Data Server

Model Deployment Initiative

Acceptance Test Plan

Version 1.1

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Acronym List

ATMS	Advanced Traffic Management System
ATP	Acceptance Test Plan
AVI	Automatic Vehicle Identification
AVIC	Automatic Vehicle Identification Component
AWARD	Advance Warning to Avoid Railroad Delay
CMS	Changeable Message Sign
DCIS	Data Consumer Interface Subsystem
DGIS	Data Generator Interface Subsystem
DGS	Data Generator Subsystem
DS	Data Server
DSC	Data Server Component
DSILC	Data Server Interface Library Component
DSILS	Data Server Interface Library Subsystem
DSS	Data Server Subsystem
GPS	Global Positioning System
GPSTHC	Global Positioning System / Theoretical Data Component
GUI	Graphical User Interface
ID	Identifier
IVN	In-Vehicle Navigation
IVNIC	In-Vehicle Navigation Interface Component
LCGUIC	Lane Closure GUI Component
LCS	Lane Control Signal
MCS	Master Computer Subsystem
MDI	Model Deployment Initiative
RCIC	Road Closed Interface Component
RDIC	Realtime Data Interface Component
RFO	Request For Offer
RTBC	Realtime Data Broadcast Component
RTCIC	Realtime Collect Interface Component
SAAWDB	San Antonio Area Wide Database
SGUIC	Status Graphical User Interface Component
SGUIS	Status Graphical User Interface Subsystem
SwRI	Southwest Research Institute
TG	TransGuide
TxDOT	Texas Department of Transportation
VIC	VIA Interface Component
WIC	Weather Interface Component
WWW	World Wide Web
WWWIC	World Wide Web Interface Component
911IC	911 Interface Component

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Software Acceptance Test Plan

1. SCOPE

This document establishes the Software Acceptance Test Plan (ATP) for the Data Server project of the TransGuide Model Deployment Initiative (MDI) System Integration program performed by Southwest Research Institute (SwRI) for the Texas Department of Transportation (TxDOT).

1.1 Identification

This ATP is developed to provide the acceptance criteria and tests for the MDI Data Server. The basis for the development of this ATP document is the Data Server Model Deployment Initiative Software Design Document Version 1.0. The ATP is developed for testing the Data Server applications of the Data Server Master Computer Version 1.0. These applications are identified in the Data Server Model Deployment Initiative Version Description Document, Version 1.0.

1.2 System Overview

The Data Server is the central archive within the TransGuide environment for storing the data that is necessary to support both the TransGuide Advanced Traffic Management Systems (ATMS) operations and the MDI projects. The MDI Data Server is an extension of the first-generation Data Server developed by SwRI on the TransGuide Software Maintenance contract. Storing the data collected and utilized by the TransGuide system in a central common data repository, allows the MDI projects to seamlessly access the information they need. The Data Server is developed around the concept of Data Generators, which supply data, and Data Consumers, which access the data stored.

The Data Server is not a traditional database, instead the data in the Data Server is stored in shared memory, and in files. Data that is of limited and known size, such as speed data from the various types of TransGuide segments, is stored in shared memory. Data that is of varying amount, such as ATMS incidents and lane closures, is stored in files. The Data Server is also capable of storing files for later retrieval. In addition to traffic data, the Data Server also receives and stores a heartbeat message from each of the MDI subsystems in shared memory.

The data and files sent to the Data Server by the Data Generators can be requested by the Data Consumers. The heartbeat messages and other status information is accessed at regular intervals, and displayed on the MDI System Status Graphical User Interface (GUI). This status GUI allows the user to determine the overall status of the MDI subsystems at a glance. Each subsystem has a window on the GUI, which allows the user to get a detailed status of that sub-system.

Figure 1.1 shows a diagram of the Data Server system architecture.

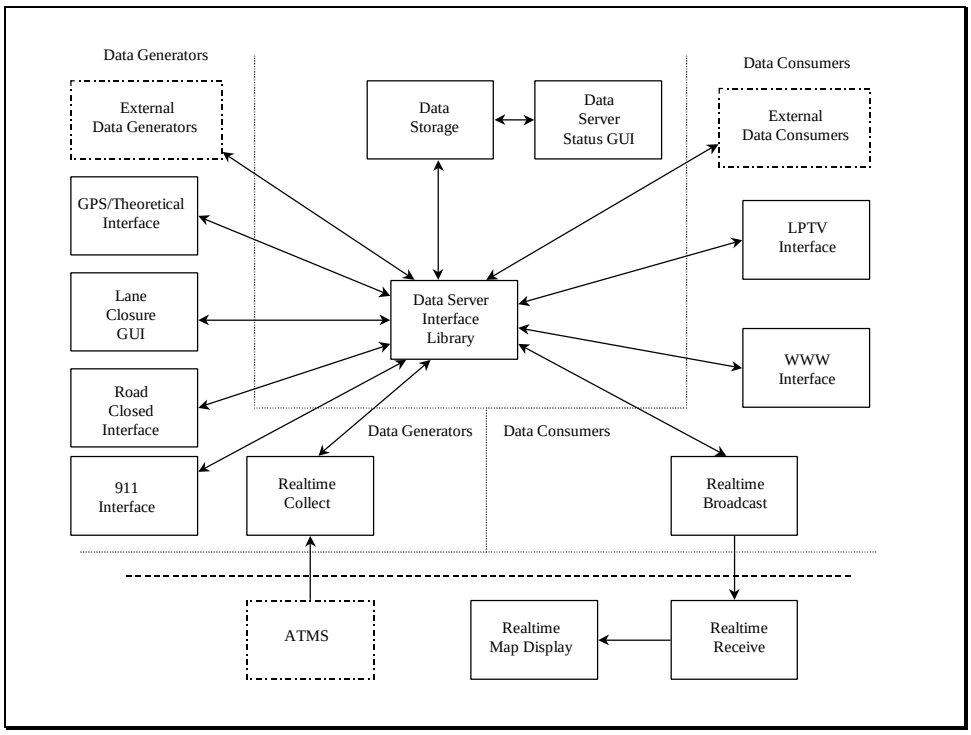

Figure 1.1 Data Server System Architecture

1.3 Goals and Objectives

The Data Server design gives consideration to the following design goals and objectives:

- The MDI Data Server shall provide a central access point for the storage and distribution of data for both the TransGuide ATMS and the MDI subsystems.
- The Data Server shall treat traffic management data in a homogeneous fashion to allow applications to seamlessly access data.
- The Data Server shall store the data so that it can be geographically filtered when accessed.
- The Data Server shall provide rapid response to data requests.
- The Data Server shall easily incorporate new data sources in the future.
- The Data Server shall be implemented with data structures that closely resemble the TransGuide graphical map data structures.
- The Data Server shall be integrated into the existing TransGuide environment with minimal impact on the existing TransGuide ATMS.

- The Data Server shall use intelligent map objects (similar to those stored in the TransGuide ATMS map) to store data.

1.4 Referenced Documents

Southwest Research Institute, *Proposal for the Model Deployment Initiative System Integration*, SwRI Proposal No. 10-20352, November 1996.

Texas Department of Transportation, *Request for Offer (RFO) for the Model Deployment Initiative System Integration, 60115-7-70030*, Specification No. TxDOT 795-SAT-01, October 1996.

Southwest Research Institute, *Data Server Model Deployment Initiative Preliminary Software Design Document*, Version 1.0, February 1997.

Southwest Research Institute, *Data Server Model Deployment Initiative Software Development Plan*, Version 2.0, November 1997.

2. TEST DESCRIPTIONS

This section describes the test procedures for executing the Data Server Software ATP. The test cases to be completed during execution of this ATP have been designed to demonstrate that the Data Server System meets all specified requirements. Each of these requirements are further documented in Section 3 in the traceability matrix. For each requirement, the matrix contains traceability information to show the relationship between the requirement and other requirements, design elements, and the ATP.

The ATP is divided into individual test cases that are grouped by function. Each test case will include a synopsis of the function being tested, the requirements being verified, a description of the Data Server system components and special test configurations, the test protocol, and an appropriate space for recording test results. The tests will be identified with a project unique identifier. This identifier will have the following format:

<System Mnemonic> - <Subsystem Mnemonic> - <Test Number>

The System Mnemonic for the Data Server is DS. The Subsystem Mnemonic is an acronym for the subsystem that is tested, and the Test Number is a sequential number within the subsystem being tested.

The goal of this ATP is to demonstrate the capability of the Data Server system in its operational environment and to validate that it meets TxDOT requirements. Test cases contained in this ATP have been derived from the requirements contained in the *Data Server Model Deployment Initiative Software Design Document*. This "black box" testing strategy is designed to discover faults of omission by identifying which requirements have and have not been fulfilled. Execution of test cases will follow the order defined in the ATP; however, individual test cases may be executed during regression testing.

2.1 DS-PHYS Test

This test verifies that the Data Server System's physical requirements are met.

2.1.1 Hardware Preparation

Data Server Master Computer installed in operating configuration.

2.1.2 Software Preparation

None.

2.1.3 Other Pre-test Preparation

Make sure that no one else is logged on to the Data Server while this test is being performed.

2.1.4 Test Descriptions

The following test case is implemented under this test:

DS-PHYS-01 Data Server Master Computer Physical Requirements

2.1.4.1 DS-PHYS-01 Data Server Master Computer Physical Requirements

This test case verifies that the physical requirements for the Data Server Master Computer are met.

2.1.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.1.

Table 2.1 Requirements Addressed by Test DS-PHYS-01

REQUIREMENT NUMBER	REQUIREMENT
DS-PY-1	The system will reside on a computer separate from the TG operational computers.
DS-PY-1.1	The Master Computer Subsystem (MCS) shall be a Sun Microsystems Ultra SPARCStation or better
DS-PY-1.2	The MCS shall have, at a minimum, the following items: • 167MHz SPARC CPU • 4.2 GB Hard Disk • 128 MB RAM • Floppy Disk drive • CD-ROM drive • Turbo GX+ Graphics • 20" Sun color monitor • 2 Ethernet interfaces • 2 SCSI channels

2.1.4.1.2 Prerequisite Conditions

None.

2.1.4.1.3 Test Inputs

None.

2.1.4.1.4 Test Results Evaluation

Results will be validated through inspection and demonstration. Since TxDOT procured the Data Server Master Computer hardware, TxDOT will be responsible for resolving any issues that arise if the equipment does not meet the physical requirements.

2.1.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a window on the Data Server Master Computer.
2. Enter the UNIX command *dmesg* in the window.
3. Inspect the output of the command, and verify that the line starting with 'cpu...' specifies a 167MHz SPARC CPU or better.
4. Inspect the same output, and verify that the line starting with 'mem...' specifies at least 128 MB of memory.
5. Inspect the same output, and verify that there are at least 2 Ethernet interfaces (lines that contain one of the strings 'be0', 'hme0', 'tp0' or 'le0').
6. Make sure that the CD-ROM drive has a disk in it. Enter the UNIX command *df*. Inspect the output generated by the command, and verify that there is a line that indicates the presence of a floppy disk drive (/dev/fd), and another line that indicates the presence of a CD-ROM drive (/cdrom/...).
7. Login as root, and type the UNIX command *format*. The output of this command lists the existing Hard Disk drive(s). Verify that the size(s) of the disk(s) add up to at least 4.2 GB. Specify a disk drive number as requested by the prompt. Then enter 'quit' after the format menu has been displayed. (Do NOT format the disk).
8. Enter the UNIX command *prtconf* in the window. Inspect the output of the command, and verify that there are at least 2 SCSI channels (lines that contain the string 'fas').
9. Visually inspect the monitor and verify that it is a 20" Sun color monitor, or better.

2.1.4.1.6 Assumptions and Constraints

None.

2.1.4.1.7 Test Results

Comments:

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2.2 DS-RD Test

This test verifies that the requirements attributable to the Roadway Closed Database interface process are met.

2.2.1 Hardware Preparation

- Data Server Master Computer running in normal mode.
- TransGuide Web Server running in normal mode.

2.2.2 Software Preparation

- Data Server process running on Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.
- Roadway Closed Database interface process running on the Data Server Master Computer.

2.2.3 Other Pre-test Preparation

This test should not be performed while the Highway Condition file is being updated (which occurs approximately 10 minutes after the hour during the workday, and additionally at approximately 8:40 am). Log in as *mdi* to execute this test.

2.2.4 Test Descriptions

The following test cases are implemented under this test:

DS-RD-01 Roadway Closed Database interface process status information test.

DS-RD-02 Roadway Closed Database file transfer test.

2.2.4.1 DS-RD-01 Roadway Closed Database interface process status information test

This test case verifies that the Roadway Closed Database interface process interfaces with the Data Server, and that the MDI System Status GUI reflects its process status.

2.2.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.2.

Table 2.2 Requirements Addressed by Test DS-RD-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TransGuide (TG) Operations user.
DS-IF-3.1	The Data Generator Subsystem (DGS) shall interface with the TG Operations user using a GUI.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3.2	The Status Graphical User Interface Subsystem (SGUIS) shall interface with the TG Operations user using a GUI.
DS-IF-3.2.1	The Status Graphical User Interface Component (SGUIC) shall interface with the user using a GUI.
DS-FN-9	The system shall maintain MDI System status data.
DS-FN-9.9	The SGUIS shall display DS DGIS process information.
DS-FN-9.9.5	The SGUIC shall display DS Road Closed Interface Component (RCIC) process status information.

2.2.4.1.2 Prerequisite Conditions

This test case assumes that the system is running normally and that the Roadway Closed Database interface process (as shown on the Data Server detailed status window) is operating normally before starting the test.

2.2.4.1.3 Test Inputs

The input to this test is the Highway Condition Report file, 'REPORT', that has been stored on the Web-server by the Texas State Roadway Closed database. This file is periodically updated by the Texas State Roadway Closed database.

2.2.4.1.4 Test Results Evaluation

This test case will demonstrate that the Roadway Closed Database interface process interfaces with the MDI System Status GUI.

Before running this test, the Data Server detailed status window is inspected to verify that the heartbeats from the Road Closed Database interface process are being received at regular intervals, and that the background color of the Data Server window header in the Status GUI is green. When the Highway Condition Report file is removed, the heartbeats should continue as before, but the background color of the Data Server window header should change to red within a few minutes, due to the status of the Road Closed Database interface process status having changed. The color will change the next time that the process checks to see if the Highway Conditions file has been updated. This time depends on the *FREQUENCY* parameter in the Roadway Closed configuration file $ATMS/etc/road_closed.cfg. When the file is restored, the Data Server window header's background color should change back to green, indicating the status of the process.

2.2.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the Data Server status window header in the Status GUI. The background color should be green.
2. Click on the Data Server window on the Status GUI to display the detailed status window.
3. Observe that the time indicating when the latest heartbeat was received from the Road Closed File Transfer process is updating. The update rate depends on the heartbeat interval specified by the *FREQUENCY* value in the Roadway Closed configuration file $ATMS/etc/road_closed.cfg, and the *MAX_HB_INTERVAL* value in the MDI configuration file $ATMS/etc/mdi.cfg. The actual update rate is the lesser of these two values.
4. Open a terminal window on the Web-server. In that window, change into the Roadway Closed Database file directory by entering the UNIX command *cd ../hwycond*. The name of this directory is specified by the *DIRECTORY_PATH* value in the Roadway Closed configuration file $ATMS/etc/road_closed.cfg. Rename the Highway Condition Report file 'REPORT' to a different name, using the command *mv REPORT <new_name>*.
5. When the report file is checked again (the time interval at which the file is checked is specified by the *FREQUENCY* value in the Roadway Closed configuration file $ATMS/etc/roadclosed.cfg), the background color of the Data Server status window header should turn red when the report file cannot be found.
6. Restore the name of the report file to 'REPORT', using the command *mv <new_name> REPORT*.
7. When the report file is checked next time, the background color of the Data Server status window header should turn green.
8. Close the detailed status window.

2.2.4.1.6 Assumptions and Constraints

Make sure that this test is not executed while a new Highway Condition Report file is being transferred to the Web-server (at approximately 10 minutes past the hour during the workday, and additionally at approximately 8:40 am). This file is automatically created, if it does not previously exist, or written over the previous file, if one exists.

2.2.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.2.4.2 DS-RD-02 Roadway Closed Database file transfer test

This test case verifies the transfer of the non-construction related information contained in the Highway Conditions file from the Web-server to the Data Server Master Computer. This test retrieves the resulting file from the Data Server process, and compares its information to the Highway Conditions Report that is published on the World Wide Web (WWW).

2.2.4.2.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.3.

Table 2.3 Requirements Addressed by Test DS-RD-02

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-4	The system shall interface with the Texas State Roadway Closed database.
DS-IF-4.1	The Data Generator Interface Subsystem (DGIS) shall interface with the Texas State Roadway Closed database.
DS-IF-4.1.1	The RCIC shall interface with the Texas State Roadway Closed database.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-4	The system shall maintain lane closure data.
DS-FN-4.1	The Data Server Subsystem (DSS) shall store State of Texas lane closure data.
DS-FN-4.1.1	The Data Server Component (DSC) shall store non-construction related lane closure information for State of Texas roadway closed data.
DS-FN-4.4	The DGIS shall acquire State of Texas roadway closed data.
DS-FN-4.4.1	The RCIC shall acquire non-construction related lane closure information for State of Texas road closed data.
DS-FN-4.5	The Data Server Interface Library Subsystem (DSILS) shall provide State of Texas roadway closed data.

2.2.4.2.2 Prerequisite Conditions

This test case assumes that the previous test was successfully completed. Make sure that the Data Server Process is running on the Data Server Master Computer and that the latest Highway Condition report file exists in its directory on the Web-server.

2.2.4.2.3 Test Inputs

None.

2.2.4.2.4 Test Results Evaluation

This test case will demonstrate that the non-construction related road closures will be extracted from the Highway Condition Report, stored in a file, which is transferred to the Data Server, where it is stored. The stored file is inspected to verify that the data matches the information displayed on TxDOT's Web-page.

2.2.4.2.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a terminal window on the Data Server. In that window, change to the Data Server bin directory by entering the UNIX command *cd $ATMS/bin*.
2. Retrieve the latest Highway Condition report from the Data Server by running *get_file REPORT* in the terminal window.
3. Using a Web browser, view the Highway Condition Report Web-page, located at http://www.dot.state.tx.us/highway.html.
4. In the terminal window, view the filtered Highway Condition Report file 'REPORT' by entering *more /tmp/REPORT*.

5. Select non-construction related closures from the Web-page at random and compare them with the closures listed in the '/tmp/REPORT' file.

2.2.4.2.6 Assumptions and Constraints

The Highway Condition Report is updated hourly throughout the day, at approximately 10 minutes after the hour. In addition to this, an extra update is performed at approximately 8:40 am. Care must be taken not to run this test while an update is being done, to insure that the information is in synch throughout the test.

2.2.4.2.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.3 DS-GPSTH Test

This test verifies that the requirements attributable to the Global Positioning System (GPS)/Theoretical process are met.

2.3.1 Hardware Preparation

- Data Server Master Computer running in normal mode.

2.3.2 Software Preparation

- Data Server Process running on the Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.
- Realtime Map Display running on a workstation.

2.3.3 Other Pre-test Preparation

Login as *mdi* to execute this test.

2.3.4 Test Descriptions

DS-GPSTH-01 GPS/Theoretical process status information test.

DS-GPSTH-02 GPS/Theoretical process travel data test.

DS-GPSTH-03 GPS/Theoretical process adjustment factor test.

2.3.4.1 DS-GPSTH-01 GPS/Theoretical process status information test

This test case verifies that the GPS/Theoretical process interfaces with the Data Server and that the MDI System Status GUI reflects its process status.

2.3.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.4.

Table 2.4 Requirements Addressed by Test DS-GPSTH-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-3.2	The SGUIS shall interface with the TG Operations user using a GUI.
DS-FN-9	The system shall maintain MDI System status data.
DS-FN-9.1	The DGS shall monitor DGS process status information.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-9.1.3	The Global Positioning System / Theoretical Data Component (GPSTHC) shall provide GPSTHC process status information.
DS-FN-9.8	The SGUI shall display DSDGS process status information.
DS-FN-9.8.3	The SGUI shall display DS GPSTHC process status information.

2.3.4.1.2 Prerequisite Conditions

This test case assumes that the system is running normally, and that the GPS/Theoretical process (as shown on the Data Server detailed status window) is operating normally before starting the test.

2.3.4.1.3 Test Inputs

The input to this test is the GPS/Theoretical process data file, and the heartbeat from the GPS/Theoretical process.

2.3.4.1.4 Test Results Evaluation

This test case will demonstrate that the GPS/Theoretical process interfaces with the MDI System Status GUI.

Before running this test, the Data Server detailed status window is inspected to verify that the heartbeats from the GPS/Theoretical process are being received at regular intervals, and that the background color of the Data Server window header in the Status GUI is green. When the GPS/Theoretical process data file is removed, the heartbeats should continue as before, but the background color of the Data Server window header should change to red within a few minutes, due to the status of the GPS/Theoretical process having changed the next time it attempts to read the data file. The data file is read every 15 minutes on the even quarter hour (on the hour and 15, 30 and 45 minutes past the hour). When the file is restored, the Data server window header's background color should change back to green.

2.3.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the Data Server status window header in the Status GUI. The background color should be green.
2. Click on the Data Server status window on the Status GUI to display the detailed status window.

3. Observe that the time indicating when the latest heartbeat was received from the GPS/Theoretical process, is updating. This update rate is specified by the *GPSTH_HB_INTERVAL* value in the Data Server configuration file $ATMS/etc/dataserver.cfg.
4. Open a terminal window on the Data Server. In that window, change to the GPS/Theoretical process data directory by entering the UNIX command *cd $ATMS/data*. The name of this directory is specified by the *GPSTH_DATA_PATH* value in the Data Server configuration file $ATMS/etc/dataserver.cfg. Rename the GPS/Theoretical process data file gpsth_data.dat to a different name, using the command *mv gpsth_data.dat <new_name>*. The name of the data file is specified by the *GPSTH_DATA_FILE* value in the Data Server configuration file.
5. When the GPS/Theoretical process attempts to read the data file the next time (at the next even quarter hour), the background color of the Data Server status window header should turn red when the data file is not found.
6. Restore the name of the data file to 'gpsth_data.dat', by using the UNIX command *mv <new_name> gpsth_data.dat*.
7. When the data file is read the next time, the background color of the Data Server status window header should turn green.

2.3.4.1.6 Assumptions and Constraints

Make sure that this test is started in ample time to perform the necessary steps before the even quarter hour.

2.3.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.3.4.2 DS-GPSTH-02 GPS/Theoretical process travel data test.

This test case verifies that the GPS/Theoretical process sends travel data for the GPS and Theoretical TransGuide road segments at 15-minute intervals to the Data Server. The test also verifies that this data is then stored to the Data Server, from where it can be retrieved and sent to Data Consumers, such as the Realtime Map Display.

2.3.4.2.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.5.

Table 2.5 Requirements Addressed by Test DS-GPSTH-02

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-3	The system shall maintain travel data for the TG road segments.
DS-FN-3.3	The DSS shall store theoretical travel data for the theoretical TG road segments.
DS-FN-3.3.1	The DSC shall store the current theoretical vehicle speed associated with theoretical TG road segments.
DS-FN-3.4	The DSS shall store GPS travel data for the GPS TG road segments.
DS-FN-3.4.1	The DSC shall store the current GPS-measured vehicle speed associated with GPS TG road segments.
DS-FN-3.5	The DGS shall store theoretical travel data for the theoretical TG road segments at 15-minute time intervals.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-3.5.1	The GPSTH C shall store the vehicle speed at 15-minute time intervals for theoretical TG road segments.
DS-FN-3.6	The DGS shall store GPS travel data for the GPS TG road segments at 15-minute intervals.
DS-FN-3.6.1	The GPSTH C shall store the vehicle speed at 15-minute time intervals for GPS TG road segments and theoretical TG road segments.
DS-FN-3.11	The Data Consumer Interface Subsystem (DCIS) shall provide theoretical travel data for the theoretical TG road segments.
DS-FN-3.11.3	The Real-time Data Broadcast Component (RTBC) shall provide the current theoretical vehicle speed associated with theoretical TG road segments to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-3.12	The DCIS shall provide GPS travel data for the GPS TG road segments.
DS-FN-3.12.3	The RTBC shall provide the current GPS-measured vehicle speed associated with GPS TG road segments to the TG ATMS Map system, the MDI In-Vehicle Navigation (IVN)/KIOSK System, and other ATMS data broadcast listeners.

2.3.4.2.2 Prerequisite Conditions

This test case assumes that the previous test case was successfully completed, that the system is running normally, and that the GPS/Theoretical process (as shown on the Data Server detailed status window) is operating normally before starting the test.

This test should not be started too close before an even quarter hour, when the new speeds are sent to the Data Server process, replacing any speeds that were there.

2.3.4.2.3 Test Inputs

The test inputs for this test case are contained in the GPS/Theoretical test data file 'gpsth_data.dat'. These speeds are sent by the GPS/Theoretical process to the Data Server at 15-minute intervals.

2.3.4.2.4 Test Results Evaluation

This test case will demonstrate that the GPS/Theoretical process updates travel data for the GPS/Theoretical TransGuide road segments at 15-minute intervals. The speeds for selected GPS/Theoretical segments are inspected to verify the change.

2.3.4.2.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a terminal window on the workstation. In that window, change to the Data Server bin directory $ATMS/bin.
2. Get the current speed for a randomly selected GPS or Theoretical road segment by running *get_gpsth_data <segment link ID>* in the terminal window. Note the speed and link ID value.
3. Wait for the time to pass the next even quarter-hour.
4. Get the current speed for the same GPS or Theoretical road segment, as in step 2.
5. Verify that the speed has changed.
6. Click on random GPS or Theoretical road segments on the Realtime Map Display to display a popup window showing the speed of that segment. Get the current speed for that segment (see step 2), and verify that the two speeds are the same.

2.3.4.2.6 Assumptions and Constraints

This test assumes that the speeds in the test data file change on all segments every 15-minutes.

2.3.4.2.7 Test Results

☐ PASS ☐ FAIL SwRI: ___________________________ Date: _____________

TxDOT: ________________________ Date: _____________

Comments:

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2.3.4.3 DS-GPSTH-03 GPS/Theoretical process adjustment factor test

This test case verifies that the travel data sent by the GPS/Theoretical process is adjusted based on current conditions.

2.3.4.3.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.6.

Table 2.6 Requirements Addressed by Test DS-GPSTH-03

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-3	The system shall maintain travel data for the TG road segments.
DS-FN-3.3	The DSS shall store theoretical travel data for the theoretical TG road segments.
DS-FN-3.3.1	The DSC shall store the current theoretical vehicle speed associated with theoretical TG road segments.
DS-FN-3.4	The DSS shall store GPS travel data for the GPS TG road segments.
DS-FN-3.4.1	The DSC shall store the current GPS-measured vehicle speed associated with GPS TG road segments.
DS-FN-3.5	The DGS shall store theoretical travel data for the theoretical TG road segments at 15-minute time intervals.
DS-FN-3.5.1	The GPSTH C shall store the vehicle speed at 15-minute intervals for theoretical TG road segments.
DS-FN-3.6	The DGS shall store GPS travel data for the GPS TG road segments at 15-minute intervals.
DS-FN-3.6.1	The GPSTH C shall store the vehicle speed at 15-minute intervals for GPS TG road segments and theoretical TG road segments.
DS-FN-3.11	The DCIS shall provide theoretical travel data for the theoretical TG road segments.
DS-FN-3.12	The DCIS shall provide GPS travel data for the GPS TG road segments.
DS-FN-10	The system shall adjust travel data for TG road segments based on current conditions.
DS-FN-10.1	The DGS shall adjust theoretical travel data for theoretical TG road segments based on time of day.
DS-FN-10.1.1	The GPSTH C shall adjust theoretical travel data for theoretical TG road segments based on current conditions using adjustment factors based on type of day and/or weather.
DS-FN-10.2	The DGS shall adjust GPS travel data for GPS TG road segments based on time of day.
DS-FN-10.2.1	The GPSTH C shall adjust GPS travel data for GPS TG road segments based on current conditions using adjustment factors based on type of day and/or weather.

2.3.4.3.2 Prerequisite Conditions

This test case assumes that the previous test case was successfully completed, that the system is running normally, and that the GPS/Theoretical process (as shown on the Data Server detailed status window) is operating normally before starting the test.

This test should not be started too close before an even quarter hour when the new speeds are sent to the Data Server, resulting in all speed values being updated.

2.3.4.3.3 Test Inputs

The test inputs for this test case are contained in the GPS/Theoretical test data file 'gpsth_data.dat'. These speeds are sent by the GPS/Theoretical process to the Data Server at 15-minute intervals.

The '*today*' GUI is used by the tester to adjust the current conditions.

2.3.4.3.4 Test Results Evaluation

This test case will demonstrate that the GPS/Theoretical process adjusts the travel data for the GPS/Theoretical TransGuide road segments based on current condition factors when the speeds are updated. The speeds for selected GPS/Theoretical segments are inspected to verify the change.

2.3.4.3.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. In the same terminal window that was opened in the previous test case, change to the Data Server bin directory $ATMS/bin.
2. Launch the today GUI by running '*today dataserver.cfg*'. Set one or more of the toggle buttons in the GUI. Select the *Apply* button before selecting the *Exit* button.
3. Wait for the next even quarter hour to pass.
4. Get the base speed for a randomly selected GPS or Theoretical road segment by running *get_base_gpsth_data <segment linkID>* in the terminal window. Note the speed and link ID value.
5. Get the current speed for the same road segment by running *get_gpsth_data <segment linkID>* in the terminal window. Verify that second speed is lower than the first, due to the factor(s) applied in step 2.

2.3.4.3.6 Assumptions and Constraints

This test assumes that the factors applied to the speeds are less than 1.0 and that the speed for the selected road segment in the test data file is non-zero.

2.3.4.3.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.4 DS-RT Test

This test verifies that the requirements attributable to the Realtime Collect, Realtime Broadcast, Realtime Receive, Realtime Map Display and Emergency Response interface processes are met.

2.4.1 Hardware Preparation

- Data Server Master Computer running in normal mode.
- VAX 810 running in normal mode.

2.4.2 Software Preparation

- Data Server running on the Data Server Master Computer.
- Realtime Collect and Realtime Broadcast running on the Data Server Master Computer.
- Realtime Receive and Realtime Map Display running on a workstation connected to the Data Server Master Computer.
- Verify that *'send_broadcast_data DATASERVER'* is running on the VAX 810.

2.4.3 Other Pre-test Preparation

Log in as *mdi* to execute this test.

2.4.4 Test Descriptions

The following test cases are implemented under this test:

DS-RT-01 Realtime Processes Status Information Test.

DS-RT-02 Realtime Map Display Test.

2.4.4.1 DS-RT-01 Realtime Processes Status Information Test

This test case verifies that the Realtime Collect and Realtime Broadcast processes interface with the Data Server, and that the MDI System Status GUI reflects their system status.

2.4.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.7.

Table 2.7 Requirements Addressed by Test DS-RT-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-3.2	The SGUIS shall interface with the TG Operations user using a GUI.
DS-IF-3.2.1	The SGUIC shall interface with the user using a GUI.
DS-FN-9	The system shall maintain MDI System status data.
DS-FN-9.9	The SGUIS shall display DS DGIS process information.
DS-FN-9.9.1	The SGUIC shall display DS Realtime Collect Interface Component (RTCIC) process status information.
DS-FN-9.11	The SGUIS shall display DS DCIS process information.
DS-FN-9.11.5	The SGUIC shall display DS RTBC process information.

2.4.4.1.2 Prerequisite Conditions

This test case assumes that the system is running normally and that the Realtime Collect and Realtime Broadcast processes (as shown on the Data Server detailed status window) are operating normally before starting the test.

2.4.4.1.3 Test Inputs

Heartbeat from the processes under test.

2.4.4.1.4 Test Results Evaluation

This test case will demonstrate that the MDI System Status GUI displays the status of the realtime processes. The Data Server detailed status window is inspected to verify that heartbeats are being received, and the Data Server status window is inspected to verify that the background color of the heading changes, when the processes 'status changes.

Before running this test, the background color of the Data Server window header in the Status GUI should be green. When one of the processes is killed, the background color should change within a few minutes (this time depends on the maximum heartbeat interval *MAX_HB_INTERVAL* value specified in the MDI configuration file, $ATMS/etc/mdi.cfg). When that process is restarted, the background color of the Data Server window header should change back to green, indicating that all the processes are sending heartbeats.

2.4.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a terminal window on the Data Server. In that window, change to the ATMS bin directory by entering *cd $ATMS/bin*.

2. For both processes under test (Realtime Collect, and Realtime Broadcast), do the following steps.
3. Observe the background color of the Data Server status window header in the Status GUI. The background color should be green.
4. Click on the Data Server window on the Status GUI to display the detailed status window.
5. Observe that the times indicating when the latest heartbeats were received from the realtime processes, are updating. The heartbeat update rate is approximately every 5 seconds.
6. In the terminal window, enter *'ps -ef | grep realtime'* to display the UNIX process status of any realtime processes currently running. Note that the Realtime Broadcast process *realtimebroadcast* and the Realtime Collect process *realtimecollect* both appear in the output.
7. In the detailed status window, click on the button labeled 'Stop' at the end of the Realtime Broadcast entry.
8. In the terminal window enter *'ps -ef | grep realtime'*. Note that the Realtime Broadcast process *realtimebroadcast* is not listed as running.
9. In the detailed status window, click on the button labeled 'Stop' at the end of the Realtime Collect entry.
10. In the terminal window enter *'ps -ef | grep realtime'*. Note that the Realtime Collect process *realtimecollect* is not listed as running.
11. Observe that the background color of the Data Server window header changes within a few minutes. Also observe on the Data Server detailed status window, that heartbeats are not being received.
12. In the detailed status window, click on the buttons labeled 'Start' at the end of both the Realtime Collect and Realtime Broadcast entries.
13. Observe that the background color of the Data Server window header changes back to green, and that heartbeats are being received again.
14. Close the detailed status window.

2.4.4.1.6 Assumptions and Constraints

None.

2.4.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.4.4.1.8 DS-RT-02 Realtime Map Display Test

This test case verifies that the realtime data is acquired from ATMS and MDI sources, collected and distributed by the realtime processes and displayed on the Realtime Map Display.

2.4.4.1.9 Requirements Addressed

This test addresses the requirements detailed in Table 2.8.

Table 2.8 Requirements Addressed by Test DS-RT-02

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-1	The system shall interface with the TG ATMS.
DS-IF-1.1	The DGIS shall interface with the TG ATMS using protocol defined by the existing TG ATMS data broadcast.
DS-IF-1.1.1	The RTCIC shall interface with the TG ATMS using protocol defined by the existing TG ATMS data broadcast.
DS-IF-10	The system shall interface with the Emergency Response system.
DS-IF-10.1	The DCIS shall interface with the Emergency Response system.
DS-IF-10.1.1	The RTBC shall interface with the Emergency Response system.
DS-IF-12	The system shall interface with the TG ATMS Map system.
DS-IF-12.1	The DCIS shall interface with the TG ATMS Map system.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-12.1.1	The RTBC shall interface with TG ATMS Map system using the protocol defined by the current TG ATMS operations broadcast system.
DS-FN-1	The system shall maintain road segment data for the TG road segments.
DS-FN-1.1	The DSS shall store TG Link Identifier data for the TG road segments.
DS-FN-1.1.1	The DSC shall store a TG Link Identifier for the TG road segments.
DS-FN-1.1.2	The DSC shall store TG Equipment Identifier for TG equipment associated with a segment of interest.
DS-FN-2	The system shall maintain map data for areas outside of the segments of interest.
DS-FN-2.1	The system shall store San Antonio map data for areas outside the TG road segments.
DS-FN-3	The system shall maintain travel data for the TG road segments.
DS-FN-3.1	The DSS shall store TG ATMS travel data for TG ATMS road segments.
DS-FN-3.1.1	The DSC shall store the current travel data for the travel data elements defined by the existing TG ATMS data broadcast system.
DS-FN-3.7	The DSILS shall acquire TG ATMS travel data for TG ATMS road segments.
DS-FN-3.7.1	The RTCIC shall acquire the current travel data for the travel data elements defined by the existing TG ATMS data broadcast system.
DS-FN-3.9	The DCIS shall provide TG ATMS travel data for TG ATMS road segments.
DS-FN-3.9.4	The RTBC shall provide the current travel data for the travel data elements defined by the existing TG ATMS data broadcast system to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-6	The system shall maintain traffic incident data.
DS-FN-6.1	The DSS shall store TG ATMS traffic incident data.
DS-FN-6.1.1	The DSC shall store current incident data for the incident data elements defined in the existing TG ATMS data broadcast system.
DS-FN-6.4	The DGIS shall acquire TG ATMS traffic incident data.
DS-FN-6.4.1	The RTCIC shall acquire current incident data for the incident data elements defined in the existing TG ATMS data broadcast system.
DS-FN-6.8	The DCIS shall provide TG ATMS traffic incident data.
DS-FN-6.8.4	The RTBC shall provide current incident data for the incident data elements defined in the existing TG ATMS data broadcast system to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-8	The system shall maintain TG ATMS equipment status data.
DS-FN-8.1	The DSS shall store TG ATMS Changeable Message Sign (CMS) data.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-8.1.1	The DSC shall store the current CMS data for the CMS data elements defined in the existing TG ATMS data broadcast system.
DS-FN-8.2	The DSS shall store TG ATMS Lane Control Signal (LCS) data.
DS-FN-8.2.1	The DSC shall store the current LCS data for the LCS data elements defined in the existing TG ATMS data broadcast system.
DS-FN-8.3	The DGIS shall acquire TG ATMS CMS data.
DS-FN-8.3.1	The RTCIC shall acquire the current CMS data for the CMS data elements defined in the existing TG ATMS data broadcast system.
DS-FN-8.4	The DGIS shall acquire TG ATMS LCS data.
DS-FN-8.4.1	The RTCIC shall acquire the current LCS data for the LCS data elements defined in the existing TG ATMS data broadcast system.
DS-FN-8.5	The DCIS shall provide TG ATMS CMS data.
DS-FN-8.5.1	The RTBC shall provide the current CMS data for the CMS data elements defined in the existing TG ATMS data broadcast system to the TG ATMS Map system and other ATMS data broadcast listeners.
DS-FN-8.6	The DCIS shall provide TG ATMS LCS data.
DS-FN-8.6.1	The RTBC shall provide the current LCS data for the LCS data elements defined in the existing TG ATMS data broadcast system to the TG ATMS Map system and other ATMS data broadcast listeners.
DS-FN-11	The system shall have the ability to access the data based on geographic attributes.
DS-FN-11.1	The DSS shall store geographic attributes of data.
DS-FN-11.1.1	The DSC shall store the altitude, latitude, and longitude of the endpoints of the TG road segments.

2.4.4.1.10 Prerequisite Conditions

This test assumes that the previous test case was successfully completed, that the system is running normally, and that the Realtime Collect and Realtime Broadcast processes (as shown on the Data Server detailed status window) are operating normally before starting the test.

2.4.4.1.11 Test Inputs

User selected segments, incidents and equipment.

2.4.4.1.12 Test Results Evaluation

This test case will demonstrate that the Realtime Map Display correctly displays the data sent by the existing TG ATMS data broadcast system. The segment speeds, incident information

and equipment data are inspected and compared to the existing ATMS map to verify that that the information matches.

The Realtime Map Display data file is also inspected to verify that the segments contain geographical attributes, and link identifiers.

2.4.4.1.13 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a terminal window on the workstation. In that window, change to the ATMS bin directory by entering *cd $ATMS/bin*.
2. Run the realtime receive process if it is not already running, by entering *realtimereceive mdi.cfg dataserver.cfg &*.
3. Run the MDI Realtime Map Display by entering *$ITG/map/bin/mdi_realtime_map $ITG/map/src/displays/bexarmdi.dsp -m &*.
4. Run the ATMS receive broadcast process if it is not already running, by entering *receive_brodcast &*.
5. Run the existing ATMS Map by entering *atms_map &*.
6. Click the left mouse button on randomly selected ATMS segments on both maps (same segment on each map), and inspect the pop-up windows displayed as a result of this action to verify that the speeds are the same. Also verify that the Link Identifiers displayed on the title-bar of the pop-ups are the same.
7. Click the left mouse button on randomly selected ATMS incidents on both maps (same incident on each map), and inspect the pop-up windows displayed as a result of this action to verify that the incident information is the same.
8. Click the left mouse button on randomly selected LCS icons on both maps (same LCS icon on each map), and inspect the pop-up windows displayed as a result of this action to verify that the equipment information is the same.
9. Click the left mouse button on randomly selected CMS icons on both maps (same CMS icon on each map), and inspect the pop-up windows displayed as a result of this action to verify that the equipment information is the same.
10. Inspect the Realtime Map Display to verify that it maintains map data outside the segments of interest, such as background data.
11. In the terminal window, view the Realtime Map Display data file, by entering *more $ITG/map/src/displays/bexarmdi.dsp*. Observe that the segments contained in the file have geographical attributes and link IDs.
12. Exit the Realtime Map Display and the ATMS map.

2.4.4.1.14 Assumptions and Constraints

The Realtime Map Display application is the Emergency Response System's interface to the Data Server.

ATMS incidents are transitional and one may not exist at all times. They are most likely to occur during rush-hour traffic in the mornings and afternoons.

2.4.4.1.15 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.5 DS-WWW Test

This test verifies that the requirements attributable to the WWW process are met.

2.5.1 Hardware Preparation

- Data Server Master Computer running in normal mode.
- TransGuide Web Server running in normal mode.

2.5.2 Software Preparation

- Data Server process running on the Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.
- WWW interface process running on the TransGuide Web Server.
- Realtime Map Display running on a workstation.
- Web-browser running on a workstation.

2.5.3 Other Pre-test Preparation

Log in as *mdi* to execute this test.

2.5.4 Test Descriptions

The following test cases are implemented under this test.

DS-WWW-01 WWW interface process status information test.

DS-WWW-02 WWW traveldata test.

2.5.4.1 DS-WWW-01 WWW interface process status information test

This test case verifies that the WWW interface process interfaces with the Data Server and that the MDI System Status GUI reflects its process status.

2.5.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.9.

Table 2.9 Requirements Addressed by Test DS-WWW-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shallinterface with the TG Operations user.
DS-IF-3.1	The DGS shallinterface with the TG Operations user using a GUI.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3.2	The SGUI shall interface with the TG Operations user using a GUI.
DS-FN-9	The system shall maintain MDI System status data.
DS-FN-9.11	The SGUI shall display DSDCIS process information.
DS-FN-9.11.1	The SGUIC shall display DS World Wide Web Interface Component (WWWIC) process information.

2.5.4.1.2 Prerequisite Conditions

This test case assumes that the system is running normally and that the WWW interface process (as shown on the MDI system Status GUI) is operating normally before starting the test.

2.5.4.1.3 Test Inputs

Heartbeat from the WWW interface process.

2.5.4.1.4 Test Results Evaluation

This test case will demonstrate that the WWW interface process interfaces with the MDI System Status GUI.

Before running this test, the background color of the WWW window header in the Status GUI should be green. The WWW status window is inspected to verify that heartbeats are being received from the WWW interface process at regular intervals. When the WWW interface process is killed, heartbeats should no longer be received, and the background color of the WWW window header should change within a few minutes (this time depends on the maximum heartbeat interval *MAX_HB_INTERVAL* value specified in the MDI configuration file, $ATMS/etc/mdi.cfg). When the process is restarted, the background color of the WWW window header should change back to green, indicating that the process is sending heartbeats.

2.5.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the WWW status window in the Status GUI. The background color should be green.
2. Observe that the time indicating when the latest heartbeat was received from the WWW interface process is updating. This update rate depends on the heartbeat interval specified by the *www_hb_interval* value in the WWW interface configuration file $ATMS/etc/www.cfg, and the MAX_HB_INTERVAL value in the MDI configuration file $ATMS/etc/mdi.cfg. The actual update rate is the lesser of these two values.

3. Click on the WWW window on the Status GUI to display the detailed status window.
4. Select the button labeled 'Stop' on the detailed status screen to stop the WWW interface process.
5. Observe that the background color of the WWW interface process's status window header changes to gray in a few minutes after the WWW interface process has stopped sending heartbeats. This time depends on the value of the *MAX_HB_INTERVAL* parameter in the MDI configuration file $ATMS/etc/mdi.cfg.
6. Restart the WWW interface process by selecting the button labeled 'Start' on the detailed status screen.
7. Observe that the background color of the WWW interface process status window header changes back to green when the heartbeats are being received again.
8. Close the detailed status window.

2.5.4.1.6 Assumptions and Constraints

None.

2.5.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.5.4.2 DS-WWW-02 WWW travel data test

This test case verifies that the current travel data is displayed on the WWW.

2.5.4.2.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.10.

Table 2.10 Requirements Addressed by Test DS-WWW-02

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-8	The system shall interface with the TG WWW system.
DS-IF-8.1	The DCIS shall interface with the TG WWW system.
DS-IF-8.1.1	The WWWIC shall interface with the TG WWW system.
DS-FN-1	The system shall maintain road segment data for the TG road segments.
DS-FN-3	The system shall maintain travel data for the TG road segments.
DS-FN-3.9	The DCIS shall provide TG ATMS travel data for TG ATMS road segments.
DS-FN-3.9.1	The WWWIC shall provide the current travel data for the travel data elements defined by the existing TG ATMS data broadcast system to the TG WWW system.
DS-FN-3.9.4	The RTBC shall provide the current travel data for the travel data elements defined by the existing TG ATMS data broadcast system to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-3.10	The DCIS shall provide MDI AVI travel data for MDI Automatic Vehicle Identification (AVI) TG road segments.
DS-FN-3.10.5	The RTBC shall provide the current MDI AVI-measured vehicle travel time associated with MDI AVI TG road segments to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-3.10.6	The RTBC shall provide the current MDI AVI-measured vehicle speed associated with MDI AVI TG road segments to the TG ATMS Map system, the IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-4	The system shall maintain lane closure data.
DS-FN-4.6	The DCIS shall provide TG lane closure data.
DS-FN-6	The system shall maintain traffic incident data.
DS-FN-6.8	The DCIS shall provide TG ATMS traffic incident data.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-6.8.4	The RTBC shall provide current incident data for the incident data elements defined in the existing TG ATMS data broadcast system to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-6.9	The DCIS shall provide 911 traffic incident data.
DS-FN-6.9.4	The RTBC shall provide accident related 911 traffic incident data to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-6.10	The DCIS shall provide railroad delay incident data.

2.5.4.2.2 Prerequisite Conditions

This test assumes that the previous test case was successfully completed, that the system is running normally, and that the WWW interface process (as shown on the Data Server detailed status window) is operating normally before starting the test. If the Common Gateway Interface (CGI) task that services the httpd requests is not running, start it from the $ATMS/bin directory by entering *tgmap &*.

2.5.4.2.3 Test Inputs

ATMS broadcast of traffic data.

2.5.4.2.4 Test Results Evaluation

This test case will demonstrate that the current traffic data is being displayed on the WWW system. The speeds of the segments displayed on the Web-page are compared to the speeds displayed on the Realtime Map Display.

2.5.4.2.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Using the Web browser, view the Web-page that contains the TransGuide Realtime Map, located at http://www.transguide.dot.state.tx.us/map/ (http://206.254.37.10/map/)
2. View the Realtime Map Display on a workstation. Make sure that the Schematic Map mode is turned off.
3. Compare the link colors of a randomly selected ATMS segment on the Realtime Map and on the Web-page map (same segment on both maps). Due to the difference in update frequency between the Realtime Map Display and the Web-page map, the colors may not match exactly. The colors will be more likely to be the same for a selected segment immediately after the WWW map has been updated.

4. Compare the link colors of a randomly selected AVI segment on the Realtime Map and on the Web-page map (same segment on both maps). Due to the difference in update frequency between the Realtime Map Display and the Web-page map, the colors may not match exactly. The colors will be more likely to be the same for a selected segment immediately after the WWW map has been updated.
5. Compare the locations of a randomly selected traffic incident icon on the Realtime Map and on the Web-page map (same segment on both maps), and verify that the icons are located in the same place on both maps.
6. Compare the locations of a randomly selected lane closure icon on the Realtime Map and on the Web-page map (same segment on both maps), and verify that the icons are located in the same place on both maps.

2.5.4.2.6 Assumptions and Constraints

Note that the only segments shown on the Web-page are the ATMS and AVI instrumented segments. Also note that there will usually be a difference in the speeds shown for the same segment on the Realtime Map Display and the Web-page. This is due to the fact that the Realtime Map Display is updated much more frequently (approximately every 2 seconds) than the Web page, which is updated every five minutes.

Traffic incidents are transitional and one may not exist at all times. They are most likely to occur during rush-hour traffic in the mornings and afternoons. Lane closures are also transitional.

2.5.4.2.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.6 DS-LC Test

This test verifies that the requirements attributable to the Lane Closure GUI process are met.

2.6.1 Hardware Preparation

- Data Server Master Computer running in normal mode.

2.6.2 Software Preparation

- Data Server Process running on the Data Server Master Computer.
- Realtime Map Display running on a workstation.

2.6.3 Other Pre-test Preparation

Log in as *mdi* to execute this test.

2.6.4 Test Descriptions

The following test case is implemented under this test:

DS-LC-01 Lane Closure incident transfer test.

2.6.4.1 DS-LC-01 Lane Closure incident transfer test

This test case verifies that lane closures can be entered into and retrieved from the Data Server.

2.6.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.11.

Table 2.11 Requirements Addressed by Test DS-LC-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-3.1.1	The LCGUIC shall interface with the TG Operations user using a GUI.
DS-FN-4	The system shall maintain lane closure data.
DS-FN-4.2	The DSS shall store San Antonio lane closure data.
DS-FN-4.2.1	The DSC shall store the lane closure data elements defined in the current TG Lane Closure system for San Antonio lane closure data.
DS-FN-4.3	The DGS shall acquire lane closure data.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-4.3.1	The LCGUIC shall acquire the lane closure data elements defined in the current TG Lane Closure system for TG lane closure data.
DS-FN-4.6	The DCIS shall provide TG lane closure data.
DS-FN-4.6.2	The RTBC shall provide the lane closure data elements defined in the current TG Lane Closure system for San Antonio lane closure data to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.

2.6.4.1.2 Prerequisite Conditions

Make sure that the Lane Closure GUI is not running on another workstation. The Realtime Map Display must be running on the test workstation.

2.6.4.1.3 Test Inputs

A Lane Closure entered by the user.

2.6.4.1.4 Test Results Evaluation

This test case will demonstrate that lane closures can be entered using the Lane Closure GUI, and that lane closures can be stored in and retrieved from the Data Server. The output of a program that reads all the lane closures from the Data Server will be inspected to verify that it includes the lane closure that was entered. The Lane Closure GUI is then re-launched to verify that the entered lane closure is still there. Finally, the test lane closure is removed and the resulting lane closures are retrieved from the Data Server and examined.

2.6.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Launch the Lane Closure GUI by clicking the right mouse button on the Realtime Map Display screen, and selecting the *Enter lane closure* option from the popup menu displayed. The location where the mouse was positioned determines the location of a new Lane Closure incident.
2. Enter data for a new lane closure in the fields of the Lane Closure GUI. Exit the Lane Closure GUI by selecting *'Exit and save'* from the File menu.
3. Verify that the new lane closure is displayed on the Realtime Map Display screen where it was placed.
4. Open a terminal window on the workstation. In that window, change into the Data Server bin directory by entering the UNIX command *cd $ATMS/bin*.

5. Retrieve the current lane closure incidents from the Data Server by running *get_lc_incidents* from the terminal window.
6. Verify that the lane closure that was entered is the last lane closure in the output list.
7. Launch the Lane Closure GUI again.
8. Verify that the lane closure that was entered is still in the scrolling list of lane closures located at the top part of the GUI.
9. Remove the test lane closure. Exit the Lane Closure GUI by selecting *'Exit and save'* from the File menu.
10. Retrieve the current lane closure incidents from the Data Server by running *get_lc_incidents* in the terminal window.
11. Verify that the lane closure that was removed is not in the output list.

2.6.4.1.6 Assumptions and Constraints

None.

2.6.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.7 DS-KIOSK/IVN Test

This test verifies that the requirements attributable to the Data Server's interface with the Kiosk and IVN systems are met.

These two systems receive the traffic data that is broadcast by the Data Server. Both systems heartbeat to the Data Server

2.7.1 Hardware Preparation

- Data Server Master Computer running in normal mode.

2.7.2 Software Preparation

- Data Server process running on the Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.

2.7.3 Other Pre-test Preparation

Log in as *mdi* to execute this test.

2.7.4 Test Descriptions

The following test cases are implemented under this test:

DS-KIOSK/IVN-01 Kiosk and IVN system status information test.

2.7.4.1 DS-KIOSK/IVN-01 Kiosk and IVN system status information test.

This test case verifies that the Data Server interfaces with both the Kiosk and IVN systems, and that the status of both the Kiosk and IVN systems are displayed on the MDI System Status GUI.

2.7.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.12

Table 2.12 Requirements Addressed by Test DS-KIOSK/IVN-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-3.2	The SGUIS shall interface with the TG Operations user using a GUI.
DS-IF-3.2.1	The SGUIC shall interface with the user using a GUI.
DS-IF-6	The system shall interface with the IVN/Kiosk system.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-6.1	The DSILS shall interface with the IVN/Kiosk system.
DS-IF-6.1.1	The DSILC shall interface with the MDI IVN/Kiosk system.
DS-FN-9	The system shall maintain MDI System status data.
DS-FN-9.5	The SGUIS shall display MDI IVN system status information.
DS-FN-9.5.1	The SGUIC shall display MDI IVN system current status.
DS-FN-9.5.2	The SGUIC shall display MDI IVN system detailed status information.
DS-FN-9.6	The SGUIS shall display MDI Kiosk system status information.
DS-FN-9.6.1	The SGUIC shall display MDI Kiosk system current status.
DS-FN-9.6.2	The SGUIC shall display MDI Kiosk system detailed status information.

2.7.4.1.2 Prerequisite Conditions

This test assumes that the Kiosk and IVN systems are both running normally on the Kiosk/IVN Master Computer before starting the test.

2.7.4.1.3 Test Inputs

Heartbeats from the Kiosk and IVN systems.

2.7.4.1.4 Test Results Evaluation

This test case will demonstrate that the MDI System Status GUI displays the Kiosk and IVN systems 'status. The Kiosk and IVN system status windows on the MDI System Status GUI are inspected to verify that the background color of the respective heading changes when the system status changes.

2.7.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the Kiosk system status window header in the Status GUI. The background color should be green. Observe the background color of the IVN system status window header in the Status GUI. This background color should also be green.
2. Click on the Kiosk window on the Status GUI to display the detailed status window.
3. Select the button labeled Stop 'on the detailed status screen to stop the Kiosk system.

4. Observe that the background color of the Kiosk system's status window header changes to gray in a few minutes after the Kiosk system has stopped sending heartbeats. This time depends on the value of the *MAX_HB_INTERVAL* parameter in the MDI configuration file $ATMS/etc/mdi.cfg.
5. Restart the Kiosk system by selecting the button labeled 'Start' on the Kiosk system's detailed status screen.
6. Observe that the background color of the Kiosk system's status window header changes back to green when heartbeats are being received again.
7. Close the Kiosk detailed status window.
8. Click on the IVN window on the Status GUI to display the detailed status window.
9. Select the button labeled 'Stop' on the detailed status screen to stop the IVN system.
10. Observe that the background color of the IVN system's status window header changes to gray in a few minutes after the IVN system has stopped sending heartbeats. This time depends on the value of the *MAX_HB_INTERVAL* parameter in the MDI configuration file $ATMS/etc/mdi.cfg.
11. Restart the IVN system by selecting the button labeled 'Start' on the IVN system's detailed status screen.
12. Observe that the background color of the IVN system's status window header changes back to green when heartbeats are being received again.
13. Close the IVN detailed status window.

2.7.4.1.6 Assumptions and Constraints

None.

2.7.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.8 DS-WV Test

This test verifies that the requirements attributable to the Data Server's interface with the VIA and Weather interface processes are met.

The VIA interface process and the Weather interface process interface with the Data Server through file transfers of VIA and Weather data files, respectively.

2.8.1 Hardware Preparation

- Data Server Master Computer running in normal mode.

2.8.2 Software Preparation

- Data Server process running on the Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.

2.8.3 Other Pre-test Preparation

Log in as *mdi* to execute this test.

2.8.4 Test Descriptions

The following test cases are implemented under this test:

DS-WV-01 Weather and VIA process status information test.

DS-WV-02 Weather and VIA file transfer test.

2.8.4.1 DS-WV-01 Weather and VIA process status information test.

This test case verifies that the Weather interface process and the VIA interface process both interface with the Data Server and that the MDI System Status GUI reflects the status of both of these processes.

2.8.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.13

Table 2.13 Requirements Addressed by Test DS-WV-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-3.2	The SGUIS shall interface with the TG Operations user using a GUI.
DS-IF-3.2.1	The SGUIC shall interface with the user using a GUI.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-9	The system shall maintain MDI System status data.
DS-FN-9.9	The SGUI shall display DS DGIS process information.
DS-FN-9.9.6	The SGUI shall display DS VIA Interface Component (VIC) process status information.
DS-FN-9.9.7	The SGUI shall display DS Weather Interface Component (WIC) process status information.

2.8.4.1.2 Prerequisite Conditions

This test assumes that the system is running normally and that the Weather and VIA interface processes (as shown on the Data Server detailed status window) are operating normally before starting the test.

2.8.4.1.3 Test Inputs

Heartbeats from the Weather and VIA interface processes.

2.8.4.1.4 Test Results Evaluation

This test case will demonstrate that the Weather and VIA interface processes interface with the MDI System Status GUI.

Before running this test, the background color of the Data Server window header should be green. The Data Server detailed status window is inspected to verify that heartbeats are being received from the VIA interface process and from the Weather interface process at regular intervals. When the VIA or Weather interface process is killed, heartbeats should no longer be received, and the background color of the Data Server window header should change within a few minutes (this time depends on the maximum heartbeat interval *MAX_HB_INTERVAL* value specified in the MDI configuration file, $ATMS/etc/mdi/cfg). When the systems or processes are restarted, the background color of the Data Server window header should change back to green, indicating that the processes are sending heartbeats.

2.8.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the Data Server status window header in the Status GUI. The background color should be green.
2. Click on the Data Server window on the Status GUI to display the detailed status window.
3. Observe that the time indicating when the latest heartbeat was received from the Weather

interface process is updating. This update rate depends on the heartbeat interval specified by the *FREQUENCY* value in the Weather interface configuration file $ATMS/etc/weather.cfg.

4. Open a terminal window on the Data Server. In that window, enter the UNIX command 'ps -ef | grep weather' to display the UNIX process status of the Weather interface process. Note that the Weather interface process *transferfiles* appears in the output.
5. In the detailed status window, click on the button labeled *Stop* at the end of the Weather File Transfer entry.
6. In the terminal window enter *'ps -ef | grep weather'*. Note that the Weather interface process is not listed as running.
7. Observe on the Data Server detailed status window that heartbeats are not being received from the Weather interface process.
8. In the detailed status window, click on the button labeled *Start* at the end of the Weather File Transfer entry.
9. Observe that the detailed status window shows that heartbeats are being received again from the Weather interface process.
10. Observe the Data Server detailed status window to verify that the time indicating when the latest heartbeat was received from the VIA interface process is updating. This update rate depends on the heartbeat interval specified by the *FREQUENCY* value in the VIA interface configuration file $ATMS/etc/VIA.cfg.
11. In the terminal window, enter the UNIX command 'ps -ef | grep VIA' to display the UNIX process status of the VIA interface process. Note that the VIA interface process *transferfiles* appears in the output.
12. In the detailed status window, click on the button labeled *Stop* at the end of the VIA File Transfer entry.
13. In the terminal window enter *'ps -ef | grep VIA'*. Note that the VIA interface process is not listed as running.
14. Observe on the Data Server detailed status window that heartbeats are not being received from the VIA interface process.
15. In the detailed status window, click on the button labeled *Start* at the end of the VIA File Transfer entry.
16. Observe that the detailed status window shows that heartbeats are being received again from the VIA interface process.
17. Close the detailed status window.

2.8.4.1.6 Assumptions and Constraints

None.

2.8.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.8.4.2 DS-WV-02 Weather and VIA file transfer test.

This test case verifies that the Weather and VIA data can be sent to and retrieved from the Data Server.

2.8.4.2.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.14

Table 2.14 Requirements Addressed by Test DS-WV-02

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-7	The system shall maintain traveler information.
DS-FN-7.1	The DSS shall store VIA data.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-7.1.1	The DSC shall store VIA data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.
DS-FN-7.2	The DSS shall store weather data.
DS-FN-7.2.1	The DSC shall store weather data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.
DS-FN-7.4	The DSILS shall acquire VIA data.
DS-FN-7.4.1	The DSILC shall acquire VIA data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.
DS-FN-7.5	The DSILS shall acquire Weather data.
DS-FN-7.5.1	The DSILC shall acquire weather data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.
DS-FN-7.6	The DSILS shall provide VIA data.
DS-FN-7.6.1	The DSILC shall provide VIA data as specified in the MDI Traveler Information Kiosk Preliminary Design Document to the MDI IVN/KIOSK System.
DS-FN-7.8	The DSILS shall provide weather data.
DS-FN-7.8.1	The DSILC shall provide weather data as specified in the MDI Traveler Information Kiosk Preliminary Design Document to the MDI IVN/KIOSK System.

2.8.4.2.2 Prerequisite Conditions

This test assumes that the previous test was successfully completed.

2.8.4.2.3 Test Inputs

Weather and VIA data files to be transferred.

2.8.4.2.4 Test Results Evaluation

This test case will demonstrate that Weather and VIA data files can be transferred to and retrieved from the MDI Data Server.

2.8.4.2.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a terminal window on the workstation. In that window, change into the Data Server bin directory $ATMS/bin.
2. Send a Weather data file to the Data Server process by running *send_weather_data_file weather.dat* in the terminal window.

3. Retrieve the Weather file from the Data Server process and store it under a different name, by running *get_weather_data_file weather.dat NEWWEATHER.DAT* in the terminal window.
4. Compare the two files by executing the UNIX command *diff weather.dat NEWWEATHER.DAT*. The files should be identical (i.e., the diff command should produce no output).
5. Send a VIA data file to the Data Server process by running *send_via_data_file VIADATA.DAT* in the terminal window.
6. Retrieve the VIA file from the Data Server process and store it under a different name, by running *get_via_data_file VIADATA.DAT NEW VIA.DAT* in the terminal window.
7. Compare the two files by executing the UNIX command *diff VIADATA.DAT NEW VIA.DAT*. The files should be identical (i.e., the diff command should produce no output).

2.8.4.2.6 Assumptions and Constraints

None.

2.8.4.2.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.9 DS-AWARD Test

This test verifies that the requirements attributable to the Advance Warning to Avoid Railroad Delay (AWARD) interface process are met.

2.9.1 Hardware Preparation

- Data Server Master Computer running in normal mode.

2.9.2 Software Preparation

- Data Server process running on the Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.

2.9.3 Other Pre-test Preparation

Log in as *mdi* to execute this test.

2.9.4 Test Descriptions

The following test cases are implemented under this test:

DS-AWARD-01 AWARD system status information test.

DS-AWARD-02 AWARD interface process incident data test.

2.9.4.1 DS-AWARD-01 AWARD system status information test

This test case verifies that the status of the AWARD system is displayed on the MDI System Status GUI.

2.9.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.15.

Table 2.15 Requirements Addressed by Test DS-AWARD-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-3.2	The SGUIS shall interface with the TG Operations user using a GUI.
DS-IF-3.2.1	The SGUIC shall interface with the user using a GUI.
DS-IF-13	The system shall interface with the MDI Railroad Delay system.
DS-IF-13.1	The DSILS shall interface with the MDI Railroad Delay system.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-13.1.1	The DSILC shall interface with the Railroad Delay system.
DS-FN-9	The system shall maintain MDI system status data.
DS-FN-9.3	The DSILS shall acquire MDI Railroad Delay system status information.
DS-FN-9.7	The SGUIS shall display MDI Railroad Delay system status information.
DS-FN-9.7.1	The SGUIC shall display MDI Railroad Delay system current status.
DS-FN-9.7.2	The SGUIC shall display MDI Railroad Delay system detailed status information.
DS-FN-9.9	The SGUIS shall display DSDGIS process information.
DS-FN-9.9.2	The SGUIC shall display DSRDIC process status information.

2.9.4.1.2 Prerequisite Conditions

This test case assumes that the Railroad Delay system is running normally on the AWARD Master Computer before starting the test.

2.9.4.1.3 Test Inputs

Heartbeat from the AWARD system.

2.9.4.1.4 Test Results Evaluation

This test case will demonstrate that the MDI System Status GUI displays the AWARD system's status. The AWARD system status window on the MDI System Status GUI is inspected to verify that the background color of the heading changes when the AWARD system status changes. The AWARD detailed status window is inspected to verify that it displays the AWARD system's detailed status.

2.9.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the AWARD system status window header in the Status GUI. The background color should be green.
2. Click on the AWARD window on the Status GUI to display the detailed status window.
3. Observe that the detailed status window displays the detailed status of the AWARD system.
4. Select the button labeled 'Stop' on the detailed status screen to stop the AWARD system.
5. Observe that the background color of the AWARD system's status window header changes

to gray in a few minutes after the AWARD system has stopped sending heartbeats. This time depends on the value of the *MAX_HB_INTERVAL* parameter in the MDI configuration file $ATMS/etc/mdi.cfg.

6. Restart the AWARD system by selecting the button labeled 'Start' on the AWARD system's detailed status screen.
7. Observe that the background color of the AWARD system's status window header changes back to green when heartbeats are being received again.
8. Close the AWARD detailed status window.

2.9.4.1.6 Assumptions and Constraints

None.

2.9.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.9.4.2 DS-AWARD-02 AWARD interface process incident data test

This test case verifies that the Data Server system maintains, stores, acquires and provides Railroad Delay incident data.

2.9.4.2.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.16.

Table 2.16 Requirements Addressed by Test DS-AWARD-02

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-6	The system shall maintain traffic incident data.
DS-FN-6.3	The DSS shall store Railroad Delay incident data.
DS-FN-6.3.1	The DSC shall store current incident data for Railroad Delay incident data.
DS-FN-6.6	The DSILS shall acquire Railroad Delay incident data.
DS-FN-6.6.1	The DSILC shall acquire current incident data for Railroad Delay incidents.
DS-FN-6.10	The DCIS shall provide railroad delay incident data.

2.9.4.2.2 Prerequisite Conditions

This test case assumes that the previous test was successfully completed and that the AWARD system is not running on any workstation connected to the Data Server Master Computer before starting the test.

2.9.4.2.3 Test Inputs

The input data for the test is contained in the *'TEST_RR_INC.DAT'* and *'NO_RR_INC.DAT'* data files.

2.9.4.2.4 Test Results Evaluation

This test case will demonstrate that the AWARD interface process can send Railroad Delay incident data to the Data Server, where it is stored and from where it can be retrieved.

2.9.4.2.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a terminal window on the workstation. In that window, change to the Data Server bin directory $ATMS/bin.

2. Retrieve all Railroad Delay incidents from the Data Server by running *get_rr_inc* in the terminal window.
3. If there are no current Railroad Delay incidents in the system, send a Railroad Delay incident to the Data Server by running *send_rr_inc TEST_RR_INC.DAT* in the terminal window.
4. Retrieve all Railroad Delay incidents from the Data Server by running *get_rr_inc* in the terminal window.
5. Compare the output of this program to the data values in the 'TEST_RR_INC.DAT file, and verify that they match. The contents of the data file can be displayed by entering the UNIX command *'cat TEST_RR_INC.DAT'*.
6. Remove all Railroad Delay crossing incidents from the Data Server by running *send_rr_inc NO_RR_INC.DAT* in the terminal window.
7. Retrieve all Railroad Delay incidents from the Data Server by running *get_rr_inc* in the terminal window.
8. Verify that there are no crossings listed in the output of this program.

2.9.4.2.6 Assumptions and Constraints

The test routines simulate data sent by the Railroad Delay system by using the same interface routines.

2.9.4.2.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.10 DS-AVI Test

This test verifies that the requirements attributable to the Data Server's interface with the AVI process are met.

2.10.1 Hardware Preparation

- Data Server Master Computer running in normal mode.

2.10.2 Software Preparation

- Data Server process running on the Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.
- Realtime Map Display running on a workstation.

2.10.3 Other Pre-test Preparation

Log in as *mdi* to execute this test.

2.10.4 Test Descriptions

The following test cases are implemented under this test:

DS-AVI-01 AVI system status information test.

DS-AVI-02 AVI speed and traveltime test.

2.10.4.1 DS-AVI-01 AVI system status information test

This test case verifies that the Data Server interfaces with the AVI system, and that the status of the AVI system is displayed on the MDI System Status GUI.

2.10.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.17.

Table 2.17 Requirements Addressed by Test DS-AVI-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-2	The system shall interface with the AVI system.
DS-IF-2.1	The DSILS shall interface with the MDI AVI system.
DS-IF-2.1.1	The DSILC shall interface with the MDI AVI system.
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3.2	The SGUI shall interface with the TG Operations user using a GUI.
DS-IF-3.2.1	The SGUI shall interface with the user using a GUI.
DS-FN-9	The system shall maintain MDI system status data.
DS-FN-9.2	The DSILS shall acquire MDI AVI system status information.
DS-FN-9.4	The SGUI shall display MDI AVI system status information.
DS-FN-9.4.1	The SGUI shall display MDI AVI system current status.
DS-FN-9.4.2	The SGUI shall display MDI AVI system detailed status information.
DS-FN-9.9	The SGUI shall display DSDGIS process information.
DS-FN-9.9.3	The SGUI shall display DSAVIC process status information.

2.10.4.1.2 Prerequisite Conditions

This test assumes that the AVI system is running normally on the AVI Master Computer before starting the test.

2.10.4.1.3 Test Inputs

Heartbeat from the AVI system.

2.10.4.1.4 Test Results Evaluation

This test case will demonstrate that the MDI System Status GUI displays the AVI system's status. The AVI system status window on the MDI System Status GUI is inspected to verify that the background color of the heading changes when the AVI system status changes.

2.10.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the AVI system status window header in the Status GUI. The background color should be green.
2. Click on the AVI window on the Status GUI to display the detailed status window.
3. Observe that the detailed status window displays the detailed status of the AVI system.
4. Select the button labeled 'Stop' on the detailed status screen to stop the AVI system.
5. Observe that the background color of the AVI system's status window header changes to gray in a few minutes after the AVI system has stopped sending heartbeats. This time depends on the value of the *MAX_HB_INTERVAL* parameter in the MDI configuration file

$ATMS/etc/mdi.cfg.

6. Restart the AVI system by selecting the button labeled 'Start' on the AVI system's detailed status screen.
7. Observe that the background color of the AVI system's status window header changes back to green when heartbeats are being received again.
8. Close the AVI detailed status window.

2.10.4.1.6 Assumptions and Constraints

None.

2.10.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.10.4.2 DS-AVI-02 AVI speed and travel time test

This test verifies that the Data Server maintains, stores, acquires and provides AVI speed and travel time information.

2.10.4.2.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.18.

Table 2.18 Requirements Addressed by Test DS-AVI-02

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-3	The system shall maintain travel data for the TG road segments.
DS-FN-3.2	The DSS shall store MDI AVI travel data for MDI AVI TG road segments.
DS-FN-3.2.1	The DSC shall store the current MDI AVI-measured vehicle travel time associated with MDI AVI TG road segments.
DS-FN-3.2.2	The DSC shall store the current MDI AVI-measured vehicle speed associated with MDI AVI TG road segments.
DS-FN-3.8	The DSILS shall acquire MDI AVI travel data for MDI AVI TG road segments.
DS-FN-3.8.1	The DSILC shall acquire the current MDI AVI-measured vehicle travel time associated with MDI AVI TG road segments.
DS-FN-3.8.2	The DSILC shall acquire the current MDI AVI-measured vehicle speed associated with MDI AVI TG road segments.
DS-FN-3.10	The DCIS shall provide MDI AVI travel data for MDI AVI TG road segments.
DS-FN-3.10.5	The RTBC shall provide the current MDI AVI-measured vehicle travel time associated with MDI AVI TG road segments to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.
DS-FN-3.10.6	The RTBC shall provide the current MDI AVI-measured vehicle speed associated with MDI AVI TG road segments to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.

2.10.4.2.2 Prerequisite Conditions

This test assumes that the previous test case was successfully completed, and that the AVI system is not running on any workstation connected to the Data Server Master Computer before starting the test.

2.10.4.2.3 Test Inputs

User supplied AVI link IDs, speeds and travel times.

2.10.4.2.4 Test Results Evaluation

This test case will demonstrate that the AVI interface process can send AVI speed and travel time information to the Data Server, where it is stored, and from where it can be retrieved. The Realtime Map Display is inspected to verify that the speed data sent to the Data Server is displayed on the map.

2.10.4.2.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Open a terminal window on the workstation. In that window, change into the Data Server bin directory $ATMS/bin.
2. Set the speed and travel time of a desired AVI segment by running *set_avi_data <AVI segment LinkID> <speed> <travel time>* in the terminal window. The speed and travel time values must be positive integers.
3. Retrieve the speed and travel time of the AVI segment selected in step 2 by running *get_avi_data <AVI segment LinkID>* in the terminal window. Alternatively the speeds and travel times of all AVI segments can be obtained by running *get_all_avi_data* in the terminal window. The latter program can also be used to obtain a link ID value for an AVI segment in step 2.
4. Verify that the speed and travel time returned are the same as the values that were entered in step 2.
5. Click on randomly selected AVI segments on the Realtime Map Display to display a popup showing the speed of that segment. Compare the speed shown in the popup with the speed retrieved in step 3.

2.10.4.2.6 Assumptions and Constraints

The test routines simulate data sent by the AVI system by using the same interface routines.

2.10.4.2.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.11 DS-911 Test

This test verifies that the requirements attributable to the Police 911 Dispatch Data interface process are met.

2.11.1 Hardware Preparation

- Data Server Master Computer running in normal mode.
- Police network TCP/IP connection running in normal mode.

2.11.2 Software Preparation

- Data Server process running on the Data Server Master Computer.
- MDI System Status GUI running on the Data Server Master Computer.

2.11.3 Other Pre-test Preparation

Login as *mdi* to execute this test.

2.11.4 Test Descriptions

The following test cases are implemented under this test:

DS-911-01 911 Dispatch Data interface process status information test

DS-911-02 911 Dispatch Data incident transfer test

2.11.4.1 DS-911-01 911 Dispatch Data interface process status information test

This test case verifies that the 911 Dispatch Data interface process interfaces with the Data Server, and that the Status GUI reflects its status.

2.11.4.1.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.19.

Table 2.19 Requirements Addressed by Test DS-911-01

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-3	The system shall interface with the TG Operations user.
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.
DS-IF-3.2	The SGUIS shall interface with the TG Operations user using a GUI.
DS-IF-3.2.1	The SGUIC shall interface with the user using a graphical user interface.
DS-IF-7	The system shall interface with the San Antonio Police 911 Dispatch system.

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-7.1	The DGIS shall interface with the San Antonio Police 911 Dispatch system.
DS-IF-7.1.1	The 911IC shall interface with the San Antonio Police 911 Dispatch System.
DS-FN-9	The system shall maintain MDI System status data.
DS-FN-9.9	The SGUIS shall display DS DGIS process information.
DS-FN-9.9.4	The SGUIC shall display DS 911IC process status information.

2.11.4.1.2 Prerequisite Conditions

This test case assumes that the system is running normally and that the 911 Dispatch Data interface process (as shown on the Data Server detailed status window) is operating normally before starting the test.

2.11.4.1.3 Test Inputs

Heartbeat from the 911 Dispatch Data interface process.

2.11.4.1.4 Test Results Evaluation

This test case will demonstrate that the 911 Dispatch Data process interfaces with the MDI System Status GUI.

Before running this test, the background color of the Data Server window header in the Status GUI should be green. The Data Server detailed status window is inspected to verify that heartbeats are being received from the 911 Dispatch Data process at regular intervals. When the 911 Dispatch Data process is killed, heartbeats should no longer be received, and the background color of the Data Server window header should change within a few minutes (this time depends on the maximum heartbeat interval *MAX_HB_INTERVAL* value specified in the MDI configuration file, $ATMS/etc/mdi.cfg). When the process is restarted, the background color of the Data Server window header should change back to green, indicating that all the processes are sending heartbeats.

2.11.4.1.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Observe the background color of the Data Server status window in the Status GUI. The background color should be green.
2. Click on the Data Server window in the Status GUI to display the detailed status window.
3. Observe that the time indicating when the latest heartbeat was received from the 911 Dispatch Data process is updating.

4. Open a terminal window on the Data Server. In that window, enter *'ps -ef | grep 911'* to display the UNIX process status of the 911 Dispatch Data process currently running. Note that the 911 interface process *911connection* appears in the output.
5. In the detailed status window, click on the button labeled *'Stop'* at the end of the 911 Connection entry.
6. In the terminal window enter *'ps -ef | grep 911'*. Note that the 911 interface process is not listed.
7. Also observe on the Data Server detailed status window that heartbeats are not being received from the 911 Dispatch Data process.
8. In the detailed status window, click on the button labeled *'Start'* at the end of the 911 Connection entry.
9. Observe that the detailed status window shows that heartbeats are being received again.
10. Close the detailed status window.

2.11.4.1.6 Assumptions and Constraints

If the 911 Dispatch Data process is not operating when the San Antonio 911 Police Dispatch system attempts to send data, it may cause the Police Dispatch system connection to fail. If this happens, call 207-8323 to request that the TCP CICS connection be reset.

2.11.4.1.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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2.11.4.2 DS-911-02 911 Dispatch Data incident transfer test

This test case verifies that traffic accident incidents, contained in the 911 Dispatch Data transmission, are transferred to and stored at the Data Server Master Computer.

2.11.4.2.1 Requirements Addressed

This test addresses the requirements detailed in Table 2.20.

Table 2.20 Requirements Addressed by Test DS-911-02

REQUIREMENT NUMBER	REQUIREMENT
DS-IF-7	The system shall interface with the San Antonio Police 911 Dispatch system.
DS-IF-7.1	The DGIS shall interface with the San Antonio Police 911 Dispatch system.
DS-IF-7.1.1	The 911IC shall interface with the San Antonio Police 911 Dispatch System.
DS-FN-6	The system shall maintain traffic incident data.
DS-FN-6.2	The DSS shall store 911 traffic incident data.
DS-FN-6.2.1	The DSC shall store accident related incident data for 911 traffic incident data.
DS-FN-6.5	The DGIS shall acquire 911 traffic incident data.
DS-FN-6.5.1	The 911IC shall acquire accident related 911 traffic incident data.
DS-FN-6.9	The DCIS shall provide 911 traffic incident data.

REQUIREMENT NUMBER	REQUIREMENT
DS-FN-6.9.4	The RTBC shall provide accident related 911 traffic incident data to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.

2.11.4.2.2 Prerequisite Conditions

This test case assumes that the previous test was successfully completed. Make sure that the system is running normally, that the connection to the Police Dispatch system is operating, and that the 911 Dispatch Data interface process (as shown on the Data Server detailed status window) is operating normally before starting the test.

2.11.4.2.3 Test Inputs

911 Dispatch Data transmissions from the police network.

2.11.4.2.4 Test Results Evaluation

This test case will demonstrate that the traffic accident incidents from the 911 Dispatch Data transmissions are transferred to the Data Server, where they are stored. The output of a program, that reads all the 911 incidents from the Data Server, will be compared to the Real Time Traffic Data displayed on the City of San Antonio Police Department's Web-page.

2.11.4.2.5 Test Procedure

The test procedure consists of the following steps, performed in order.

1. Using a Web browser, view the City of San Antonio Police Department's Real Time Traffic Report Web-page, located at *http://161.226.90.34/ixpress/city/city/cosa3*.
2. Open a terminal window on the workstation. In that window, change to the Data Server bin directory $ATMS/bin.
3. Retrieve the current 911 incidents from the Data Server by running *get_911_incidents* from the terminal window.
4. Select accident related traffic incidents (ACC MAJR or ACC MINR) from the Web-page at random and compare them to the incidents retrieved from the Data Server.

2.11.4.2.6 Assumptions and Constraints

The 911 police data is currently transmitted at three minute intervals to the Data Server. The data displayed on the Web-page and the output of the *get_911_incidents* program may be out of synch towards the end of this three-minute interval. If an update was received by the Web-page after the latest transmission, or if the Data Server incidents were retrieved before the latest transmission of data occurred, re-run the *get_911_incidents* program.

Note that only minor and major traffic accidents are sent to and stored at the Data Server.

2.11.4.2.7 Test Results

☐ PASS ☐ FAIL SwRI: _____ Date: _____

TxDOT: _____ Date: _____

Comments:

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3. REQUIREMENTS TRACEABILITY

The traceability matrix for the DS System is presented in this section. It lists the requirements of the system that were presented in Section 2 of this document. Along with each requirement is the source of the requirement and the test case that verifies the requirement.

This table is based on the traceability matrix from the Data Server Software Design Document. This table was used throughout the design, development, and test of the system to ensure that the requirements have been met. It was continually updated as requirements and design elements were refined.

The requirements in the traceability matrix are organized by requirement number. The general requirements are presented first, followed by the interface, functional, and physical requirements.

Table 3.1. Data Server System Traceability Matrix

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-GN-1	An 80% System Design Document shall be delivered.	P-2.1.2.8.2	N/A
DS-GN-2	A 100% design document shall be delivered.	P-2.1.2.8.2	N/A
DS-GN-3	A Software Acceptance Test Plan shall be delivered.	P-2.1.2.8.2	N/A
DS-GN-4	A Version Description Document shall be delivered.	P-2.1.2.8.2	N/A
DS-GN-5	Monthly status reports shall be delivered.	P-2.1.2.8.2	N/A
DS-GN-6	A training program on the SAAWDB shall be presented after final software integration has completed.	P-2.1.2.8.5	N/A
DS-GN-7	A videotape of the training program shall be delivered.	P-2.1.2.8.5	N/A
DS-GN-8	A final report shall be delivered.	P-2.1.2.8.2	N/A
DS-IF-1	The system shall interface with the TGATMS.	P-2.1.2.3p1	DS-RT-02
DS-IF-1.1	The DGIS shall interface with the TGATMS using protocol defined by the existing TGATMS data broadcast.	DS-IF-1	DS-RT-02
DS-IF-1.1.1	The RTCIC shall interface with the TGATMS using protocol defined by the existing TGATMS data broadcast.	DS-IF-1.1	DS-RT-02
DS-IF-2	The system shall interface with the AVI system.	P-2.1.2.3p2	DS-AVI-01
DS-IF-2.1	The DSILS shall interface with the MDIAVI system.	DS-IF-2	DS-AVI-01
DS-IF-2.1.1	The DSILC shall interface with the MDIAVI system.	DS-IF-2.1	DS-AVI-01

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-IF-3	The system shall interface with the TG Operations user.	P-2.1.2.2p1	DS-RD-01 DS-GPSTH-01 DS-RT-01 DS-WWW-01 DS-WWW-02 DS-LC-01 DS-KIOSK/IVN-01 DS-AWARD-01 DS-AVI-01 DS-911-01 DS-WV-01
DS-IF-3.1	The DGS shall interface with the TG Operations user using a GUI.	DS-IF-3	DS-RD-01 DS-GPSTH-01 DS-RT-01 DS-WWW-01 DS-WWW-02 DS-LC-01 DS-KIOSK/IVN-01 DS-AWARD-01 DS-AVI-01 DS-911-01 DS-WV-01
DS-IF-3.1.1	The LCGUIC shall interface with the TG Operations user using a GUI.	DS-IF-3.1	DS-LC-01
DS-IF-3.2	The SGUIS shall interface with the TG Operations user using a GUI.	P-2.1.2.2 DS-IF-3	DS-RD-01 DS-GPSTH-01 DS-RT-01 DS-WWW-01 DS-KIOSK/IVN-01 DS-AWARD-01 DS-AVI-01 DS-911-01 DS-WV-01
DS-IF-3.2.1	The SGUIC shall interface with the user using a GUI.	DS-IF-3.2	DS-RD-01 DS-RT-01 DS-KIOSK/IVN-01 DS-AWARD-01 DS-AVI-01 DS-911-01 DS-WV-01
DS-IF-4	The system shall interface with the Texas State Roadway Closed database.	P-2.1.2.3p7	DS-RD-02
DS-IF-4.1	The DGIS shall interface with the Texas State Roadway Closed database.	DS-IF-3	DS-RD-02
DS-IF-4.1.1	The RCIC shall interface with the Texas State Roadway Closed database.	DS-IF-4.1	DS-RD-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-IF-6	The system shall interface with the IVN/Kiosk system.	P-2.1.2.4p3 P.2.1.2.4p4	DS-KIOSK/IVN-01
DS-IF-6.1	The DSILS shall interface with the IVN/Kiosk system.	DS-IF-6	DS-KIOSK/IVN-01
DS-IF-6.1.1	The DSILC shall interface with the MDI IVN/Kiosk system.	DS-IF-6.1	DS-KIOSK/IVN-01
DS-IF-7	The system shall interface with the San Antonio Police 911 Dispatch system.	P-2.1.2.3p5	DS-911-01 DS-911-02
DS-IF-7.1	The DGIS shall interface with the San Antonio Police 911 Dispatch system.	DS-IF-7	DS-911-01 DS-911-02
DS-IF-7.1.1	The 911IC shall interface with the San Antonio Police 911 Dispatch System.	DS-IF-7.1	DS-911-01 DS-911-02
DS-IF-8	The system shall interface with the TG WWW system.	P-2.1.2.4p5	DS-WWW-02
DS-IF-8.1	The DCIS shall interface with the TG WWW system.	DS-IF-8	DS-WWW-02
DS-IF-8.1.1	The WWWIC shall interface with the TG WWW system.	DS-IF-8.1	DS-WWW-02
DS-IF-10	The system shall interface with the Emergency Response system.	P-2.1.2.4p6	DS-RT-02
DS-IF-10.1	The DCIS shall interface with the Emergency Response system.	DS-IF-10	DS-RT-02
DS-IF-10.1.1	The RTBC shall interface with the Emergency Response system.	DS-IF-10.1	DS-RT-02
DS-IF-12	The system shall interface with the TG ATMS Map system.	2.1.2.4p1	DS-RT-02
DS-IF-12.1	The DCIS shall interface with the TG ATMS Map system.	DS-IF-12	DS-RT-02
DS-IF-12.1.1	The RTBC shall interface with TG ATMS Map system using the protocol defined by the current TG ATMS operations broadcast system.	DS-IF-12.1	DS-RT-02
DS-IF-13	The system shall interface with the MDI Railroad Delay system.	P-2.1.2.3p8	DS-AWARD-01
DS-IF-13.1	The DSILS shall interface with the MDI Railroad Delay system.	DS-IF-13	DS-AWARD-01
DS-IF-13.1.1	The DSILC shall interface with the Railroad Delay system.	DS-IF-13.1	DS-AWARD-01
DS-FN-1	The system shall maintain road segment data for the TG road segments.	P-2.1.1p4	DS-RT-02 DS-WWW-02
DS-FN-1.1	The DSS shall store TG Link Identifier data for the TG road segments.	DS-FN-1	DS-RT-02
DS-FN-1.1.1	The DSC shall store a TG Link Identifier for the TG road segments.	DS-FN-1.1	DS-RT-02
DS-FN-1.1.2	The DSC shall store TG Equipment Identifier for TG equipment associated with a segment of interest.	P-2.1.1p4 DS-FN-1.1	DS-RT-02
DS-FN-2	The system shall maintain map data for areas outside of the segments of interest.	P-2.1.1p5	DS-RT-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-FN-2.1	The system shall store San Antonio map data for areas outside the TG road segments.	DS-FN-2	DS-RT-02
DS-FN-3	The system shall maintain travel data for the TG road segments.	P-2.1.2.1p2	DS-GPSTH-02 DS-GPSTH-03 DS-RT-02 DS-WWW-02 DS-AVI-02
DS-FN-3.1	The DSS shall store TG ATMS travel data for TG ATMS road segments.	P-2.1.2.3p1 DS-FN-3	DS-RT-02
DS-FN-3.1.1	The DSC shall store the current travel data for the travel data elements defined by the existing TG ATMS data broadcast system.	DS-FN-3.1	DS-RT-02
DS-FN-3.2	The DSS shall store MDI AVI travel data for MDI AVI TG road segments.	P-2.1.2.3p2 DS-FN-3	DS-AVI-02
DS-FN-3.2.1	The DSC shall store the current MDI AVI-measured vehicle travel time associated with MDI AVI TG road segments.	DS-FN-3.2	DS-AVI-02
DS-FN-3.2.2	The DSC shall store the current MDI AVI-measured vehicle speed associated with MDI AVI TG road segments.	DS-FN-3.2	DS-AVI-02
DS-FN-3.3	The DSS shall store theoretical travel data for the theoretical TG road segments.	P-2.1.2.3p3 DS-FN-3	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.3.1	The DSC shall store the current theoretical vehicle speed associated with theoretical TG road segments.	DS-FN-3.3	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.4	The DSS shall store GPS travel data for the GPS TG road segments.	DS-FN-3	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.4.1	The DSC shall store the current GPS-measured vehicle speed associated with GPS TG road segments.	DS-FN-3.4	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.5	The DGS shall store theoretical travel data for the theoretical TG road segments at 15-minute time intervals.	P-2.1.2.3p3 DS-FN-3	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.5.1	The GPSTH C shall store the vehicle speed at 15-minute intervals for theoretical TG road segments.	DS-FN-3.5	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.6	The DGS shall store GPS travel data for the GPS TG road segments at 15-minute intervals.	DS-FN-3	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.6.1	The GPSTH C shall store the vehicle speed at 15-minute intervals for GPS TG road segments and theoretical TG road segments.	DS-FN-3.6	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.7	The DSILS shall acquire TG ATMS travel data for TG ATMS road segments.	P-2.1.2.3p1 DS-FN-3	DS-RT-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-FN-3.7.1	The RTCIC shall acquire the current travel data for the travel data elements defined by the existing TGATMS data broadcast system.	DS-FN-3.7	DS-RT-02
DS-FN-3.8	The DSILS shall acquire MDIAVI travel data for MDIAVI TG road segments.	P-2.1.2.3p2 DS-FN-3	DS-AVI-02
DS-FN-3.8.1	The DSILC shall acquire the current MDIAVI-measured vehicle travel time associated with MDIAVI TG road segments.	DS-FN-3.8	DS-AVI-02
DS-FN-3.8.2	The DSILC shall acquire the current MDIAVI-measured vehicle speed associated with MDIAVI TG road segments.	DS-FN-3.8	DS-AVI-02
DS-FN-3.9	The DCIS shall provide TGATMS travel data for TGATMS road segments.	P-2.1.2.3p1 DS-FN-3	DS-RT-02 DS-WWW-02
DS-FN-3.9.1	The WWWIC shall provide the current travel data for the travel data elements defined by the existing TGATMS data broadcast system to the TGWWW system.	DS-FN-3.9	DS-WWW-02
DS-FN-3.9.4	The RTBC shall provide the current travel data for the travel data elements defined by the existing TGATMS data broadcast system to the TGATMS Map system, the MDIIVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-3.9	DS-RT-02 DS-WWW-02
DS-FN-3.10	The DCIS shall provide MDIAVI travel data for MDIAVI TG road segments.	P-2.1.2.3p2 DS-FN-3	DS-WWW-02 DS-AVI-02
DS-FN-3.10.5	The RTBC shall provide the current MDIAVI-measured vehicle travel time associated with MDIAVI TG road segments to the TGATMS Map system, the MDIIVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-3.10	DS-WWW-02 DS-AVI-02
DS-FN-3.10.6	The RTBC shall provide the current MDIAVI-measured vehicle speed associated with MDIAVI TG road segments to the TGATMS Map system, the MDIIVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-3.10	DS-WWW-02 DS-AVI-02
DS-FN-3.11	The DCIS shall provide theoretical travel data for the theoretical TG road segments.	P-2.1.2.3p3 DS-FN-3	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.11.3	The RTBC shall provide the current theoretical vehicle speed associated with theoretical TG road segments to the TGATMS Map system, the MDIIVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-3.11	DS-GPSTH-02
DS-FN-3.12	The DCIS shall provide GPS travel data for the GPS TG road segments.	DS-FN-3	DS-GPSTH-02 DS-GPSTH-03
DS-FN-3.12.3	The RTBC shall provide the current GPS-measured vehicle speed associated with GPS TG road segments to the TGATMS Map system, the MDIIVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-3.12	DS-GPSTH-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-FN-4	The system shall maintain lane closure data.	P-2.1.2.3p1	DS-RD-02 DS-WWW-02 DS-LC-01
DS-FN-4.1	The DSS shall store State of Texas lane closure data.	P-2.1.2.3p7 DS-FN-4	DS-RD-02
DS-FN-4.1.1	The DSC shall store non-construction related lane closure information for State of Texas roadway closed data.	DS-FN-4.1	DS-RD-02
DS-FN-4.2	The DSS shall store San Antonio lane closure data.	DS-FN-4	DS-LC-01
DS-FN-4.2.1	The DSC shall store the lane closure data elements defined in the current TG Lane Closure system for San Antonio lane closure data.	DS-FN-4.2	DS-LC-01
DS-FN-4.3	The DGS shall acquire lane closure data.	DS-FN-4	DS-LC-01
DS-FN-4.3.1	The LCGUIC shall acquire the lane closure data elements defined in the current TG Lane Closure system for TG lane closure data.	DS-FN-4.3	DS-LC-01
DS-FN-4.4	The DGIS shall acquire State of Texas roadway closed data.	P-2.1.2.3p7 DS-FN-4	DS-RD-02
DS-FN-4.4.1	The RCIC shall acquire non-construction related lane closure information for State of Texas road closed data.	DS-FN-4.4	DS-RD-02
DS-FN-4.5	The DSILS shall provide State of Texas roadway closed data.	P-2.1.2.3p7 DS-FN-4	DS-RD-02
DS-FN-4.6	The DCIS shall provide TG lane closure data.	DS-FN-4	DS-WWW-02 DS-LC-01
DS-FN-4.6.2	The RTBC shall provide the lane closure data elements defined in the current TG Lane Closure system for San Antonio lane closure data to the TG ATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-4.6	DS-LC-01
DS-FN-6	The system shall maintain traffic incident data.	P-2.1.2.3p1 P-2.1.2.3p5 P-2.1.2.3p6	DS-RT-02 DS-WWW-02 DS-AWARD-02 DS-911-02
DS-FN-6.1	The DSS shall store TG ATMS traffic incident data.	DS-FN-6	DS-RT-02
DS-FN-6.1.1	The DSC shall store current incident data for the incident data elements defined in the existing TG ATMS data broadcast system.	DS-FN-6.1	DS-RT-02
DS-FN-6.2	The DSS shall store 911 traffic incident data.	P-2.1.2.3p5 DS-FN-6	DS-911-02
DS-FN-6.2.1	The DSC shall store accident related incident data for 911 traffic incident data.	DS-FN-6.2	DS-911-02
DS-FN-6.3	The DSS shall store Railroad Delay incident data.	P-2.1.2.3p8 DS-FN-6	DS-AWARD-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-FN-6.3.1	The DSC shall store current incident data for Railroad Delay incident data.	DS-FN-6.3	DS-AWARD-02
DS-FN-6.4	The DGIS shall acquire TGATMS traffic incident data.	DS-FN-6	DS-RT-02
DS-FN-6.4.1	The RTCIC shall acquire current incident data for the incident data elements defined in the existing TGATMS data broadcast system.	DS-FN-6.4	DS-RT-02
DS-FN-6.5	The DGIS shall acquire 911 traffic incident data.	P-2.1.2.3p5 DS-FN-6	DS-911-02
DS-FN-6.5.1	The 911IC shall acquire accident related 911 traffic incident data.	DS-FN-6.5	DS-911-02
DS-FN-6.6	The DSILS shall acquire Railroad Delay incident data.	P-2.1.2.3p8 DS-FN-6	DS-AWARD-02
DS-FN-6.6.1	The DSILC shall acquire current incident data for Railroad Delay incidents.	DS-FN-6.6	DS-AWARD-02
DS-FN-6.8	The DCIS shall provide TGATMS traffic incident data.	DS-FN-6	DS-RT-02 DS-WWW-02
DS-FN-6.8.4	The RTBC shall provide current incident data for the incident data elements defined in the existing TGATMS data broadcast system to the TGATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-6.8	DS-RT-02 DS-WWW-02
DS-FN-6.9	The DCIS shall provide 911 traffic incident data.	P-2.1.2.3p5	DS-WWW-02 DS-911-02
DS-FN-6.9.4	The RTBC shall provide accident related 911 traffic incident data to the TGATMS Map system, the MDI IVN/KIOSK System, and other ATMS data broadcast listeners.	DS-FN-6.9	DS-WWW-02 DS-911-02
DS-FN-6.10	The DCIS shall provide railroad delay incident data.	P-2.1.2.3p5 DS-FN-6	DS-WWW-02 DS-AWARD-02
DS-FN-7	The system shall maintain traveler information.	P-2.1.2.1p1	DS-WV-02
DS-FN-7.1	The DSS shall store VIA data.	P-2.1.2.3p10 DS-FN-7	DS-WV-02
DS-FN-7.1.1	The DSC shall store VIA data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.	DS-FN-7.1	DS-WV-02
DS-FN-7.2	The DSS shall store weather data.	Design	DS-WV-02
DS-FN-7.2.1	The DSC shall store weather data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.	DS-FN-7.2	DS-WV-02
DS-FN-7.4	The DSILS shall acquire VIA data.	P-2.1.2.3p10 DS-FN-7	DS-WV-02
DS-FN-7.4.1	The DSILC shall acquire VIA data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.	DS-FN-7.4	DS-WV-02
DS-FN-7.5	The DSILS shall acquire Weather data.	DS-FN-7	DS-WV-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-FN-7.5.1	The DSILC shall acquire weather data as specified in the MDI Traveler Information Kiosk Preliminary Design Document.	DS-FN-7.5	DS-WV-02
DS-FN-7.6	The DSILS shall provide VIA data.	P-2.1.2.3p10 DS-FN-7	DS-WV-02
DS-FN-7.6.1	The DSILC shall provide VIA data as specified in the MDI Traveler Information Kiosk Preliminary Design Document to the MDI IVN/KIOSK System.	DS-FN-7.6	DS-WV-02
DS-FN-7.8	The DSILS shall provide weather data.	DS-FN-7	DS-WV-02
DS-FN-7.8.1	The DSILC shall provide weather data as specified in the MDI Traveler Information Kiosk Preliminary Design Document to the MDI IVN/KIOSK System.	DS-FN-7.9	DS-WV-02
DS-FN-8	The system shall maintain TG ATMS equipment status data.	2.1.2.3p1	DS-RT-02
DS-FN-8.1	The DSS shall store TG ATMS CMS data.	DS-FN-8	DS-RT-02
DS-FN-8.1.1	The DSC shall store the current CMS data for the CMS data elements defined in the existing TG ATMS data broadcast system.	DS-FN-8.1	DS-RT-02
DS-FN-8.2	The DSS shall store TG ATMS LCS data.	DS-FN-8	DS-RT-02
DS-FN-8.2.1	The DSC shall store the current LCS data for the LCS data elements defined in the existing TG ATMS data broadcast system.	DS-FN-8.2	DS-RT-02
DS-FN-8.3	The DGIS shall acquire TG ATMS CMS data.	DS-FN-8	DS-RT-02
DS-FN-8.3.1	The RTCIC shall acquire the current CMS data for the CMS data elements defined in the existing TG ATMS data broadcast system.	DS-FN-8.3	DS-RT-02
DS-FN-8.4	The DGIS shall acquire TG ATMS LCS data.	DS-FN-8	DS-RT-02
DS-FN-8.4.1	The RTCIC shall acquire the current LCS data for the LCS data elements defined in the existing TG ATMS data broadcast system.	DS-FN-8.4	DS-RT-02
DS-FN-8.5	The DCIS shall provide TG ATMS CMS data.	DS-FN-8	DS-RT-02
DS-FN-8.5.1	The RTBC shall provide the current CMS data for the CMS data elements defined in the existing TG ATMS data broadcast system to the TG ATMS Map system and other ATMS data broadcast listeners.	DS-FN-8.5	DS-RT-02
DS-FN-8.6	The DCIS shall provide TG ATMS LCS data.	DS-FN-8	DS-RT-02
DS-FN-8.6.1	The RTBC shall provide the current LCS data for the LCS data elements defined in the existing TG ATMS data broadcast system to the TG ATMS Map system and other ATMS data broadcast listeners.	DS-FN-8.6	DS-RT-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-FN-9	The system shall maintain MDI system status data.	2.1.2.2p1	DS-RD-01 DS-GPSTH-01 DS-RT-01 DS-WWW-01 DS-KIOSK/IVN-01 DS-AWARD-01 DS-AVI-01 DS-911-01
DS-FN-9.1	The DGS shall monitor DGS process status information.	DS-FN-9	DS-GPSTH-01
DS-FN-9.1.3	The GPSTH C shall provide GPSTH C process status information.	DS-FN-9.1	DS-GPSTH-01
DS-FN-9.2	The DSILS shall acquire MDI AVI system status information.	DS-FN-9	DS-AVI-01
DS-FN-9.3	The DSILS shall acquire MDI Railroad Delay system status information.	DS-FN-9	DS-AWARD-01
DS-FN-9.4	The SGUIS shall display MDI AVI system status information.	DS-FN-9	DS-AVI-01
DS-FN-9.4.1	The SGUIC shall display MDI AVI system current status.	DS-FN-9.4	DS-AVI-01
DS-FN-9.4.2	The SGUIC shall display MDI AVI system detailed status information.	DS-FN-9.4	DS-AVI-01
DS-FN-9.5	The SGUIS shall display MDI IVN system status information.	DS-FN-9	DS-KIOSK/IVN-01
DS-FN-9.5.1	The SGUIC shall display MDI IVN system current status.	DS-FN-9.5	DS-KIOSK/IVN-01
DS-FN-9.5.2	The SGUIC shall display MDI IVN system detailed status information.	DS-FN-9.5	DS-KIOSK/IVN-01
DS-FN-9.6	The SGUIS shall display MDI Kiosk system status information.	DS-FN-9	DS-KIOSK/IVN-01
DS-FN-9.6.1	The SGUIC shall display MDI Kiosk system current status.	DS-FN-9.6	DS-KIOSK/IVN-01
DS-FN-9.6.2	The SGUIC shall display MDI Kiosk system detailed status information.	DS-FN-9.6	DS-KIOSK/IVN-01
DS-FN-9.7	The SGUIS shall display MDI Railroad Delay system status information.	DS-FN-9	DS-AWARD-01
DS-FN-9.7.1	The SGUIC shall display MDI Railroad Delay system current status.	DS-FN-9.7	DS-AWARD-01
DS-FN-9.7.2	The SGUIC shall display MDI Railroad Delay system detailed status information.	DS-FN-9.7	DS-AWARD-01
DS-FN-9.8	The SGUIS shall display DS DGS process status information.	DS-FN-9	DS-GPSTH-01
DS-FN-9.8.3	The SGUIC shall display DS GPSTH C process status information.	DS-FN-9.8	DS-GPSTH-01

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-FN-9.9	The SGUIS shall display DSDGIS process information.	DS-FN-9	DS-RD-01 DS-RT-01 DS-AWARD-01 DS-AVI-01 DS-911-01 DS-WV-01
DS-FN-9.9.1	The SGUIC shall display DSRTCIC process status information.	DS-FN-9.9	DS-RT-01
DS-FN-9.9.2	The SGUIC shall display DSRDIC process status information.	DS-FN-9.9	DS-AWARD-01
DS-FN-9.9.3	The SGUIC shall display DSAVIC process status information.	DS-FN-9.9	DS-AVI-01
DS-FN-9.9.4	The SGUIC shall display DS911IC process status information.	DS-FN-9.9	DS-911-01
DS-FN-9.9.5	The SGUIC shall display DSRCIC process status information.	DS-FN-9.9	DS-RD-01
DS-FN-9.9.6	The SGUIC shall display DSVIC process status information.	DS-FN-9.9	DS-WV-01
DS-FN-9.9.7	The SGUIC shall display DSWIC process status information.	DS-FN-9.9	DS-WV-01
DS-FN-9.11	The SGUIS shall display DSDCIS process information.	DS-FN-9	DS-RT-01 DS-WWW-01
DS-FN-9.11.1	The SGUIC shall display DSWWWIC process information.	DS-FN-9.11	DS-WWW-01
DS-FN-9.11.5	The SGUIC shall display DSRTBC process information.	DS-FN-9.11	DS-RT-01
DS-FN-10	The system shall adjust travel data for TG road segments based on current conditions.	P-2.1.2.1p2	DS-GPSTH-03
DS-FN-10.1	The DGS shall adjust theoretical travel data for theoretical TG road segments based on time of day.	P-2.1.2.3p4 DS-FN-10	DS-GPSTH-03
DS-FN-10.1.1	The GPSTHC shall adjust theoretical travel data for theoretical TG road segments based on current conditions using adjustment factors based on type of day and/or weather.	DS-FN-10.1	DS-GPSTH-03
DS-FN-10.2	The DGS shall adjust GPS travel data for GPS TG road segments based on time of day.	DS-FN-10	DS-GPSTH-03
DS-FN-10.2.1	The GPSTHC shall adjust GPS travel data for GPS TG road segments based on current conditions using adjustment factors based on type of day and/or weather.	DS-FN-10.2	DS-GPSTH-03
DS-FN-11	The system shall have the ability to access the data based on geographic attributes.	P-2.1.1p5	DS-RT-02
DS-FN-11.1	The DSS shall store geographic attributes of data.	P-2.1.1p4 DS-FN-11	DS-RT-02
DS-FN-11.1.1	The DSC shall store the altitude, latitude, and longitude of the endpoints of the TG road segments.	DS-FN-11.1	DS-RT-02

REQUIREMENT NUMBER	REQUIREMENT	SOURCE	TEST CASE(S)
DS-PY-1	The system will reside on a computer separate from the TG operational computers.	P-2.1.2.7	DS-PHYS-01
DS-PY-1.1	The MCS shall be a Sun Microsystems Ultra SPARCStation or better.	P-2.1.2.7 DS-PY-1	DS-PHYS-01
DS-PY-1.2	The MCS shall have, at a minimum, the following items: • 167MHz SPARC CPU • 4.2 GB Hard Disk • 128 MB RAM • Floppy Disk drive • Sun CD-ROM drive • Turbo GX+ Graphics card • 20" Sun color monitor • 2 Ethernet cards • 2 SCSI channels	P-2.1.2.7 DS-PY-1	DS-PHYS-01