and the system will still function.

component_ID	component_name	component_description
C-1	Vehicle On-Board Systems	The equipment and software installed in a transit vehicle to perform transit management functions. On-Board systems will typically include a Mobile Data Terminal and associated peripherals such as magnetic stripe card readers, on-board annunciators and electronic message signs, and driver's emergency button.
C-2	Vehicle Wireless Data Communications System	The wireless data communications system used for communications between the central dispatch center and On-Board Systems. This system will typically be used to allow the bus to communicate position, stop arrivals and departures, boarding information, etc. to the central dispatch system.
C-3	Dynamic Roadside Information Display	An electronic, remotely controlled display that presents information regarding estimated time of arrival of buses to passengers waiting at bus stops. These displays typically provide "real-time" information based upon bus progress along route.
C-4	Roadside Data Communications System	The wireless or wired communications from the central dispatch site to roadside information displays. This communications link allows the signs to know vehicle locations on route so that the roadside information display can display estimated minutes until arrival for routes at stops.
C-5	Advanced Transit Management System	The software application that will run at locations such as the dispatch center and other management offices, typically providing personnel with information such as vehicle position and location, schedule adherence data, boarding and ridership data, and statistical analysis and reporting of the above functions.
C-6	ATRMS Communications	The data communications system used for communications between the central dispatch center and the ATRMS.
C-7	Central Site Software	The software that will run at a fixed, central location to receive, transmit, store, and facilitate the exchange of data between other components. Such software typically provides an interface to communicate with On-Board and Roadside components, stores and retrieves collected system data, and provides Application Programming Interfaces (APIs) to both ATRMS and Traveler Information systems.
C-8	System Input Data	The information required to be entered into the system for it to function. This would include data such stop-point references, schedules and timetables, map data, and valid driver and rider lists.

Element Definition: A subassembly or subsystem of a component. Does not need to be interchangeable with other like elements.

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
Vehicle On-Board Systems					
E-101	Mobile Data Terminal (MDT)	Vehicle On-Board Systems	C-1	A device that provides the driver access to various functions such as schedule adherence status, passenger boarding status, time of day, time of day, route being driven. The MDT provides driver input and output functions and is likely connected to other on-board elements.	
E-102	Pass / Fare Media Reader	Vehicle On-Board Systems	C-1	A device installed in the passenger boarding area that accepts fare and pass media from passengers during boarding.	
E-103	Emergency Actuator	Vehicle On-Board Systems	C-1	A device that drivers will utilize to send an emergency notification or "Mayday" message to the dispatcher indicating they have a situation on their bus which poses a physical threat to themselves or any of the passengers. The Emergency Actuator would typically be installed in the driver's compartment so that the driver could actuate it unbeknownst to anyone else on the bus.	
E-104	On-Board Audio Annunciator	Vehicle On-Board Systems	C-1	A device audibly announces information concerning the next stop, the stop being arrived at, and other information such as key destinations and landmarks to help passengers determine when to disembark from the bus.	
E-105	On-Board Electronic Sign	Vehicle On-Board Systems	C-1	A device that visually indicates information concerning the next stop, the stop being arrived at, and other information such as key destinations and landmarks to help passengers determine when they should disembark from the bus. The On-Board Electronic Sign may be installed at the front of the bus and possibly at other locations.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-106	APC (Automatic Passenger Counter)	Vehicle On-Board Systems	C-1	Devices mounted at all bus entry and exit locations that detect passengers embarking and disembarking from the bus. APCs typically keep track of the total number of people riding on the bus at any given time. Data may be downloaded at the end of the day or may be transferred to another on-board devices such as the MDT as it is determined.	
E-107	MDT Functional Processes	Vehicle On-Board Systems	C-1	Software that executes on the MDT to perform functions such as detecting bus stops, accepting data from devices such as an Automatic Passenger Counter or a media reader, or controlling on-board devices such as annunciators and electronic display signs.	
E-108	MDT Vehicle Wireless Data Communications System Driver	Vehicle On-Board Systems	C-1	Software that executes on the MDT interface to the Vehicle Wireless Data Communications System. This software may perform data encoding/decoding.	
Vehicle Wireless Data Communications System					
E-201	On-Board Wide-Area Wireless Data Interface	Vehicle Wireless Data Communications System	C-2	An on-board device, such as a modem or data communications card, that allows the on-board computational equipment (the MDT) to make a data communications connection to the central site from anywhere in the transit service area.	
E-202	On-board Wide-Area Communications Infrastructure / Repeaters	Vehicle Wireless Data Communications System	C-2	Equipment located on mountaintops, buildings, poles, etc. that serves as a relay station for bi-directional wireless data communications transmissions between the central site and buses anywhere in the transit service area.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-203	Central-Site Wide-Area Wireless Data Interface	Vehicle Wireless Data Communications System	C-2	A device such as a modem, data communications card, or network access card that allows the central site communications servers to make a connection to transit vehicle on-board systems anywhere in the transit service area via the Wireless Communications system.	
E-204	On-Board High-Speed Data Interface	Vehicle Wireless Data Communications System	C-2	An on-board device, such as a modem or data communications card, that allows the on-board computational equipment (the MDT) to make a high-speed data communications connection to the central site from within the transit facility.	
E-205	On-board High-Speed Communications Infrastructure / Repeaters	Vehicle Wireless Data Communications System	C-2	Equipment located on the transit facility that serves as a relay station for high-speed bi-directional wireless data communications transmissions between the central site and transit vehicle on-board systems in the transit facility.	
E-206	Central-Site High-Speed Data Interface	Vehicle Wireless Data Communications System	C-2	A device such as a modem, data communications card, or network access card that allows the central site communications servers to make a high-speed wireless data connection to transit On-Board Systems of transit vehicles within the transit facility.	
Dynamic Roadside Information Display					
E-301	Roadside Sign / Display	Dynamic Roadside Information Display	C-3	A device (typically installed on a post or pole) that presents "live" data regarding estimated time of arrival or minutes until arrival for transit vehicles arriving at a stop. This sign/display may display information for more than one route at a given stop and also may display other messages such as public service announcements or system status information.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-302	Roadside Post	Dynamic Roadside Information Display	C-3	A post or pole that supports the Roadside Information Display.	This is a critical safety item and must be properly designed to safely support the post and its attached display under any anticipated adverse environmental conditions
E-303	Roadside Post Foundation	Dynamic Roadside Information Display	C-3	The foundation for the Roadside Post.	This is a critical safety item and must be properly designed to safely support the post and its attached display under any anticipated adverse environmental conditions
E-304	RID Functional Processes	Dynamic Roadside Information Display	C-3	Software that executes on the RID and receives messages from the central site and performs functions such as calculating estimated minutes for arrival for buses, formatting public service messages for display.	
E-305	RID Communications System Driver	Dynamic Roadside Information Display	C-3	Software that executes on the RID and interfaces to the RID Data Communications System. This software may perform data encoding/decoding.	
Roadside Data Communications System					
E-401	Roadside Data Interface	Roadside Data Communications System	C-4	A device, such as a modem, data communications card, or network access card that allows the Dynamic Roadside Information Display to make a data communications connection to the central site.	
E-402	Roadside Communications Infrastructure / Repeaters	Roadside Data Communications System	C-4	Equipment located on mountaintops, buildings, poles, etc. that is serves a relay station for uni-directional or bi-directional wireless data communications transmissions between Roadside Information Displays and the central site.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-403	Central-Site Data Interface	Roadside Data Communications System	C-4	A device such as a modem, data communications card, or network access card that allows the central site communications servers to make a data communications connection to buses via the On-Board Wireless Communications system.	
Advanced Transit Management System					
E-501	Vehicle Tracking Display	Advanced Transit Management System	C-5	A GUI screen with controls that allows a dispatch and/or management user to observe real-time vehicle positions. The screen may display information in a map-based or tabular form, depending upon specific user requirements.	
E-502	Schedule Adherence Display	Advanced Transit Management System	C-5	A GUI screen with controls that allows a dispatch or management user to observe vehicle schedule adherence on a user-defined per stop, per trip, per route, per hour, or per day basis.	
E-503	Passenger Boardings Display	Advanced Transit Management System	C-5	A GUI screen with controls that allows a dispatch and/or management user to observe passenger boardings on a user-defined per stop, per trip, per route, per hour, or per day basis.	
E-504	Emergency Management Display	Advanced Transit Management System	C-5	A GUI screen that alerts a dispatch and/or management user when a driver has depressed his or her emergency actuator. This screen creates audible and visible indications of the emergency conditions and does not allow any other activity on any ATRMS console until the emergency has been acknowledged and coordination responsibility is assumed by a dispatch or management user. It enables continuous "live" tracking of the vehicle reporting the emergency and allows the emergency to be closed out and automatically logged when it is over.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-505	Ridership Statistics Reporting Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows a dispatch or management user to generate reports regarding ridership statistics on a user-defined per stop, per trip, per route, per hour, or per day basis.	
E-506	Schedule Adherence Statistics Reporting Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows a dispatch or management user to generate reports regarding vehicle schedule adherence on a user-defined per stop, per trip, per route, per hour, or per day basis. Reports generated may be either statistical or exception based in nature.	
E-507	Bus Pass List Dissemination Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows a dispatch or management user to initiate the download of bus-pass lists or portions thereof to specific buses or the the entire fleet. Controls will allow the user to determine the status of bus pass lists that have been downloaded from the central site to buses.	
E-508	System User Management Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows a management user to create new system users, modify the permissions of existing users, or delete users.	
E-509	On-Board Equipment Administration Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows a management user to adminster the MDT computer and its operating system remotely from the central site. Administration capabilities include loading new configuration files, software executables, system schedules / timetables, and retrieving log files of various system functions. These administration tools give the remote administrator the same tools they would have if the were connected into the MDT's operating system via a hard-wire connection.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-510	Schedule Management & Administration Tools & Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows a management user to build, modify, or delete system schedules on a per time period, per route, or per system basis.	
E-511	Roadside Information Display Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows a management user to reconfigure Roadside Information Displays to serve different stops, update their schedules, or update them with public service or system status banner messages.	
E-512	Driver Management Controls	Advanced Transit Management System	C-5	A GUI screen with controls that allows the addition, removal, and editing of drivers and driver information within the system.	
E-513	ATRMS Data Communications System Driver	Advanced Transit Management System	C-5	Software that executes on the ATRMS interface to the ATRMS Communications System. This software may perform data encoding/decoding.	
ATRMS Communications					
E-601	ATRMS / Central-Site Data Interfaces	ATRMS Communications	C-6	The local area networking (LAN) cards installed in central-site workstations and servers.	
E-602	ATRMS Communications Infrastructure / Repeaters	ATRMS Communications	C-6	The local area networking (LAN) equipment used to connect central-site workstations and servers to each other and to remote ATRMS clients via the Internet.	This equipment may utilize hardwired connections, wireless connections, or both.
Central Site Software					
E-701	On-Board Systems API	Central Site Software	C-7	A software application that runs at the central site and communicates with all Mobile Data Terminals (MDTs) in the fleet via the Central Site Wireless Data Interface and the On-Board Communications Infrastructure and Repeaters. This communications server provides all access to Mobile Data Terminals in vehicles for the central site.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-702	Roadside Information Display API	Central Site Software	C-7	A software application that runs at the central site and communicates with all Roadside Information Displays via the Central Site Data Interface and the Roadside Communications Infrastructure and Repeaters. This communications server provides all access to Roadside Information Displays for the central site.	
E-703	Traveler Information API	Central Site Software	C-7	A software application that runs at the central site and provides a set of functions that return information regarding vehicle location on route, schedule adherence, and vehicle seat availability to applications that will provide this information the public through various communications and display schemes.	
E-704	ATRMS API	Central Site Software	C-7	A software application that runs at the central site and provides a set of functions that return information to support all ATRMS GUI screens.	
E-705	Data Store	Central Site Software	C-7	A software application or function (most likely a dbms) that provides short term and long term storage of all system data received from transit vehicles and system schedules.	
E-706	Data Store API	Central Site Software	C-7	An application programmers interface that provides read-write access to the Data Store for software applications such as the Central Site Software and the ATRMS.	
E-707	CSS Functional Processes	Central Site Software	C-7	Software that executes at the central site to perform functions such as calculating schedule adherence, processing driver emergencies, generating reports, managing schedules, etc.	

element_ID	element_name	element_of_component	component_ID	element_description	element_notes
E-708	CSS Vehicle Wireless Data Communications Systems Driver	Central Site Software	C-7	Software that executes at the central site and interfaces to the Vehicle Wireless Data Communications System. This software may perform data encoding/decoding.	
E-709	CSS RID Data Communications System Driver	Central Site Software	C-7	Software that executes at the central site and interfaces to the RID Communications System. This software may perform data encoding/decoding.	
E-710	CSS ATRMS Data Communications System Driver	Central Site Software	C-7	Software that executes at the central site and interfaces to the ATRMS Communications System. This software may perform data encoding/decoding.	
System Input Data					
E-801	Stop-Point List	System Input Data	C-8	The master list of all stops in the transit system. Each stop has a unique identifier number or designation as well as latitude, longitude, and direction of travel for the stop. It may also include other identification information such as common street names, intersection and/or stop name.	
E-802	Timetable	System Input Data	C-8	The master schedule for the transit system, indicating all routes, trips, and stops on trips in the system.	
E-803	Work / Runs List	System Input Data	C-8	The master list of all runs in the system.	
E-804	Stop-point and Landmark Voice and Text	System Input Data	C-8	ASCII text of ADA mandated on-board display and announcement content for all stops in the system.	
E-805	Passenger Pass Lists	System Input Data	C-8	Passenger bus-pass lists of unique pass ID numbers for use in validating passenger passes via electronic means during boarding.	
E-806	Emergency Contact Callout List	System Input Data	C-8	A list of names and telephone, pager, and fax numbers to be called when an on-board emergency acuator is depressed and an emergency is received in dispatch.	
E-807	Street Maps	System Input Data	C-8	Street maps for display of transit vehicle location on route and transit stops via the ATRMS Vehicle Tracking Display.	

element_ID	element_name	element_of_ component	component_ ID	element_description	element_notes
E-808	Valid Drivers List	System Input Data	C-8	A list of valid transit fleet drivers.	

Market Package Definition: Market Packages represent slices of the National ITS Architecture. A market package collects together several different subsystems, equipment packages, terminators, and architecture flows that provide the desired service.

market_package_ID	market_package_number	market_package_service_area	market_package_name	market_package_description
Archived Data Management				
MPKG-01	AD1	Archived Data Management	ITS Data Mart	This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.
Public Transportation				
MPKG-02	APTS1	Public Transportation	Transit Vehicle Tracking	This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider.
MPKG-03	APTS2	Public Transportation	Transit Fixed-Route Operations	This market package performs vehicle routing and scheduling, as well as automatic operator assignment and system monitoring for fixed-route and flexible-route transit services. This service determines current schedule performance using AVL data and provides information displays at the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

market_package_ID	market_package_number	market_package_service_area	market_package_name	market_package_description
MPKG-04	APTS4	Public Transportation	Transit Passenger and Fare Management	This market package manages passenger loading and fare payments on-board transit vehicles using electronic means. It allows transit users to use a traveler card or other electronic payment device. Sensors mounted on the vehicle permit the operator and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem. Two other market packages, ATMS10: Electronic Toll Collection and ATMS16: Parking Facility Management also provide electronic payment services. These three market packages in combination provide an integrated electronic payment system for transportation services.
MPKG-05	APTS5	Public Transportation	Transit Security	This market package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment is deployed to perform surveillance and sensor monitoring in order to warn of potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this market package provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring).
MPKG-06	APTS8	Public Transportation	Transit Traveler Information	This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.

market_package_ID	market_package_number	market_package_service_area	market_package_name	market_package_description
Traveler Information				
MPKG-07	ATIS1	Traveler Information	Broadcast Traveler Information	This market package collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadly disseminates this information through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). The information may be provided directly to travelers or provided to merchants and other traveler service providers so that they can better inform their customers of travel conditions. Different from the market package ATMS6 - Traffic Information Dissemination, which provides localized HAR and DMS information capabilities, ATIS1 provides a wide area digital broadcast service. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.
MPKG-08	ATIS2	Traveler Information	Interactive Traveler Information	This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. A range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications between the traveler and Information Service Provider. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices. This market package also allows value-added resellers to collect transportation information that can be aggregated and be available to their personal devices or remote traveler systems to better inform their customers of transportation conditions. Successful
Emergency Management				

market_package_ID	market_package_number	market_package_service_area	market_package_name	market_package_description
MPKG-09	EM01	Emergency Management	Emergency Call-Taking and Dispatch	This market package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Subsystem and an Emergency Vehicle supports dispatch and provision of information to responding personnel.
MPKG-10	EM03	Emergency Management	Mayday and Alarms Support	This market package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user, gather information about the incident, and determine the appropriate response. The request for assistance may be manually initiated or automated and linked to vehicle sensors. This market package also includes general surveillance capabilities that enable the Emergency Management Subsystem to remotely monitor public areas (e.g., rest stops, parking lots) to improve security in these areas. The Emergency Management Subsystem may be operated by the public sector or by a private sector telematics service provider.
MPKG-11	EM06	Emergency Management	Wide-Area Alert	This market package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information web sites.

market_package_ID	market_package_number	market_package_service_area	market_package_name	market_package_description
MPKG-12	EM09	Emergency Management	Evacuation and Reentry Management	<p>This market package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The market package addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning.</p> <p>This market package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times.</p> <p>Evacuations are also supported by EM10, the "Disaster Traveler Information" market package, which keeps the public informed during evacuations. See that market package for more information.</p>

market_package_ID	market_package_number	market_package_service_area	market_package_name	market_package_description
MPKG-13	EM10	Emergency Management	Disaster Traveler Information	<p>This market package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This market package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems.</p> <p>A disaster will stress the surface transportation system since it may damage transportation facilities at the same time that it places unique demands on these facilities to support public evacuation and provide access for emergency responders. Similarly, a disaster may interrupt or degrade the operation of many traveler information systems at the same time that safety-critical information must be provided to the traveling public. This market package keeps the public informed in these scenarios, using all available means to provide information about the disaster area including damage to the transportation system, detours and closures in effect, special traffic restrictions and allowances, special transit schedules, and real-time information on traffic conditions and transit system performance in and around the disaster.</p> <p>This market package also provides emergency information to assist the public with evacuations when necessary. Information on mandatory and voluntary evacuation zones, evacuation times, and instructions are provided. Available evacuation routes and destinations and current and anticipated travel conditions along those routes are provided so evacuees are prepared and know their destination and preferred evacuation route. Information on available transit services and traveler services (shelters, medical services, hotels, restaurants, gas stations, etc.) is also provided. In addition to general evacuation information, this market package provides</p>

Category Definition: General areas in which metrics are grouped. Categories were chosen based upon the Sample Metrics Table created as part of the Literature Review.

category_ID	category_name	category_description
MCAT-01	Communications & Electrical Interfacing	Communications and Electrical Interfacing performance metrics define required data communications latency, reliability, and throughput, and electrical interfacing standards.
MCAT-02	Computational Hardware	Computational Hardware performance metrics define required minimum processing capability, request responsiveness, memory capacity, operating and archive storage capacities for EDAPTS computer-based systems.
MCAT-03	Design & Architecture	Design and Architecture performance metrics address internal system architecture issues such as product extensibility and interoperability as well as site selection and evaluation for the Roadside Information Display.
MCAT-04	Documentation	Documentation performance metrics define requirements for legibility, comprehensiveness, clarity, and writing level of user and system maintenance documentation.
MCAT-05	Functional Performance	Functional performance metrics detail all required system functions.
MCAT-06	Human Factors	Human factors performance metrics define accessibility (including ADA), inobtrusiveness of on-board and roadside system elements, and readability and font/graphic scalability of system Graphical User Interfaces (GUIs).
MCAT-07	Installation & Maintenance	Installation and Maintenance performance metrics indicate how efficiently and easily the system should be able to be installed and maintained with the goal of minimizing use of monetary, employee, and time resources of the system owner.
MCAT-08	Manufacturing	Manufacturing performance metrics dictate requirements for manufactured system elements to ensure they are physically standardized and are suitable for installation and use in a public commercial environment.
MCAT-09	Mechanical Interfacing	Mechanical Interfacing permissible performance metrics indicate tolerances for bolt/screw hole sizes, hole patterns, and weight of system elements.
MCAT-10	Power	Power performance metrics indicate power source characteristics, maximum power consumption, minimum power quality, and device power autonomy (i.e. solar, standards for any power consuming system element operated from a solar power source)
MCAT-11	Privacy & Security	Privacy and Security performance metrics indicate how the system shall ensure privacy of any collected or utilized customer information (i.e. ID card numbers) as well as the system's immunity to intrusion from nefarious sources via any communications link.

category_ID	category_name	category_description
MCAT-12	Ruggedness & Reliability	Ruggedness and Reliability performance metrics indicate how the system shall provide reliable service on an ongoing basis with minimal upkeep or repairs despite its elements being installed in locations subject to vibration, shock, temperature extremes, heavy use by transit employees, and exposure to general public usage.
MCAT-13	Data Formatting	Data Formatting performance metrics indicate the content of all inter-component communications to ensure interoperability and compatibility of components procured from different vendors or sources.
MCAT-14	Safety & Certification	Safety and Certification performance metrics define system impact on public safety and to users. This includes users located 1.) at offices 2.) at maintenance facilities 3.) in transit vehicles and 4.) on the the roadside.
MCAT-15	Standards & Practices	Standards and Practices performance metrics indicate minimum workmanship levels for installation of all system elements and their associated cabling and connections, geologic design parameters, units for latitude, longitude values, measurement system, binary representation of integers and real numbers, service labeling of all cables, connectors, and cable jacks, installation methods to eliminate vibration related abrasion of cables, equipment commonality and standarization, database management system query language, and software engineering and reliability programs.
MCAT-16	System Accuracy	System Accuracy performance metrics indicate required accuracy for data of the followign types: time, vehicle position and heading, stop locations on routes, street data information for building GUI map displays, the accuracy of data presented to users, and automatic fault detection for all system elements.

Metric Definition: The individual performance measure of a system element or component. This includes units necessary for measuring the metric, and the procedure required to measure it.

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component name
Communications & Electrical Interfacing										
M-01001	interfacing_MDT	<p>For its wired electrical control/data interfaces, the MDT shall be able to connect to other on-board peripherals and other equipment using easy to remove connectors or terminals.</p> <p>The MDT control/data signal interfaces shall be interference-tolerant in a production bus environment. Control/data interface signal levels shall be fully defined, non-proprietary and easily accessible to other connecting on-board peripherals and equipment. Control/data signal interfaces shall utilize commonly accepted standards and protocols such as SAE J1708, RS232, TCIP, IEEE, etc. Signal structures used (levels, timing, etc.) shall be compatible with data needs.</p>	T/F	Verify in vendor's specifications	TRUE		MCAT-01	Communications & Electrical Interfacing	E-101	Mobile Data Terminal (MDT)
M-01002	interfacing_Media_Reader	<p>For its wired electrical control/data interfaces, the Media Reader shall be able to connect to the MDT, other on-board peripherals and other equipment using easy to remove connectors or terminals.</p> <p>Signal levels shall be compatible with MDT signal input specifications. Signal structure (protocol, timing, etc.) shall be compatible with MDT signal structure needs. Appropriate use of sheilding or filtering to reduce electrical interference shall be included where appropriate</p>	T/F	Verify in vendor's specifications	TRUE		MCAT-01	Communications & Electrical Interfacing	E-102	Pass / Fare Media Reader
M-01003	interfacing_E_Actuator	<p>For its wired electrical control/data interfaces, the Emergency Actuator shall be able to connect to the MDT, or other on-board peripherals and other equipment.</p> <p>Signal levels shall be compatible with MDT signal input specifications. Signal structure (protocol, timing, etc.) shall be compatible with MDT signal structure needs.</p>	T/F	Verify in vendor's specifications	TRUE		MCAT-01	Communications & Electrical Interfacing	E-103	Emergency Actuator
M-01004	latency_OBS_Wireless_Communications	Maximum time for vehicle-update messages sent from the On-Board System to be received by the CSS under typical system load conditions.	Seconds	Test by measuring time delay	15 seconds		MCAT-01	Communications & Electrical Interfacing	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
M-01005	reliability_OBS_Wireless_Communications	The On-Board Wireless Communications system shall have a specified successful rate (in percentage) in transporting vehicle updates between vehicles and the central site.	%	Test by measuring delivery rate	99.900%		MCAT-01	Communications & Electrical Interfacing	E-202	On-board Wide-Area Communications Infrastructure / Repeaters

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-01006	throughput_OBS_Wireless_Communications	The On-Board Wireless Communications system shall have a sufficient data-communications throughput rate to ensure that all vehicles in the fleet with the specified update frequency,	Vehicle updates per minute	Test by measuring throughput	[USER DETERMINED DATA]	What AVL update rate do you require for your system? Please formulate your answer in the number of updates per minute per vehicle.	MCAT-01	Communications & Electrical Interfacing	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
M-01007	latency_RID_Communications	Maximum time for vehicle-update messages sent from the CSS to be received by the RID under typical system load conditions.	Seconds	Test by measuring time delay	15 seconds		MCAT-01	Communications & Electrical Interfacing	E-402	Roadside Communications Infrastructure / Repeaters
M-01008	reliability_RID_Communications	The Roadside Information Display (RID) communications system shall meet or exceed the specified successful delivery rate (in percentage) for all vehicle updates transported between vehicles and the central site.	%	Test by measuring delivery rate	99.900%		MCAT-01	Communications & Electrical Interfacing	E-402	Roadside Communications Infrastructure / Repeaters
M-01009	throughput_RID_Communications	The Roadside Information Display Communications system shall have a sufficient throughput rate to ensure that all vehicles in the fleet with the specified update frequency.	RID updates per minute	Test by measuring throughput	[USER DETERMINED DATA]	What per/minute update rate do you require for your Roadside Information Displays.	MCAT-01	Communications & Electrical Interfacing	E-402	Roadside Communications Infrastructure / Repeaters
M-01010	reliability_ATRMS_Comm	The ATRMS Communications System shall meet or exceed the specified successful delivery percentage rate for all data transported between the ATRMS and the ATRMS API.	%	Test by measuring delivery rate	99.99%		MCAT-01	Communications & Electrical Interfacing	E-602	ATRMS Communications Infrastructure / Repeaters
M-01011	latency_ATRMS_Comm	Maximum time for a message and response between the ATRMS and the CSS.	Seconds	Test by measuring time delay	5		MCAT-01	Communications & Electrical Interfacing	E-602	ATRMS Communications Infrastructure / Repeaters
Computational Hardware										
M-02001	user_input_responsiveness_MDT	The maximum amount of time the MDT shall take to respond to driver or passenger input for normal (non-emergency) operations.	Seconds	Test by timing user operations.	1		MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02002	memory_capacity_MDT	The MDT shall have sufficient memory capacity to handle transit system operational parameters as given in this specification.	T/F	Verify in vendor specifications.	TRUE		MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02003	storage_capacity_MDT	The MDT shall have necessary non-volatile storage capacity to sustain operations with all necessary transit system operation parameter maximums as given in this specification.	T/F	Verify in vendor specifications.	TRUE		MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02004	logging_capacity_MDT	The MDT shall have the necessary non-volatile storage capacity to store all collected stop data for the minimum specified period.	Days	Verify in vendor specifications.	30		MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02005	logging_capacity_CSS	The Central Site Software shall have the necessary non-volatile storage capacity to store all collected data for the greater of either the specified value or given transit provider requirement.	Years	Verify in vendor specifications.	1		MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-02006	processing_capacity_media_reader_MDT	The Mobile Data Terminal shall be capable of validating, logging, and forwarding to the central site the specified number of pass-card media reads per minute.	Pass-card reads per minute	Verify in vendor specifications and inspect deliverables to ensure compliance	[USER DEFINED VALUE]	What is the maximum amount of pass-card swipes (boardings) per minute you expect on a bus?	MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02007	processing_capacity_APC_MDT	The Mobile Data Terminal shall be capable of logging and forwarding to the central site the specified number of counts per minute.	APC counts per minute	Verify in vendor specifications and inspect deliverables to ensure compliance	[USER DEFINED VALUE]	What is the maximum amount of boardings or alightings per minute you expect on a bus?	MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02008	latency_emergency_actuator_MDT	The Mobile Data Terminal shall be capable of detecting an emergency actuator signal from the driver and transmitting the message to the central dispatch site within the specified number of seconds.	Seconds	Verify in vendor specifications.	2 seconds		MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02009	processing_capacity_MDT	The Mobile Data Terminal shall be capable of validating, logging, and forwarding to the central site the specified number of vehicle location and status per minute.	Location updates per minute	Verify in vendor specifications and inspect deliverables to ensure compliance	[USER DEFINED VALUE]	What is the maximum amount of MDT-to-Central update messages per minute you expect on a bus?	MCAT-02	Computational Hardware	E-101	Mobile Data Terminal (MDT)
M-02010	update_message_reponsiveness_RID	The maximum amount of time the RID shall take to calculate and make available a received update message for display.	Seconds	Verify in vendor specifications.	1		MCAT-02	Computational Hardware	E-301	Roadside Sign / Display
M-02011	memory_capacity_RID	The Roadside Information Display shall have the necessary memory capacity to handle transit system operational parameter maximums as given in this specification.	T/F	Verify in vendor specifications.	TRUE		MCAT-02	Computational Hardware	E-301	Roadside Sign / Display
M-02012	storage_capacity_RID	The Roadside Information Display shall have the necessary non-volatile storage capacity to sustain operations with all necessary transit system operation parameter maximums as given in this specification.	T/F	Verify in vendor specifications.	TRUE		MCAT-02	Computational Hardware	E-301	Roadside Sign / Display
M-02013	user_input_responsiveness_ATRMS	The maximum amount of time the ATRMS shall take to respond to operator input for vehicle tracking operations.	Seconds	Test by timing user operations.	1		MCAT-02	Computational Hardware	C-5	Advanced Transit Management System
M-02014	memory_capacity_ATRMS	The ATRMS shall have the necessary memory capacity to handle transit system operational parameter maximums as given in this specification.	T/F	Verify in vendor specifications.	TRUE		MCAT-02	Computational Hardware	C-5	Advanced Transit Management System
M-02015	responsiveness_CSS	The maximum amount of time the Central Site Software shall take to respond to user or system-driven input for vehicle tracking operations	Seconds	Time system operations.	1		MCAT-02	Computational Hardware	C-7	Central Site Software
M-02016	memory_capacity_CSS	The Central Site Software shall have the necessary memory capacity to handle transit system operational parameter maximums as given in this specification, and the required number of field elements as specified by the transit provider.	T/F	Verify in vendor specifications.	TRUE		MCAT-02	Computational Hardware	C-7	Central Site Software

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-02017	storage_capacity_CSS	The Central Site Software shall have the necessary non-volatile storage capacity to sustain operations with all necessary transit system operation parameter maximums as given in this specification.	T/F	Verify in vendor specifications.	TRUE		MCAT-02	Computational Hardware	C-7	Central Site Software
Design & Architecture										
M-03001	extensibility_MDT	The MDT shall support additional on-board APTS applications in software and hardware.	Applications	Verify in vendor specifications.	[USER DEFINED VALUE]	What is the number of additional APTS applications do you anticipate adding on to the MDT in the future?	MCAT-03	Design & Architecture	E-101	Mobile Data Terminal (MDT)
M-03002	extensibility_OBS_API	Future modifications to the OBS API shall be possible and shall not affect existing functionality.	T/F	Verify in API documentation.	TRUE		MCAT-03	Design & Architecture	E-101	Mobile Data Terminal (MDT)
M-03003	extensibility_RID_API	Future modifications to the RID API shall be possible and shall not affect existing functionality.	T/F	Verify in API documentation.	TRUE		MCAT-03	Design & Architecture	E-301	Roadside Sign / Display
M-03004	extensibility_Traveler_Information_API	Future modifications to the Traveler Information API shall be possible shall not affect existing functionality.	T/F	Verify in API documentation.	TRUE		MCAT-03	Design & Architecture	E-703	Traveler Information API
M-03005	extensibility_ATRMS_API	Future modifications to the ATRMS API shall be possible shall not affect existing functionality.	T/F	Verify in API documentation.	TRUE		MCAT-03	Design & Architecture	E-704	ATRMS API
M-03006	open_data_storage_facility	Direct, unfiltered, read-only access shall be provided to the data store.	T/F	Verify in vendor documentation and specifications.	TRUE		MCAT-03	Design & Architecture	E-705	Data Store
Documentation										
M-04001	document_writing_level	All documents shall be presented clearly and concisely, and reflect writing of at least a 12th grade level.	T/F	Verify writing level.	TRUE		MCAT-04	Documentation	*	ALL
M-04002	document_reading_comprehension_level	All documents shall be clearly understandable by audiences with 12th grade reading comprehension level.	T/F	Inspect deliverable documents to ensure compliance.	TRUE		MCAT-04	Documentation	*	ALL
M-04003	document_clarity	All documents shall conform to the MIL-STD-962D documentation standard, section 4.7 for clarity.	T/F	Verify conformance with standard.	TRUE		MCAT-04	Documentation	*	ALL
M-04004	document_style	All documents shall conform to the U.S. Government Printing Office Style Manual for style and grammar.	T/F	Verify conformance with standard.	TRUE		MCAT-04	Documentation	*	ALL
M-04005	document_wiring_diagrams_identifiers	All cables and wires on wiring diagrams shall utilize unique identifiers which match physical labels on cables.	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	*	ALL
M-04006	document_wiring_diagrams_inter_page_connections	All wiring diagram inter-page connections shall be clearly marked at the left or right hand side of the page with the wire or cable's unique identifier.	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	*	ALL
M-04007	document_wiring_diagram_individual_signals	All wiring diagrams shall reflect individual signal levels for multi-conductor cables.	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	*	ALL
M-04008	document_wiring_diagrams_standard_connections	System wiring diagrams shall indicate all individual conductors/signals by unique identifier	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	*	ALL
M-04009	system_manual_theory	The System Manual shall include a Theory of Operation outlining the operation of the system and how it functions.	T/F	Verify conformance with standard.	TRUE		MCAT-04	Documentation	*	ALL
M-04010	system_manual_comprehensiveness	The System Manual shall be comprehensive and cover all system-operation scenarios in clear step-by-step detail.	T/F	Verify document comprehensiveness.	TRUE		MCAT-04	Documentation	*	ALL
M-04011	system_manual_troubleshooting	The System Manual shall include clear step-by-step instructions for troubleshooting any potential system problems.	T/F	Verify troubleshooting procedures and completeness.	TRUE		MCAT-04	Documentation	*	ALL

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-04012	system_manual_installation_documentation	The System Manual shall include clear step-by-step instructions for installing the EDAPTS system.	T/F	Verify troubleshooting procedures and completeness.	TRUE		MCAT-04	Documentation	*	ALL
M-04013	system_manual_maintenance_instructions	The System Manual shall include clear step-by-step instructions for all necessary routine or scheduled maintenance procedures.	T/F	Verify troubleshooting procedures and completeness.	TRUE		MCAT-04	Documentation	*	ALL
M-04014	operator_manual_comprehensiveness	The User Manual shall be comprehensive and cover all user-operation scenarios in clear step-by-step detail.	T/F	Verify document comprehensiveness.	TRUE		MCAT-04	Documentation	*	ALL
M-04015	operator_manual_troubleshooting	The User Manual shall include clear step-by-step instructions for troubleshooting common potential problems.	T/F	Verify troubleshooting procedures and completeness.	TRUE		MCAT-04	Documentation	*	ALL
M-04016	interface_documentation_media_reader_MDT	Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT and the media reader shall be provided by the vendor upon delivery.	T/F	Inspect documentation deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	E-102	Pass / Fare Media Reader
M-04017	interface_documentation_emergency_actuator_MDT	Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT and the emergency actuator shall be provided by the vendor upon delivery.	T/F	Inspect documentation deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	E-103	Emergency Actuator
M-04018	interface_documentation_audio_annunciator_MDT	Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT and the audio annunciator shall be provided by the vendor upon delivery.	T/F	Inspect documentation deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	E-104	On-Board Audio Annunciator
M-04019	interface_documentation_on_board_electronic_sign_MDT	Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT and the onboard electronic sign shall be provided by the vendor upon delivery.	T/F	Inspect documentation deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	E-105	On-Board Electronic Sign
M-04020	interface_documentation_APC_MDT	Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT and the automatic passenger counter shall be provided by the vendor upon delivery.	T/F	Inspect documentation deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	E-106	APC (Automatic Passenger Counter)
M-04021	interface_documentation_MDT_comm_driver	Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the MDT wireless data-communications system driver and the on-board wireless data interface shall be provided by the vendor upon delivery.	T/F	Inspect documentation deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	E-108	MDT Vehicle Wireless Data Communications System Driver
M-04022	open_data_storage_documentation	The open data-storage-facility documentation shall be comprehensive and cover all aspects of the data-store including providing a complete data-dictionary, table definitions and relationships as necessary, and all data structure information necessary to query the data-store from an external interface.	T/F	Verify document comprehensiveness.	TRUE		MCAT-04	Documentation	E-705	Data Store
M-04023	interface_documentation_CSS_comm_driver	Documentation detailing the complete physical, electrical, and messaging requirements for the interface between the CSS vehicle communications system driver and the central-site wireless data interface shall be provided by the vendor upon delivery.	T/F	Inspect documentation deliverables to ensure compliance.	TRUE		MCAT-04	Documentation	E-708	CSS Vehicle Wireless Data Communications Systems Driver
Functional Performance										

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-05001	supported_vehicle_quantity	The minimum number of vehicles supported by the system shall be the specified number plus 50%.	Vehicles	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of vehicles you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL
M-05002	supported_sign_quantity	The minimum number of Dynamic Roadside Information Displays supported by the system shall be the specified number plus 50%.	Signs	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of Roadside Information Displays you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL
M-05003	supported_run_quantity	The minimum number of scheduled runs supported by the system shall be the specified number plus 50%.	Runs	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of scheduled runs you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL
M-05004	supported_route_quantity	The minimum number of scheduled routes supported by the system shall be the specified number plus 50%.	Routes	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of scheduled routes you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL
M-05005	supported_trip_quantity	The minimum number of scheduled trips supported by the system shall be the specified number plus 50%.	Trips	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of scheduled trips you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL
M-05006	supported_stop_quantity	The minimum number of stops supported by the system shall be the specified number plus 50%.	Stops	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of stops you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-05007	supported_driver_quantity	The minimum number of drivers supported by the system shall be the specified number plus 50%.	Drivers	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of drivers you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL
M-05008	supported_farecard_quantity	The minimum number of passenger farecards supported by the system shall be the specified number plus 50%.	Fare Cards	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	[USER DETERMINED DATA]	What is the minimum number of passenger farecards you would like the EDAPTS system to support, now or in the future?	MCAT-05	Functional Performance	*	ALL
M-05009	power_switch_MDT	The MDT shall have an accessible power switch in the driver's compartment.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05010	time_of_day_clock_MDT	The MDT shall have a large format clock to display time to the driver when the coach is in motion	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05011	stop_arrival_display_MDT	The MDT shall display bus stop name to the driver upon arrival at a stop.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05012	schedule_adherence_display_MDT	The MDT shall display bus stop arrival schedule adherence information to the driver when at a stop	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05013	departure_countdown_display_MDT	The MDT shall display countdown until departure in minutes to a driver while at a stop or on break.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05014	bus_pass_validation_MDT	The MDT shall validate bus pass data presented by the Pass / Fare media reader, validate the data, and indicate if it is valid or invalid to the driver and the rider who presented the pass to the media reader.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05015	process_APC_counts_MDT	The MDT shall receive APC boarding and alighting data from the APC, display a cumulative count to the driver, associate this data with stops during the day, and incorporate the data into the stop record transmitted to the central site for each stop.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05016	receive_undetermined_data_MDT	The MDT shall have the capability to receive data from yet to be determined on-board devices, associate this data with stops, and transmit it to the central site upon departure from a stop.	T/F	Verify in system design document or specifications.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05017	control_annunciator_MDT	The MDT shall have the capability to control an on-board annunciator to notify passengers upon arrival at a stop, departure from a stop, and when travelling between stops.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-05018	control_electronic_sign_MDT	The MDT shall have the capability to control an on-board electronic sign to notify passengers upon arrival at a stop, departure from a stop, and when travelling between stops.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05019	detect_arrivals_&_departures_MDT	The MDT shall have the capability to detect arrivals and departures from stops, when at a stop, and when between stops based on the transit schedule and master stop list.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05020	prompt_for_driver_MDT	The MDT shall have the capability to prompt a driver for their ID number upon login, and then associate the ID number with an ID number / name cross reference in the MDT.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05021	prompt_for_route_number_MDT	The MDT shall have the capability to prompt a driver for route number upon login.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05022	route_change_MDT	The MDT shall have the capability to prompt the driver for a route number during a route change during the day.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05023	log_boarding_data_MDT	The MDT shall have the capability to log boarding and alighting data for retrieval and post processing.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05024	system_administration_MDT	The MDT shall have the capability to be remotely administered from the central site.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05025	log_arrival_departure_data_MDT	The MDT shall have the capability to log stop departure and arrival data for retrieval and post processing.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05026	declare_on_board_emergency_MDT	The MDT shall have the capability to declare on-board emergencies to central dispatch and then send regular position updates to the central site.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05027	survey_stops_MDT	The MDT shall have the capability to survey route stops for latitude, longitude, and direction (heading).	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05028	admin_data_comm_MDT	The MDT shall have the capability to communicate with the central site to support administrative functions such as software updates, schedule downloads, and retrieval of data logged on the MDT.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05029	self_test_MDT	The MDT shall have the capability to perform a comprehensive self-test upon power up.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05030	commanded_diagnostics_MDT	The MDT shall have the capability to perform self-test and diagnostics of other on-board devices upon a command from the MDT front panel (user interface).	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-05031	receive_vehicle_faults_MDT	The MDT shall have the capability to receive mechanical malfunction reporting from the driver for a bus.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-101	Mobile Data Terminal (MDT)
M-05032	bus_pass_reading_Media_Reader	The pass/fare media reader shall accept bus pass media presented by passengers.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-102	Pass / Fare Media Reader
M-05033	command_and_control_APC	The APC shall be able to have collected data retrieved remotely	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-106	APC (Automatic Passenger Counter)
M-05034	count_passengers_APC	The APC unit shall count boardings and alightings and provide data to the MDT.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-106	APC (Automatic Passenger Counter)
M-05035	command_and_control_RID	The RID shall be able to have configuration and system schedule information downloaded to it remotely from the central site.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-301	Roadside Sign / Display
M-05036	banner_message_size_RID	The Dynamic Roadside Information Display shall be capable of receiving and then displaying banner messages up to the given character limit.	Characters	Verify in system design document or specifications. Test installation to ensure compliance.	[USER DETERMINED DATA]	How many characters would you like for public service banner messages to be able to contain?	MCAT-05	Functional Performance	E-301	Roadside Sign / Display
M-05037	banner_message_quantity_RID	The Dynamic Roadside Information Display shall be capable of storing and then displaying at least the given number of individual public service banner messages..	Messages	Verify in system design document or specifications. Test installation to ensure compliance.	[USER DETERMINED DATA]	How many different public service or banner messages would you like to be able to load and store in your system?	MCAT-05	Functional Performance	E-301	Roadside Sign / Display
M-05038	provide_ETA_RID	The Dynamic Roadside Information Display shall have the capability to present minutes until arrival for buses arriving at a stop based on real-time bus trajectory.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-301	Roadside Sign / Display
M-05040	out_of_service_info_RID	The Dynamic Roadside Information Display shall have the capability to indicate when it is out of service to passengers waiting at a stop.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-301	Roadside Sign / Display
M-05041	ADA_RID	The Dynamic Roadside Information Display shall be capable of supporting the optional dissemination of information to riders with hearing and sight disabilities in accordance with the Americans with Disabilities Act (ADA).	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-301	Roadside Sign / Display

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-05042	ATRMS_client_quantity_CSS	The central software shall be capable of supporting at least the given number of simultaneously running ATRMS clients.	Clients	Verify system design document or specifications.	[USER DETERMINED DATA]	How many ATRMS display consoles, i.e. dispatch stations, would you like to run in your system?	MCAT-05	Functional Performance	C-5	Advanced Transit Management System
M-05043	emergency_handling_quantity_CSS	The central software shall be capable of supporting at least the given number of simultaneous emergency conditions.	Emergencies	Verify in system design document or specifications. Test installation to ensure compliance.	5		MCAT-05	Functional Performance	C-5	Advanced Transit Management System
M-05044	track_transit_fleet_ATRMS	The ATRMS consoles shall have the capability to track transit vehicles via map-based and tabular display.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-501	Vehicle Tracking Display
M-05045	schedule_adherence_display_ATRMS	The ATRMS consoles shall have the capability to track transit vehicle schedule information and display it to the user.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-502	Schedule Adherence Display
M-05046	vehicle_loading_info_ATRMS	The ATRMS consoles shall have the capability to track transit vehicle loading information and display it to the user.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-503	Passenger Boardings Display
M-05047	emergency_alarm_handling_ATRMS	The ATRMS consoles shall have the capability to receive vehicle emergency alarms, track vehicles with alarms, and log actions taken.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-504	Emergency Management Display
M-05048	ridership_reports_ATRMS	The ATRMS consoles shall have the capability to compile and present ridership reports for the user.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-505	Ridership Statistics Reporting Controls
M-05049	schedule_adherence_reports_ATRMS	The ATRMS consoles shall have the capability to compile and present schedule adherence reports for the user.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-506	Schedule Adherence Statistics Reporting Controls
M-05050	pass_list_controls_ATRMS	The ATRMS consoles shall have the capability to allow the user to disseminate bus pass lists to the fleet and track the pass list status on each vehicle in the fleet.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-507	Bus Pass List Dissemination Controls
M-05051	ATRMS_user_admin_ATRMS	The ATRMS consoles shall have the capability to allow the user to administer all system users and their permissions.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-508	System User Management Controls
M-05052	OBS_administration_ATRMS	The ATRMS consoles shall have the capability to allow the user to remotely administer the On-Board Systems aboard each vehicle.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-509	On-Board Equipment Administration Controls
M-05053	schedule_builder_ATRMS	The ATRMS consoles shall have the capability to allow the user to build a schedule, disseminate it to the fleet, and track the schedule version on each vehicle in the fleet.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-510	Schedule Management & Administration Tools & Controls

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-05054	RID_administration_ATRMS	The ATRMS consoles shall have the capability to allow the user to administer each Dynamic Roadside Information Display in the system, including downloading schedules and executables, operational status, and tracking file versions on each sign.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-511	Roadside Information Display Controls
M-05055	network_connectivity_central_site	If utilizing TCP/IP communication, ATRMS clients shall function from within a Network Address Translation (NAT) network.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-601	ATRMS / Central-Site Data Interfaces
M-05056	provide_data_store_CSS	The central site software shall have a data store for all system configuration, schedule, and collected data.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	C-7	Central Site Software
M-05057	MDT_wireless_data_interface_CSS	The central site software shall have an interface to the on-board systems wireless data communications system.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-701	On-Board Systems API
M-05058	RID_data_interface_CSS	The central site software shall have an interface to the Dynamic Roadside Information Display data communications system.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-702	Roadside Information Display API
M-05059	Traveler_Information_API_CSS	The central site software shall have the capability to provide system data to outside system functions via electronic computer calls over a network.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-703	Traveler Information API
M-05060	ATRMS_API_CSS	The central site software shall have the capability to provide system data to other system functions via electronic computer calls over a network.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-704	ATRMS API
M-05061	capacity_datastore	The capacity required to store all entered and recorded data for a minimum period of time before expungment or other such maintenance is required.	Months	Verify in system design document or specifications.	60		MCAT-05	Functional Performance	E-705	Data Store
M-05062	backup_interval_datastore	The minimum allowable intervals between backups of the data store.	Days	Verify in system design document or specifications.	[USER DETERMINED DATA]	How often in days will you backup your data store, i.e. database?	MCAT-05	Functional Performance	E-705	Data Store
M-05063	export_capability_datastore	The data storage facility shall have the capability to export data in whole or in part for given ranges, to be used for other functions.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-705	Data Store
M-05064	expunge_capability_datastore	The data storage facility shall have the capability to expunge all entered or recorded data for a given date range.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-705	Data Store
M-05065	backup_capability_datastore	The data storage facility shall have the capability to back up or archive all entered and recorded data in whole or in part (given data range). Mechanisms shall be available for both user-initiated and scheduled automatic backups.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-705	Data Store

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-05066	emergency_planning_ATRMS	The ATMS consoles shall have the capability to guide users through the process of creating an emergency plan for handling driver's emergency alarms. This plan shall include procedures for interacting with local law enforcement and forms for developing an emergency callout list.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-05	Functional Performance	E-504	Emergency Management Display
Human Factors										
M-06001	ease_of_use_ALL	All devices displaying information to or requiring information from a user shall be easy to use and display clear operational usage instructions to the user	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-06	Human Factors	*	ALL
M-06002	inobtrusiveness_OBS	On-board devices shall not impede driver's view of the road, normal driver operations, movement in the driver's or passenger compartments, nor entry or egress from the vehicle.	T/F	Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	C-1	Vehicle On-Board Systems
M-06003	ergonomics_accessibility_MDT	The MDT controls and interface shall be easily operable by the driver without requiring a significant shift from driving position.	T/F	Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	E-101	Mobile Data Terminal (MDT)
M-06004	ergonomics_readability_MDT	The MDT display shall be clearly readable by the driver from its installation location as he or she conducts normal operations. The MDT display shall maintain clear readability under both day and night-time conditions.	T/F	Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	E-101	Mobile Data Terminal (MDT)
M-06005	ergonomics_audibility_MDT	All sounds, tones, or other audible feedback generated by the MDT shall be of sufficient volume to be audible in the driver's compartment above background vehicle noise.	T/F	Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	E-101	Mobile Data Terminal (MDT)
M-06006	ergonomics_ease_of_use_MDT	The MDT shall provide a simple, easy to use, uncluttered interface to the driver. All commonly used actions such as log-in, log-out, and route-change shall be easily accessible and provide integrated step-by-step instructions. Buttons and screen controls shall be easily used and activated.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	E-101	Mobile Data Terminal (MDT)
M-06007	ergonomics_driver_interaction_MDT	The MDT shall require minimal interaction by the driver as during normal driver operations.	T/F	Verify in vendor specifications.	TRUE		MCAT-06	Human Factors	E-101	Mobile Data Terminal (MDT)
M-06008	accessibility_MediaReader	The device shall be easily accessibility to passengers and the driver as part of passenger entry and fare collection.	T/F	Verify in vendor specifications.	TRUE		MCAT-06	Human Factors	E-102	Pass / Fare Media Reader
M-06009	ergonomics_ease_of_use_MediaReader	Media Reader shall provide audible or visual positive or negative transaction cues.	T/F	Verify in vendor specifications.	TRUE		MCAT-06	Human Factors	E-102	Pass / Fare Media Reader
M-06010	accessibility_E-Actuator	The Emergency Actuator shall be operable from the driver's position, and shall be able to unobtrusively activated in the event of an emergency. The actuator shall be resistant to accidental activation due to normal movement in the driver's compartment.	T/F	Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	E-103	Emergency Actuator
M-06011	inobtrusiveness_E-Actuator	The Emergency Actuator shall be hidden from passenger view.	T/F	Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	E-103	Emergency Actuator
M-06012	ADA_accessibility_RID	The Roadside Information display shall be conformant to ADA Standards for Accessible Design, 28 CFR Part 36, Chapter 10.	T/F	Inspect supplied ADA certification	TRUE		MCAT-06	Human Factors	E-301	Roadside Sign / Display

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-06013	GUI_readability_ATRMS	The ATRMS GUI shall be readable by employees of varying visual capabilities.	T/F	Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	C-5	Advanced Transit Management System
M-06014	font_scalability_ATRMS	ATRMS display fonts shall be scalable from small to large.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	C-5	Advanced Transit Management System
M-06015	audibility_emergency_ATRMS	The ATRMS shall sound an audio alarm of at least the specified volume at 1 meter.	dB	Verify in system design document or specifications. Test installation to ensure compliance.	85		MCAT-06	Human Factors	E-504	Emergency Management Display
M-06016	visibility_emergency_ATRMS	The ATRMS shall have a visual emergency indicator that flashes and attracts the attention of any employee within the room the ATRMS is installed in.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-06	Human Factors	E-504	Emergency Management Display
Installation & Maintenance										
M-07001	element_installability	All system elements shall be installable by qualified transit property personnel.	T/F	Test installation to ensure compliance.	TRUE		MCAT-07	Installation & Maintenance	*	ALL
M-07002	element_part_availability	The transit property shall have the ability to self-maintain all system Elements due to the availability of spare parts and the capability to retain a supply of spares.	T/F	Verify in vendor's contract documents.	TRUE		MCAT-07	Installation & Maintenance	*	ALL
M-07003	removal_and_replacement_OBS	The maximum amount of time required to remove and replace an On-Board system element.	Minutes	Test installation to ensure compliance.	10 minutes		MCAT-07	Installation & Maintenance	C-1	Vehicle On-Board Systems
M-07004	self_diagnostics_OBS	The On-Board systems shall provided self-test diagnostics to aid in fault isolation.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-07	Installation & Maintenance	C-1	Vehicle On-Board Systems
M-07005	removal_and_replacement_OBS_Comm	On-Board System elements shall be able to be removed and replaced within the specified amount of time.	Minutes	Test installation to ensure compliance.	10 minutes		MCAT-07	Installation & Maintenance	C-2	Vehicle Wireless Data Communications System
M-07006	self_diagnostics_OBS_Comm	The On-Board Wireless Communications system shall provide self-test diagnostics to aid in fault isolation.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-07	Installation & Maintenance	C-2	Vehicle Wireless Data Communications System
M-07007	removal_and_replacement_RID	Roadside Information Display elements shall be able to be removed and replaced within the specified amount of time.	Minutes	Test installation to ensure compliance.	30 minutes		MCAT-07	Installation & Maintenance	C-3	Dynamic Roadside Information Display
M-07008	self_diagnostics_RID	The Roadside Information Display shall provided self-test diagnostics to aid in fault isolation.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-07	Installation & Maintenance	C-3	Dynamic Roadside Information Display
M-07009	removal_and_replacement_RID_Comm	Roadside Information Display elements shall be able to be removed and replaced within the specified amount of time.	Minutes	Test installation to ensure compliance.	30 minutes		MCAT-07	Installation & Maintenance	C-4	Roadside Data Communications System
M-07010	self_diagnostics_RID_Comm	The Roadside Information Display Communications system shall provided self-test diagnostics to aid in fault isolation.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-07	Installation & Maintenance	C-7	Central Site Software

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-07011	self_diagnostics_RID_Comm	The Central Site Software shall provide self-test diagnostics to aid in fault isolation.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-07	Installation & Maintenance	C-7	Central Site Software
Manufacturing										
M-08001	part_edge_trueness	Any non-radiused external part edges shall be smooth, straight, and true.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-08	Manufacturing	*	ALL
M-08002	part_corners	All installed physical parts shall have smoothed (radiused / non-sharp) corners.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-08	Manufacturing	*	ALL
M-08003	part_physical_tolerances	All physical parts shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	0.005		MCAT-08	Manufacturing	*	ALL
M-08004	part_interchangability	All parts having the same manufacturer's part number are functionally and physically interchangeable.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-08	Manufacturing	*	ALL
M-08005	part_availability	All system elements and their associated parts shall have a reasonable expectation of being available for a minimum period of five years.	T/F	Verify availability in supply contract.	TRUE		MCAT-08	Manufacturing	*	ALL
M-08006	part_corrosion_resistance	All external metal parts and exposed fasteners shall be corrosion resistant.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-08	Manufacturing	*	ALL
M-08007	part_emi_transmission	All installed parts shall meet FCC guidelines and licensing as appropriate and shall meet MIL-STD-461 tolerances for radiated emissions.	Specifications	Inspect supplied certifications.	TRUE		MCAT-08	Manufacturing	*	ALL
M-08008	abrasion_resistance_OBS	All installed cables shall utilize cable clamps, split loom, cable raceways, or other similar methods to minimize cable abrasion along the length of the cable.	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-08	Manufacturing	*	ALL
Mechanical Interfacing										
M-09001	mounting_hole_pattern_tolerances_OBS	All On-Board System element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-1	Vehicle On-Board Systems
M-09002	mounting_hole_size_tolerances_OBS	All On-Board System element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-1	Vehicle On-Board Systems
M-09003	mounting_hole_pattern_tolerances_OBS_Comm	All On-Board Communications element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-2	Vehicle Wireless Data Communications System
M-09004	mounting_hole_size_tolerances_OBS_Comm	All On-Board Communications element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-2	Vehicle Wireless Data Communications System

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-09005	mounting_hole_pattern_tolerances_RID	All Roadside Information Display element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-3	Dynamic Roadside Information Display
M-09006	mounting_hole_size_tolerances_RID	All Roadside Information Display element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-3	Dynamic Roadside Information Display
M-09007	mounting_hole_pattern_tolerances_RID_Comm	All Roadside Communications element mounting hole patterns shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-4	Roadside Data Communications System
M-09008	mounting_hole_size_tolerances_RID_Comm	All Roadside Communications element mounting hole dimensions shall be manufactured to within the given tolerance of their specified dimensions.	Inches	Inspect deliverables to ensure compliance.	0.005		MCAT-09	Mechanical Interfacing	C-4	Roadside Data Communications System
Power										
M-10001	over_current_protection_OBS	All power connections shall be fused or circuit breaker protected at the source connection.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-10	Power	C-1	Vehicle On-Board Systems
M-10002	supply_power_dissipation_maximum_MDT	Maximum power dissipation allowable by the device.	Watts	Verify in vendor's specifications	30		MCAT-10	Power	E-101	Mobile Data Terminal (MDT)
M-10003	supply_voltage_range_MDT	Voltage ranges the device must be able to operate under.	Volts DC	Verify in vendor's specifications	9 to 32		MCAT-10	Power	E-101	Mobile Data Terminal (MDT)
M-10004	supply_allowable_noise_MDT	The Mobile Data Terminal shall conform to the SAE J1455 standard, section 4.11.2 for transients and noise ranges the device must be able to operate under.	T/F	Verify conformance with standard.	TRUE		MCAT-10	Power	E-101	Mobile Data Terminal (MDT)
M-10005	over_current_protection_OBS_Comm	All power connections shall be fused or breakered at the source connection.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-10	Power	C-2	Vehicle Wireless Data Communications System
M-10006	over_current_protection_RID_Comm	Any required external power connection shall be fused or breakered at the source connection.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-10	Power	C-2	Vehicle Wireless Data Communications System
M-10007	backup_power_OBS_Comm_emergency_management	Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.	Hours	Test by measuring time delay	1		MCAT-10	Power	C-2	Vehicle Wireless Data Communications System
M-10008	maximum_power_consumption_RID	Maximum current draw allowable by the device.	Watts	Verify in vendor's specifications	10		MCAT-9	#N/A	E-301	Roadside Sign / Display
M-10009	AC_supply_voltage_range_RID	Voltage range the device must be able to operate within if powered by direct current.	VAC	Verify in vendor's specifications	110 - 125		MCAT-10	Power	E-301	Roadside Sign / Display
M-10010	autonomous_power_inclement_weather_RID	The Roadside Information Display shall have the specified number of days of solar autonomy if no external power source is part of the system. Any internal batteries shall not be discharged below 50% capacity in order to reach this autonomy.	Days	Test by measuring autonomy	14		MCAT-10	Power	E-301	Roadside Sign / Display
M-10011	autonomous_power_system_recovery_RID	If no external power source is part of the system, the Roadside Information Display shall recover from a 50% discharge level to a 90% charge level within the specified maximum number of days of normal solar operation.	Days	Test by measuring time	5		MCAT-10	Power	E-301	Roadside Sign / Display

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-10012	over_current_protection_RID	All power connections shall be fused or breakered at the source connection.	T/F	Verify in vendor's specifications	TRUE		MCAT-10	Power	E-301	Roadside Sign / Display
M-10013	backup_power_ATRMS_emergency_management	Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.	Hours	Test by measuring time	1		MCAT-10	Power	C-5	Advanced Transit Management System
M-10014	backup_power_ATRMS_Comm_emergency_management	Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.	Hours	Test by measuring time	1		MCAT-10	Power	C-6	ATRMS Communications
M-10015	backup_power_CSS_emergency_management	Minimum period of autonomous operation required to support emergency functionality in the event of a power loss.	Hours	Test by measuring time	1		MCAT-10	Power	C-7	Central Site Software
Privacy & Security										
M-11001	rider_ID_privacy	Raw passenger fare or pass identification numbers or strings that directly identify a specific rider may not be stored anywhere in the EDAPTS system or transmitted across any EDAPTS communications link. Any obfuscation method of these numbers must be one-way and non-reversible, preventing the transformation back to a raw ID number or string.	T/F	Verify in system design document or specifications. Test installation to ensure compliance.	TRUE		MCAT-11	Privacy & Security	*	ALL
M-11002	driver_ID_privacy	Driver's identification numbers or strings containing	T/F	Verify in system design	TRUE		MCAT-11	Privacy & Security	*	ALL
M-11003	network_attack_resistance	All EDAPTS components utilizing a TCP/IP connection for communication shall be resistant to compromise by common network attacks such as spoofing and packet flooding (DDOS).	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-11	Privacy & Security	*	ALL
M-11004	communications_link_attack_resistance	ALL EDAPTS components utilizing a wireless communications link shall encode, encrypt, or otherwise protect communications against snooping or unauthorized use. Such protection shall meet or exceed common industry best practices.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-11	Privacy & Security	*	ALL
Ruggedness & Reliability										
M-12001	operational_lifecycle	The expected lifecycle of EDAPTS system elements shall exceed the specified number of years.	Years	Inspect manufacturer certification	7		MCAT-12	Ruggedness & Reliability	*	ALL
M-12002	mayday_message_reliability	Mayday messages initiated by the driver shall be received with the specified percent reliability.	Percent	Verify in system design document or specifications. Test installation to ensure compliance.	100		MCAT-12	Ruggedness & Reliability	*	ALL
M-12003	weather_resistance	All EDAPTS elements installed in an outdoor environment shall be weather resistant to the installed environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	*	ALL
M-12004	data_corruption_resistance	All EDAPTS elements shall be resistant to corruption of data due to power loss, shock, or other external forces.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	*	ALL
M-12005	data_retention	On-Board System elements shall maintain configuration and calibration information in memory for a minimum number of days while powered off.	Days	Inspect manufacturer certification	180		MCAT-12	Ruggedness & Reliability	*	ALL
M-12006	power_loss_recovery	All EDAPTS elements shall be able to recover from a power loss and resume normal operations without requiring specialized technical interaction.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	*	ALL
M-12007	operating_environment_max_ambient_temperature	All outdoor or vehicle-installed EDAPTS elements shall operate in ambient temperatures up to the specified maximum.	Degrees Fahrenheit	Inspect manufacturer certification	120		MCAT-12	Ruggedness & Reliability	*	ALL

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-12008	operating_environment_max_induced_temperature	All outdoor or vehicle-installed EDAPTS elements shall operate in induced temperatures (include allowances for the effects of solar heating) up to the specified maximum.	Degrees Fahrenheit	Inspect manufacturer certification	160		MCAT-12	Ruggedness & Reliability	*	ALL
M-12009	operating_environment_min_temperature	All outdoor or vehicle installed EDAPTS elements shall operate in temperatures down to the specified minimum.	Degrees Fahrenheit	Inspect manufacturer certification	-24		MCAT-12	Ruggedness & Reliability	*	ALL
M-12010	operating_environment_max_humidity	All outdoor or vehicle-installed EDAPTS elements shall operate at relative humidity levels up to the specified maximum.	Percent	Inspect manufacturer certification	100		MCAT-12	Ruggedness & Reliability	*	ALL
M-12011	contaminant_protection	All outdoor or vehicle-installed EDAPTS elements shall protect against external contaminants such as dust, salt air, and fog as necessary to prevent interruption of operation.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	*	ALL
M-12012	operational_lifetime	All EDAPTS elements shall operate for a minimum number of years before expected replacement.	Years	Inspect manufacturer certification	7		MCAT-12	Ruggedness & Reliability	*	ALL
M-12013	emi_resistance_OBS	On-Board System elements shall be resistant to levels of EMI present in a commercial environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-1	Vehicle On-Board Systems
M-12014	mtbf_OBS	The expected MTBF of On-Board system elements shall exceed the specified number of hours.	Hours	Inspect manufacturer certification	7,500		MCAT-12	Ruggedness & Reliability	C-1	Vehicle On-Board Systems
M-12015	physical_shock_resistance_OBS	On-Board System elements shall not be negatively affected by physical shocks and impacts present in a commercial transit environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-1	Vehicle On-Board Systems
M-12016	vibration_resistance_OBS	On-Board System elements shall not be negatively affected by the vibrations in a commercial transit environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-1	Vehicle On-Board Systems
M-12017	contaminant_protection_OBS	On-Board System elements shall be resistant to external contaminants such as dust, salt air, and fog to prevent interruption of operation.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-1	Vehicle On-Board Systems
M-12018	stop_detection_reliability_MDT	The MDT shall detect stops with the specified percent reliability when GPS is available.	Percent	Verify in system design document or specifications. Test installation to ensure compliance.	99.5		MCAT-12	Ruggedness & Reliability	E-101	Mobile Data Terminal (MDT)
M-12019	noise_resistance_E-Actuator	The Emergency Actuator's control/data signal interface to the MDT shall be resistant to noise generated in a production bus environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	E-103	Emergency Actuator
M-12020	emi_resistance_OBS_Comm	Shall be resistant to levels of EMI present in a commercial environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-2	Vehicle Wireless Data Communications System
M-12021	mtbf_OBS_Comm	Expected mean time between failures.	Hours	Inspect manufacturer certification	15,000		MCAT-12	Ruggedness & Reliability	C-2	Vehicle Wireless Data Communications System
M-12022	availability_OBS_Comm	Acceptable levels of minimum uptime / maximum downtime in a normal operating environment	Percent	Inspect manufacturer certification	99.9		MCAT-12	Ruggedness & Reliability	C-2	Vehicle Wireless Data Communications System
M-12023	physical_shock_resistance_OBS_Comm	On-Board Wireless Communications elements shall not be negatively affected by physical shocks and impacts present in a commercial transit environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	E-201	On-Board Wide-Area Wireless Data Interface

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-12024	vibration_resistance_OBS_Comm	On-Board Wireless Communications elements shall not be negatively affected by the vibrations in a commercial transit environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	E-201	On-Board Wide-Area Wireless Data Interface
M-12025	emi_resistance_RID	Shall be resistant to levels of EMI present in a commercial environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-3	Dynamic Roadside Information Display
M-12026	mtbf_RID	Expected mean time between failures.	Hours	Inspect manufacturer certification	7,500		MCAT-12	Ruggedness & Reliability	C-3	Dynamic Roadside Information Display
M-12027	vandalism_resistance_RID	Shall be resistant to displacement or damage by vandalism.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-3	Dynamic Roadside Information Display
M-12028	emi_resistance_RID_Comm	Shall be resistant to levels of EMI present in a commercial environment.	T/F	Inspect manufacturer certification	TRUE		MCAT-12	Ruggedness & Reliability	C-4	Roadside Data Communications System
M-12029	mtbf_RID_Comm	Expected mean time between failures.	Hours	Inspect manufacturer certification	15,000		MCAT-12	Ruggedness & Reliability	C-4	Roadside Data Communications System
M-12030	availability_RID_Comm	Acceptable levels of minimum uptime / maximum downtime in a normal operating environment	Percent	Inspect manufacturer certification	99.9		MCAT-12	Ruggedness & Reliability	C-4	Roadside Data Communications System
M-12031	mtbf_ATRMS_Comm	Expected mean time between failures.	Hours	Inspect manufacturer certification	15,000		MCAT-12	Ruggedness & Reliability	C-6	ATRMS Communications
M-12032	availability_ATRMS_Comm	Acceptable levels of minimum uptime / maximum downtime	Percent	Inspect manufacturer certification	99.9		MCAT-12	Ruggedness &	C-6	ATRMS
M-12033	availability_CSS	Acceptable levels of minimum uptime / maximum downtime in a normal operating environment	Percent	Inspect manufacturer certification	99.99		MCAT-12	Ruggedness & Reliability	C-7	Central Site Software
M-12034	operational_lifecycle_data_backup	Maximum time between backups of data-storage facility	Days	Inspect manufacturer certification	30		MCAT-12	Ruggedness & Reliability	E-705	Data Store
Data Formatting										
M-13001	data_format_MDT_functional_processes	The MDT functional processes shall transfer data to and from the MDT Vehicle Wireless Data Communications System Driver in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-107	MDT Functional Processes
M-13002	data_format_MDT_vehicle_wireless_data_communications_system_driver	The MDT Vehicle Wireless Data Communications System Driver shall receive data from the MDT Functional Processes in accordance with the EDAPTS Data Formatting Standard. Any MDT Vehicle Wireless Data Communications System Driver internal data formatting and compression methods used shall be documented and provided to the transit property.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-108	MDT Vehicle Wireless Data Communications System Driver
M-13003	data_format_RID_functional_processes	The RID functional processes shall transfer data to the RID Data Communications System Driver in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-304	RID Functional Processes
M-13004	data_format_RID_functional_processes	The RID functional processes shall transfer data to and from the RID Communications System Driver in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-304	RID Functional Processes

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-13005	data_format_RID_vehicle_wireless_data_communications_system_driver	The RID Communications System Driver shall receive data from the RID Functional Processes in accordance with the EDAPTS Data Formatting Standard. Any RID Communications System Driver internal data formatting and compression methods used shall be documented and provided to the transit property.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-305	RID Communications System Driver
M-13006	data_format_RID_data_communications_system_driver	The RID Data Communications System Driver shall receive data from the RID Functional Processes in accordance with the EDAPTS Data Formatting Standard. Any RID Data Communications System Driver internal data formatting and compression methods used shall be documented and provided to the transit property.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-305	RID Communications System Driver
M-13007	data_format_vehicle_tracking_display	The Vehicle Tracking Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-501	Vehicle Tracking Display
M-13008	data_format_schedule_adherence_display	The Schedule Adherence Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-502	Schedule Adherence Display
M-13009	data_format_passenger_boardings_display	The Passenger Boardings Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-503	Passenger Boardings Display
M-13010	data_format_emergency_management_display	The Emergency Management Display shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-504	Emergency Management Display
M-13011	data_format_ridership_statistics_reporting	The Ridership Statistics Reporting Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-505	Ridership Statistics Reporting Controls
M-13012	data_format_schedule_adherence_statistics_reporting	The Schedule Adherence Statistics Reporting Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-506	Schedule Adherence Statistics Reporting Controls
M-13013	data_format_bus_pass_list_dissemination_controls	The Bus Pass List Dissemination Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-507	Bus Pass List Dissemination Controls
M-13014	data_format_system_user_management_controls	The System User Management Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-508	System User Management Controls
M-13015	data_format_on_board_equipment_administration_controls	The On-Board Equipment Administration Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-509	On-Board Equipment Administration Controls
M-13016	data_format_schedule_management_&_administration_tools_&_controls	The Schedule Management & Administration Tools & Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-510	Schedule Management & Administration Tools & Controls
M-13017	data_format_roadside_information_display_controls	The Roadside Information Display Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-511	Roadside Information Display Controls

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-13018	data_format_driver_management_controls	The Driver Management Controls shall transfer data to and from the ATRMS API in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-512	Driver Management Controls
M-13019	data_format_OBS_API	The CSS On-Board Systems API shall transfer from the CSS Vehicle Wireless Data Communications Driver in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-701	On-Board Systems API
M-13020	data_format_CSS_RID_API	The CSS RID API shall receive data from the CSS RID Data Communications System Driver in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-702	Roadside Information Display API
M-13021	data_format_traveler_information_API	The Traveler Information API shall transfer data to and from all external traveler information using entities in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-703	Traveler Information API
M-13022	data_format_ATRMS_API	The ATRMS API shall transfer data to and from all ATRMS displays in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-704	ATRMS API
M-13023	data_format_CSS_vehicle_wireless_data_communications_system_driver	The CSS Vehicle Wireless Data Communications System Driver shall transfer data to the CSS On-Board Systems API in accordance with the EDAPTS Data Formatting Standard. Any CSS Vehicle Wireless Data Communications System Driver internal data formatting and compression methods used over the communications link shall be documented and provided to the transit property.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-708	CSS Vehicle Wireless Data Communications Systems Driver
M-13024	data_format_CSS_roadside_communications_system_driver	The CSS RID Communications System Driver shall transfer data to the CSS Roadside Display API in accordance with the EDAPTS Data Formatting Standard. Any CSS RID Communications System Driver internal data formatting and compression methods used over the communications link shall be documented and provided to the transit property.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-709	CSS RID Data Communications System Driver
M-13025	data_format_stop_point_list	The Stop-Point List shall be formatted in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-801	Stop-Point List
M-13026	data_format_timetable	The Timetable shall be formatted in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-802	Timetable
M-13027	data_format_work_runs_list	The Work/Runs List shall be formatted in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-803	Work / Runs List
M-13028	passenger_pass_lists	The Passenger Pass Lists shall be formatted in accordance with the EDAPTS Data Formatting Standard.	T/F	Verify documented data formats in system design documents or specifications.	TRUE		MCAT-13	Data Formatting	E-805	Passenger Pass Lists
Safety & Certification										
M-14001	dot_certification_OBS	All On-Board Systems elements shall meet all applicable state and federal DOT standards.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-1	Vehicle On-Board Systems
M-14002	fcc_licensing_OBS	All On-Board Systems elements utilizing wireless transmission for inter-element data transfer shall be provided with necessary FCC licenses for operation in the transit system.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-1	Vehicle On-Board Systems

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-14003	ewra_compliance_OBS	All On-Board Systems elements shall be compliant with the California Electronic Waste Recycling Act of 2003.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-1	Vehicle On-Board Systems
M-14004	coach_in_motion_MDT	The Mobile Data Terminal shall detect when the vehicle is in motion, and shall blank its screen to prevent driver distraction. Display of the time in large characters is acceptable.	T/F	Verify in system design document or specifications. Test deliverables to ensure compliance.	TRUE		MCAT-14	Safety & Certification	E-101	Mobile Data Terminal (MDT)
M-14005	fcc_licensing_OBS_Comm	All On-Board Systems Wireless Communications elements shall be provided with necessary FCC licenses for operation in the transit system.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-2	Vehicle Wireless Data Communications System
M-14006	ewra_compliance_OBS_Comm	All On-Board Systems elements shall be compliant with the California Electronic Waste Recycling Act of 2003.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-2	Vehicle Wireless Data Communications System
M-14007	dot_certification_OBS_Comm	All On-Board Systems Wireless Communications elements shall meet all applicable state and federal DOT standards.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	E-201	On-Board Wide-Area Wireless Data Interface
M-14008	ul_certification_RID	The Roadside Information Display shall be listed with Underwriters Laboratories if externally AC powered.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	E-301	Roadside Sign / Display
M-14009	rigidity_RID_Mounting	Roadside Information Display post shall meet applicable state and federal DOT standards for crash safety.	T/F	Perform design analysis or inspect supplied certifications.	TRUE		MCAT-14	Safety & Certification	E-302	Roadside Post
M-14010	fcc_licensing_RID	All Roadside Information Display elements shall be provided with necessary FCC licenses for operation in the transit system.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-3	Dynamic Roadside Information Display
M-14011	ewra_compliance_RID	All Roadside Information Display elements shall be compliant with the California Electronic Waste Recycling Act of 2003.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-3	Dynamic Roadside Information Display
M-14012	wind_resistance_RID_Mounting	Roadside Information Display foundations and posts shall comply with the Uniform Building Code with regard to wind resistance.	T/F	Perform design analysis or inspect supplied certifications.	TRUE		MCAT-14	Safety & Certification	E-303	Roadside Post Foundation
M-14013	earthquake_resistance_RID_Mounti	Roadside Information Display foundations and posts shall	T/F	Perform design analysis or	TRUE		MCAT-14	Safety & Certification	E-303	Roadside Post
M-14014	fcc_licensing_RID_Comm	All Roadside Information Display elements shall be provided with necessary FCC licenses for operation in the transit system.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-4	Roadside Data Communications System
M-14015	ewra_compliance_RID_Comm	All Roadside Information Display elements shall be compliant with the California Electronic Waste Recycling Act of 2003.	T/F	Inspect supplied certifications	TRUE		MCAT-14	Safety & Certification	C-4	Roadside Data Communications System
Standards & Practices										
M-15001	product_marking	All installed parts shall bear a manufacturer's nameplate or sticker, containing the manufacturer's name, product part number and revision as applicable, and serial number.	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15002	cable_standards	All field-installed interface wires and cables shall use suitable guage, shielding, and color for the application in conformance with applicable SAE and state and federal DOT standards.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-15	Standards & Practices	*	ALL

metric_ID	metric_name	metric_requirement	metric_units	metric_verification_method	metric_value	user_determined_data_questions	metric_category_ID	metric_category_name	element_ID or component ID	element_name or component_name
M-15003	cable_marking	All installed interconnect cables shall bear a cable marker at six inches from each end of the cable, and at regular intervals along the cable.	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15004	null_values	Null values shall be used when initializing or creating any data or data types, or recording an out-of-range value.	T/F	Verify in system design document or specifications. Test deliverables to ensure compliance.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15005	workmanship	All equipment and accessories shall be a product of good workmanship and shall be free from any defects that will affect their appearance or serviceability.	T/F	Inspect deliverables to ensure compliance.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15006	equipment_commonality	All installed equipment shall share Component-level part commonality, allowing for ease of swappage or replacement with minimal reconfiguration.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15007	hardware_commonality	All user or maintenance accessible hardware (including mounting hardware) shall share Component-level part commonality, and also at the system-wide level where possible.	T/F	Verify in system design document or specifications. Inspect deliverables to ensure compliance.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15008	specification_conflicts	In case of conflict between regulatory body, classification and international regulations and requirements, and this specification, the more stringent requirement shall take precedence.	T/F	Verify in system design document or specifications.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15009	data_transparency	All data transferred between subsystems or components shall be left in an uncompressed, unencoded, or unencrypted form, except as needed for reasons such as security or passage through low-throughput communications links. In instances where compression, encoding, or encryption is deemed necessary, documentation shall be provided describing the compression / encoding / encryption algorithms required and fully detailing the implementation used.	T/F	Verify in system design document or specifications and upon system delivery.	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15010	data_validation	All transferred data between elements or components shall be validated upon receipt and before use to eliminate out-of-range and non-sensical values.	T/F	Verify in system design document or specifications or inspect supplied certifications	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15011	data_corruption	All transferred data between EDAPTS Components shall include a checksum or other similar method to test for data corruption, and shall be tested for such corruption upon receipt.	T/F	Verify in system design document or specifications or inspect supplied certifications	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15012	data_structure_extensibility	If extension of an EDAPTS protocol is deemed necessary, it	T/F	Verify in system design	TRUE		MCAT-15	Standards & Practices	*	ALL
M-15013	software_programming_languages	All vendor-developed software shall be written in an industry standard, high level, non-proprietary language.	T/F	Verify in system design document or specifications or inspect supplied certifications	TRUE		MCAT-15	Standards & Practices	*	ALL
System Accuracy										
M-16001	georeference_accuracy_MDT	Latitude and longitude estimates shall be accurate to within the specified number of meters.	Meters	Inspect supplied certifications	10		MCAT-16	System Accuracy	E-101	Mobile Data Terminal (MDT)
M-16002	time_reporting_accuracy_MDT	Time estimates shall be accurate within the specified number of seconds.	Seconds	Test deliverables to ensure compliance or inspect supplied certifications	1		MCAT-16	System Accuracy	E-101	Mobile Data Terminal (MDT)
M-16003	time_synchronization_MDT	If any time measurement is utilized, it shall be synchronized with Coordinated Universal Time (UTC), and maintain accuracy within the specified number of seconds	Seconds	Inspect supplied certifications	1		MCAT-16	System Accuracy	E-101	Mobile Data Terminal (MDT)

Functions in Functional Groups Definition: Provides the association between all system functions and functional groups, allowing one to know all required system functions for a specific functional group.

functional_group_ID	functional_group_name	member_function_ID	member_function_name
Driver Assistance			
FG-01	Driver Assistance	F-101	Display time of day to driver
FG-01	Driver Assistance	F-112	Provide notification of stop arrivals and departures to driver
Schedule Adherence Monitoring & Reporting			
FG-02	Schedule Adherence Monitoring & Reporting	F-104	Display current stop schedule adherence to driver
FG-02	Schedule Adherence Monitoring & Reporting	F-105	Display time-until-departure at current stop
FG-02	Schedule Adherence Monitoring & Reporting	F-108	Receive, store, and transfer bus stop data from peripheral on-board devices
FG-02	Schedule Adherence Monitoring & Reporting	F-114	Collect route number during login
FG-02	Schedule Adherence Monitoring & Reporting	F-115	Change driver's work assignment during the day
FG-02	Schedule Adherence Monitoring & Reporting	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
FG-02	Schedule Adherence Monitoring & Reporting	F-402	Display schedule adherence information for dispatch & management users
FG-02	Schedule Adherence Monitoring & Reporting	F-406	Provide statistical schedule adherence reports for dispatch & management users
Vehicle Load Monitoring & Reporting			
FG-03	Vehicle Load Monitoring & Reporting	F-107	Automatically collect and record boardings & alightings counts
FG-03	Vehicle Load Monitoring & Reporting	F-108	Receive, store, and transfer bus stop data from peripheral on-board devices
FG-03	Vehicle Load Monitoring & Reporting	F-114	Collect route number during login
FG-03	Vehicle Load Monitoring & Reporting	F-115	Change driver's work assignment during the day
FG-03	Vehicle Load Monitoring & Reporting	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
FG-03	Vehicle Load Monitoring & Reporting	F-403	Display passenger boarding / alighting information for dispatch & management users
FG-03	Vehicle Load Monitoring & Reporting	F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users
Roadside Traveler Information			
FG-04	Roadside Traveler Information	F-114	Collect route number during login
FG-04	Roadside Traveler Information	F-115	Change driver's work assignment during the day
FG-04	Roadside Traveler Information	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
FG-04	Roadside Traveler Information	F-201	Provide estimated time until arrival to passengers at stops

functional_group_ID	functional_group_name	member_function_ID	member_function_name
FG-04	Roadside Traveler Information	F-202	Provide dynamic public service information to passengers at stops
FG-04	Roadside Traveler Information	F-412	Provide system user administration
On-Board Passenger Next-Stop Notification			
FG-05	On-Board Passenger Next-Stop Notification	F-114	Collect route number during login
FG-05	On-Board Passenger Next-Stop Notification	F-115	Change driver's work assignment during the day
FG-05	On-Board Passenger Next-Stop Notification	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
FG-05	On-Board Passenger Next-Stop Notification	F-109	Provide on-board stop annunciation
FG-05	On-Board Passenger Next-Stop Notification	F-110	Provide on-board stop signage
Vehicle Location Monitoring			
FG-06	Vehicle Location Monitoring	F-114	Collect route number during login
FG-06	Vehicle Location Monitoring	F-115	Change driver's work assignment during the day
FG-06	Vehicle Location Monitoring	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
FG-06	Vehicle Location Monitoring	F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users
Emergency Notification & Management			
FG-07	Emergency Notification & Management	F-113	Collect driver ID during login
FG-07	Emergency Notification & Management	F-114	Collect route number during login
FG-07	Emergency Notification & Management	F-115	Change driver's work assignment during the day
FG-07	Emergency Notification & Management	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
FG-07	Emergency Notification & Management	F-118	Declare on board emergency
FG-07	Emergency Notification & Management	F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users
FG-07	Emergency Notification & Management	F-404	Handle driver emergency button alarms for dispatch and management users
Boarding Pass Validation & Reporting			
FG-08	Boarding Pass Validation & Reporting	F-106	Automatically accept, validate, and log pass media during boarding
FG-08	Boarding Pass Validation & Reporting	F-108	Receive, store, and transfer bus stop data from peripheral on-board devices
FG-08	Boarding Pass Validation & Reporting	F-114	Collect route number during login
FG-08	Boarding Pass Validation & Reporting	F-115	Change driver's work assignment during the day
FG-08	Boarding Pass Validation & Reporting	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
FG-08	Boarding Pass Validation & Reporting	F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management

Elements in Components Definition: Provides the association between all system elements and components, allowing one to know all required elements for a specific system component.

component_ID	component_name	element_ID	element_name
Vehicle On-Board Systems			
C-1	Vehicle On-Board Systems	E-101	Mobile Data Terminal (MDT)
C-1	Vehicle On-Board Systems	E-102	Pass / Fare Media Reader
C-1	Vehicle On-Board Systems	E-103	Emergency Actuator
C-1	Vehicle On-Board Systems	E-104	On-Board Audio Annunciator
C-1	Vehicle On-Board Systems	E-105	On-Board Electronic Sign
C-1	Vehicle On-Board Systems	E-106	APC (Automatic Passenger Counter)
C-1	Vehicle On-Board Systems	E-107	MDT Functional Processes
C-1	Vehicle On-Board Systems	E-108	MDT Vehicle Wireless Data Communications System Driver
Vehicle Wireless Data Communications System			
C-2	Vehicle Wireless Data Communications System	E-201	On-Board Wide-Area Wireless Data Interface
C-2	Vehicle Wireless Data Communications System	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
C-2	Vehicle Wireless Data Communications System	E-203	Central-Site Wide-Area Wireless Data Interface
C-2	Vehicle Wireless Data Communications System	E-204	On-Board High-Speed Data Interface
C-2	Vehicle Wireless Data Communications System	E-205	On-board High-Speed Communications Infrastructure / Repeaters
C-2	Vehicle Wireless Data Communications System	E-206	Central-Site High-Speed Data Interface
Dynamic Roadside Information Display			
C-3	Dynamic Roadside Information Display	E-301	Roadside Sign / Display
C-3	Dynamic Roadside Information Display	E-302	Roadside Post
C-3	Dynamic Roadside Information Display	E-303	Roadside Post Foundation
C-3	Dynamic Roadside Information Display	E-304	RID Functional Processes
C-3	Dynamic Roadside Information Display	E-305	RID Communications System Driver
Roadside Data Communications System			
C-4	Roadside Data Communications System	E-401	Roadside Data Interface
C-4	Roadside Data Communications System	E-402	Roadside Communications Infrastructure / Repeaters
C-4	Roadside Data Communications System	E-403	Central-Site Data Interface
Advanced Transit Management System			
C-5	Advanced Transit Management System	E-501	Vehicle Tracking Display
C-5	Advanced Transit Management System	E-502	Schedule Adherence Display
C-5	Advanced Transit Management System	E-503	Passenger Boardings Display
C-5	Advanced Transit Management System	E-504	Emergency Management Display
C-5	Advanced Transit Management System	E-505	Ridership Statistics Reporting Controls
C-5	Advanced Transit Management System	E-506	Schedule Adherence Statistics Reporting Controls
C-5	Advanced Transit Management System	E-507	Bus Pass List Dissemination Controls

component_ID	component_name	element_ID	element_name
C-5	Advanced Transit Management System	E-508	System User Management Controls
C-5	Advanced Transit Management System	E-509	On-Board Equipment Administration Controls
C-5	Advanced Transit Management System	E-510	Schedule Management & Administration Tools & Controls
C-5	Advanced Transit Management System	E-511	Roadside Information Display Controls
C-5	Advanced Transit Management System	E-512	Driver Management Controls
C-5	Advanced Transit Management System	E-513	ATRMS Data Communications System Driver
ATRMS Communications			
C-6	ATRMS Communications	E-601	ATRMS / Central-Site Data Interfaces
C-6	ATRMS Communications	E-602	ATRMS Communications Infrastructure / Repeaters
Central Site Software			
C-7	Central Site Software	E-701	On-Board Systems API
C-7	Central Site Software	E-702	Roadside Information Display API
C-7	Central Site Software	E-703	Traveler Information API
C-7	Central Site Software	E-704	ATRMS API
C-7	Central Site Software	E-705	Data Store
C-7	Central Site Software	E-706	Data Store API
C-7	Central Site Software	E-707	CSS Functional Processes
C-7	Central Site Software	E-708	CSS Vehicle Wireless Data Communications Systems Driver
C-7	Central Site Software	E-709	CSS RID Data Communications System Driver
C-7	Central Site Software	E-710	CSS ATRMS Data Communications System Driver
System Input Data			
C-8	System Input Data	E-801	Stop-Point List
C-8	System Input Data	E-802	Timetable
C-8	System Input Data	E-803	Work / Runs List
C-8	System Input Data	E-804	Stop-point and Landmark Voice and Text
C-8	System Input Data	E-805	Passenger Pass Lists
C-8	System Input Data	E-806	Emergency Contact Callout List
C-8	System Input Data	E-807	Street Maps
C-8	System Input Data	E-808	Valid Drivers List

Elements in Functions Definition: Provides the association between all elements and system functions, allowing one to know which elements are required to implement a specific system function.

function_ID	function_name	element_ID	element_name
Vehicle On-Board Systems			
F-101	Display time of day to driver	E-101	Mobile Data Terminal (MDT)
F-101	Display time of day to driver	E-107	MDT Functional Processes
F-102	Blank screen while bus is moving	E-101	Mobile Data Terminal (MDT)
F-102	Blank screen while bus is moving	E-107	MDT Functional Processes
F-104	Display current stop schedule adherence to driver	E-101	Mobile Data Terminal (MDT)
F-104	Display current stop schedule adherence to driver	E-107	MDT Functional Processes
F-104	Display current stop schedule adherence to driver	E-108	MDT Vehicle Wireless Data Communications System Driver
F-104	Display current stop schedule adherence to driver	E-204	On-Board High-Speed Data Interface
F-104	Display current stop schedule adherence to driver	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-104	Display current stop schedule adherence to driver	E-206	Central-Site High-Speed Data Interface
F-104	Display current stop schedule adherence to driver	E-509	On-Board Equipment Administration Controls
F-104	Display current stop schedule adherence to driver	E-510	Schedule Management & Administration Tools & Controls
F-104	Display current stop schedule adherence to driver	E-513	ATRMS Data Communications System Driver
F-104	Display current stop schedule adherence to driver	E-601	ATRMS / Central-Site Data Interfaces
F-104	Display current stop schedule adherence to driver	E-602	ATRMS Communications Infrastructure / Repeaters
F-104	Display current stop schedule adherence to driver	E-701	On-Board Systems API
F-104	Display current stop schedule adherence to driver	E-704	ATRMS API
F-104	Display current stop schedule adherence to driver	E-705	Data Store
F-104	Display current stop schedule adherence to driver	E-706	Data Store API
F-104	Display current stop schedule adherence to driver	E-707	CSS Functional Processes
F-104	Display current stop schedule adherence to driver	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-104	Display current stop schedule adherence to driver	E-710	CSS ATRMS Data Communications System Driver
F-104	Display current stop schedule adherence to driver	E-801	Stop-Point List
F-104	Display current stop schedule adherence to driver	E-802	Timetable
F-104	Display current stop schedule adherence to driver	E-803	Work / Runs List
F-105	Display time-until-departure at current stop	E-101	Mobile Data Terminal (MDT)
F-105	Display time-until-departure at current stop	E-107	MDT Functional Processes

function_ID	function_name	element_ID	element_name
F-105	Display time-until-departure at current stop	E-108	MDT Vehicle Wireless Data Communications System Driver
F-105	Display time-until-departure at current stop	E-204	On-Board High-Speed Data Interface
F-105	Display time-until-departure at current stop	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-105	Display time-until-departure at current stop	E-206	Central-Site High-Speed Data Interface
F-105	Display time-until-departure at current stop	E-509	On-Board Equipment Administration Controls
F-105	Display time-until-departure at current stop	E-510	Schedule Management & Administration Tools & Controls
F-105	Display time-until-departure at current stop	E-513	ATRMS Data Communications System Driver
F-105	Display time-until-departure at current stop	E-601	ATRMS / Central-Site Data Interfaces
F-105	Display time-until-departure at current stop	E-602	ATRMS Communications Infrastructure / Repeaters
F-105	Display time-until-departure at current stop	E-701	On-Board Systems API
F-105	Display time-until-departure at current stop	E-704	ATRMS API
F-105	Display time-until-departure at current stop	E-705	Data Store
F-105	Display time-until-departure at current stop	E-706	Data Store API
F-105	Display time-until-departure at current stop	E-707	CSS Functional Processes
F-105	Display time-until-departure at current stop	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-105	Display time-until-departure at current stop	E-710	CSS ATRMS Data Communications System Driver
F-105	Display time-until-departure at current stop	E-801	Stop-Point List
F-105	Display time-until-departure at current stop	E-802	Timetable
F-105	Display time-until-departure at current stop	E-803	Work / Runs List
F-106	Automatically accept, validate, and log pass media during boarding	E-101	Mobile Data Terminal (MDT)
F-106	Automatically accept, validate, and log pass media during boarding	E-102	Pass / Fare Media Reader
F-106	Automatically accept, validate, and log pass media during boarding	E-107	MDT Functional Processes
F-106	Automatically accept, validate, and log pass media during boarding	E-108	MDT Vehicle Wireless Data Communications System Driver
F-106	Automatically accept, validate, and log pass media during boarding	E-204	On-Board High-Speed Data Interface
F-106	Automatically accept, validate, and log pass media during boarding	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-106	Automatically accept, validate, and log pass media during boarding	E-206	Central-Site High-Speed Data Interface

function_ID	function_name	element_ID	element_name
F-106	Automatically accept, validate, and log pass media during boarding	E-507	Bus Pass List Dissemination Controls
F-106	Automatically accept, validate, and log pass media during boarding	E-509	On-Board Equipment Administration Controls
F-106	Automatically accept, validate, and log pass media during boarding	E-510	Schedule Management & Administration Tools & Controls
F-106	Automatically accept, validate, and log pass media during boarding	E-513	ATRMS Data Communications System Driver
F-106	Automatically accept, validate, and log pass media during boarding	E-601	ATRMS / Central-Site Data Interfaces
F-106	Automatically accept, validate, and log pass media during boarding	E-602	ATRMS Communications Infrastructure / Repeaters
F-106	Automatically accept, validate, and log pass media during boarding	E-701	On-Board Systems API
F-106	Automatically accept, validate, and log pass media during boarding	E-704	ATRMS API
F-106	Automatically accept, validate, and log pass media during boarding	E-705	Data Store
F-106	Automatically accept, validate, and log pass media during boarding	E-706	Data Store API
F-106	Automatically accept, validate, and log pass media during boarding	E-707	CSS Functional Processes
F-106	Automatically accept, validate, and log pass media during boarding	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-106	Automatically accept, validate, and log pass media during boarding	E-710	CSS ATRMS Data Communications System Driver
F-106	Automatically accept, validate, and log pass media during boarding	E-801	Stop-Point List
F-106	Automatically accept, validate, and log pass media during boarding	E-802	Timetable
F-106	Automatically accept, validate, and log pass media during boarding	E-803	Work / Runs List
F-107	Automatically collect and record boardings & alightings counts	E-101	Mobile Data Terminal (MDT)
F-107	Automatically collect and record boardings & alightings counts	E-106	APC (Automatic Passenger Counter)
F-107	Automatically collect and record boardings & alightings counts	E-107	MDT Functional Processes
F-107	Automatically collect and record boardings & alightings counts	E-108	MDT Vehicle Wireless Data Communications System Driver

function_ID	function_name	element_ID	element_name
F-107	Automatically collect and record boardings & alightings counts	E-204	On-Board High-Speed Data Interface
F-107	Automatically collect and record boardings & alightings counts	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-107	Automatically collect and record boardings & alightings counts	E-206	Central-Site High-Speed Data Interface
F-107	Automatically collect and record boardings & alightings counts	E-509	On-Board Equipment Administration Controls
F-107	Automatically collect and record boardings & alightings counts	E-510	Schedule Management & Administration Tools & Controls
F-107	Automatically collect and record boardings & alightings counts	E-513	ATRMS Data Communications System Driver
F-107	Automatically collect and record boardings & alightings counts	E-601	ATRMS / Central-Site Data Interfaces
F-107	Automatically collect and record boardings & alightings counts	E-602	ATRMS Communications Infrastructure / Repeaters
F-107	Automatically collect and record boardings & alightings counts	E-701	On-Board Systems API
F-107	Automatically collect and record boardings & alightings counts	E-704	ATRMS API
F-107	Automatically collect and record boardings & alightings counts	E-705	Data Store
F-107	Automatically collect and record boardings & alightings counts	E-706	Data Store API
F-107	Automatically collect and record boardings & alightings counts	E-707	CSS Functional Processes
F-107	Automatically collect and record boardings & alightings counts	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-107	Automatically collect and record boardings & alightings counts	E-710	CSS ATRMS Data Communications System Driver
F-107	Automatically collect and record boardings & alightings counts	E-801	Stop-Point List
F-107	Automatically collect and record boardings & alightings counts	E-802	Timetable
F-107	Automatically collect and record boardings & alightings counts	E-803	Work / Runs List
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-101	Mobile Data Terminal (MDT)
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-107	MDT Functional Processes

function_ID	function_name	element_ID	element_name
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-108	MDT Vehicle Wireless Data Communications System Driver
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-201	On-Board Wide-Area Wireless Data Interface
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-203	Central-Site Wide-Area Wireless Data Interface
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-701	On-Board Systems API
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-705	Data Store
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-706	Data Store API
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-707	CSS Functional Processes
F-108	Receive, store, and transfer bus stop data from peripheral on-board devices	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-109	Provide on-board stop annunciation	E-101	Mobile Data Terminal (MDT)
F-109	Provide on-board stop annunciation	E-104	On-Board Audio Annunciator
F-109	Provide on-board stop annunciation	E-107	MDT Functional Processes
F-109	Provide on-board stop annunciation	E-108	MDT Vehicle Wireless Data Communications System Driver
F-109	Provide on-board stop annunciation	E-204	On-Board High-Speed Data Interface
F-109	Provide on-board stop annunciation	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-109	Provide on-board stop annunciation	E-206	Central-Site High-Speed Data Interface
F-109	Provide on-board stop annunciation	E-509	On-Board Equipment Administration Controls
F-109	Provide on-board stop annunciation	E-510	Schedule Management & Administration Tools & Controls
F-109	Provide on-board stop annunciation	E-513	ATRMS Data Communications System Driver
F-109	Provide on-board stop annunciation	E-601	ATRMS / Central-Site Data Interfaces
F-109	Provide on-board stop annunciation	E-602	ATRMS Communications Infrastructure / Repeaters
F-109	Provide on-board stop annunciation	E-701	On-Board Systems API
F-109	Provide on-board stop annunciation	E-704	ATRMS API
F-109	Provide on-board stop annunciation	E-705	Data Store
F-109	Provide on-board stop annunciation	E-706	Data Store API
F-109	Provide on-board stop annunciation	E-707	CSS Functional Processes

function_ID	function_name	element_ID	element_name
F-109	Provide on-board stop annunciation	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-109	Provide on-board stop annunciation	E-710	CSS ATRMS Data Communications System Driver
F-109	Provide on-board stop annunciation	E-801	Stop-Point List
F-109	Provide on-board stop annunciation	E-802	Timetable
F-109	Provide on-board stop annunciation	E-803	Work / Runs List
F-109	Provide on-board stop annunciation	E-804	Stop-point and Landmark Voice and Text
F-110	Provide on-board stop signage	E-101	Mobile Data Terminal (MDT)
F-110	Provide on-board stop signage	E-105	On-Board Electronic Sign
F-110	Provide on-board stop signage	E-107	MDT Functional Processes
F-110	Provide on-board stop signage	E-108	MDT Vehicle Wireless Data Communications System Driver
F-110	Provide on-board stop signage	E-204	On-Board High-Speed Data Interface
F-110	Provide on-board stop signage	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-110	Provide on-board stop signage	E-206	Central-Site High-Speed Data Interface
F-110	Provide on-board stop signage	E-509	On-Board Equipment Administration Controls
F-110	Provide on-board stop signage	E-510	Schedule Management & Administration Tools & Controls
F-110	Provide on-board stop signage	E-513	ATRMS Data Communications System Driver
F-110	Provide on-board stop signage	E-601	ATRMS / Central-Site Data Interfaces
F-110	Provide on-board stop signage	E-602	ATRMS Communications Infrastructure / Repeaters
F-110	Provide on-board stop signage	E-701	On-Board Systems API
F-110	Provide on-board stop signage	E-704	ATRMS API
F-110	Provide on-board stop signage	E-705	Data Store
F-110	Provide on-board stop signage	E-706	Data Store API
F-110	Provide on-board stop signage	E-707	CSS Functional Processes
F-110	Provide on-board stop signage	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-110	Provide on-board stop signage	E-710	CSS ATRMS Data Communications System Driver
F-110	Provide on-board stop signage	E-801	Stop-Point List
F-110	Provide on-board stop signage	E-802	Timetable
F-110	Provide on-board stop signage	E-803	Work / Runs List
F-110	Provide on-board stop signage	E-804	Stop-point and Landmark Voice and Text
F-111	Collect vehicle odometer data	E-101	Mobile Data Terminal (MDT)
F-111	Collect vehicle odometer data	E-107	MDT Functional Processes

function_ID	function_name	element_ID	element_name
F-111	Collect vehicle odometer data	E-108	MDT Vehicle Wireless Data Communications System Driver
F-111	Collect vehicle odometer data	E-204	On-Board High-Speed Data Interface
F-111	Collect vehicle odometer data	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-111	Collect vehicle odometer data	E-206	Central-Site High-Speed Data Interface
F-111	Collect vehicle odometer data	E-701	On-Board Systems API
F-111	Collect vehicle odometer data	E-705	Data Store
F-111	Collect vehicle odometer data	E-706	Data Store API
F-111	Collect vehicle odometer data	E-707	CSS Functional Processes
F-111	Collect vehicle odometer data	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-112	Provide notification of stop arrivals and departures to driver	E-101	Mobile Data Terminal (MDT)
F-112	Provide notification of stop arrivals and departures to driver	E-107	MDT Functional Processes
F-112	Provide notification of stop arrivals and departures to driver	E-108	MDT Vehicle Wireless Data Communications System Driver
F-112	Provide notification of stop arrivals and departures to driver	E-204	On-Board High-Speed Data Interface
F-112	Provide notification of stop arrivals and departures to driver	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-112	Provide notification of stop arrivals and departures to driver	E-206	Central-Site High-Speed Data Interface
F-112	Provide notification of stop arrivals and departures to driver	E-509	On-Board Equipment Administration Controls
F-112	Provide notification of stop arrivals and departures to driver	E-510	Schedule Management & Administration Tools & Controls
F-112	Provide notification of stop arrivals and departures to driver	E-513	ATRMS Data Communications System Driver
F-112	Provide notification of stop arrivals and departures to driver	E-601	ATRMS / Central-Site Data Interfaces
F-112	Provide notification of stop arrivals and departures to driver	E-602	ATRMS Communications Infrastructure / Repeaters
F-112	Provide notification of stop arrivals and departures to driver	E-701	On-Board Systems API
F-112	Provide notification of stop arrivals and departures to driver	E-704	ATRMS API
F-112	Provide notification of stop arrivals and departures to driver	E-705	Data Store
F-112	Provide notification of stop arrivals and departures to driver	E-706	Data Store API
F-112	Provide notification of stop arrivals and departures to driver	E-707	CSS Functional Processes
F-112	Provide notification of stop arrivals and departures to driver	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-112	Provide notification of stop arrivals and departures to driver	E-710	CSS ATRMS Data Communications System Driver
F-112	Provide notification of stop arrivals and departures to driver	E-801	Stop-Point List
F-112	Provide notification of stop arrivals and departures to driver	E-802	Timetable
F-112	Provide notification of stop arrivals and departures to driver	E-803	Work / Runs List

function_ID	function_name	element_ID	element_name
F-113	Collect driver ID during login	E-101	Mobile Data Terminal (MDT)
F-113	Collect driver ID during login	E-107	MDT Functional Processes
F-113	Collect driver ID during login	E-108	MDT Vehicle Wireless Data Communications System Driver
F-113	Collect driver ID during login	E-204	On-Board High-Speed Data Interface
F-113	Collect driver ID during login	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-113	Collect driver ID during login	E-206	Central-Site High-Speed Data Interface
F-113	Collect driver ID during login	E-509	On-Board Equipment Administration Controls
F-113	Collect driver ID during login	E-512	Driver Management Controls
F-113	Collect driver ID during login	E-513	ATRMS Data Communications System Driver
F-113	Collect driver ID during login	E-601	ATRMS / Central-Site Data Interfaces
F-113	Collect driver ID during login	E-602	ATRMS Communications Infrastructure / Repeaters
F-113	Collect driver ID during login	E-701	On-Board Systems API
F-113	Collect driver ID during login	E-704	ATRMS API
F-113	Collect driver ID during login	E-705	Data Store
F-113	Collect driver ID during login	E-706	Data Store API
F-113	Collect driver ID during login	E-707	CSS Functional Processes
F-113	Collect driver ID during login	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-113	Collect driver ID during login	E-710	CSS ATRMS Data Communications System Driver
F-113	Collect driver ID during login	E-808	Valid Drivers List
F-114	Collect route number during login	E-101	Mobile Data Terminal (MDT)
F-114	Collect route number during login	E-107	MDT Functional Processes
F-114	Collect route number during login	E-108	MDT Vehicle Wireless Data Communications System Driver
F-114	Collect route number during login	E-204	On-Board High-Speed Data Interface
F-114	Collect route number during login	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-114	Collect route number during login	E-206	Central-Site High-Speed Data Interface
F-114	Collect route number during login	E-509	On-Board Equipment Administration Controls
F-114	Collect route number during login	E-510	Schedule Management & Administration Tools & Controls
F-114	Collect route number during login	E-513	ATRMS Data Communications System Driver
F-114	Collect route number during login	E-601	ATRMS / Central-Site Data Interfaces
F-114	Collect route number during login	E-602	ATRMS Communications Infrastructure / Repeaters
F-114	Collect route number during login	E-701	On-Board Systems API

function_ID	function_name	element_ID	element_name
F-114	Collect route number during login	E-704	ATRMS API
F-114	Collect route number during login	E-705	Data Store
F-114	Collect route number during login	E-706	Data Store API
F-114	Collect route number during login	E-707	CSS Functional Processes
F-114	Collect route number during login	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-114	Collect route number during login	E-710	CSS ATRMS Data Communications System Driver
F-114	Collect route number during login	E-801	Stop-Point List
F-114	Collect route number during login	E-802	Timetable
F-114	Collect route number during login	E-803	Work / Runs List
F-115	Change driver's work assignment during the day	E-101	Mobile Data Terminal (MDT)
F-115	Change driver's work assignment during the day	E-107	MDT Functional Processes
F-115	Change driver's work assignment during the day	E-108	MDT Vehicle Wireless Data Communications System Driver
F-115	Change driver's work assignment during the day	E-204	On-Board High-Speed Data Interface
F-115	Change driver's work assignment during the day	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-115	Change driver's work assignment during the day	E-206	Central-Site High-Speed Data Interface
F-115	Change driver's work assignment during the day	E-509	On-Board Equipment Administration Controls
F-115	Change driver's work assignment during the day	E-510	Schedule Management & Administration Tools & Controls
F-115	Change driver's work assignment during the day	E-513	ATRMS Data Communications System Driver
F-115	Change driver's work assignment during the day	E-601	ATRMS / Central-Site Data Interfaces
F-115	Change driver's work assignment during the day	E-602	ATRMS Communications Infrastructure / Repeaters
F-115	Change driver's work assignment during the day	E-701	On-Board Systems API
F-115	Change driver's work assignment during the day	E-704	ATRMS API
F-115	Change driver's work assignment during the day	E-705	Data Store
F-115	Change driver's work assignment during the day	E-706	Data Store API
F-115	Change driver's work assignment during the day	E-707	CSS Functional Processes
F-115	Change driver's work assignment during the day	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-115	Change driver's work assignment during the day	E-710	CSS ATRMS Data Communications System Driver
F-115	Change driver's work assignment during the day	E-801	Stop-Point List
F-115	Change driver's work assignment during the day	E-802	Timetable
F-115	Change driver's work assignment during the day	E-803	Work / Runs List

function_ID	function_name	element_ID	element_name
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-101	Mobile Data Terminal (MDT)
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-107	MDT Functional Processes
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-108	MDT Vehicle Wireless Data Communications System Driver
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-201	On-Board Wide-Area Wireless Data Interface
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-203	Central-Site Wide-Area Wireless Data Interface
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-204	On-Board High-Speed Data Interface
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-206	Central-Site High-Speed Data Interface
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-509	On-Board Equipment Administration Controls
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-510	Schedule Management & Administration Tools & Controls
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-513	ATRMS Data Communications System Driver
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-601	ATRMS / Central-Site Data Interfaces
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-602	ATRMS Communications Infrastructure / Repeaters
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-701	On-Board Systems API
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-705	Data Store
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-706	Data Store API
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-707	CSS Functional Processes
F-116	Provide real-time vehicle updates (location, schedule adherence, etc)	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-118	Declare on board emergency	E-101	Mobile Data Terminal (MDT)
F-118	Declare on board emergency	E-107	MDT Functional Processes

function_ID	function_name	element_ID	element_name
F-118	Declare on board emergency	E-108	MDT Vehicle Wireless Data Communications System Driver
F-118	Declare on board emergency	E-201	On-Board Wide-Area Wireless Data Interface
F-118	Declare on board emergency	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-118	Declare on board emergency	E-203	Central-Site Wide-Area Wireless Data Interface
F-118	Declare on board emergency	E-504	Emergency Management Display
F-118	Declare on board emergency	E-513	ATRMS Data Communications System Driver
F-118	Declare on board emergency	E-601	ATRMS / Central-Site Data Interfaces
F-118	Declare on board emergency	E-602	ATRMS Communications Infrastructure / Repeaters
F-118	Declare on board emergency	E-701	On-Board Systems API
F-118	Declare on board emergency	E-704	ATRMS API
F-118	Declare on board emergency	E-705	Data Store
F-118	Declare on board emergency	E-706	Data Store API
F-118	Declare on board emergency	E-707	CSS Functional Processes
F-118	Declare on board emergency	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-118	Declare on board emergency	E-710	CSS ATRMS Data Communications System Driver
F-119	Survey stop locations	E-101	Mobile Data Terminal (MDT)
F-119	Survey stop locations	E-107	MDT Functional Processes
F-119	Survey stop locations	E-801	Stop-Point List
F-120	Manually collect and record passenger boarding counts.	E-101	Mobile Data Terminal (MDT)
F-120	Manually collect and record passenger boarding counts.	E-107	MDT Functional Processes
F-120	Manually collect and record passenger boarding counts.	E-108	MDT Vehicle Wireless Data Communications System Driver
F-120	Manually collect and record passenger boarding counts.	E-204	On-Board High-Speed Data Interface
F-120	Manually collect and record passenger boarding counts.	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-120	Manually collect and record passenger boarding counts.	E-206	Central-Site High-Speed Data Interface
F-120	Manually collect and record passenger boarding counts.	E-509	On-Board Equipment Administration Controls
F-120	Manually collect and record passenger boarding counts.	E-510	Schedule Management & Administration Tools & Controls
F-120	Manually collect and record passenger boarding counts.	E-513	ATRMS Data Communications System Driver
F-120	Manually collect and record passenger boarding counts.	E-601	ATRMS / Central-Site Data Interfaces
F-120	Manually collect and record passenger boarding counts.	E-602	ATRMS Communications Infrastructure / Repeaters
F-120	Manually collect and record passenger boarding counts.	E-701	On-Board Systems API

function_ID	function_name	element_ID	element_name
F-120	Manually collect and record passenger boarding counts.	E-704	ATRMS API
F-120	Manually collect and record passenger boarding counts.	E-705	Data Store
F-120	Manually collect and record passenger boarding counts.	E-706	Data Store API
F-120	Manually collect and record passenger boarding counts.	E-707	CSS Functional Processes
F-120	Manually collect and record passenger boarding counts.	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-120	Manually collect and record passenger boarding counts.	E-710	CSS ATRMS Data Communications System Driver
F-120	Manually collect and record passenger boarding counts.	E-801	Stop-Point List
F-120	Manually collect and record passenger boarding counts.	E-802	Timetable
F-120	Manually collect and record passenger boarding counts.	E-803	Work / Runs List
Dynamic Roadside Information Display			
F-201	Provide estimated time until arrival to passengers at stops	E-101	Mobile Data Terminal (MDT)
F-201	Provide estimated time until arrival to passengers at stops	E-107	MDT Functional Processes
F-201	Provide estimated time until arrival to passengers at stops	E-108	MDT Vehicle Wireless Data Communications System Driver
F-201	Provide estimated time until arrival to passengers at stops	E-201	On-Board Wide-Area Wireless Data Interface
F-201	Provide estimated time until arrival to passengers at stops	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-201	Provide estimated time until arrival to passengers at stops	E-203	Central-Site Wide-Area Wireless Data Interface
F-201	Provide estimated time until arrival to passengers at stops	E-204	On-Board High-Speed Data Interface
F-201	Provide estimated time until arrival to passengers at stops	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-201	Provide estimated time until arrival to passengers at stops	E-206	Central-Site High-Speed Data Interface
F-201	Provide estimated time until arrival to passengers at stops	E-301	Roadside Sign / Display
F-201	Provide estimated time until arrival to passengers at stops	E-302	Roadside Post
F-201	Provide estimated time until arrival to passengers at stops	E-303	Roadside Post Foundation
F-201	Provide estimated time until arrival to passengers at stops	E-304	RID Functional Processes
F-201	Provide estimated time until arrival to passengers at stops	E-305	RID Communications System Driver
F-201	Provide estimated time until arrival to passengers at stops	E-401	Roadside Data Interface
F-201	Provide estimated time until arrival to passengers at stops	E-402	Roadside Communications Infrastructure / Repeaters
F-201	Provide estimated time until arrival to passengers at stops	E-403	Central-Site Data Interface
F-201	Provide estimated time until arrival to passengers at stops	E-509	On-Board Equipment Administration Controls
F-201	Provide estimated time until arrival to passengers at stops	E-510	Schedule Management & Administration Tools & Controls
F-201	Provide estimated time until arrival to passengers at stops	E-511	Roadside Information Display Controls
F-201	Provide estimated time until arrival to passengers at stops	E-601	ATRMS / Central-Site Data Interfaces
F-201	Provide estimated time until arrival to passengers at stops	E-602	ATRMS Communications Infrastructure / Repeaters

function_ID	function_name	element_ID	element_name
F-201	Provide estimated time until arrival to passengers at stops	E-701	On-Board Systems API
F-201	Provide estimated time until arrival to passengers at stops	E-702	Roadside Information Display API
F-201	Provide estimated time until arrival to passengers at stops	E-704	ATRMS API
F-201	Provide estimated time until arrival to passengers at stops	E-705	Data Store
F-201	Provide estimated time until arrival to passengers at stops	E-706	Data Store API
F-201	Provide estimated time until arrival to passengers at stops	E-707	CSS Functional Processes
F-201	Provide estimated time until arrival to passengers at stops	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-201	Provide estimated time until arrival to passengers at stops	E-709	CSS RID Data Communications System Driver
F-201	Provide estimated time until arrival to passengers at stops	E-710	CSS ATRMS Data Communications System Driver
F-201	Provide estimated time until arrival to passengers at stops	E-801	Stop-Point List
F-201	Provide estimated time until arrival to passengers at stops	E-802	Timetable
F-201	Provide estimated time until arrival to passengers at stops	E-803	Work / Runs List
F-202	Provide dynamic public service information to passengers at stops	E-301	Roadside Sign / Display
F-202	Provide dynamic public service information to passengers at stops	E-302	Roadside Post
F-202	Provide dynamic public service information to passengers at stops	E-303	Roadside Post Foundation
F-202	Provide dynamic public service information to passengers at stops	E-304	RID Functional Processes
F-202	Provide dynamic public service information to passengers at stops	E-305	RID Communications System Driver
F-202	Provide dynamic public service information to passengers at stops	E-401	Roadside Data Interface
F-202	Provide dynamic public service information to passengers at stops	E-402	Roadside Communications Infrastructure / Repeaters
F-202	Provide dynamic public service information to passengers at stops	E-403	Central-Site Data Interface
F-202	Provide dynamic public service information to passengers at stops	E-511	Roadside Information Display Controls
F-202	Provide dynamic public service information to passengers at stops	E-601	ATRMS / Central-Site Data Interfaces
F-202	Provide dynamic public service information to passengers at stops	E-602	ATRMS Communications Infrastructure / Repeaters
F-202	Provide dynamic public service information to passengers at stops	E-702	Roadside Information Display API
F-202	Provide dynamic public service information to passengers at stops	E-704	ATRMS API

function_ID	function_name	element_ID	element_name
F-202	Provide dynamic public service information to passengers at stops	E-705	Data Store
F-202	Provide dynamic public service information to passengers at stops	E-706	Data Store API
F-202	Provide dynamic public service information to passengers at stops	E-707	CSS Functional Processes
F-202	Provide dynamic public service information to passengers at stops	E-709	CSS RID Data Communications System Driver
F-202	Provide dynamic public service information to passengers at stops	E-710	CSS ATRMS Data Communications System Driver
Central Site Software			
F-301	Provide API for transit traveler information	E-510	Schedule Management & Administration Tools & Controls
F-301	Provide API for transit traveler information	E-601	ATRMS / Central-Site Data Interfaces
F-301	Provide API for transit traveler information	E-602	ATRMS Communications Infrastructure / Repeaters
F-301	Provide API for transit traveler information	E-703	Traveler Information API
F-301	Provide API for transit traveler information	E-704	ATRMS API
F-301	Provide API for transit traveler information	E-705	Data Store
F-301	Provide API for transit traveler information	E-706	Data Store API
F-301	Provide API for transit traveler information	E-707	CSS Functional Processes
F-301	Provide API for transit traveler information	E-710	CSS ATRMS Data Communications System Driver
F-301	Provide API for transit traveler information	E-801	Stop-Point List
F-301	Provide API for transit traveler information	E-802	Timetable
F-301	Provide API for transit traveler information	E-803	Work / Runs List
Advanced Transit Management System			
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-101	Mobile Data Terminal (MDT)
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-107	MDT Functional Processes
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-108	MDT Vehicle Wireless Data Communications System Driver
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-201	On-Board Wide-Area Wireless Data Interface
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-203	Central-Site Wide-Area Wireless Data Interface

function_ID	function_name	element_ID	element_name
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-204	On-Board High-Speed Data Interface
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-206	Central-Site High-Speed Data Interface
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-501	Vehicle Tracking Display
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-509	On-Board Equipment Administration Controls
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-510	Schedule Management & Administration Tools & Controls
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-601	ATRMS / Central-Site Data Interfaces
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-602	ATRMS Communications Infrastructure / Repeaters
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-701	On-Board Systems API
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-704	ATRMS API
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-705	Data Store
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-706	Data Store API
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-707	CSS Functional Processes
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-710	CSS ATRMS Data Communications System Driver
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-801	Stop-Point List
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-802	Timetable
F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users	E-803	Work / Runs List
F-402	Display schedule adherence information for dispatch & management users	E-101	Mobile Data Terminal (MDT)
F-402	Display schedule adherence information for dispatch & management users	E-107	MDT Functional Processes

function_ID	function_name	element_ID	element_name
F-402	Display schedule adherence information for dispatch & management users	E-108	MDT Vehicle Wireless Data Communications System Driver
F-402	Display schedule adherence information for dispatch & management users	E-201	On-Board Wide-Area Wireless Data Interface
F-402	Display schedule adherence information for dispatch & management users	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-402	Display schedule adherence information for dispatch & management users	E-203	Central-Site Wide-Area Wireless Data Interface
F-402	Display schedule adherence information for dispatch & management users	E-204	On-Board High-Speed Data Interface
F-402	Display schedule adherence information for dispatch & management users	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-402	Display schedule adherence information for dispatch & management users	E-206	Central-Site High-Speed Data Interface
F-402	Display schedule adherence information for dispatch & management users	E-502	Schedule Adherence Display
F-402	Display schedule adherence information for dispatch & management users	E-509	On-Board Equipment Administration Controls
F-402	Display schedule adherence information for dispatch & management users	E-510	Schedule Management & Administration Tools & Controls
F-402	Display schedule adherence information for dispatch & management users	E-601	ATRMS / Central-Site Data Interfaces
F-402	Display schedule adherence information for dispatch & management users	E-602	ATRMS Communications Infrastructure / Repeaters
F-402	Display schedule adherence information for dispatch & management users	E-701	On-Board Systems API
F-402	Display schedule adherence information for dispatch & management users	E-704	ATRMS API
F-402	Display schedule adherence information for dispatch & management users	E-705	Data Store
F-402	Display schedule adherence information for dispatch & management users	E-706	Data Store API
F-402	Display schedule adherence information for dispatch & management users	E-707	CSS Functional Processes
F-402	Display schedule adherence information for dispatch & management users	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-402	Display schedule adherence information for dispatch & management users	E-710	CSS ATRMS Data Communications System Driver
F-402	Display schedule adherence information for dispatch & management users	E-801	Stop-Point List

function_ID	function_name	element_ID	element_name
F-402	Display schedule adherence information for dispatch & management users	E-802	Timetable
F-402	Display schedule adherence information for dispatch & management users	E-803	Work / Runs List
F-403	Display passenger boarding / alighting information for dispatch & management users	E-101	Mobile Data Terminal (MDT)
F-403	Display passenger boarding / alighting information for dispatch & management users	E-107	MDT Functional Processes
F-403	Display passenger boarding / alighting information for dispatch & management users	E-108	MDT Vehicle Wireless Data Communications System Driver
F-403	Display passenger boarding / alighting information for dispatch & management users	E-201	On-Board Wide-Area Wireless Data Interface
F-403	Display passenger boarding / alighting information for dispatch & management users	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-403	Display passenger boarding / alighting information for dispatch & management users	E-203	Central-Site Wide-Area Wireless Data Interface
F-403	Display passenger boarding / alighting information for dispatch & management users	E-204	On-Board High-Speed Data Interface
F-403	Display passenger boarding / alighting information for dispatch & management users	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-403	Display passenger boarding / alighting information for dispatch & management users	E-206	Central-Site High-Speed Data Interface
F-403	Display passenger boarding / alighting information for dispatch & management users	E-503	Passenger Boardings Display
F-403	Display passenger boarding / alighting information for dispatch & management users	E-509	On-Board Equipment Administration Controls
F-403	Display passenger boarding / alighting information for dispatch & management users	E-510	Schedule Management & Administration Tools & Controls
F-403	Display passenger boarding / alighting information for dispatch & management users	E-601	ATRMS / Central-Site Data Interfaces
F-403	Display passenger boarding / alighting information for dispatch & management users	E-602	ATRMS Communications Infrastructure / Repeaters
F-403	Display passenger boarding / alighting information for dispatch & management users	E-701	On-Board Systems API
F-403	Display passenger boarding / alighting information for dispatch & management users	E-704	ATRMS API
F-403	Display passenger boarding / alighting information for dispatch & management users	E-705	Data Store
F-403	Display passenger boarding / alighting information for dispatch & management users	E-706	Data Store API

function_ID	function_name	element_ID	element_name
F-403	Display passenger boarding / alighting information for dispatch & management users	E-707	CSS Functional Processes
F-403	Display passenger boarding / alighting information for dispatch & management users	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-403	Display passenger boarding / alighting information for dispatch & management users	E-710	CSS ATRMS Data Communications System Driver
F-403	Display passenger boarding / alighting information for dispatch & management users	E-801	Stop-Point List
F-403	Display passenger boarding / alighting information for dispatch & management users	E-802	Timetable
F-403	Display passenger boarding / alighting information for dispatch & management users	E-803	Work / Runs List
F-404	Handle driver emergency button alarms for dispatch and management users	E-101	Mobile Data Terminal (MDT)
F-404	Handle driver emergency button alarms for dispatch and management users	E-103	Emergency Actuator
F-404	Handle driver emergency button alarms for dispatch and management users	E-107	MDT Functional Processes
F-404	Handle driver emergency button alarms for dispatch and management users	E-108	MDT Vehicle Wireless Data Communications System Driver
F-404	Handle driver emergency button alarms for dispatch and management users	E-201	On-Board Wide-Area Wireless Data Interface
F-404	Handle driver emergency button alarms for dispatch and management users	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-404	Handle driver emergency button alarms for dispatch and management users	E-203	Central-Site Wide-Area Wireless Data Interface
F-404	Handle driver emergency button alarms for dispatch and management users	E-204	On-Board High-Speed Data Interface
F-404	Handle driver emergency button alarms for dispatch and management users	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-404	Handle driver emergency button alarms for dispatch and management users	E-206	Central-Site High-Speed Data Interface
F-404	Handle driver emergency button alarms for dispatch and management users	E-504	Emergency Management Display
F-404	Handle driver emergency button alarms for dispatch and management users	E-510	Schedule Management & Administration Tools & Controls
F-404	Handle driver emergency button alarms for dispatch and management users	E-601	ATRMS / Central-Site Data Interfaces
F-404	Handle driver emergency button alarms for dispatch and management users	E-602	ATRMS Communications Infrastructure / Repeaters

function_ID	function_name	element_ID	element_name
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-701	On-Board Systems API
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-704	ATRMS API
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-705	Data Store
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-706	Data Store API
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-707	CSS Functional Processes
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-710	CSS ATRMS Data Communications System Driver
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-801	Stop-Point List
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-802	Timetable
F-404	Handle driver emergency button alarms for dispatch and mangement users	E-803	Work / Runs List
F-405	Provide statistical ridership reports for dispatch & management users	E-101	Mobile Data Terminal (MDT)
F-405	Provide statistical ridership reports for dispatch & management users	E-107	MDT Functional Processes
F-405	Provide statistical ridership reports for dispatch & management users	E-108	MDT Vehicle Wireless Data Communications System Driver
F-405	Provide statistical ridership reports for dispatch & management users	E-201	On-Board Wide-Area Wireless Data Interface
F-405	Provide statistical ridership reports for dispatch & management users	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-405	Provide statistical ridership reports for dispatch & management users	E-203	Central-Site Wide-Area Wireless Data Interface
F-405	Provide statistical ridership reports for dispatch & management users	E-204	On-Board High-Speed Data Interface
F-405	Provide statistical ridership reports for dispatch & management users	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-405	Provide statistical ridership reports for dispatch & management users	E-206	Central-Site High-Speed Data Interface
F-405	Provide statistical ridership reports for dispatch & management users	E-505	Ridership Statistics Reporting Controls

function_ID	function_name	element_ID	element_name
F-405	Provide statistical ridership reports for dispatch & management users	E-509	On-Board Equipment Administration Controls
F-405	Provide statistical ridership reports for dispatch & management users	E-510	Schedule Management & Administration Tools & Controls
F-405	Provide statistical ridership reports for dispatch & management users	E-601	ATRMS / Central-Site Data Interfaces
F-405	Provide statistical ridership reports for dispatch & management users	E-602	ATRMS Communications Infrastructure / Repeaters
F-405	Provide statistical ridership reports for dispatch & management users	E-701	On-Board Systems API
F-405	Provide statistical ridership reports for dispatch & management users	E-704	ATRMS API
F-405	Provide statistical ridership reports for dispatch & management users	E-705	Data Store
F-405	Provide statistical ridership reports for dispatch & management users	E-706	Data Store API
F-405	Provide statistical ridership reports for dispatch & management users	E-707	CSS Functional Processes
F-405	Provide statistical ridership reports for dispatch & management users	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-405	Provide statistical ridership reports for dispatch & management users	E-710	CSS ATRMS Data Communications System Driver
F-405	Provide statistical ridership reports for dispatch & management users	E-801	Stop-Point List
F-405	Provide statistical ridership reports for dispatch & management users	E-802	Timetable
F-405	Provide statistical ridership reports for dispatch & management users	E-803	Work / Runs List
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-101	Mobile Data Terminal (MDT)
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-107	MDT Functional Processes
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-108	MDT Vehicle Wireless Data Communications System Driver
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-201	On-Board Wide-Area Wireless Data Interface
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-203	Central-Site Wide-Area Wireless Data Interface

function_ID	function_name	element_ID	element_name
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-204	On-Board High-Speed Data Interface
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-206	Central-Site High-Speed Data Interface
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-506	Schedule Adherence Statistics Reporting Controls
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-509	On-Board Equipment Administration Controls
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-510	Schedule Management & Administration Tools & Controls
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-601	ATRMS / Central-Site Data Interfaces
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-602	ATRMS Communications Infrastructure / Repeaters
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-701	On-Board Systems API
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-704	ATRMS API
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-705	Data Store
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-706	Data Store API
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-707	CSS Functional Processes
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-710	CSS ATRMS Data Communications System Driver
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-801	Stop-Point List
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-802	Timetable
F-406	Provide statistical schedule adherence reports for dispatch & management users	E-803	Work / Runs List
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-101	Mobile Data Terminal (MDT)
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-107	MDT Functional Processes

function_ID	function_name	element_ID	element_name
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-108	MDT Vehicle Wireless Data Communications System Driver
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-201	On-Board Wide-Area Wireless Data Interface
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-203	Central-Site Wide-Area Wireless Data Interface
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-204	On-Board High-Speed Data Interface
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-206	Central-Site High-Speed Data Interface
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-507	Bus Pass List Dissemination Controls
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-509	On-Board Equipment Administration Controls
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-510	Schedule Management & Administration Tools & Controls
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-601	ATRMS / Central-Site Data Interfaces
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-602	ATRMS Communications Infrastructure / Repeaters
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-701	On-Board Systems API
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-704	ATRMS API
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-705	Data Store
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-706	Data Store API
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-707	CSS Functional Processes
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-710	CSS ATRMS Data Communications System Driver
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-801	Stop-Point List

function_ID	function_name	element_ID	element_name
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-802	Timetable
F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management	E-803	Work / Runs List
F-411	Provide controls for roadside banner message display	E-301	Roadside Sign / Display
F-411	Provide controls for roadside banner message display	E-302	Roadside Post
F-411	Provide controls for roadside banner message display	E-303	Roadside Post Foundation
F-411	Provide controls for roadside banner message display	E-304	RID Functional Processes
F-411	Provide controls for roadside banner message display	E-305	RID Communications System Driver
F-411	Provide controls for roadside banner message display	E-401	Roadside Data Interface
F-411	Provide controls for roadside banner message display	E-402	Roadside Communications Infrastructure / Repeaters
F-411	Provide controls for roadside banner message display	E-403	Central-Site Data Interface
F-411	Provide controls for roadside banner message display	E-511	Roadside Information Display Controls
F-411	Provide controls for roadside banner message display	E-601	ATRMS / Central-Site Data Interfaces
F-411	Provide controls for roadside banner message display	E-602	ATRMS Communications Infrastructure / Repeaters
F-411	Provide controls for roadside banner message display	E-702	Roadside Information Display API
F-411	Provide controls for roadside banner message display	E-704	ATRMS API
F-411	Provide controls for roadside banner message display	E-705	Data Store
F-411	Provide controls for roadside banner message display	E-706	Data Store API
F-411	Provide controls for roadside banner message display	E-707	CSS Functional Processes
F-411	Provide controls for roadside banner message display	E-709	CSS RID Data Communications System Driver
F-411	Provide controls for roadside banner message display	E-710	CSS ATRMS Data Communications System Driver
F-412	Provide system user administration	E-508	System User Management Controls
F-412	Provide system user administration	E-601	ATRMS / Central-Site Data Interfaces
F-412	Provide system user administration	E-602	ATRMS Communications Infrastructure / Repeaters
F-412	Provide system user administration	E-704	ATRMS API
F-412	Provide system user administration	E-705	Data Store
F-412	Provide system user administration	E-706	Data Store API
F-412	Provide system user administration	E-707	CSS Functional Processes
F-412	Provide system user administration	E-710	CSS ATRMS Data Communications System Driver
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-101	Mobile Data Terminal (MDT)

function_ID	function_name	element_ID	element_name
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-106	APC (Automatic Passenger Counter)
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-107	MDT Functional Processes
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-108	MDT Vehicle Wireless Data Communications System Driver
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-201	On-Board Wide-Area Wireless Data Interface
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-202	On-board Wide-Area Communications Infrastructure / Repeaters
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-203	Central-Site Wide-Area Wireless Data Interface
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-204	On-Board High-Speed Data Interface
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-205	On-board High-Speed Communications Infrastructure / Repeaters
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-206	Central-Site High-Speed Data Interface
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-505	Ridership Statistics Reporting Controls
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-510	Schedule Management & Administration Tools & Controls
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-601	ATRMS / Central-Site Data Interfaces
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-602	ATRMS Communications Infrastructure / Repeaters
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-701	On-Board Systems API
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-704	ATRMS API
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-705	Data Store
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-706	Data Store API
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-707	CSS Functional Processes
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-708	CSS Vehicle Wireless Data Communications Systems Driver
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-710	CSS ATRMS Data Communications System Driver

function_ID	function_name	element_ID	element_name
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-801	Stop-Point List
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-802	Timetable
F-413	Provide statistical boarding, alighting, and vehicle loading reports for dispatch & management users	E-803	Work / Runs List

Functions in Market Packages Definition: Provides the association between all system functions and National ITS Architecture Market Packages, allowing one to know which system functions have been implemented for a specific Market Package.

market_package_ID	market_package_number	market_package_service_area	function_ID	function_name
Archived Data Management				
MPKG-01	AD1	ITS Data Mart	F-301	Provide API for transit traveler information
Public Transportation				
MPKG-02	APTS1	Transit Vehicle Tracking	F-301	Provide API for transit traveler information
MPKG-02	APTS1	Transit Vehicle Tracking	F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users
MPKG-02	APTS1	Transit Vehicle Tracking	F-402	Display schedule adherence information for dispatch & management users
MPKG-02	APTS1	Transit Vehicle Tracking	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
MPKG-03	APTS2	Transit Fixed-Route Operations	F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users
MPKG-03	APTS2	Transit Fixed-Route Operations	F-402	Display schedule adherence information for dispatch & management users
MPKG-03	APTS2	Transit Fixed-Route Operations	F-406	Provide statistical schedule adherence reports for dispatch & management users
MPKG-03	APTS2	Transit Fixed-Route Operations	F-408	#N/A
MPKG-04	APTS4	Transit Passenger and Fare Management	F-106	Automatically accept, validate, and log pass media during boarding
MPKG-04	APTS4	Transit Passenger and Fare Management	F-107	Automatically collect and record boardings & alightings counts
MPKG-04	APTS4	Transit Passenger and Fare Management	F-403	Display passenger boarding / alighting information for dispatch & management users
MPKG-04	APTS4	Transit Passenger and Fare Management	F-405	Provide statistical ridership reports for dispatch & management users
MPKG-04	APTS4	Transit Passenger and Fare Management	F-407	Provide controls for dissemination of bus pass lists to fleet for dispatch & management
MPKG-05	APTS5	Transit Security	F-118	Declare on board emergency
MPKG-05	APTS5	Transit Security	F-404	Handle driver emergency button alarms for dispatch and mangement users
MPKG-06	APTS8	Transit Traveler Information	F-109	Provide on-board stop annunciation
MPKG-06	APTS8	Transit Traveler Information	F-110	Provide on-board stop signage
MPKG-06	APTS8	Transit Traveler Information	F-201	Provide estimated time until arrival to passengers at stops
MPKG-06	APTS8	Transit Traveler Information	F-202	Provide dynamic public service information to passengers at stops

market_package_ID	market_package_number	market_package_service_area	function_ID	function_name
MPKG-06	APTS8	Transit Traveler Information	F-411	Provide controls for roadside banner message display
Emergency Management				
MPKG-10	EM03	Mayday and Alarms Support	F-118	Declare on board emergency
MPKG-10	EM03	Mayday and Alarms Support	F-404	Handle driver emergency button alarms for dispatch and management users
MPKG-12	EM09	Evacuation and Reentry Management	F-202	Provide dynamic public service information to passengers at stops
MPKG-12	EM09	Evacuation and Reentry Management	F-411	Provide controls for roadside banner message display
MPKG-13	EM10	Disaster Traveler Information	F-202	Provide dynamic public service information to passengers at stops
MPKG-13	EM10	Disaster Traveler Information	F-411	Provide controls for roadside banner message display
MPKG-13	EM10	Disaster Traveler Information	F-401	Provide geolocation tracking display of transit vehicles for dispatch & management users
MPKG-13	EM10	Disaster Traveler Information	F-402	Display schedule adherence information for dispatch & management users
MPKG-13	EM10	Disaster Traveler Information	F-116	Provide real-time vehicle updates (location, schedule adherence, etc)
MPKG-13	EM10	Disaster Traveler Information	F-408	#N/A

APPENDIX D

EDAPTS DATA-FORMATTING STANDARD

EDAPTS Data Formatting Standard

Prepared For:

California Partners for Advanced Transit and Highways (PATH)

California Department of Transportation

By:

California Polytechnic State University

San Luis Obispo, California

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1. INTRODUCTION AND OVERVIEW

The EDAPTS Data-Formatting Standard consists of the following three sections:

- Specified Interface Object Transfers
- Interface-Specific Data Objects
- Common Data Objects

Section 2, Specified Interface Object Transfers, defines all data objects which may be made between EDAPTS Components. These data object transfers are based on EDAPTS system functions, which are things that the system does a user or an entity. Note that these transfers are not specifying inter-element movement of data, but rather inter-component data movement.

Section 3, Interface-Specific Data Objects, defines the content of each EDAPTS Interface Object Transfer specified in section 2.

Section 4, Common Data Objects provides the low-level details of each Interface Specific Data Object defined in section 3.

The EDAPTS Data-Formatting Standard document is in compliance with Extensible Markup Language XML 1.1.

2. SPECIFIED INTERFACE OBJECT TRANSFERS

Interface object transfers are specified for these four general categories of EDAPTS inter-Component transfers:

- OnBoard Systems to/from Central Site Software
- Central Site Software to/from Roadside Information Display
- Central Site Software to External Traveler Information Service
- ATRMS to/from Central Site Software

Each data transfer specified is directly traceable to EDAPTS system functions as selectable in the EDAPTS Performance Specification Generator software. Note that the data transfers are merely specified by name in this section with no low-level details provided.

The tables contained within this section are used by first looking up the EDAPTS system function, then looking within the table following to determine the name of the EDAPTS data object, the names of the EDAPTS elements the data is transferred between, and any assumptions made. For example, section 2.1.1 (titled “Display current stop schedule adherence to driver (F-104)”) refers to the system function that lets the driver of the transit vehicle know what their schedule adherence is when they arrive at a stop. This system function can be found under F-104 in the EDAPTS System Functions worksheet of the EDAPTS Performance Specification Tables. Looking at the table following the section 2.1.1 heading, the name of the EDAPTS data object is listed that is used to implement this function – PiSchedAdherenceOffSched. This data object can then be looked up in section 3 below to learn more about its contents. The next two columns in the table are titled “origin element” and “destination element”. These indicate the EDAPTS Element where the data object originates from and terminates at. For this example, the PiSchedAdherenceOffSched data object originates at element E-701, On-board Systems API and terminates at element E-107, MDT Functional Processes. Although EDAPTS Element names are noted in this table, it is important to note that these are merely the elements within the EDAPTS components that the data transfer is between. Lastly, each data object transfer table within this section lists any assumptions made for the defined transfer.

2.1 OnBoard Systems to/from Central Site Software

2.1.1 DISPLAY CURRENT STOP SCHEDULE ADHERENCE TO DRIVER (F-104)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<PiSchedAdherenceOffSched>	E-701	E-107
	On-Board Systems API	MDT Functional Processes
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.2 DISPLAY TIME-UNTIL-DEPARTURE AT CURRENT STOP (F-105)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<PiSchedAdherenceOffSched>	E-701	E-107
	On-Board Systems API	MDT Functional Processes
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.3 ACCEPT, VALIDATE, AND LOG PASS MEDIA DURING BOARDING (F-106)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<FcMediaList>	E-102	E-107
	Pass/Fare Media Reader	MDT Functional Processes
ASSUMPTIONS: None.		

2.1.4 COLLECT AND RECORD BOARDINGS AND ALIGHTINGS (F-107)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ObStopPointRecord>	E-106 Automatic Passenger Counter	E-107 MDT Functional Processes
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.5 RECEIVE, STORE, & TRANSFER BUS STOP DATA (F-108)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ObStopPointRecord>	E-107 MDT Functional Processes	E-701 On-Board Systems API
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.6 COLLECT VEHICLE ODOMETER DATA (F-111)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<CptPTVehicleParameter>	E-107 MDT Functional Processes	E-701 On-Board Systems API
ASSUMPTIONS: None.		

2.1.7 PROVIDE NOTIFICATION OF STOP ARRIVALS AND DEPARTURES (F-112)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<PiSchedAdherenceOffSched>	E-701	E-107
	On-Board Systems API	MDT Functional Processes
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.8 COLLECT DRIVER ID DURING LOGIN (F-113)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<CPT_OperatorID>	E-107	E-701
	MDT Functional Processes	On-Board Systems API
ASSUMPTIONS: None.		

2.1.9 COLLECT ROUTE NUMBER DURING LOGIN (F-114)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<PiSchedAdherenceOffSched>	E-107	E-701
	MDT Functional Processes	On-Board Systems API
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.10 PROVIDE REAL-TIME VEHICLE UPDATES (F-116)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<RealTimeVehiclePosition>	E-107 MDT Functional Processes	E-701 On-Board Systems API
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.11 DECLARE ON-BOARD EMERGENCY (F-118)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ImEvent>	E-107 MDT Functional Processes	E-701 On-Board Systems API
<IM_EventLocation>	E-107 MDT Functional Processes	E-701 On-Board Systems API
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.1.12 MANUALLY COLLECT AND RECORD PASSENGER BOARDING (F-120)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ObStopPointRecord>	E-107 MDT Functional Processes	E-701 On-Board Systems API
<FC_RiderClassification>	E-107 MDT Functional Processes	E-701 On-Board Systems API
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-107, MDT Functional Processes.		

2.2 Central Site Software (CSS) to/from Roadside Information Display (RID)

2.2.1 PROVIDE ESTIMATED TIME UNTIL ARRIVAL AT STOPS (F-201)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<TravInfoObStopPointRecord>	E-702	E-304
	Roadside Display API	RID Functional Processes
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-304, RID Functional Processes.		

2.2.2 PROVIDE DYNAMIC PUBLIC SERVICE INFORMATION AT STOPS (F-202)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<RoadsideBannerMsg>	E-702	E-304
	Roadside Display API	RID Functional Processes
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-304, RID Functional Processes.		

2.3 Central Site Software (CSS) to External Traveler Information Services

2.3.1 PROVIDE API FOR TRANSIT TRAVELER INFORMATION (F-301)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<TravInfoObStopPointRecord>	E-703 Traveler Information API	External data syncs
<RealTimeVehiclePosition>	E-701 On-Board Systems API	External data syncs
<SchMasterSchedulePackage>	E-703 Traveler Information API	External data syncs
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-304, RID Functional Processes.		

2.4 ATRMS to/from Central Site Software (CSS)

2.4.1 PROVIDE GEOLOCATION TRACKING DISPLAY (F-401)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<RealTimeVehiclePosition>	E-701 On-Board Systems API	E-501 Vehicle Tracking Display
<ObStopPointRecord>	E-704 ATRMS API	E-501 Vehicle Tracking Display
<SchMasterSchedulePackage>	E-704 ATRMS API	E-501 Vehicle Tracking Display
<ImEvent>	E-704 ATRMS API	E-501 Vehicle Tracking Display
<ImEventLocation>	E-704 ATRMS API	E-501 Vehicle Tracking Display
ASSUMPTIONS: None.		

2.4.2 DISPLAY SCHEDULE ADHERENCE INFORMATION (F-402)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ObStopPointRecord>	E-704 ATRMS API	E-501 Vehicle Tracking Display
<SchMasterSchedulePackage>	E-704 ATRMS API	E-501 Vehicle Tracking Display
ASSUMPTIONS: None.		

2.4.3 DISPLAY PASSENGER BOARDING / ALIGHTING INFORMATION (F-403)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ObStopPointRecord>	E-704 ATRMS API	E-501 Vehicle Tracking Display
<SchMasterSchedulePackage>	E-704 ATRMS API	E-501 Vehicle Tracking Display
ASSUMPTIONS: None.		

2.4.4 HANDLE DRIVER EMERGENCY BUTTON DISPATCH & MANAGEMENT (F-404)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ImEvent>	E-701 On-Board Systems API	E-504 Emergency Management Display
<ImEventLocation>31	E-701 On-Board Systems API	E-504 Emergency Management Display
<RealTimeVehiclePosition>	E-704 ATRMS API	E-501 Vehicle Tracking Display
<SchMasterSchedulePackage>	E-704 ATRMS API	E-501 Vehicle Tracking Display
ASSUMPTIONS: None.		

2.4.5 PROVIDE STATISTICAL RIDERSHIP REPORTS FOR DISPATCH & MANAGEMENT (F-405)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ObStopPointRecord>	E-707	E-505
	CSS Functional Processes	Ridership Statistics Reporting
<SchMasterSchedulePackage>	E-707	E-505
	CSS Functional Processes	Ridership Statistics Reporting
ASSUMPTIONS: None.		

2.4.6 PROVIDE STATISTICAL SCHEDULE ADHERENCE REPORTS (F-406)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<PiSchedAdherenceOffSched>	E-707	E-506
	CSS Functional Processes	Schedule Adherence Statistics
<SchMasterSchedulePackage>	E-707	E-506
	CSS Functional Processes	Schedule Adherence Statistics
ASSUMPTIONS: None.		

2.4.7 PROVIDE CONTROLS FOR DISSEMINATION OF BUS PASS LISTS (F-407)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<FcMediaList>	E-805 Passenger Pass Lists	E-507 Bus Pass List Dissemination Controls
<FcElectronicTransaction>	E-701 On-Board Systems API	E-507 Bus Pass List Dissemination Controls
ASSUMPTIONS: None.		

2.4.8 PROVIDE CONTROLS FOR ROADSIDE BANNER MESSAGE DISPLAY (F-411)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<RoadsideBannerMsg>	E-511 Roadside Administration Controls	E-304 RID Functional Processes
<SchMasterSchedulePackage>	E-702 Roadside Display API	E-511 Roadside Administration Controls
<ImEvent>	E-701 On-Board Systems API	E-511 Roadside Administration Controls
<PiSchedAdherenceOffSched>	E-701 On-Board Systems API	E-511 Roadside Administration Controls
ASSUMPTIONS: This function requires that <SchMasterSchedulePackage> is available to element E-304, RID Functional Processes.		

2.4.9 PROVIDE STATISTICAL BOARDING AND ALIGHTING REPORTS (F-413)

EDAPTS DATA OBJECT	ORIGIN ELEMENT	DESTINATION ELEMENT
<ObStopPointRecord>	E-707 CSS Functional Processes	E-505 Ridership Statistics Reporting
<SchMasterSchedulePackage>	E-707 CSS Functional Processes	E-505 Ridership Statistics Reporting
<ObDoorRecord>	E-704 ATRMS API	E-503 Passenger Boardings Display
ASSUMPTIONS: None.		

3. INTERFACE-SPECIFIC DATA OBJECTS

This section provides a listing of all Interface Specific Data Objects and indicates all Common Data Objects required for each one. Consider the data object <PiSchedAdherenceOffSched>, which is listed in section 3.7 below. This object contains various common data objects, including route_id, trip_id, and time_point_id. Each of these common data objects can be looked in Section 4 of this document, Common Data Objects to understand the details within the object.

3.1 FcElectronicTransaction

The FcElectronicTransaction object transmits information from the farecard machine to the MDT on the bus and then to the central dispatch regarding transactions with passengers. It contains information relating to the boarding transaction, the school id, and the account id of the card swept.

Note: Although this is an interface specific object, it is also used by other objects and thus is additionally listed as a common data object in section 4.9.

```
<FcElectronicTransaction>
  <boarding_transaction>
    <!-- Refer to FcBoardingTransaction -->
  </boarding_transaction>
  <institution_id>
    <!-- Refer to FC_InstitutionID -->
  </institution_id>
  <account_id>
    <!-- Refer to FC_AccountID -->
  </account_id>
</FcElectronicTransaction>
```

3.2 FcMediaList

The FcMediaList object represents a type of list that distinguishes valid and invalid ids for riders of the transit vehicle when their card is swiped. When the card is swiped, the farecard machine sends the card's information to the MDT to be verified. This object contains information relating to the type of farecard list, the type of rider, the type of monetary instrument used, and a list of valid account ids for comparison.

```
<FcMediaList>
  <list_type>
    <!-- Refer to FC_ListType -->
  </list_type>
```

```

<rider_class>
  <!-- Refer to FC_RiderClassification -->
</rider_class>

<monetary_inst_type>
  <!-- Refer to FC_MonetaryInstrumentType -->
</monetary_inst_type>

<account_id_list>
  <!-- Refer to a list of FC_AccountID -->
</account_id_list>

</FcMediaList>

```

3.3 ImEvent

The IMEvent object is generated when an emergency event occurs and is transmitted to the central software. IMEvent contains a Boolean for whether or not the emergency is active. It contains the ids for the dispatcher, source, route, and driver. IMEvent contains information related to the type of source the object is coming from, type of emergency, severity level, the type of acknowledgement of the emergency, and a description of the emergency. It gives the time the emergency is declared, emergency is acknowledged, a response occurs, and emergency terminated. Lastly, it transmits the location of the vehicle, the location time, and the location the event took place.

```

<ImEvent>

  <active>
    <!-- Refer to IM_Active -->
  </active>

  <source_id>
    <!-- Refer to IM_SourceID -->
  </source_id>

  <route_id>
    <!-- Refer to SCH_RouteID -->
  </route_id>

  <driver_id>
    <!-- Refer to CPT_OperatorID -->
  </driver_id >

  <dispatcher_id>
    <!-- Refer to CPT_OperatorID -->
  </dispatcher_id>

  <source_type>
    <!-- Refer to IM_SourceType -->
  </source_type>

```



```
<incident_type>
  <!-- Refer to IM_IncidentType -->
</incident_type>

<severity_level>
  <!-- Refer to CPT_SeverityLevel -->
</severity_level>

<description>
  <!-- Refer to IM_IncidentDescription -->
</description>

<request_time>
  <!-- Refer to IM_EventDateTime -->
</request_time>

<acknowledge_time>
  <!-- Refer to IM_EventDateTime -->
</acknowledge_time>

<response_time>
  <!-- Refer to IM_EventDateTime -->
</response_time>

</termination_time>
  <!-- Refer to IM_EventDateTime -->
</termination_time>

<acknowledge_type>
  <!-- Refer to IM_AcknowledgeType -->
</acknowledge_type>

<request_location>
  <!-- Refer to SpGeoPoint -->
</request_location>

<location_time>
  <!-- Refer to IM_EventDateTime -->
</location_time>

<event_location>
  <!-- Refer to IM_EventLocation -->
</event_location>

</ImEvent>
```

3.4 MDActivityList

The MDActivityList object generates a list of all things relating to the Activity of an MDT. It contains lists of the type of activities that the MDT has been performing, the routes the MDT has been on, the time the activities undertaken by the MDT occurred at, and a list of stop point records for the MDT.

```
<MDActivityList>
```

Array lists of:

```
<mdt_activity_type>  
  <!-- Refer to MDT_ActivityType -->  
</mdt_activity_type>  
  
<mdt_activity_time>  
  <!-- Refer to MDT_ActivityTime -->  
</mdt_activity_time>  
  
<day_type>  
  <!-- Refer to SCH_DayType -->  
</day_type>  
  
<mdt_route>  
  <!-- Refer to MDT_Route -->  
</mdt_route>  
  
<mdt_stop>  
  <!-- Refer to MDTStopPointRecord -->  
</mdt_stop>
```

```
</MDActivityList>
```

3.5 MDLogRequest

The MDLogRequest object sends a log from the MDT to the central server with all information regarding the activity of an MDT. The MDLogRequest contains a list of MDT activities and a list of the boarding transactions for the MDT.

```
<MDLogRequest>
```

```
<activity_list>  
  <!-- Refer to MDActivityList -->  
</activity_list>  
  
<boarding_list>  
  <!-- Refer to a list of FcBoardingTransaction -->  
</boarding_list>
```

```
</MDLogRequest>
```

3.6 ObStopPointRecord

The ObStopPointRecord object is transmitted from a transit vehicle to the central dispatch site upon departure from a stop, and contains information related to vehicle location, stop location, schedule adherence, boardings, and fares collected at the stop.

<ObStopPointRecord>

```
<agency_id>
  <!-- Refer to CPT_AgencyID -->
</agency_id>

<vehicle_id>
  <!-- Refer to CPT_PTVehicleID -->
</vehicle_id>

<time_table_version_id>
  <!-- Refer to SCH_TimeTableVersionID -->
</time_table_version_id>

<stop_point_zone_entry>
  <!-- Refer to OB_StopPointZoneEntry -->
</stop_point_zone_entry>

<stop_point_zone_exit>
  <!-- Refer to OB_StopPointZoneExit -->
</stop_point_zone_exit>

<door_record>
  <!-- Refer to ObDoorRecord -->
</door_record>

<sched_adherence_off_sched>
  <!-- Refer to PiSchedAdherenceOffSched -->
</sched_adherence_off_sched>
```

</ObStopPointRecord>

3.7 ObUpdate

The ObUpdate object represents all of the necessary software for an MDT to run that can be sent to MDT's from the central server for updating. The ObUpdate object contains information relating to the loader firmware, bin, wrapper, process and settings configuration files, and the version file.

<ObUpdate>

```
<loader>
  <!-- Refer to MDT_Loader -->
</loader>
```

```

<mdt>
    <!-- Refer to MDT_Bin -->
</mdt>

<mdt_wrapper>
    <!-- Refer to MDT_Wrapper -->
</mdt_wrapper>

<process>
    <!-- Refer to MDT_Process -->
</process>

<settings>
    <!-- Refer to MDT_Settings -->
</settings>

<version>
    <!-- Refer to MDT_Version -->
</version>

</ObUpdate>

```

3.8 PiSchedAdherenceOffSched

The PiSchedAdherenceOffSched object is used as a log for the schedule adherence of a bus on a given set of routes that is sent to central dispatch from the MDT. The object contains lists of information relating to the route number, the trip number, the name and id of the time point, the type of day, the stop point, the schedule's depart time, the vehicle's location at that time, and the amount of seconds off schedule.

Array List of:

<PiSchedAdherenceOffSched>

```

<route_id>
    <!-- Refer to SCH_RouteID -->
</route_id>

<trip_id>
    <!-- Refer to SCH_TripID -->
</trip_id>

<time_point_id>
    <!-- Refer to SCH_TimePointID -->
</time_point_id>

<time_point_name>
    <!-- Refer to SCH_TimePointName -->
</time_point_name>

<day_type>
    <!-- Refer to SCH_DayType -->
</day_type>

```

```

    <stop_point_sequence_no>
      <!-- Refer to SCH_StopPointSequenceNo -->
    </stop_point_sequence_no>

    <depart_time_scheduled>
      <!-- Refer to PI_DepartTimeScheduled -->
    </depart_time_scheduled>

    <vehicleLocation>
      <!-- Refer to SpGeoPoint -->
    </vehicleLocation>

    <off_schedule>
      <!-- Refer to PI_OffSchedule -->
    </off_schedule>
  </PiSchedAdherenceOffSched>

```

3.9 RealTimeVehiclePosition

The RealTimeVehiclePosition object represents the latitudinal and longitudinal inter-stop positions of a transit vehicle on route. RealTimeVehiclePosition contains a SpGeoPoint object that contains all necessary tracking information.

```

<RealTimeVehiclePosition>
  <GeoPoint>
    <!-- Refer to SpGeoPoint -->
  </GeoPoint>
</RealTimeVehiclePosition>

```

3.10 RoadsideBannerMsg

The RoadsideBannerMsg object represents custom messages to be sent to the Roadside Information Displays. RoadsideBannerMsg contains the message to be displayed.

```

<RoadsideBannerMsg>
  <message>
    <!-- Refer to RID_BannerMsg -->
  </message>
</RoadsideBannerMsg>

```

3.11 SchMasterSchedulePackage

The SchMasterSchedulePackage object contains all information regarding the schedule for a transit agency. This schedule can be transmitted from the central server to the MDT's as well as be used for verification of data sent by MDT's to the central dispatch. The object contains information relating to the version and period of validity of the schedule, a list of holidays and dates, a list of schedules for each route, and a list of all of the stop points for each stop.

```
<SchMasterSchedulePackage>

  <timeTableVersion>
    <!-- Refer to SchTimeTableVersion -->
  </timeTableVersion>

  <holidayList>
    <!-- Refer to a list of SchHoliday -->
  </holidayList>

  <masterScheduleList>
    <!-- Refer to a list of SchMasterSchedule-->
  </masterScheduleList>

  <stopPointList>
    <!-- Refer to a list of CptStopPoint -->
  </stopPointList>

</SchMasterSchedulePackage>
```

3.12 SchTimeTableVersion

The SchTimeTableVersion object is used by the MDT and the central server to confirm updates are made to the correct schedule when the updates are sent to MDT's from the server. This object contains the schedule version id, the schedule version name, and the activation and deactivation dates of the schedule.

```
<SchTimeTableVersion>

  <timetable_version_id>
    <!-- Refer to SCH_TimeTableVersionID -->
  </timetable_version_id>

  <timetable_version_name>
    <!-- Refer to SCH_TimeTableVersionName -->
  </timetable_version_name>

  <activation_date>
    <!-- Refer to CPT_ActivationDate -->
  </activation_date>

  <deactivation_date>
    <!-- Refer to CPT_DeactivationDate-->
  </deactivation_date>
```

```

    <agency_id>
      <!-- Refer to CPT_AgencyID>
    </agency_id>
  </SchTimeTableVersion>

```

3.13 SignUpdate

The SignUpdate object can be sent from the central server to the signs to update the sign code with the newest version. The SignUpdate object contains files relating to the assembly code of the sign.

```

<SignUpdate>
  <sign_assembly>
    Type: binary file
  </sign_assembly>
</SignUpdate>

```

3.14 TravInfoObStopPointRecord

The TravInfoObStopPointRecord object is sent from the Traveler Information API to External Data Syncs to provide information regarding departures from vehicle stops. This object contains information related to vehicle location, stop location, and schedule adherence at the stop.

```

<TravInfoObStopPointRecord>
  <agency_id>
    <!-- Refer to CPT_AgencyID -->
  </agency_id>

  <vehicle_id>
    <!-- Refer to CPT_PTVehicleID -->
  </vehicle_id>

  <time_table_version_id>
    <!-- Refer to SCH_TimeTableVersionID -->
  </time_table_version_id>

  <stop_point_zone_entry>
    <!-- Refer to OB_StopPointZoneEntry -->
  </stop_point_zone_entry>

  <stop_point_zone_exit>
    <!-- Refer to OB_StopPointZoneExit -->
  </stop_point_zone_exit>

```

```
<sched_adherence_off_sched>  
  <!-- Refer to PiSchedAdherenceOffSched -->  
</sched_adherence_off_sched>  
  
</TravInfoObStopPointRecord>
```


4. COMMON DATA OBJECTS

This section defines the format of each data object found in the Interface-Specific Data Objects listed in section 3 of this document. For example, the details for the `route_id` common data object, which is referenced in the `PiSchedAdherenceOffSched` Interface Specific Data Object, can be found in section 4.47, `SCH_RouteID`. The details of `SCH_RouteID` indicate that a Route ID will be a number valued between 0 and 100,000.

4.1 CptPTVehicleParameter

The `CptPTVehicleParameter` object contains the transit vehicle's mileage. It contains an element that determines whether or not the data is from the odometer, and it contains a value representing the mileage of the transit vehicle.

```
<CptPTVehicleParameter>
  <element>
    Range: 0 - 255
      0      - ERROR
      1      - ODOMETER
      2 - 254 - unspecified
      255    - UNSPECIFIED
  </element>
  <value>
    Range: 0 - 10000000
  </value>
</CptPTVehicleParameter>
```

4.2 CptStopPoint

The `CptStopPoint` object represents a point where public transportation customers board or arrive from a transit vehicle in revenue service. The object contains the name of the time point associated with the area, the id of the time point, and the gps location of the time point.

```
<CptStopPoint>
  <timePointID>
    <!-- Refer to SCH_TimePointID-->
  </timePointID>
  <timePointName>
    <!-- Refer to SCH_TimePointName -->
  </timePointName>
  <geoPoint>
    <!-- Refer to SpGeoPoint -->
  </geoPoint>
</CptStopPoint>
```

4.3 CPT_ActivationDate

The CPT_ActivationDate object contains the activation date of a schedule.

```
<CPT_ActivationDate>
```

```
  <!-- Date measured in seconds since January 1, 1970 - Unix epoch -->
```

```
  <CPT_ActivationDate_dt>
```

```
    Range: 0 - 2147483647
```

```
  </CPT_ActivationDate_dt>
```

```
</CPT_ActivationDate>
```

4.4 CPT_AgencyID

The CPT_AgencyID object contains a unique id number for each transit agency.

```
<CPT_AgencyID>
```

```
  <CPT_AgencyID_cd>
```

```
    Range: 0 - 32768
```

```
  </CPT_AgencyID_cd>
```

```
</CPT_AgencyID>
```

4.5 CPT_DeactivationDate

The CPT_DeactivationDate object contains the deactivation date of a schedule.

```
</CPT_DeactivationDate>
```

```
  <!-- Date measured in seconds since January 1, 1970 - Unix epoch -->
```

```
  <CPT_DeactivationDate_dt>
```

```
    Range: 0 - 2147483647
```

```
  </CPT_DeactivationDate_dt>
```

```
</CPT_DeactivationDate>
```

4.6 CPT_OperatorID

The CPT_OperatorID object contains a unique id for each transit staffperson that operates a transit vehicle.

```
<CPT_OperatorID>  
  <CPT_OperatorID_nbr>  
    Range: 0 - 4294967295  
  </CPT_OperatorID_nbr>  
</CPT_OperatorID>
```

4.7 CPT_PTVehicleID

The CPT_PTVehicleID object contains a unique id for each transit vehicle in a transit agency.

```
<CPT_PTVehicleID>  
  <CPT_PTVehicleID_nbr>  
    Range: 0 - 9999999  
  </CPT_PTVehicleID_nbr>  
</CPT_PTVehicleID>
```

4.8 CPT_SeverityLevel

The CPT_SeverityLevel object is a unique number assigned by a transit agency which defines the level of severity of an event that occurred or impacts transit property, facility, or service. A "1" assumes the greatest severity, and a 245 implies a low or absence of severity.

```
<CPT_SeverityLevel>  
  <CPT_SeverityLevel_nbr>  
    Range: 1 - 245  
  </CPT_SeverityLevel_nbr>  
</CPT_SeverityLevel>
```

4.9 FcBoardingTransaction

The FcBoardingTransaction object contains all of the information relating to a boarding rider and his/her transaction with the farecard machine. This contains the classification of the rider, the type of monetary instrument used, and the transaction result.

<FcBoardingTransaction>

```
<rider_classification>
  <!-- Refer to FC_RiderClassification -->
</rider_classification>

<monetary_instrument_type>
  <!-- Refer to FC_MonetaryInstrumentType -->
</monetary_instrument_type>

<transaction_result>
  <!-- Refer to FC_TransactionResult -->
</transaction_result>
```

</FcBoardingTransaction>

4.10 FcElectronicTransaction

The FcElectronicTransaction object contains all of the information relating to a transaction that occurs from the swipe card reader. This contains the boarding transaction object, the institution of the person whose card was swiped, and the account number of the person.

<FcElectronicTransaction>

```
<boarding_transaction>
  <!-- Refer to FcBoardingTransaction -->
</boarding_transaction>

<institution_id>
  <!-- Refer to FC_InstitutionID -->
</institution_id>

<account_id>
  <!-- Refer to FC_AccountID -->
</account_id>
```

</FcElectronicTransaction>

4.11 FC_AccountID

The FC_AccountID object is the account or customer identification.

```
<FC_AccountID>
  <FC_AccountID_txt>
    Range: 1 - 256 characters
  </FC_AccountID_txt>
</FC_AccountID>
```

4.12 FC_InstitutionID

The FC_InstitutionID object is the identification number of the institution of the customer.

```
<FC_InstitutionID>
  <FC_InstitutionID_nbr>
    Range: 0 - 99999999
  </FC_InstitutionID_nbr>
</FC_InstitutionID>
```

4.13 FC_ListType

The FC_ListType object describes the type of list an FC_MediaList is. It can be either a new list, addition, or a subtraction.

```
<FC_ListType>
  <FC_ListType_nbr>
    Range: 0 - 2
    - NEW_LIST
    - ADDITIONS
    - SUBTRACTIONS
  </FC_ListType_nbr>
</FC_ListType>
```

4.14 FC_MonetaryInstrumentType

The FC_MonetaryInstrumentType object describes the type of monetary instrument a customer used for the fare card. There are up to 255 different monetary instruments accepted.

<FC_MonetaryInstrumentType>

```
<FC_MonetaryInstrumentType_cd>
  Range: 1 - 255
    1          - bill
    2          - coin
    3          - token
    4          - ticket
    5          - debit
    6          - stored value
    7          - charge
    8          - hybrid
    9          - transit check
   10         - check card
   11 - 155 - reserved
   156 - 255 - local use
</FC_MonetaryInstrumentType_cd>
```

</FC_MonetaryInstrumentType>

4.15 FC_RiderClassification

The FC_RiderClassification object describes the type of rider entering the transit vehicle. There are up to 255 different types of riders accepted.

<FC_RiderClassification>

```
<FC_RiderClassification_nbr>
  Range: 1 - 255
    1          - regular
    2          - senior
    3          - child
    4          - student
    5          - youth
    6          - ADA customer
    7          - promotional
    8          - employee
    9          - retired employee
   10         - public assistance customer
   11 - 155 - reserved
   156 - 255 - local use
</FC_RiderClassification_nbr>
```

</FC_RiderClassification>

4.16 FC_TransactionResult

The FC_TransactionResult object describes the different states after a card has been swiped. There are up to 255 states that can be accounted for.

<FC_TransactionResult>

```
<FC_TransactionResult_cd>
  Range: 0 - 255
    0          - comment
    1          - successful transaction
    2 - 9      - reserved
    10         - read error
    11 - 19    - reserved
    20         - write error
    21 - 29    - reserved
    30         - verify error
    31 - 39    - reserved
    40         - validation status error
    41 - 49    - reserved
    50         - status error
    51 - 59    - reserved
    60         - other
    61 - 155   - reserved
    156 - 255 - local use
</FC_TransactionResult_cd>
```

</FC_TransactionResult>

4.17 IM_AcknowledgeType

The IM_AcknowledgeType describes the type or classification of an incident that occurs on a transit vehicle as it is acknowledged by the transit agency.

<IM_AcknowledgeType>

```
<IM_AcknowledgeType_cd>
  Range: 0 - 255
</IM_AcknowledgeType_cd>
```

</IM_AcknowledgeType>

4.18 IM_Active

The IM_Active object determines whether or not an incident is occurring.

```
<IM_Active>
  <active>
    Type: bool
    Range: TRUE/FALSE
  </active>
</IM_Active>
```

4.19 IM_EventDateTime

The IM_EventDateTime object describes the date and time an event occurs.

```
<IM_EventDateTime>
  <!-- Measured in seconds since January 1, 1970 - Unix epoch -->
  <IM_EventDateTime_tm>
    Range: 0 - 4294967295
  </IM_EventDateTime_tm>
</IM_EventDateTime>
```

4.20 IM_EventLocation

The IM_EventLocation describes information regarding the location of a transit vehicle during an emergency. The object contains the transit vehicle's id, the source device that detects the event, and the GPS location of the vehicle.

```
<IM_EventLocation>
  <vehicle_id>
    <!-- Refer to CPT_PTVehicleID -->
  </vehicle_id>
  <source_id>
    <!-- Refer to IM_SourceID -->
  </source_id>
  <time>
    <!-- Refer to IM_EventDateTime -->
  </time>
  <location>
    <!-- Refer to SpGeoPoint -->
  </location>
</IM_EventLocation>
```


4.21 IM_IncidentDescription

The IM_IncidentDescription object is a textual description of the incident that is occurring.

```
<IM_IncidentDescription>
  <IM_IncidentDescription_txt>
    Range: 1 - 256 characters
  </IM_IncidentDescription_txt>
</IM_IncidentDescription>
```

4.22 IM_IncidentType

The IM_AcknowledgeType describes the type or classification of an incident that occurs on a transit vehicle.

```
<IM_IncidentType>
  <IM_IncidentType_cd>
    Range: 1 - 255
  </IM_IncidentType_cd>
</IM_IncidentType>
```

4.23 IM_SourceID

The IM_SourceID object is the unique id of the source device that detects an event.

```
<IM_SourceID>
  <IM_SourceID_cd>
    Range: 0 - 65535
  </IM_SourceID_cd>
</IM_SourceID>
```

4.24 IM_SourceType

The IM_SourceType object describes the type of source device that detects an event.

```
<IM_SourceType>
  <IM_SourceType_cd>
    Range: 1 - 255
  </IM_SourceType_cd>
</IM_SourceType>
```

4.25 MDTStopPointRecord

The MDTStopPointRecord object describes all information recorded at a stop by the MDT. It contains information relating to when a transit vehicle enters and exits a stop point, and the transit vehicles schedule adherence. This object is used for logs.

```
<MDTStopPointRecord>

  <stop_point_entry>
    <!-- Refer to OB_StopPointZoneEntry -->
  </stop_point_entry>

  <stop_point_exit>
    <!-- Refer to OB_StopPointZoneExit -->
  </stop_point_exit>

  <schedule_adherence>
    <!-- Refer to PiSchedAdherenceOffSched -->
  </schedule_adherence>

</MDTStopPointRecord>
```

4.26 MDT_ActivityTime

The MDT_ActivityTime object describes the date and time of an action that occurs on the MDT.

```
<MDT_ActivityTime>

  <!-- Measured in seconds since January 1, 1970 - Unix epoch -->

  <MDT_ActivityTime_nbr>
    Range: 0 - 4294967295
  </MDT_ActivityTime_nbr>

</MDT_ActivityTime>
```

4.27 MDT_ActivityType

The MDT_ActivityType object describes the different types of actions that an MDT can perform. There are up to 50 accepted actions.

```
<MDT_ActivityType>
  <MDT_ActivityType_nbr>
    Range: 1 - 50
    1          - MDT Booted up
    2          - GPS Synchronized
    3          - Maintenance Mode activated
    4          - Logged on Route
    5          - Logs off Route
    6          - Reaches Stop
    7          - MDT loses GPS sync
    8 - 25    - reserved
    26 - 50   - local use
  </MDT_ActivityType_nbr>
</MDT_ActivityType>
```

4.28 MDT_Bin

The MDT_Bin object describes the binary for the Bin object that can be uploaded to an MDT.

```
<MDT_Bin>
  <MDT_bin_bn>
    Type: binary file
  </MDT_bin_bn>
</MDT_Bin>
```

4.29 MDT_Loader

The MDT_Loader object describes the binary for the Loader object that can be uploaded to an MDT.

```
<MDT_Loader>
  <MDT_loader_bn>
    Type: binary file
  </MDT_loader_bn>
</MDT_Loader>
```

4.30 MDT_Process

The MDT_Process object describes the process configuration file that can be uploaded to an MDT.

```
<MDT_Process>
  <MDT_process_bn>
    Type: binary file
  </MDT_process_bn>
</MDT_Process>
```

4.31 MDT_Route

The MDT_Route object describes the route number a transit vehicle is running.

```
<MDT_Route>
  <MDT_Route_nbr>
    Range: 0 - 1000
      0 - Not logged on to route
      1 - 1000 Route Number
  </MDT_Route_nbr>
</MDT_Route>
```

4.32 MDT_Settings

The MDT_Settings object describes the settings configuration file that can be uploaded to an MDT.

```
<MDT_Settings>
  <MDT_settings_bn>
    Type: binary file
  </MDT_settings_bn>
</MDT_Settings>
```

4.33 MDT_Version

The MDT_Version object describes the version configuration file that can be uploaded to an MDT.

```
<MDT_Version>
  <MDT_version_bn>
    Type: binary file
  </MDT_version_bn>
</MDT_Version>
```

4.34 MDT_Wrapper

The MDT_Wrapper object describes the binary for the Wrapper object that can be uploaded to an MDT.

```
<MDT_Wrapper>
  <MDT_wrapper_bn>
    Type: binary file
  </MDT_wrapper_bn>
</MDT_Wrapper>
```

4.35 ObDoorRecord

The ObDoorRecord object describes a record for all passengers that enter a transit vehicle. The object contains information relating to the number of passengers boarded, a list of each passengers boarding transaction as well as a list of their electronic transaction.

```
<ObDoorRecord>
  <passenger_boarding>
    <!-- Refer to OB_PassengerBoarding -->
  </passenger_boarding>
  <passenger_alighting>
    <!-- Refer to OB_PassengerAlighting -->
  </passenger_alighting>
  <boarding_transaction_list>
    <!-- Refer to a list of FcBoardingTransaction -->
  </boarding_transaction_list>
  <electronic_transaction_list>
    <!-- Refer to a list of FcElectronicTransaction -->
  </electronic_transaction_list>
</ObDoorRecord>
```

4.36 OB_PassengerBoarding

The OB_PassengerBoarding object describes the amount of passengers entering a transit vehicle.

```
<OB_PassengerBoarding>
  <OB_PassengerBoarding_qty>
    Range: 0 - 10000
  </OB_PassengerBoarding_qty>
</OB_PassengerBoarding>
```

4.37 OB_PassengerAlighting

The OB_PassengerAlighting object describes the amount of passengers exiting a transit vehicle. This value is helpful in determining how many people enter and exit at a given stop.

```
<OB_PassengerAlighting>
  <OB_PassengerAlighting_qty>
    Range: 0 - 10000
  </OB_PassengerAlighting_qty>
</OB_PassengerAlighting>
```

4.38 OB_StopPointZoneEntry

The OB_StopPointZoneEntry object describes the time at which a transit vehicle enters a stop point.

```
<OB_StopPointZoneEntry>
  <!-- Measured in seconds since January 1, 1970 - Unix epoch -->
  <OB_StopPointZoneEntry_tm>
    Range: 0 - 4294967295
  </OB_StopPointZoneEntry_tm>
</OB_StopPointZoneEntry>
```

4.39 OB_StopPointZoneExit

The OB_StopPointZoneExit object describes the time at which a transit vehicle leaves a stop.

```
<OB_StopPointZoneExit>
  <!-- Measured in seconds since January 1, 1970 - Unix epoch -->
  <OB_StopPointZoneExit_tm>
    Range: 0 - 4294967295
  </OB_StopPointZoneExit_tm>
</OB_StopPointZoneExit>
```

4.40 PI_DepartTimeScheduled

The PI_DepartTimeScheduled object describes the time a transit vehicle should depart a stop.

```
<PI_DepartTimeScheduled>
  <!-- Measured in minutes from midnight (HH*60+MM) -->
  <PI_DepartTimeScheduled_tm>
    Range: 0 - 1439
  </PI_DepartTimeScheduled_tm>
</PI_DepartTimeScheduled>
```

4.41 PI_OffSchedule

The PI_OffSchedule object describes the number of seconds a transit vehicle is off schedule.

```
<PI_OffSchedule>
  <!-- Measured in seconds from schedule departure time -->
  <PI_OffSchedule_tm>
    Range: 0 - 86400
  </PI_OffSchedule_tm>
</PI_OffSchedule>
```

4.42 RID_BannerMsg

The RID_BannerMsg object describes a custom banner message made in the ATRMS.

```
<RID_BannerMsg>
  <!-- Must conform to ASCII standards -->
  <RID_BannerMsg_txt>
    Range: 1 - 256 characters
  </RID_BannerMsg_txt>
</RID_BannerMsg>
```

4.43 SchHoliday

The SchHoliday object contains the information regarding a holiday that would be listed in the schedule. The object contains a description of the holiday as well as the date of the holiday with respect to the day of the year.

```
<SchHoliday>
  <description>
    <!-- Refer to SCH_HolidayDescription -->
  </description>
  <day_of_year>
    <!-- Refer to SCH_HolidayDate -->
  </day_of_year>
</SchHoliday>
```

4.44 SchMasterSchedule

The SchMasterSchedule object contains all of the trips on a route for the schedule. It contains a specified route and a list of trips for the route.

```
<SchMasterSchedule>
  <route>
    <!-- Refer to SchRoute -->
  </route>
  <trip_list>
    <!-- Refer to a list of SchTrip -->
  </trip_list>
</SchMasterSchedule>
```


4.45 SchRoute

The SchRoute object describes basic information regarding the designation and naming of a route. The object contains an identification number of the route, a route designator, and the text name of the route.

<SchRoute>

```
<route_id>
  <!-- Refer to SCH_RouteID -->
</route_id>

<route_designator>
  <!-- Refer to SCH_RouteDesignator -->
</route_designator>

<route_name>
  <!-- Refer to SCH_RouteName -->
</route_name>
```

</SchRoute>

4.46 SchTrip

The SchTrip object describes all of the information required to make a trip for a route on a schedule. The object contains the unique identification number of the trip, the type of day the trip takes place, the route the trip will run on, the time the trip begins, the time the trip ends, and a list of the trip time point headers.

<SchTrip>

```
<trip_id>
  <!-- Refer to SCH_TripID -->
</trip_id>

<day_type>
  <!-- Refer to SCH_DayType -->
</day_type>

<route_id>
  <!-- Refer to SCH_RouteID -->
</route_id>

<time_begin>
  <!-- Refer to SCH_TimeBegin -->
</time_begin>

<time_end>
  <!-- Refer to SCH_TimeEnd -->
</time_end>
```

```

    <trip_time_pt_hdr_list>
      <!-- Refer to a list of SchTripTimePtHdr-->
    </trip_time_pt_hdr_list>
  </SchTrip>

```

4.47 SchTripTimePtHdr

The SchTripTimePtHdr object describes all of the information needed to make a time point on a trip to be placed in a schedule. The object contains information relating to the unique identification number of the time point, the sequence number of the time point, the time a transit vehicle departs from the time point, how long a transit vehicle is to wait at a time point, and attributes regarding the time point.

```

<SchTripTimePtHdr>
  <time_point_id>
    <!-- Refer to SCH_TimePointID -->
  </time_point_id>
  <stop_point_sequence_no>
    <!-- Refer to SCH_StopPointSequenceNo -->
  </stop_point_sequence_no>
  <time_point_time>
    <!-- Refer to SCH_TripTimePtTime -->
  </time_point_time>
  <time_point_wait>
    <!-- Refer to SCH_TripTimePtWait -->
  </time_point_wait>
  <time_point_attribute>
    <!-- Refer to SCH_TripTimePtAttribute -->
  </time_point_attribute>
</SchTripTimePtHdr>

```

4.48 SCH_DayType

The SCH_DayType object is the type of day that a trip or route is run on in the schedule. There are up to 255 types of days accounted for.

<SCH_DayType>

```
<SCH_DayType_cd>
  Range: 1 - 255
    1      - Sunday
    2      - Monday
    3      - Tuesday
    4      - Wednesday
    5      - Thursday
    6      - Friday
    7      - Saturday
    8      - Holiday
    9      - Weekday
   10     - Weekend
   11     - Weekday, school closed
   12 - 149 - reserved
  150 - 245 - local use
  246     - Null
  247     - not used
  248     - reset to Null
  249     - Data Unavailable
  250     - Illegal calculation
  251     - Value Out of Range
  252     - Device malfunction (nothing returned)
  253     - Data no longer available
  254     - Data suppressed for security or privacy
  255     - Unspecified
</SCH_DayType_cd>
```

</SCH_DayType>

4.49 SCH_HolidayDate

The SCH_HolidayDate is the date that a holiday exists for use with the schedule to make holiday schedules.

<SCH_HolidayDate>

```
<!-- Measured in seconds since January 1, 1970 - Unix epoch -->

<SCH_HolidayDate_dt>
  Range: 0 - 4294967295
</SCH_HolidayDate_dt>
```

</SCH_HolidayDate>

4.50 SCH_HolidayDescription

The SCH_HolidayDescription is a short textual description of a day that is deemed a holiday in the schedule.

```
<SCH_HolidayDescription>
  <description>
    Range: 1 - 256 characters
  </description>
</SCH_HolidayDescription>
```

4.51 SCH_RouteDesignator

The SCH_RouteDesignator object describes a real world view of what route a transit vehicle is running.

```
<SCH_RouteDesignator>
  <SCH_RouteDesignator_txt>
    Range: 1 - 8 characters
  </SCH_RouteDesignator_txt>
</SCH_RouteDesignator>
```

4.52 SCH_RouteID

The SCH_RouteID object describes the number of the route a transit vehicle is running.

```
<SCH_RouteID>
  <SCH_RouteID_nbr>
    Range: 0 - 100000
  </SCH_RouteID_nbr>
</SCH_RouteID>
```

4.53 SCH_RouteName

The SCH_RouteName object describes the textual description for the name of a route a transit vehicle is running.

```
<SCH_RouteName>
  <route_name>
    Range: 1 - 17 characters
  </route_name>
</SCH_RouteName>
```

4.54 SCH_StopPointSequenceNo

The SCH_StopPointSequenceNo object is used to describe the order in which a time point is placed in a trip for a schedule.

```
<SCH_StopPointSequenceNo>
  <SCH_StopPointSequenceNo_nbr>
    Range: 0 - 65535
  </SCH_StopPointSequenceNo_nbr>
</SCH_StopPointSequenceNo>
```

4.55 SCH_TimeBegin

The SCH_TimeBegin object describes the time of day a trip begins on a route.

```
<SCH_TimeBegin>
  <!-- Measured in seconds from midnight -->
  <SCH_TimeBegin_tm>
    Range: 0 - 86399
  </SCH_TimeBegin_tm>
</SCH_TimeBegin>
```

4.56 SCH_TimeEnd

The SCH_TimeEnd object describes the time of day a trip ends on a route.

```
<SCH_TimeEnd>
  <!-- Measured in seconds from midnight -->
  <SCH_TimeEnd_tm>
    Range: 0 - 86399
  </SCH_TimeEnd_tm>
</SCH_TimeEnd>
```

4.57 SCH_TimePointID

The SCH_TimePointID object describes the unique identifier for a given time point.

```
<SCH_TimePointID>
  <SCH_TimePointID_nbr>
    Range: 0 - 1000000
  </SCH_TimePointID_nbr>
</SCH_TimePointID>
```

4.58 SCH_TimePointName

The SCH_TimePointName object is the textual description of a given time point.

```
<SCH_TimePointName>
  <SCH_TimePointName_txt>
    Range: 1 - 40 characters
  </SCH_TimePointName_txt>
</SCH_TimePointName>
```

4.59 SCH_TimeTableVersionID

The SCH_TimeTableVersionID object describes the unique identifier for the version number of a schedule.

```
<SCH_TimeTableVersionID>
  <SCH_TimeTableVersionID_nbr>
    Range: 0 - 65535
  </SCH_TimeTableVersionID_nbr>
</SCH_TimeTableVersionID>
```

4.60 SCH_TimeTableVersionName

The SCH_TimeTableVersionName object is a textual description of the schedule version.

```
<SCH_TimeTableVersionName>
  <SCH_TimeTableVersionName_txt>
    Range: 1 - 17 characters
  </SCH_TimeTableVersionName_txt>
</SCH_TimeTableVersionName>
```

4.61 SCH_TripID

The SCH_TripID is the unique identifier for the number of a trip for a schedule.

<SCH_TripID>

```
<SCH_TripID_nbr>
  Range: 0 - 65535
</SCH_TripID_nbr>
```

</SCH_TripID>

4.62 SCH_TripTimePtAttribute

The SCH_TripTimeAttribute object represents the various Boolean attributes that a stop on a trip would contain in the schedule. This object contains Booleans for whether or not it is a flagged stop, if there is a time point there, if it should report the time to the driver, if it should verify the location, if passengers will board there, if the stop is repeated on the trip, if it is a start or end point for a waypoint, or if it is a waypoint.

<SCH_TripTimePtAttribute>

```
<flag_stop>
  Type: bool
  Range: TRUE/FALSE
</flag_stop>

<time_point>
  Type: bool
  Range: TRUE/FALSE
</time_point>

<report_time_to_driver>
  Type: bool
  Range: TRUE/FALSE
</report_time_to_driver>

<location_verification>
  Type: bool
  Range: TRUE/FALSE
</location_verification>

<passenger_boarding>
  Type: bool
  Range: TRUE/FALSE
</passenger_boarding>

<repeated_stop_on_trip>
  Type: bool
  Range: TRUE/FALSE
</repeated_stop_on_trip>
```

```

<start_wait_for_waypoint>
  Type: bool
  Range: TRUE/FALSE
</start_wait_for_waypoint>

<end_wait_for_waypoint>
  Type: bool
  Range: TRUE/FALSE
</end_wait_for_waypoint>

<waypoint>
  Type: bool
  Range: TRUE/FALSE
</waypoint>
</SCH_TripTimeAttribute>

```

4.63 SCH_TripTimePtTime

The SCH_TripTimePtTime object represents the time a trip takes place for a bus stop. SCH_TripTimePtTime contains a quantity representing the time a trip takes place.

```

<SCH_TripTimePtTime>
  <!-- Measured in minutes from midnight (HH*60+MM) -->

  <SCH_TripTimePtTime_tm>
    Range: 0 - 1439
  </SCH_TripTimePtTime_tm>
</SCH_TripTimePtTime>

```

4.64 SCH_TripTimePtWait

The SCH_TripTimePtWait object represents the time a bus waits at a bus stop on route. SCH_TripTimePtWait contains a quantity for the amount of time in a day that a bus must wait.

```

<SCH_TripTimePtWait>
  <!-- Measured in seconds from midnight -->

  <SCH_TripTimePtWait_tm>
    Range: 0 - 86399
  </SCH_TripTimePtWait_tm>
</SCH_TripTimePtWait>

```


4.65 SpGeoPoint

The SpGeoPoint object represents the location of a bus stop or a bus on route. SpGeoPoint contains latitude, longitude, angular heading of the direction of travel, and spatial coordinate system datum.

<SpGeoPoint>

```
<latitude>
    <!-- Refer to SP_Latitude -->
</latitude>

<longitude>
    <!-- Refer to SP_Longitude -->
</longitude>

<direction>
    <!-- Refer to SP_AngularDirection -->
</direction>

<datum>
    <!-- Refer to SP_Datum -->
</datum>
```

</SpGeoPoint>

4.66 SP_AngularDirection

The SP_AngularDirection object represents the angular heading of the direction of travel for a bus stop or a bus on route. SP_AngularDirection contains a quantity for the angular direction.

<SP_AngularDirection>

```
<!-- Measured in degrees = ddd -->

<SP_AngularDirection_qty>
    Range: 000 - 359
</SP_AngularDirection_qty>
```

</SP_AngularDirection>

4.67 SP_Datum

The SP_Datum object represents the spatial coordinate system used by the bus on route or at that stop. SP_Datum contains a quantity to represent one of three types of coordinate systems.

<SP_Datum>

```
<SP_Datum_cd>
  Range: 1 - 3
        1 - NAD27
        2 - NAD83
        3 - WGS84
</SP_Datum_cd>
```

</SP_Datum>

4.68 SP_Latitude

The SP_Latitude object represents the latitudinal location for a bus stop or a bus on route. SP_Latitude contains a quantity for the latitude that is interpreted as discussed below.

<SP_Latitude>

```
<!-- Made From:
      For North: (latitude_degrees + (latitude_minutes/360.0)) *
                 (2147483647/90)
      For South: - (latitude_degrees + (latitude_minutes/360.0)) *
                 (-2147483647/90)
-->
```

```
<!--
      NOTE: latitude_degrees and latitude_minutes in form of RMC of NMEA
            Standard
-->
```

```
<SP_Latitude_sp>
  Type: 9 - 10 digit number
  Range: 000000000 - 2147483647
</SP_Latitude_sp>
```

</SP_Latitude>

4.69 SP_Longitude

The SP_Longitude object represents the longitudinal location for a bus stop or a bus on route. SP_Longitude contains a quantity for the longitude that is interpreted as discussed below.

<SP_Longitude>

```
<!-- Made From:
      For East: (longitude_degrees + (longitude_minutes/360.0)) *
                (2147483647/180)
      For West: -(longitude_degrees + (longitude_minutes/360.0)) *
                (-2147483647/180)
-->

<!--
      NOTE: longitude_degrees and longitude_minutes in form of RMC of NMEA
            Standard
-->

<SP_Longitude_sp>
  Type: 9 - 10 digit number
  Range: 0000000000 - 2147483647
</SP_Longitude_sp>
```

</SP_Longitude>