DalTrans-OCD-1.15

Operational Concept Document

For the

DalTrans Transportation Management Center

SwRI Project No. 10.05594, EO 14 (Doc. No. 261)
P. O. No. 8-0023
Req. No. 60129-8-80020-BB

January 7, 2002

Prepared for:

Texas Department of Transportation
4777 East Highway 80
Mesquite, Texas 75150

In partnership with:

North Central Texas Council Of Governments and
Dallas Area Rapid Transit

Prepared by:

Southwest Research Institute
Post Office Drawer 28510, 6220 Culebra Road
San Antonio, Texas 78228-0510

DalTrans-OCD-1.15

January 7, 2002

Operational Concept Document

Version 1.15

For The

DalTrans Transportation Management Center

SwRI Project 10.05594, EO 14 (Doc. No. 261)

1/14/2002

Mike Brown, EO Manager **Date**

1/14/2002

Harry L. Grothues, Project/Section Manager **Date**
Intelligent Transportation Systems Section

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 SCOPE

The following sections describe the overall scope of the project and this document.

1.1 Project Identification

This document provides the operational concept for the Texas Department of Transportation (TxDOT) Dallas District Transportation Management Center (TMC) also known as the DalTrans Center and its partner Dallas Area Rapid Transit (DART).

1.2 Document Overview

This Operational Concept Document (OCD) is intended to provide a high-level overview of the characteristics and capability of DalTrans. It is developed from a user's viewpoint and is intended to communicate the overall vision of the system to the user, buyer, developer, and anyone else requiring a high-level understanding of the system. This document was originally developed under the TxDOT Statewide Integration project and is maintained by the TxDOT-Dallas district office and DART.

The remainder of Section 1 of this document provides an overview of the DalTrans system and lists documents related to this operational concept. Section 2 describes the operational concept of the existing DalTrans Satellite TMC. Section 3 describes the motivation for the development of the new TMC. Section 4 describes in detail the operational concept of the new TMC that results from the desired changes of Section 3. Section 5 provides the operational scenarios for the TMC that provide a high-level functional specification. Section 6 describes the operational impact of the proposed system on the users, developers, and support and maintenance organizations. Section 7 provides an analysis of the benefits, limitations, advantages, disadvantages, alternatives, and trade-offs considered for the DalTrans system. Finally, Section 8 provides any additional information that will aid in the understanding of this document.

1.3 System Overview

DalTrans shares a common vision with the current and planned Intelligent Transportation Systems (ITS) deployments in the region, state of Texas and nationwide. This vision focuses on improving safety, reducing congestion, improving traveler mobility, enhancing economic productivity, and promoting energy efficiency and environmental quality.

The TMC represents an application of the National ITS Architecture at a project level and implements the vision by providing the following services to Dallas area travelers:

- Pre-trip Travel Information
- Traffic Control
- Incident Management
- Travel Demand Management
- Emergency Notification

The block diagram shown in Figure 1 shows the anticipated interaction of the TMC with other components as suggested in the National ITS Architecture.

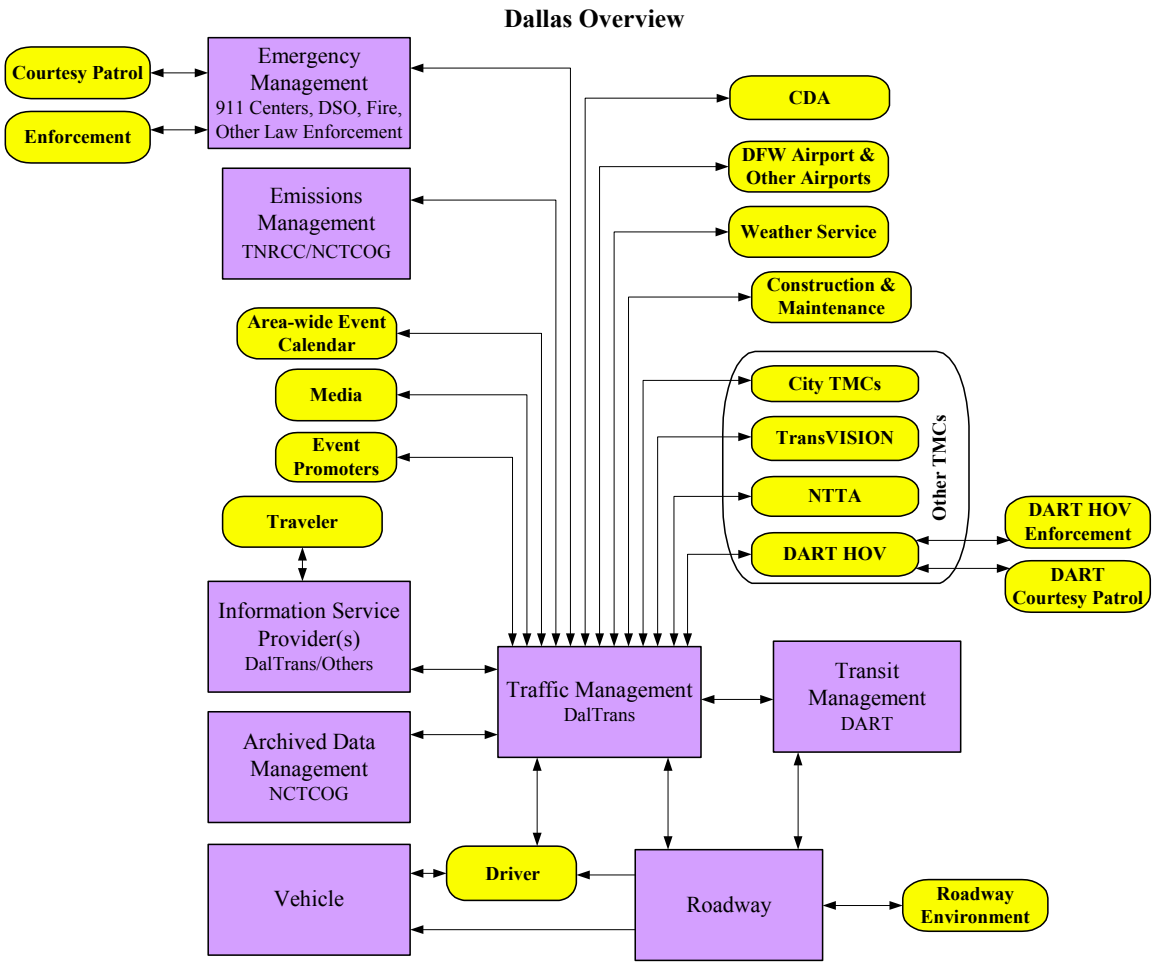

Figure 1. DalTrans Overview Block Diagram

The construction of the DalTrans TMC will be divided into the following phases:

1. Development of Operational Concept Document & System Requirements
2. Land Acquisition
3. Acquiring the services of a System Integrator
4. Acquiring the services of a Architect
5. Building Construction

Each phase will require input from various agencies to assure that completion of this project is accomplished to the satisfaction of everybody involved. TxDOT will take the lead on all phases of this project considerable input from Dallas County and DART.

The following transportation stakeholders may have a physical presence in DalTrans. This presence may be accomplished through dedicated equipment (e.g., radio gear), through fulltime staffing, or through staffing during emergencies and/or special events.

- TxDOT
- Dallas Area Rapid Transit (DART)

- Dallas Sheriff's Office (DSO)
- Dallas Fire Department
- North Texas Tollway Authority (NTTA)

Other partners anticipated to share space in the DalTrans center include various regional cities with TMCs and the Texas Transportation Institute (TTI). Agencies that are not sharing space in the center will be physically connected to the DalTrans system to realize a "virtual" control center.

DalTrans provides travelers with pre-trip travel information via the TxDOT Internet web page, private Information Service Providers (ISP) and the media. For some information, the TMC is the ISP and for other information, the TMC will simply provide data to an external ISP that is responsible for information dissemination to the traveling public. DalTrans also provides en-route information and route guidance via the roadway subsystem using Dynamic Message Signs (DMS) and Highway Advisory Radio (HAR). This information is then disseminated to the vehicle driver.

DalTrans performs incident management via the roadway subsystem. Planned incidents are gathered from an area wide event calendar and construction and maintenance schedules. Unplanned incidents are detected using loop detectors, Closed Circuit Television (CCTV) cameras, incident reports from phone calls, and coordination with the DSO and the Dallas Fire Department. The response actions to incidents are implemented using DMS, HAR, and Lane Control Signals (LCS). Similar responses are formed for normal traffic control and traffic demand management. Incident response actions requiring emergency personnel are coordinated between DalTrans, DSO, Dallas Fire Department, Courtesy Patrol, and 911 emergency centers as necessary. Less severe incidents, such as stalled vehicles, are often handled via the courtesy patrol.

Regional traffic control is accomplished through coordination and communication between DalTrans and other transportation management centers such as TransVISION, the Fort Worth TMC, and local traffic control centers as needed. This coordination of control is possible via the TxDOT Center-To-Center (C2C) interface.

1.4 Related Documents

- *System Requirements Specification for the Dallas Transportation Management Center*, Texas Department of Transportation/Southwest Research Institute/Texas Transportation Institute, January 7, 2002
- *Dallas Area-Wide Intelligent Transportation System Plan,* Texas Transportation Institute for the Texas Department of Transportation, July 1996
- *National ITS Architecture Version 3.0,* http://www.iteris.com/itsarch/
- *Transportation Management Center Concept of Operations Implementation Guide,* Federal Highways Administration, December 1999
- *IEEE Guide for Information Technology – System Definition – Concept of Operations (ConOps) Document, IEEE Std 1362-1998,* Software Engineering Standards Committee of the IEEE Computer Society, March 19, 1998
- *Statewide Security Plan,* Texas Department of Transportation

2.0 CURRENT SYSTEM

2.1 Background, objectives, and scope

2.1.1 Background of the current system

The existing DalTrans Transportation Management Satellite Center, located on Churchill Way in Dallas, provides the following capabilities.

- Operations and dispatch center for TxDOT Dallas District's freeway management activities during the early stages of its deployment.
- Operation and dispatch center for DART High Occupancy Vehicle (HOV) system.
- Host site for ancillary activities of partner agencies during that same time period (e.g., Courtesy Patrol).
- A deployment of prototype software that serves current operational requirements and also serves to solidify the requirements for an expanded freeway management system.
- Hub for the expanded future system to house communications equipment and to provide a focused operational environment when activities require this emphasis.

2.1.2 Purpose of current system

As subsequently described in Section 3.1 the North Texas regional perspective of transportation infrastructure management and operations is to provide an interdependent network of systems that can effectively provide ITS services. The current DalTrans system is TxDOT's contribution to that collective effort for the freeway infrastructure for which it has responsibility. Like many capital activities the Dallas TxDOT District is building its freeway management ITS infrastructure incrementally. The Transportation Management Satellite is likewise a staged deployment meant to match the control needs of the initial, near term TxDOT deployment.

The DART HOV system was constructed in cooperation with TxDOT to serve the high occupancy vehicles in the region. The DART HOV system is built incrementally as reconstruction of the major corridors is being upgraded.

2.2 Operational policies and constraints

The DalTrans Transportation Management Satellite operates according to the following operational arrangement.

- The DalTrans Transportation Management Satellite (TMS) is staffed from 5:00 am until 9:30 pm Monday through Friday using two shifts per day. Two operators per shift are scheduled each day of the year with the exception of Thanksgiving Day and Christmas Day.
- One Courtesy Patrol Dispatcher also works each shift. In 2001, the Courtesy Patrol will be staffed by the Dallas Sheriff's Office rather than by TxDOT. However, management will remain the responsibility of TxDOT and the Courtesy Patrol dispatch will operate out of the DalTrans facility.
- In addition, one DART operator per shift controls the regional HOV facilities
- TxDOT is the primary agency responsible for the facility and for ITS activities along freeways in Dallas region. Some area cities provide CCTV cameras on or near the freeways, and cities operate frontage road signals adjacent to the freeway. DART provides management of HOV lanes. NTTA operates the Dallas North Tollway and the President George Bush Turnpike and provides ITS services for these facilities.

As the system grows through the addition of supplemental field devices and expands to include more freeway miles, there will be a need to include additional operations staff. The size of the existing TMS Control Room cannot accommodate these additional people.

In a similar manner, growth in system size and functionality will be limited by the size of the existing equipment room in the DalTrans Transportation Management Satellite. Coordination of operations with management of the current system is further complicated by the twenty-mile separation between the Transportation Management Satellite and the TxDOT District Office in Mesquite, Texas.

2.3 Description

The DalTrans Transportation Management Satellite Center is housed in an approximately 2,100 square foot building located at 8015 Churchill Way, Dallas, Texas 75251. Dallas City Police Radio is used to monitor Dallas Police and Dallas Fire Department activity. TxDOT radio is used to communicate with Courtesy Patrol and TxDOT maintenance offices.

The DalTrans TMS shares video with the City of Dallas, City of Richardson, City of Plano, and Dallas County. The system also communicates with various city traffic departments via telephone and email.

2.3.1 System Components and Interconnection

2.3.1.1 Field and Communication Equipment

Major field device and equipment components include the following as of December 2000.

- Cameras – 57 Existing, 34 under construction, 27 in design for a total of 118. Currently using Motion JPEG video encoding of video (compatible with Ft. Worth District).
- Dynamic Message Signs (DMS) – 17 Existing, 17 under construction, 5 in design for a total of 39.
- Fiber Optic Cable – 23 miles existing, 27 miles under construction, 15 miles in design for a total of 65 miles.
- Detection – 2 miles existing, 20 miles under construction, 222 freeway miles in design (funded through a Federal Highway earmark project for creation of speed map and other integration components for the Dallas Area) for a total of 244 miles. Installing Autoscope Solo units along approx. 20 miles of freeways in north Dallas. Ten miles of loop detectors have been installed along US75 but are currently not connected to the DalTrans system.

Figure 2 shows a map of the ITS currently deployed in the Dallas area.

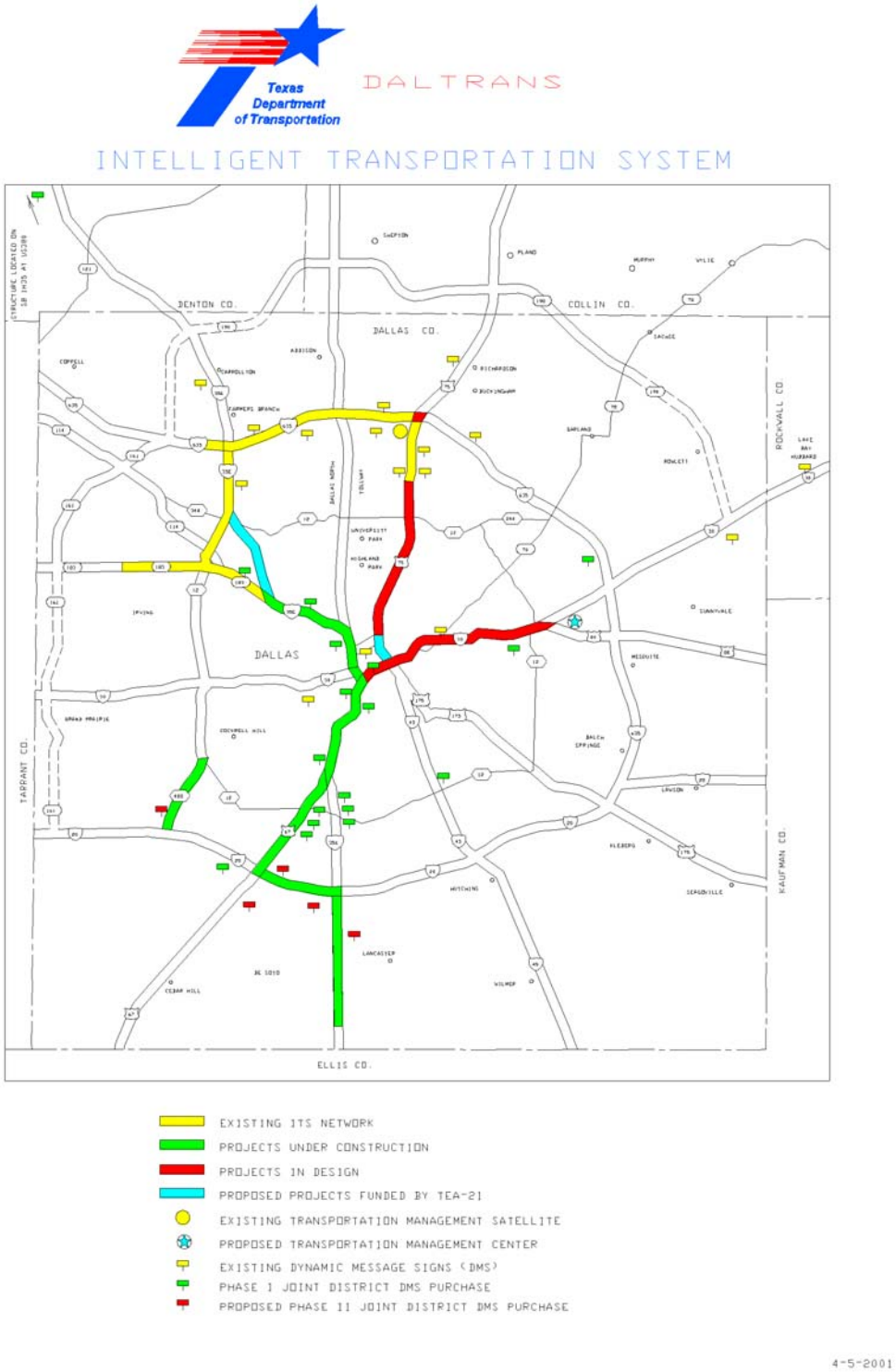

Figure 2. Current Dallas ITS Deployment

The HOV DART network consists of four HOV freeway operations at the present time: IH 30 east of downtown Dallas, IH 635 diamond lane west of US 75, IH 35E north of IH 635, and US 67 and IH 35E south of IH 30. These sections include full HOV facilities with divided barriers, plain diamond lanes and reversible lanes. Figure 3 shows the current and future services provided by the DART system for light rail, commuter rail, and HOV.

Figure 3. DART Current and Future Services

Figure 4 shows the plan for the DART rail system. It shows the opportunities for interconnection between the DART and TxDOT networks.

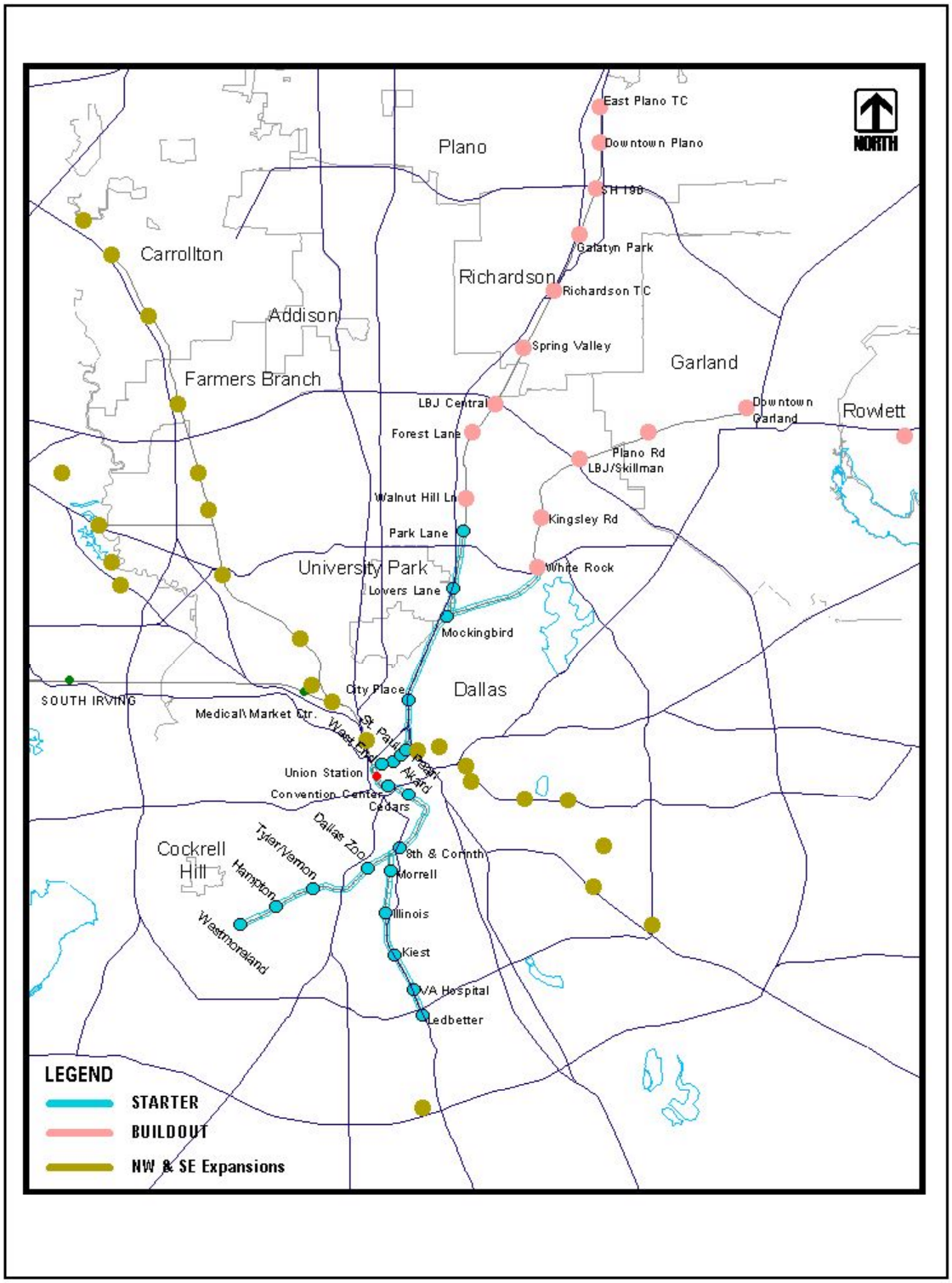

Figure 4. DART Rail System

2.3.1.2 Software Components

The major components of the prototype software are as follows.

The current Prototype DalTrans software is a distributed and modular system whose components interact with one another using real-time TCP/IP messaging. Figure 5 diagrams the system architecture.

The TMC Server is an application whose primary functions are message routing and security. The TMC Server uses a database to store configuration information for system devices and users. User Clients consume information and services and initiate device control. Data Clients contribute information or services to the TMC.

The TMC Server, User Clients, and Data Clients may all run on a single machine, be distributed across multiple machines in a TMC, reside on machines spread across the Internet, or any combination of the above.

The software architecture enables any sort of device or data source to be integrated. The TMC server imposes no restrictions on the nature of data that may be transferred or the type of devices that may be monitored and controlled. Integrating a new device or data source into the system is simply a matter of creating a data client to communicate with the device/data source and then creating a Graphical User Interface (GUI) that allows users to interact with that device/data source. While the TMC server does require that messages conform to a base protocol, that protocol provides a great deal of flexibility. Within the base protocol, developers can encode messages as binary structures, delimited strings, XML, or any other format they choose.

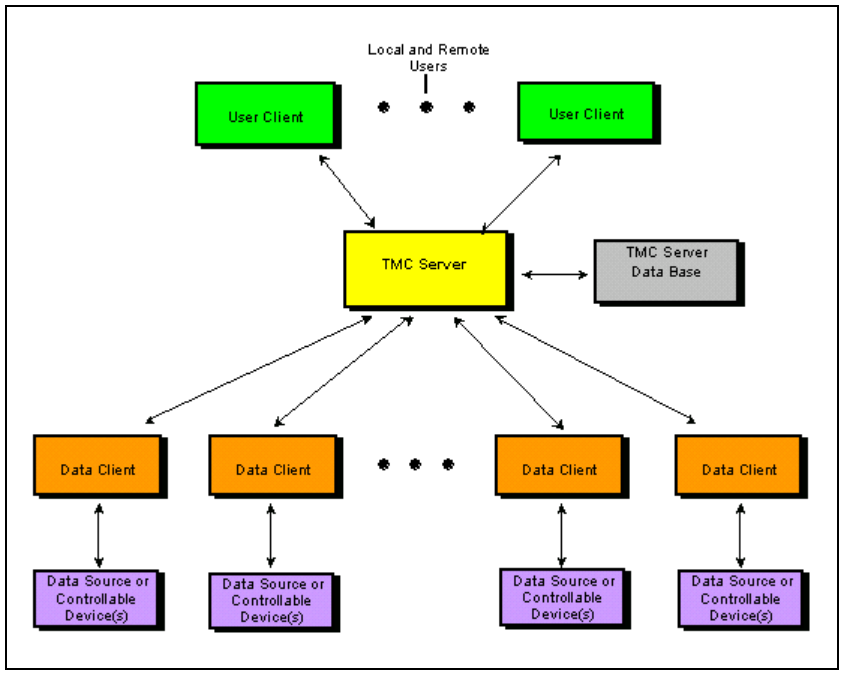

Figure 5. DalTrans Architecture Overview

Existing DART software is a collection of non-integrated systems purchased over the course of the system build out. DART has three basic systems: the Dynamic Message Sign (DMS) System by MARK IV (4 DMS's) along IH 30. The second system, designed by a local contractor, is the Dynamic Signs system of flashing beacons over static signs (12 signs) along IH 30. The third system consists of 8 LCS plus 6 flashing Dynamic Signs designed by the TxDOT Traffic Operations office. The last

piece of the DART system is the DART net where DART operators are able to connect to the existing DART system.

2.3.1.3 Interfaces to external systems

The DalTrans Transportation Management Satellite Center is interconnected with the Ft. Worth District's TransVISION facility (only two districts in the state are currently connected). Three existing satellites are operational (including the Transportation Management Satellite). Four additional satellites are under construction.

The primary communications backbone is Asynchronous Transfer Mode (ATM) running at OC-12 data rate between satellites. T-1 multiplexors are used along the roadway to transmit serial data to/from devices to closest satellite. Video and camera control data are sent via multimode fiber to the nearest satellite. Each camera uses two fibers. In areas where fiber is not available, leased ISDN lines are used to transmit compressed video at 10 - 12 frames/second.

The following external interfaces to the existing TMC have been implemented:

- City of Dallas 911 (Incident Notifications)
- City of Plano (Traffic)
- City of Richardson (Traffic)
- City of Dallas (Traffic)
- Dallas Area Metro Traffic (Incident Information)
- TxDOT Internet Software (Center-to-center)
- Fort Worth Transportation Management Center (Video Switching)
- Intelligent Transportation Systems Dallas/Fort Worth web site: http://www.dfwtraffic.dot.state.tx.us which is also accessible from http://www.daltrans.org and http://www.dfwtraffic.org

DalTrans was the first system to implement a standard Center-to-Center interface. Through the C2C interface, external users can obtain system status information and control system devices using a standard protocol. If other systems implement the C2C protocol, users of the DalTrans system will be able to monitor and control those systems through the same GUI they currently use to access the local system.

2.3.1.4 Capabilities functions and features

All software clients, both user and data, incorporate a common software component called the **TMC Client Object**. The **TMC Client Object** encapsulates all of the functionality necessary to communicate with the **TMC server**, thus making it unnecessary to rewrite this functionality into every client. A few of the many functions provided by the **TMC Client Object** are:

- Connect, Login, Logout, Disconnect
- Send data to one or all users
- Subscribe/Unsubscribe to a particular source of data
- Send data to subscribed users
- Automatic fail-over to a backup server
- File transfer

A higher-level software component, the **TMC Object Library**, provides an object-oriented interface to the system. The **TMC Object Library** exposes the following functionality:

- Incident Management
- Lane Closure Management
- DMS Monitoring and Control
- Camera Control and Snapshots
- Video Control
- Detectors

The Prototype DalTrans software provides granular security. System administrators may specify exactly which devices and restricted data functions each user is allowed to control. This flexible security scheme allows multiple agencies to attach their devices to the TMC without necessarily yielding control of those devices to every user in the system. Additionally, the system may be configured to allow one agency to share control of a subset of its devices with another agency based on the time of day and/or the day of the week.

The Prototype DalTrans software provides advanced DMS control. The operator client displays a graphical representation of the DMS that indicates the current message and the status of the DMS itself. Among the functions exposed by the GUI are the following.

- Prioritized DMS Messages – Multiple messages with different priorities may be posted on each DMS. Higher priority messages preempt lower priority messages. When a message is cleared, the next highest priority message is automatically re-displayed.
- Dynamic Messages – Users may define and post messages that contain variable detector data. For example, messages may be posted which include speed or travel time and the DMS will automatically update when those values change.
- Incident Association – DMS messages may be associated with an incident. When the incident clears, the associated message is automatically removed from the DMS(s).
- Predefined Message Management – Operators may post, create and edit predefined messages.
- Drag-and-Drop Posting – To copy a message from one DMS to another, operators may simply drag the icon of one DMS and drop it onto the icon of another. Clipboard copy and pasting of DMS messages is also provided.
- DMS Log – Users may view the log of any DMS. The log displays what messages were posted, when, and by whom.
- Message Scheduling – Users may specify a date and time at which a message should be posted and cleared
- Consistent GUI – The Prototype DalTrans software presents users with a consistent GUI for all DMSs connected to the system. The manufacturer and communications protocol used by each DMS is completely transparent to the user.

The Prototype DalTrans software enables the following camera controls: pan, tilt, zoom, iris, focus, presets, and camera power. The Prototype DalTrans software provides the means for administrators to restrict certain users from accessing advanced control functions such a programming presets and toggling camera power. Users may share control of a camera with other authorized users or they may take exclusive control of a camera. Video snapshots are available from all cameras.

Multiple control interfaces have been made available. Users may control cameras using a mouse, keyboard, or joystick.

The Prototype DalTrans software enables video blocking. When a camera is blocked, video from that camera is cut off and prevented from being routed to video outputs whose associated users have a priority for that camera that is lower than the priority of the user who initiated the block. Thus operators can prevent possibly objectionable images from being seen by the public.

The operator client GUI allows users to easily switch video by simply clicking the desired camera's icon. Dragging and dropping a camera icon onto an icon representing a video output device may also switch video.

The Prototype DalTrans software provides user definable video tours. For each video output that they are authorized to control, users may initiate a tour simply by specifying the desired cameras and the switch interval.

The Prototype DalTrans software provides support for multiple video switches. Video switches from different vendors using different protocols may coexist in the same system. Video switches may be daisy chained by routing the output from one switch to the input of another. The operator interface remains consistent regardless of the configuration of the video switches.

The Prototype DalTrans software provides lane closure management functionality. A user may enter a lane closure and that closure will appear on the maps of all interested users. The system tracks the status of each closure and modifies the appearance of the icons to reflect that status.

The Prototype DalTrans software provides incident management functionality. The customizable GUI allows users to graphically view and edit incidents. Tabular displays provide an alternate presentation of incident data. Users may activate filters that control which types of incidents they are notified of. Users may specify audible and visual alerts for notification of new incidents. The Prototype DalTrans software also provides the capability to view past incidents. One can view incidents as they existed at a specific time and one can view all incidents processed during a range of times.

In addition to the normal traffic detector values of speed, volume, occupancy, level-of-service, etc, the Prototype DalTrans software is capable of obtaining and graphically displaying to the user data from any device which returns a numeric value. It is possible to graphically display data from weather monitors, flood detectors, train presence detectors – anything that returns a numeric value. Additionally, traffic data returned by different types of detectors can be displayed in a consistent manner, making the specific source of the data irrelevant to the operator. DART would assume that DalTrans software will be shared with the HOV network in order to provide a common look for a common window for the system. The HOV system should be improved to include at least the following:

1) Remote access by DART operators
2) Ability to schedule and plan events
3) System should show a smart clock with daylight saving ability.
4) Ability for the system to recognize the location of devices in the field
5) LCS upgrade to use scratch pad for LCS proposed changes
6) Add intelligence to recognize that HOV is not open until Dynamic Signs are flashing

2.4 Modes of operation

The TMC Administrative Client enables users with administrative access to configure the TMC Server and to perform maintenance and diagnostic functions. Below are some of the administrative capabilities this client enables:

- Add and Remove Users
- Specify User Access to Controllable Devices, and Restricted Data Functions
- Add, Remove, and Configure Devices
- Monitor System Performance
- Diagnose Control and Data Access Problems
- Edit Server Parameters
- View and Clear the Server's Event Log

In addition to the primary server, a test system is normally maintained for developing and testing new functionality. Additional servers can be run virtually anywhere and data clients connected to them to provide the necessary services.

2.5 User classes and other involved personnel

Operators are responsible for monitoring freeways and HOV using the camera system, assisting with dispatching of Courtesy Patrol, notifying appropriate personnel of incidents, operating Dynamic Message Signs, inputting incident information into the database, and coordinating with local police departments and other related agencies. There are currently 2 shifts of 2 operators each with a courtesy patrol dispatcher. A high school diploma is required for an operations personnel position.

The District Freeway Management Office construction personnel (3 people) and one Intelligent Transportation Systems Analyst provide maintenance. Field equipment maintenance personnel are required to have a high school diploma.

The District Freeway Management Office handles the management of the facility. The Assistant Freeway Management Engineer is the supervisor of the facility and requires a college degree, registration as a Professional Engineer, and two years of experience after registration.

Support of the prototype software is handled by Texas Transportation Institute (TTI) and District Freeway Management personnel.

The Freeway Management Office deploys all ITS freeway-related projects for the TxDOT-Dallas District. Operators communicate with maintenance personnel to ensure system is operational. TTI provides software upgrades and patches to Freeway Management personnel for implementation.

2.6 Support environment

Currently there are maintenance contracts for the janitor, grounds, and the air conditioning system. A majority of the software support is performed by TTI. TxDOT Traffic Operations Division (TRF) maintains statewide software components. Systems and equipment required for daily operation are replaced when items have failed or there is a realization of a performance loss.

There is minimal on-site storage of equipment, which requires additional off-site storage in non-environment controlled facility. Supplies are obtained through the TxDOT procurement process (TxDOT Warehouse). There is currently no data archiving system, as the system is not database driven. Thus all data is stored on hard drives. Data and video are distributed via email, web page, leased ISDN lines, TxDOT fiber optic network, and telephone lines. The DalTrans TMC receives

information from TxDOT field devices, Courtesy Patrol, Dallas Police, local traffic reporting agencies, local city transportation offices, and the traveling public. The DART network is dependent on a dial-up network at the present time.

3.0 JUSTIFICATION FOR AND NATURE OF CHANGES

3.1 Justification of changes

The operational vision for the North Central Texas Region is a "system of interdependent transportation systems" cooperatively providing Intelligent Transportation Systems (ITS) services. The purpose of these ITS services is to assist in achieving regionally established transportation goals. Specific North Texas ITS goals developed through a region-wide consensus process include the following.[1]

- Enhance mobility of people and goods by reducing recurrent traffic congestion
- Enhance mobility of people and goods by reducing traffic congestion caused by incidents
- Enhance access and operation of high-occupancy modes of travel
- Reduce drive-alone and peak period travel
- Provide a safe transportation system
- Provide increased opportunities for air quality and other environmental improvements

Similar North Texas ITS goals were developed within the Dallas area in an earlier consensus process. They include the following.[2]

- Reduction of congestion caused by freeway incidents;
- Reduction of general congestion and the resultant delay, emissions, and fuel consumption;
- Deployment of seamless transportation systems;
- Promotion and support of multimodal transportation and of high occupancy vehicles; and
- Reduction of vehicle-miles traveled.

Meeting these goals in the face of increasing congestion, limited opportunities for growth in roadway capacity, and considering quality of life, environmental and economic issues has led to a solution path of interdependent interconnected transportation systems – a "system of systems". The promise of ITS services lies in knitting together fragmented technologies and infrastructure to create a more cohesive, integrated and effective transportation network.

New partner agencies will be integrated in this "system of systems" network including transit agencies, transportation management organizations (including state, city, toll authority, and airport), emergency management agencies, emissions management organizations, railroads, private sector information service providers, planning agencies, and fleet management centers. Connecting with these regional partners is a primary motivation for enhancing the existing TxDOT system.

In addition to adding functionality for new services with new partner organizations, another principal motivation for modifying the existing deployment is to provide for physical expansion of the system throughout the region. This means adding more traffic sensors, dynamic message signs, video cameras and other devices on freeway facilities throughout the district.

The planning and development of the DalTrans TMC will be coordinated between the TxDOT Dallas District Office and the TxDOT Austin Traffic Operations Division. This coordination will ensure that

---

[1] Wiles, P. B. et al., The Fort Worth Regional Intelligent Transportation System Plan, Texas Transportation Institute for the Texas Department of Transportation, January 1999,p. 5.

[2] Carvell, J. D., et al., Dallas Area-Wide Intelligent Transportation System Plan, Texas Transportation Institute for the Texas Department of Transportation, July 1999, p. 1-1.

the goals of both offices are maintained and the DalTrans system will represent approximately 80% of the ITS capability in the state of Texas.

3.2 Description of desired changes

As new devices and systems are added to enhance the capability of the DalTrans system, the system will continue to monitor and control the following roadside devices:

- Dynamic message signs
- CCTV video cameras
- Vehicle detection (e.g. loops, VIVDS)

ITS standards-based capability will be added for new and existing Dynamic Message Signs. New functionality will also be added for the following roadside devices:

- Lane Control Signals
- Highway Advisory Radio
- Closed-loop traffic signal systems
- Environmental Sensor Stations
- Ramp meters
- Existing HOV facilities to include:
    - Dynamic Message Signs
    - Dynamic Signs
    - Lane Control Signals
    - Loop Detectors
    - Automatic Barrier Gates

Standards-based center-to-center communications will be added in order to exchange:

- Road network descriptions
- Network state information (both existing and predicted)
- Priority route information
- Current parking availability
- Current network incident descriptions
- Planned roadway events
- Event bulletin set operation
- Exchange of traffic signal information/state
- Environmental information
- Transit Information

The DalTrans system will also include the addition of the following new functionality:

- Incident scenario response
- Maintenance dispatching / tracking system

As the system grows in size and in complexity due to the addition of supplemental functionality there could be a need to add operational staff to oversee the TxDOT infrastructure. There may also be a need to add non-TxDOT staff in the control center to coordinate incident activities with TxDOT. In addition to DART, these might include the local city traffic operations and enforcement activities.

3.3 Priorities among changes

All functionality that exists in the current DalTrans system is the highest priority for integration into the new TMC. Section 4.3 describes the prioritization among all services that will be integrated into the DalTrans system. New support for roadway devices will be integrated in the following order:

- HOV facilities
- Lane Control Signals
- Highway Advisory Radio
- Environmental Sensor Stations
- Closed-loop traffic signal systems
- Ramp meters
- Transit Systems (Ability to link DART Transit with DalTrans through the C2C communication system)

Prioritization for all requirements of the DalTrans system will be documented in the DalTrans System Requirements Specification.

3.4 Changes considered but not included

Commercial Vehicle Operation (CVO) was discussed in the planning stages of the new DalTrans TMC. As the CVO activity increases as a result of the North American Free Trade Act (NAFTA), DalTrans planning personnel may revisit the need for CVO services to be integrated into the DalTrans TMC.

Rail Management was also considered but it was determined that there are very few grade crossings that cross frontage roads. Most crossings are in city jurisdictions and there are currently no plans to coordinate with the City TMCs for Rail Management. Rail Management involving light rail will be handled by the DART Transit Management Center.

3.5 Assumptions and constraints

As noted in Section 3.1 the operational vision for the North Texas region is a system of interdependent transportation systems cooperatively providing services to the region. Considering this vision and the impetus to connect these systems using ITS standards, it is important that the DalTrans be able to communicate with other agencies using the evolving regionally deployed center-to-center network. As of early 2001 this center-to-center network is based on the following ITS standards.

- NTCIP 2304, Applications Profile for Data Exchange ASN.1 (DATEX)
- ITE TM 1.03, Standard for Functional Level Traffic Management Data Dictionary (TMDD)
- ITE TM 2.01, Message Sets for External Traffic Management Center Communications (ETMCC)

TxDOT plans on building a new facility for a regional DalTrans Transportation Management Center. The schedule for that activity includes the following.

1. Define System Requirements (EO #14 of the Statewide Integrator Project). Dates: November 2000 to March 2001
2. Review of Systems Requirements by TxDOT General Services Division (GSD). Dates: April 2001 to August 2001
3. Integration of System. Dates: September 2001 to TBD (well past the opening of the building)
4. Architectural Contract. November 2001 to October 2002
5. Construction of DalTrans TMC. Dates: March 2003 to October 2004

4.0 CONCEPTS FOR THE PROPOSED SYSTEM

The following sections document the concepts for the DalTrans TMC.

4.1 Background, objectives, and scope

The background, objectives, and scope of the DalTrans TMC are covered in Section 3.0, which discusses the rationale behind the construction of the new DalTrans ITS.

4.2 Operational policies and constraints

Currently, the plan is for DalTrans operators to control the system from 5 a.m. to 9:30 p.m. Monday through Friday of every week. These hours will be flexible and will be based on the staffing needs of the DalTrans TMC. Personnel within the DalTrans center from other agencies will maintain their own hours of operation.

4.3 Description

During the early planning stages of the DalTrans system, meetings were held to determine the system requirements. The National ITS Architecture was used to guide the discussions and provide a high level overview of the proposed system. Figure 6 shows the basic elements of the market package diagrams.

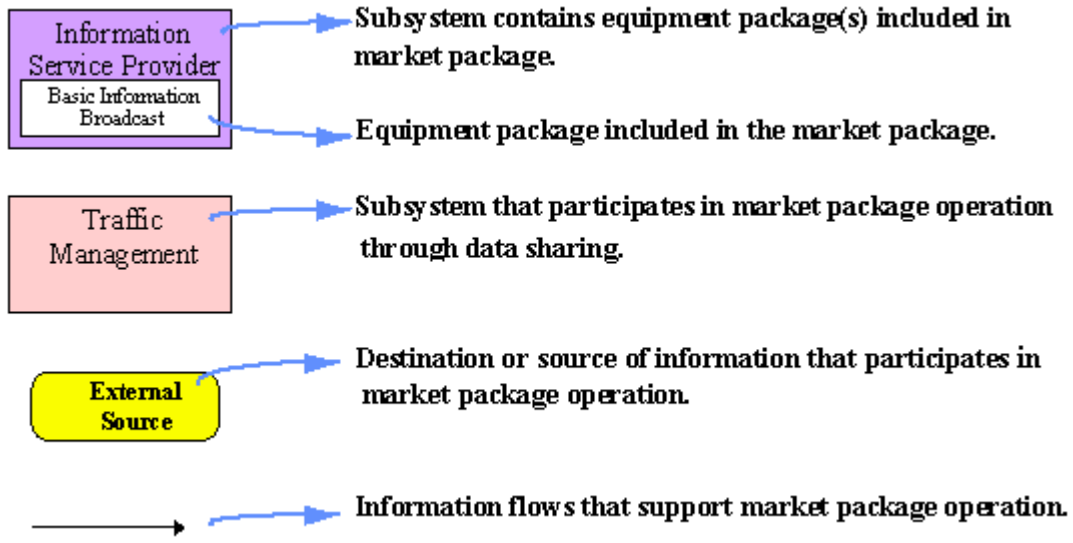

Figure 6. Elements of the National ITS Architecture market packages

The National ITS Architecture market packages were tailored for the DalTrans TMC and used to define the major system components, interconnection between these components, and interfaces to external systems. The elements in the diagrams represent logical entities. Thus elements connected by a flow do not necessarily imply that the elements are located in separate facilities. For example, the DART HOV terminator is often shown with a connecting flow to the DalTrans traffic management subsystem. The DART HOV facility will reside within the DalTrans TMC; however, the two elements represent distinct logical entities. Each package was prioritized for detailed analysis. The following sections discuss the market packages that were chosen and tailored to define the services provided by the DalTrans TMC. The market packages are presented in the order of priority to the system. The first paragraph of each section is straight from the National ITS Architecture and is followed by the

DalTrans tailored diagram. The text following each diagram provides details describing how the DalTrans TMC will provide that specific service. The word DalTrans in the following diagrams is intended to represent the TMC and the TxDOT personnel responsible for operating and maintaining the DalTrans ITS.

4.3.1 ATMS04 - Freeway Control

This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways. Coordination and integration of ramp meters are included as part of this market package. This package is consistent with typical urban traffic freeway control systems. This package incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option. This market package also includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a transportation management center; however, developments might allow for point detection with roadway equipment. For example, a CCTV might include the capability to detect an incident based upon image changes. Additionally, this market package allows general advisory and traffic control information to be provided to the driver while en-route.

The DalTrans tailored freeway control market package is shown in Figure 7.

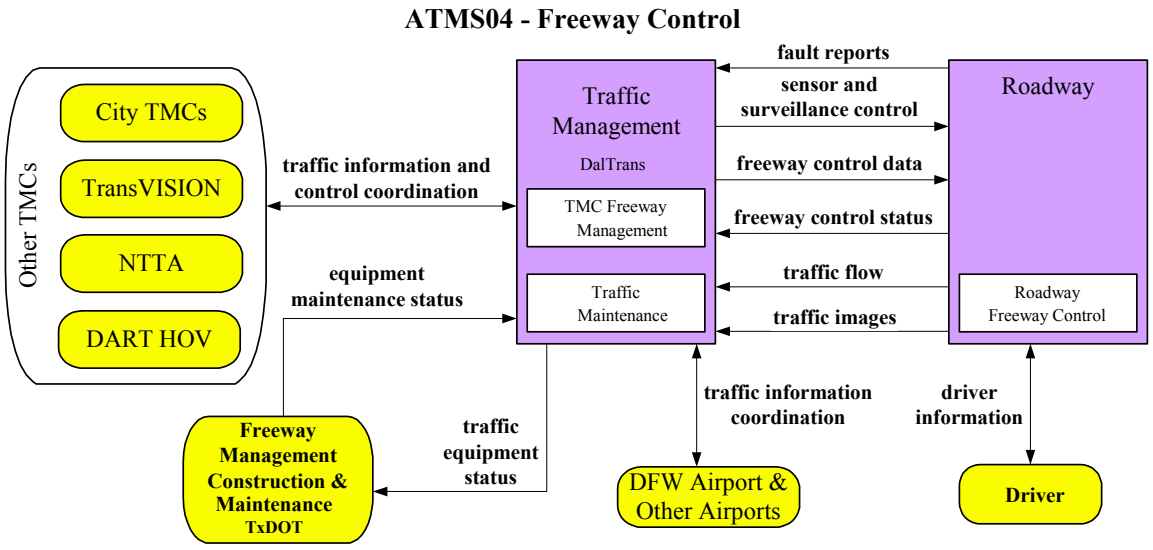

Figure 7. ATMS04 Freeway Control market package

DalTrans operators use network surveillance information discussed in Section 4.3.2 to implement necessary control strategies to manage the flow of traffic. Specific equipment to be used in freeway control by the DalTrans system includes Dynamic Message Signs, Lane Control Signals, and Ramp Meters. Dynamic Message Signs are currently used in the existing DalTrans center. Lane Control Signals are expected to be integrated into the DalTrans ITS in the near future. Ramp meter control is a long-term capability that is desired. These roadway devices will receive control data and present information to the driver to implement the control strategy.

The operational status will be obtained from each roadway device on a periodic basis to determine if the device and/or its communication link need maintenance. When a device needs maintenance, it will be reported to the maintenance software. This process can be done automatically by the software or input into the maintenance software manually by a DalTrans operator. The DalTrans system will notify the freeway management maintenance staff of traffic equipment status via work orders. Freeway management maintenance personnel will update the status of the work order when necessary, and the system will notify operations personnel when the field equipment is operational again.

The DalTrans system will coordinate traffic control information with other TMCs to implement a regional control strategy in the Dallas-Fort Worth metropolitan area. Traffic information will also be obtained from other sources such as the DFW airport and other airports.

4.3.2 ATMS01 – Network Surveillance

This market package includes traffic detectors, other surveillance equipment, the supporting field equipment, and wireline communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect sensor data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem.

The DalTrans tailored Network Surveillance market package is shown in Figure 8.

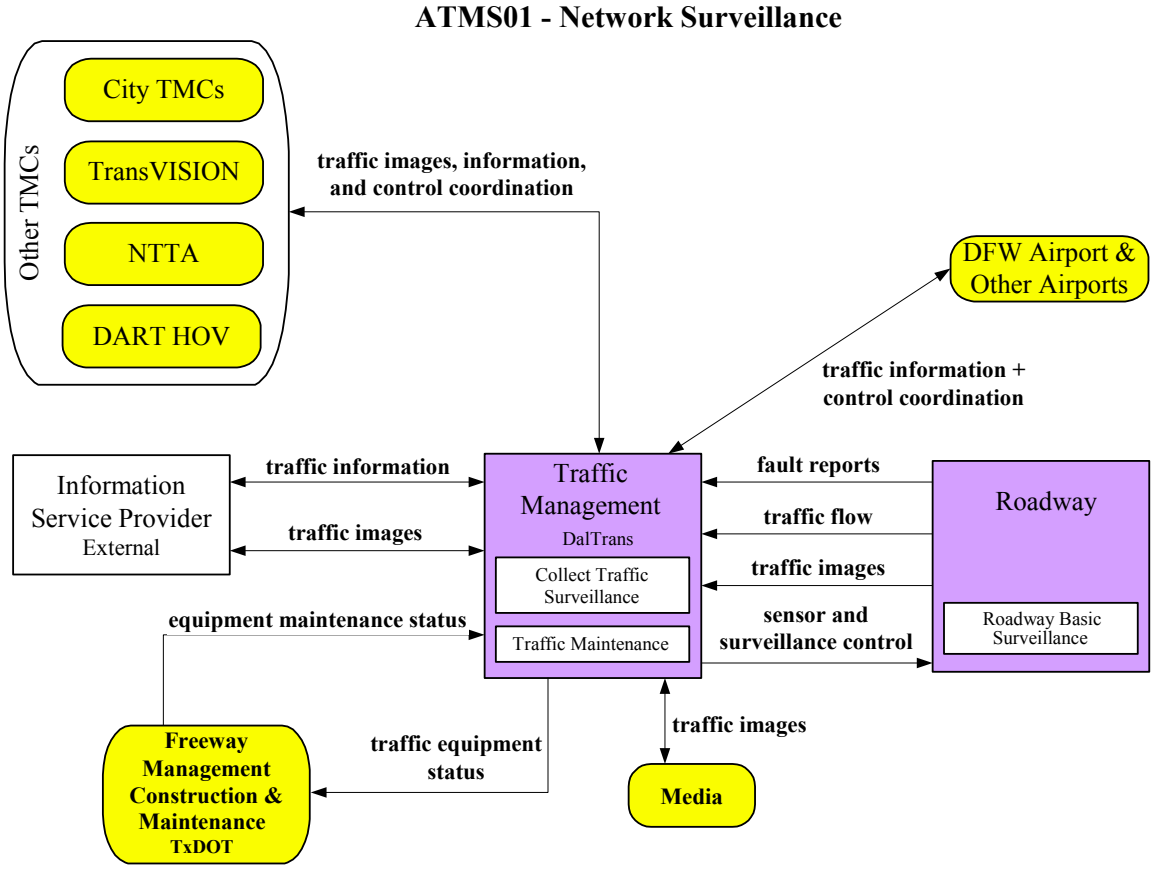

Figure 8. ATMS01 – Network Surveillance market package

DalTrans operators monitor the flow of traffic using cameras, roadway sensors, and other sources. Camera images are monitored from cameras along the roadway and from camera images obtained from other TMCs, airports, and ISPs. Cameras owned by DalTrans are placed along the freeway at approximately ¾ to 1 mile intervals depending on the roadway geometry. This placement allows complete visibility of the freeways managed by the DalTrans ITS. The video wall in the front of the DalTrans center and each operator console can display multiple video sources at a time. The control center video wall is used to display CCTV video, weather radar, maps, and other video sources. The video wall and operator console video control is integrated into the same software used by an operator.

Obtaining the operational status and performing maintenance of field equipment used in network surveillance will occur in an identical fashion as to field equipment used in freeway control (ATMS04 Section 4.3.1).

Roadway sensors used in the DalTrans system include inductive loop detectors, VIVDs, microwave sensors, and toll tag readers. Sensor information is collected and analyzed at the TMC and used for incident detection, travel time calculations, and speed and condition maps available on the DalTrans web site. Sensor information and traffic images are shared with other TMCs and airports for use in implementing regional network surveillance. The DalTrans system makes traffic images and traffic flow information available to the media, external ISPs, and other agencies.

4.3.3 ATMS08 – Incident Management System

This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized. Requisite incident detection capabilities are included in the freeway control market package and through the regional coordination with other traffic management and emergency management centers, weather service entities, and event promoters supported by this market package. Information from these diverse sources are collected and correlated by this market package to detect and verify incidents and implement an appropriate response. This market package provides Traffic Management Subsystem equipment that supports traffic operations personnel in developing an appropriate response in coordination with emergency management and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications and presentation of information to affected travelers using the Traffic Information Dissemination market package. The same equipment assists the operator by monitoring incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other field service personnel.

The DalTrans tailored Incident Management System market package is shown in Figure 9.

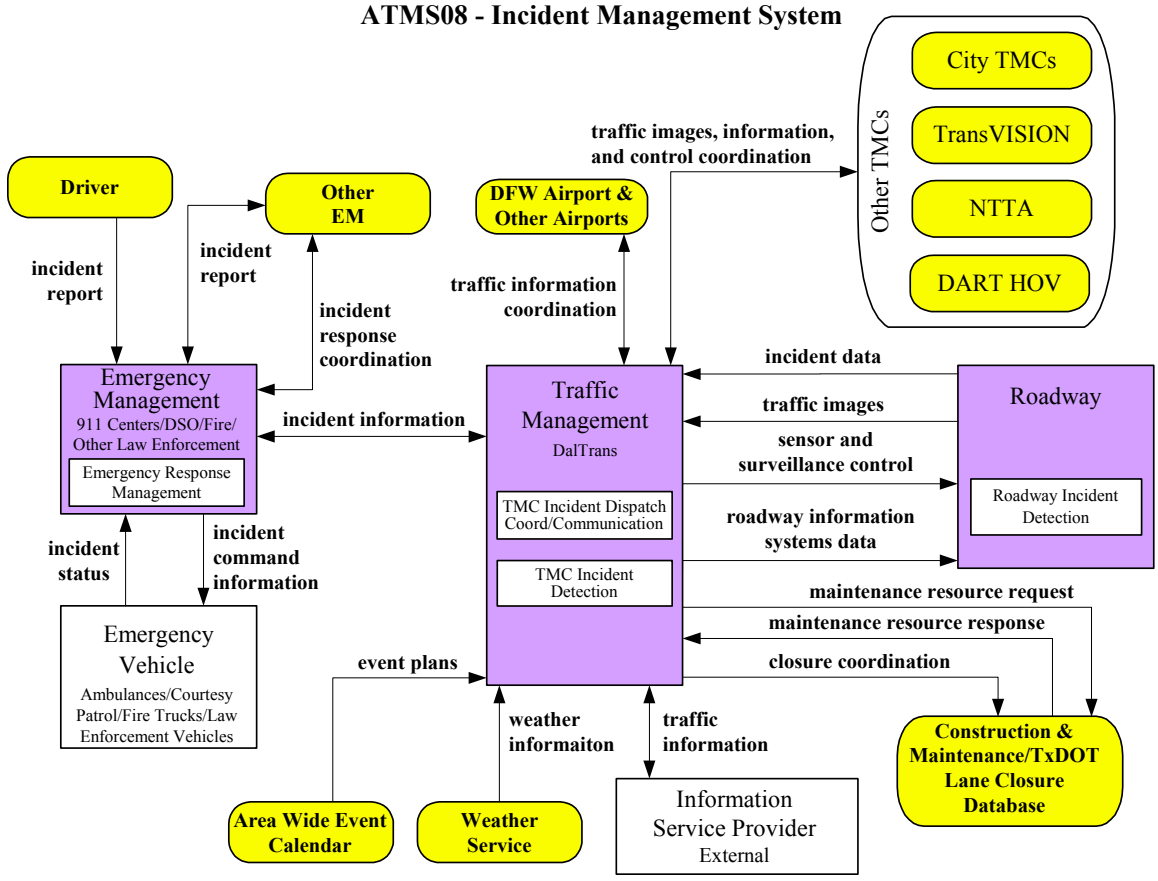

Figure 9. ATMS08 - Incident Management System market package

4.3.3.1 Incident Detection

DalTrans operations personnel will detect that an incident has occurred from the following sources:

- Traffic images – While periodically examining a section of roadway, an operator discovers that an incident has occurred.
- Traffic sensors – Using input from traffic sensors, the Analyze Traffic Data for Incidents process has detected an incident. An operator visually verifies that an incident has occurred at the specified incident location using a camera.
- 911 calls – Drivers discover or are involved in an incident and call 911. 911 personnel input the incident into the 911 system, which automatically notifies the DalTrans system of the incident. An operator visually verifies that an incident has occurred at the specified incident location using a camera.
- Police scanner – While listening to a police scanner, an operator discovers that an incident has occurred.
- Courtesy patrol calls – A driver calls directly into the courtesy patrol number that is often shown on DMSs around the region, and courtesy patrol notifies a DalTrans operator of the incident. If the courtesy patrol dispatcher is currently too busy to field the call, a DalTrans operator will take the call directly.
- Courtesy patrol drivers – A courtesy patrol driver responds to a driver in need and verifies that an incident exists. Examples of this include flat tires and stalled vehicles. A courtesy patrol operator enters the incident manually into the DSO software and the DalTrans system receives the verified incident notification from the DSO system.
- Area-wide event calendar – The DalTrans system is notified of planned events that will affect traffic flow so that operations can implement a response.
- Other TMC – The DalTrans system is notified of an incident from another TMC.
- Lane closure – A planned lane closure. Lane closures that are entered into the TxDOT Dallas District lane closure database will enter into the DalTrans system automatically as planned incidents. Likewise, lane closures that are entered directly into the DalTrans system are automatically placed in the TxDOT Dallas District lane closure database.
- Weather service – The DalTrans system implements a response plan based on current or upcoming weather conditions.
- External ISP – An Information Service Provider notifies the DalTrans system of an incident.
- Travelers – Calls from Dallas area travelers would be received by an automated answering service. The system would utilize voice recognition capabilities to allow the caller to describe the characteristics of the incident. This is a long-term desire in the DalTrans system and may eventually be integrated with the 511 traveler information service for the region.

The DalTrans system will be divided into multiple sectors with a lead operator assigned to each sector. This functionality allows the traffic management workload to be divided among all available operators. An operator may be responsible for more than one or all of the sectors and will be notified that a possible incident has occurred in a sector that he/she is assigned. The possible incident notification is referred to as an alarm and is visible and audible. An operator may also manually enter an incident that he/she has discovered or been notified of and verified. The sectors will be modifiable and incidents will be able to be assigned as needed to meet the needs of the operations staff. The DalTrans system tracks information pertaining to operator workload to assist the lead operator in

assigning new incidents. The operator will have the ability to reassign any possible and/or verified incidents.

4.3.3.2 Incident Response

DalTrans operators will create an incident response using software that generates the response based on the DalTrans incident management methodology, incident location, incident type, and equipment location. An incident response is composed of commands for a set of equipment in which all commands can be executed and/or cleared simultaneously. This will quicken the response plan by allowing the operator to execute commands for a large set of equipment rapidly. If the response has previously been generated and used, the system will retrieve the previously used response and allows the user to modify the response, execute the response, and save changes to the response plan if desired. If the system has not previously generated a response for the given incident information, it will generate a new response plan that the user can edit, execute, and save if desired. When creating a response, a user will have the ability to set a scheduled time when the response commands should be executed and will also specify the duration of the response. Once executed, other operators within the TMC will have the ability to modify the incident response and the primary operator will be notified of any modifications. Users of the DalTrans system that are external to the TMC will coordinate with the primary operator to make changes to the incident response. The user will also choose to automatically page, email, and/or instant message certain personnel when the response is executed. The text content of the message to be sent to the selected notification recipients will be automatically generated from the content of the response. The content of the generated message can be edited prior to sending.

The response plan for an incident may be coordinated among other TMCs and agencies. Once the response plan has been executed, the user will be notified of any status changes of the incident (e.g. traffic flow has resumed normal speed, lane closure ended, etc…). The operator will also able to change the software status of the incident at any time while discontinuing or modifying the response plan. The response system will be maintained by editing equipment locations and updating the rules associated with the DalTrans incident response methodology.

The DalTrans system will manage incident responses in a prioritized manner. When executing a response, the user will assign a priority to the response so that the commands will be executed or removed in lieu of a higher or lower priority incident response. For example, if a response has been executed for a planned event such as input from the area-wide event calendar, a higher priority response such as a major accident response will be executed over the lower priority response. When the major accident response has cleared, the area-wide calendar event response will be automatically executed.

DalTrans operations personnel will use a predetermined incident response or build a manual response to manage a planned incident such as a lane closure. Incident information will be distributed through the traffic information flow to an external ISP and to the other Traffic/Transit/Emergency Management/Law Enforcement centers. The DalTrans system will coordinate traffic information with other centers and agencies to implement a regional incident management system. It is a goal of the DalTrans system to utilize a regional communication system, radio or other communication technology as it becomes available, to assist in the coordination of event responses. DalTrans would eventually utilize the TxDOT statewide communication system that is being proposed for a long-term solution. In the short term, the DalTrans courtesy patrol will use the police, DSO, 900 MHz, and low band radio systems.

Incidents involving roadway debris are coordinated with the appropriate city TMC, courtesy patrol and maintenance for freeways, or DART courtesy patrol for HOV lanes. Courtesy patrols encountering incidents in HOV lanes and DART courtesy patrols encountering freeway incidents will remain on the scene until the appropriate responder arrives.

4.3.4 ATMS05 – HOV Lane Management

This market package manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals. Preferential treatment is given to HOV lanes using special bypasses, reserved lanes, and exclusive rights-of-way that may vary by time of day. Vehicle occupancy detectors may be installed to verify HOV compliance and to notify enforcement agencies of violations.

The DalTrans tailored HOV Lane Management market package is shown in Figure 10.

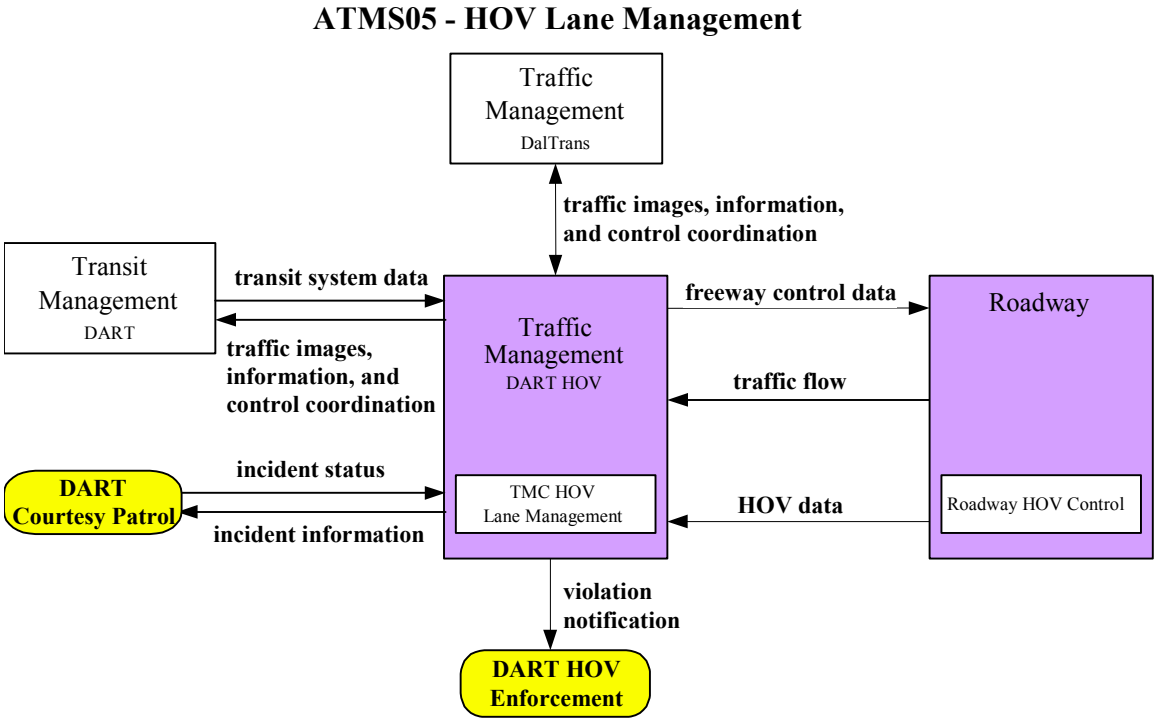

Figure 10. ATMS05 – HOV Lane Management market package

DART will perform HOV Lane Management from within the DalTrans TMC using HOV lane management software that will be integrated into the DalTrans system. This software will be a combination of the three systems currently used by DART and will use the TxDOT HOV Lane Management software package as its base. The HOV lane management software will be enhanced to allow scheduling of planned events and to collect and archive traffic count data for HOV lanes. When an incident is detected, the DalTrans system will determine which agency is responsible for the lane or lanes involved and notify the responsible party within the DalTrans TMC.

DART operations personnel will utilize the same traffic information available to the DalTrans operations personnel to make decisions regarding HOV lane management. DART will use this information along with HOV data to control HOV specific roadside devices.

4.3.5 ATMS06 – Traffic Information Dissemination

This market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio. This package provides a tool that can be used to notify drivers of incidents; careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), transit management center, emergency management center, and information service provider.

The DalTrans tailored Traffic Information Dissemination market package is shown in Figure 11.

ATMS06 Traffic Information Dissemination

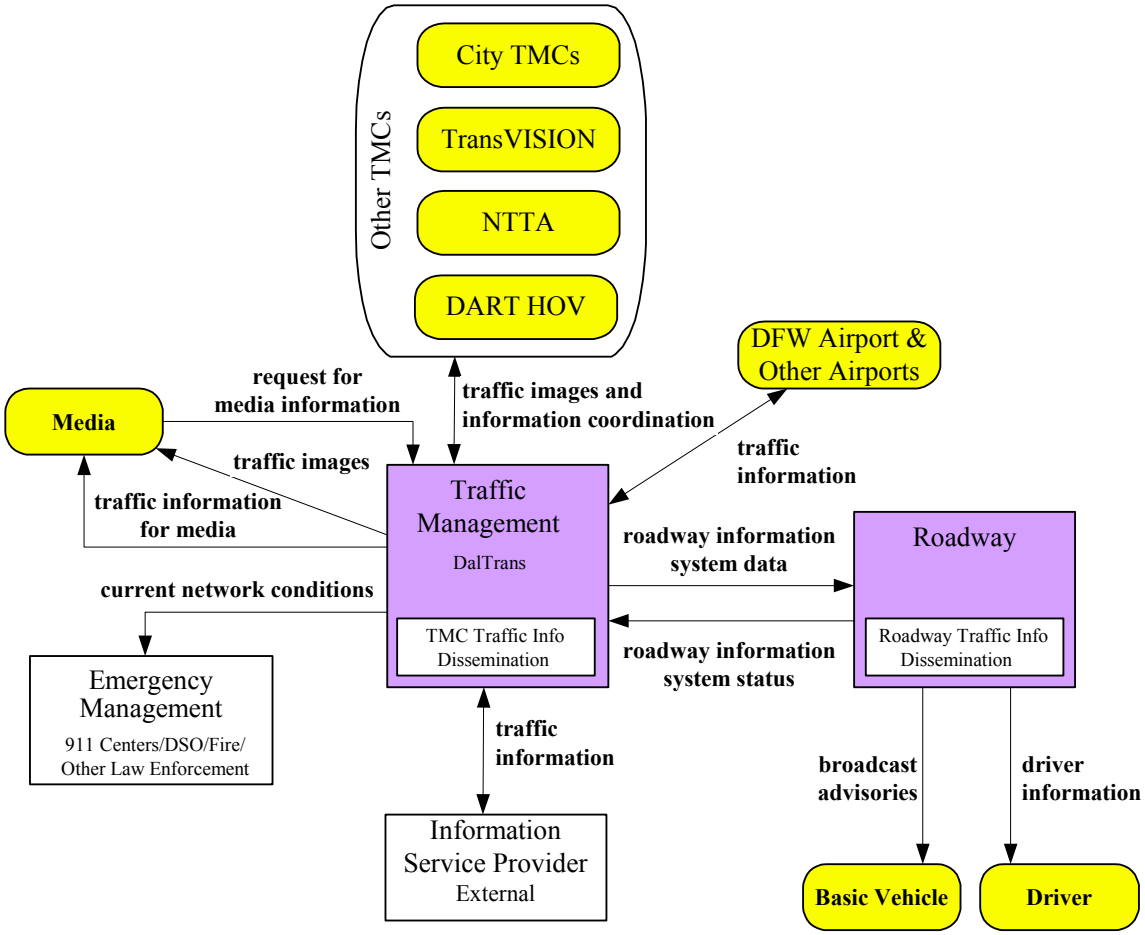

Figure 11. ATMS06 - Traffic Information Dissemination market package

The DalTrans system will disseminate traffic information to the driver via the roadway subsystem using DMSs and HARs. DMSs will display information regarding incidents, congestion, travel times, air quality alerts, traffic safety messages, and construction lane closures. The signs will be placed approximately 1 mile before every freeway interchange to inform traffic of upcoming conditions. The travel time messages will be automatically generated and updated based on calculations from speed data obtained from sensors.

The DalTrans system will use HARs to transmit a low power AM radio signal containing information content that is supplemental to the messages displayed on DMSs. HARs will be dispersed throughout the region in a manner that allows their broadcast zones to overlap. DalTrans will use the beacons on nearby Dynamic Signs to notify the traveling public of an important HAR message. The HAR message will be generated automatically using text-to-speech from an incident response plan based on DMS message content. The user will be able to edit, remove, or add to the text that is generated before executing the HAR message.

Information dissemination to another center (Traffic/Transit/Emergency/Airport) will be accomplished through the center-to-center communications link developed by the TxDOT Statewide Integrator. Traffic information and images will also be provided directly to the media.

4.3.6 ATIS1 – Broadcast Traveler Information

This market package provides the user with a basic set of ATIS services; its objective is early acceptance. It involves the collection of traffic conditions, advisories, general public transportation, toll and parking information, incident information, air quality and weather information, and the near real time dissemination of this information over a wide area through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). Different from the market package ATMS6--Traffic Information Dissemination--which provides the more basic HAR and DMS information capabilities, ATIS1 provides the more sophisticated digital broadcast service. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.

The DalTrans tailored Broadcast Traveler Information market package is shown in Figure 12.

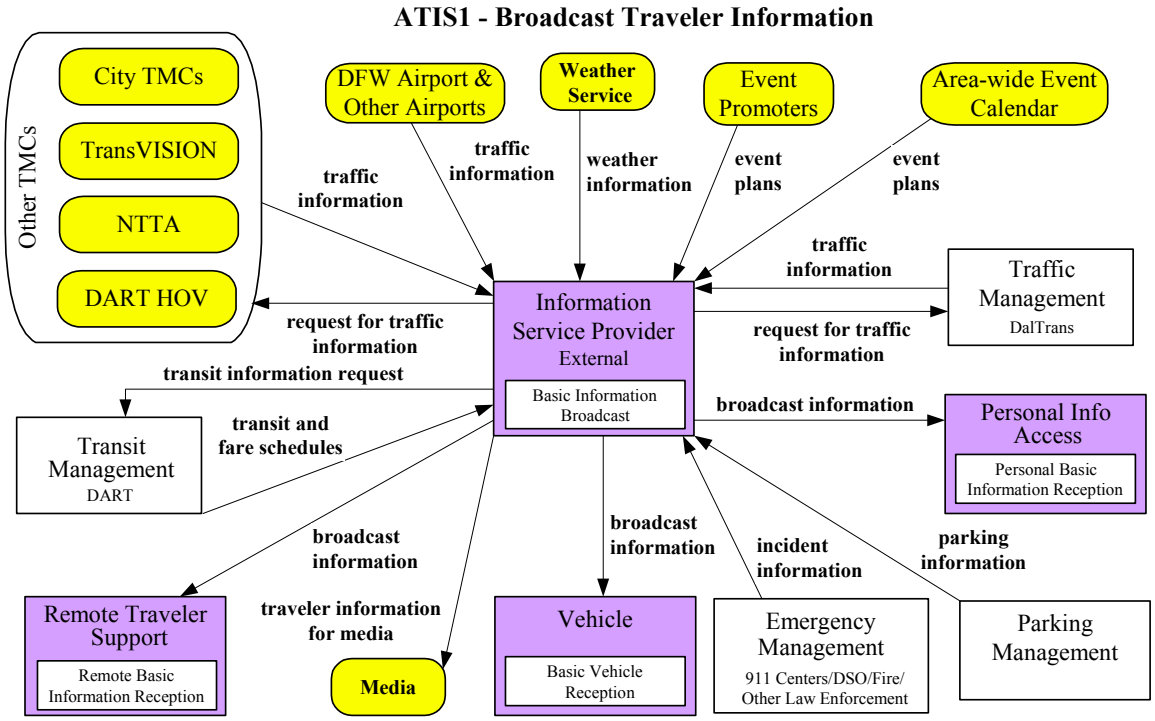

Figure 12. ATIS1 – Broadcast Traveler Information market package

In this role, the DalTrans system will simply be a supplier of traffic information to an external ISP. The ISP will request traffic information from the DalTrans system and will also gather information from other systems to provide broadcast traveler information to information consumers. This diagram represents an idealized view of broadcast traveler information provided by an ISP.

Some of the broadcast traveler information that is provided to external agencies will be accessible directly from the DalTrans system. In this role, the DalTrans system is the ISP. This configuration is shown in

Figure 13.

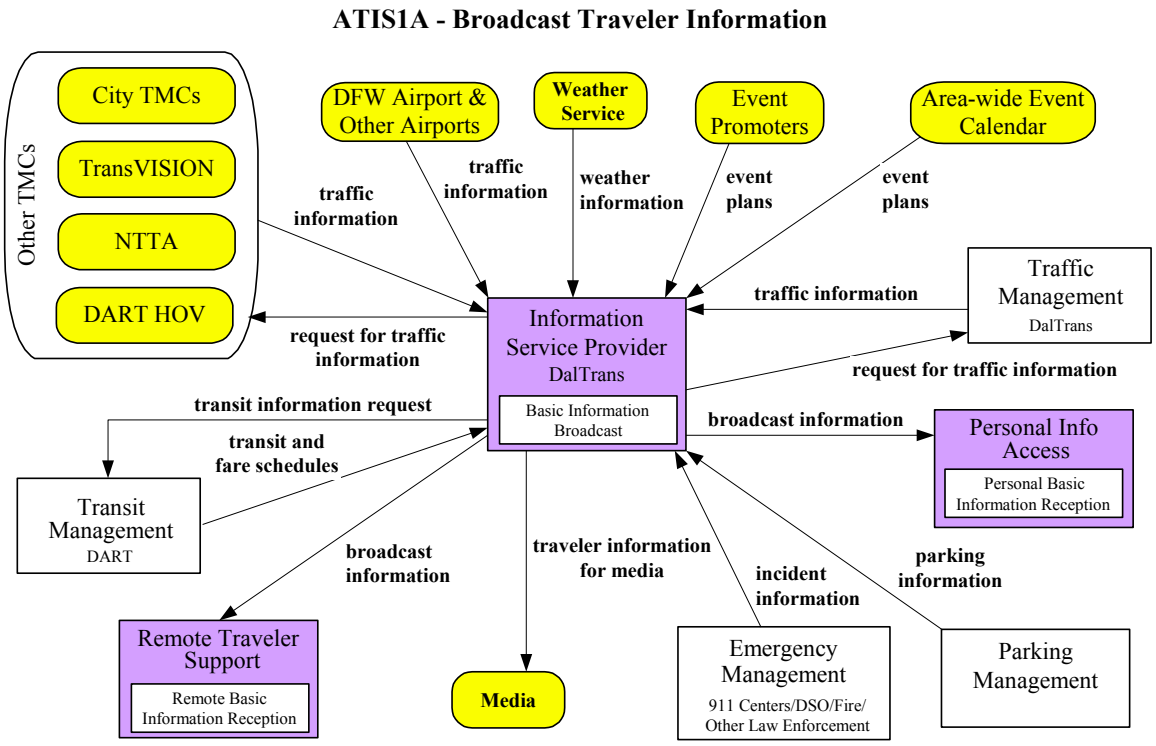

Figure 13. ATIS1A – Broadcast Traveler Information with DalTrans as ISP

4.3.7 ATIS2 - Interactive Traveller Information

This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, transit services, ride share/ride match, parking management, and pricing information. A range of two-way wide-area wireless and wireline communications systems may be used to support the required digital communications between traveler and the information service provider. A variety of interactive devices may be used by the traveler to access information prior to a trip or en-route to include phone, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles or other means.

The DalTrans tailored Interactive Traveler Information market package is shown in Figure 14.

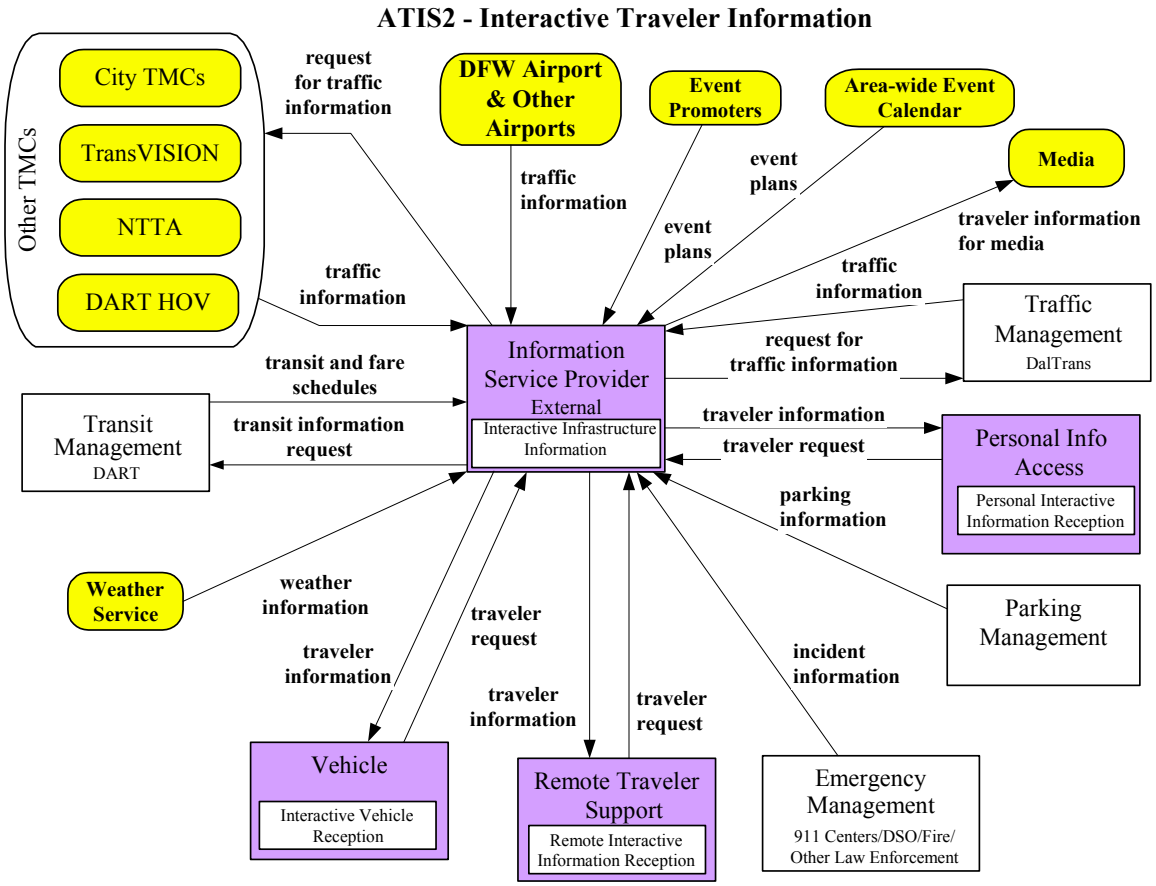

Figure 14. ATIS2 - Interactive Traveler Information market package

In this role, the DalTrans system will simply be a supplier of traffic information to an external ISP. The ISP will request traffic information from the DalTrans system and will also gather information from other systems to provide interactive traveler information to information consumers. This diagram represents an idealized view of interactive traveler information provided by an ISP.

Some of the interactive traveler information that will be provided to external agencies will be accessible directly from the DalTrans system. In this role, the DalTrans system will be the ISP. This configuration is shown in Figure 15.

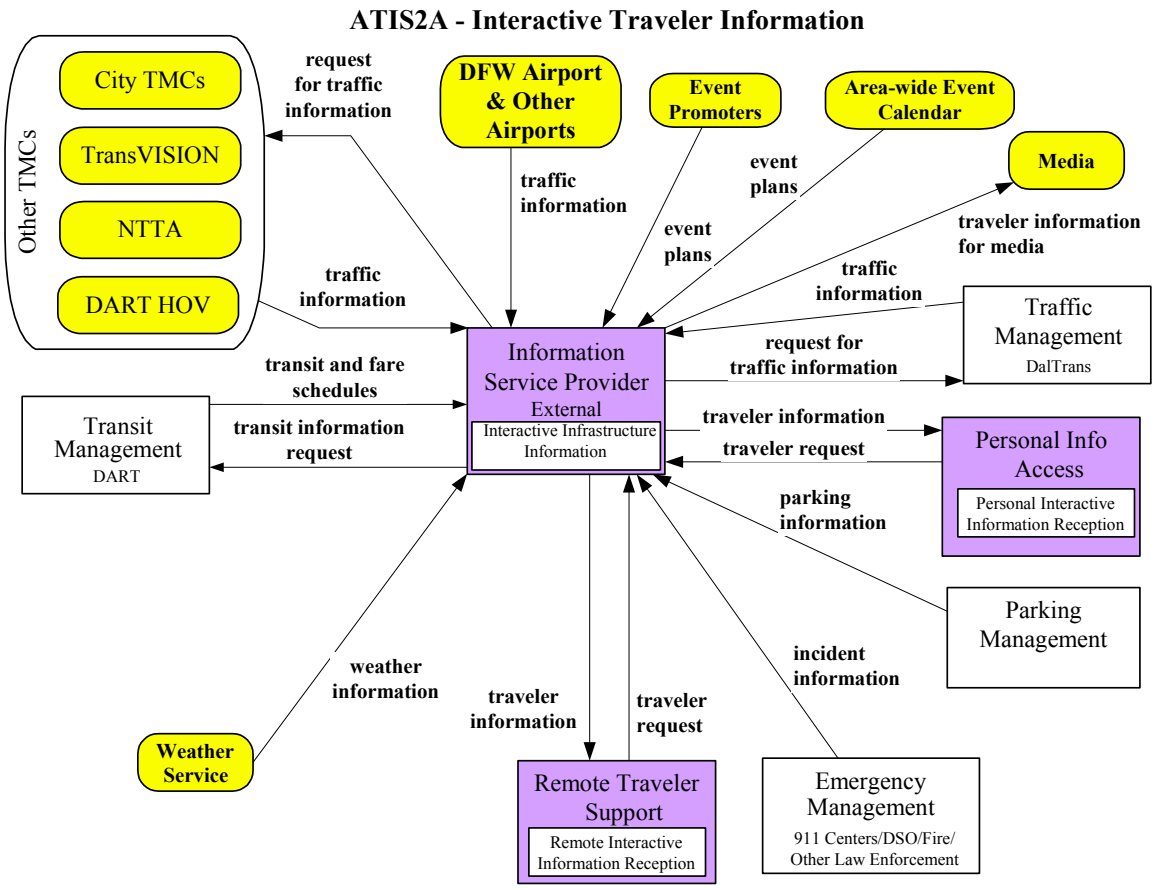

Figure 15. ATIS2A – Interactive Traveler Information with DalTrans as ISP

The DalTrans system will provide interactive traveler information via informational kiosks and the DalTrans web site. The Kiosk is represented in the diagram by the Remote Traveler Support subsystem. The DalTrans web site is represented by the Personal Info Access subsystem. Kiosk terminals will be placed throughout the region in high traffic traveler areas such as airports and malls. The kiosks will provide direct access to the DalTrans web site without allowing access to other web sites or other programs available on the computer. The following information is made available in textual and/or visual form to the traveling public via the DalTrans web site:

- Incident information
- Lane closure information
- Traffic video images
- DMS message content
- Travel times

The DalTrans system will provide tailored information to selected personnel but will not provide information tailored to a particular traveler. This information would possibly be accessible through an external ISP.

4.3.8 ATMS07 – Regional Traffic Control

This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and coordinated control strategies that enable Interjurisdictional traffic control. This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and wireline communications capabilities to implement traffic management strategies, which are coordinated between allied traffic management centers. Several levels of coordination are supported, from sharing of information through sharing of control between traffic management centers.

The DalTrans tailored Regional Traffic Control market package is shown in Figure 16.

ATMS07 - Regional Traffic Control

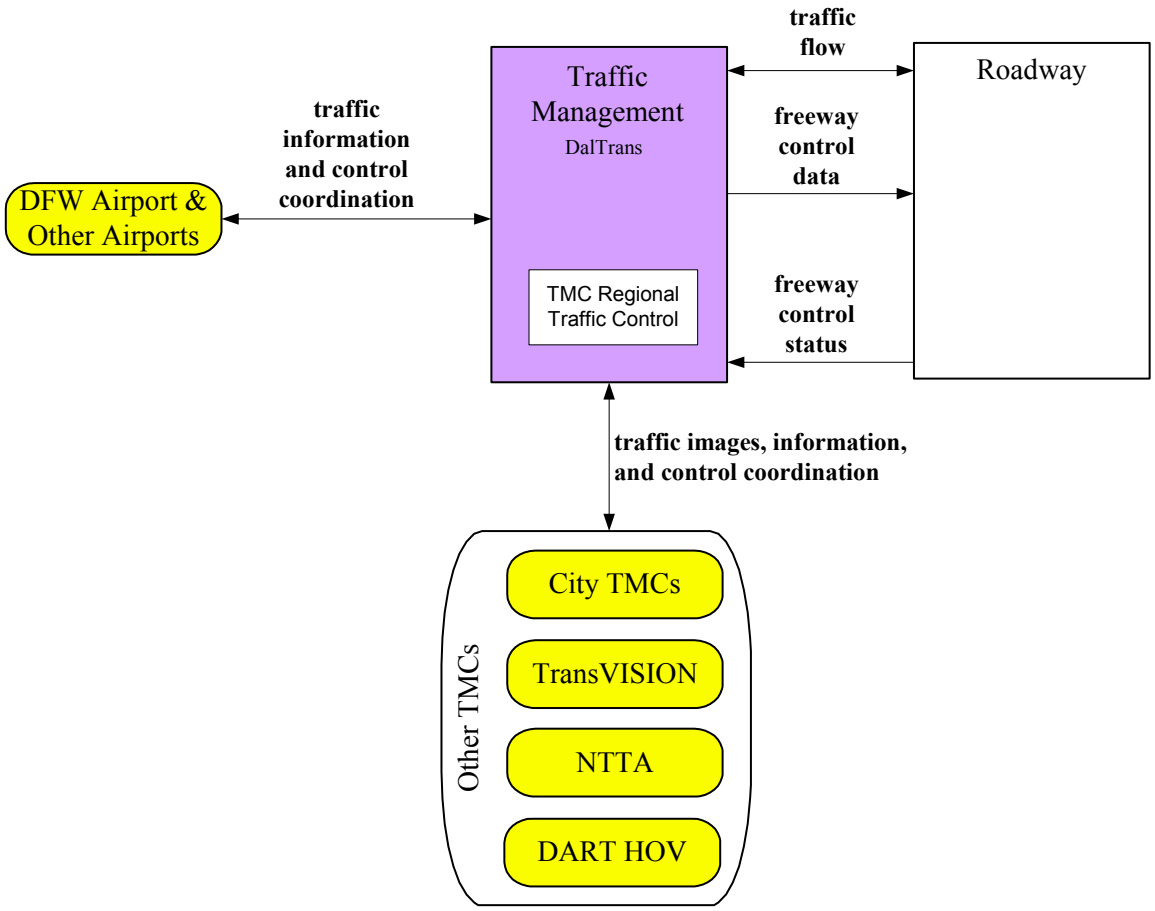

Figure 16. ATMS07 – Regional Traffic Control market package

The DalTrans system will implement regional traffic control by information and control coordination using the center-to-center interface with the following agencies:

- DART
- Airports (DFW and others)
- TransVISION
- NTTA
- City TMCs

This coordination will allow control of other TMCs during off-hours and will also allow external agencies to access the DalTrans system functionality during off-hours. Remote control access to the DalTrans system will exist but access will be granted by a DalTrans Administrator on an individual basis. If at any time an alternate traffic signal timing pattern is desired, the DalTrans system will not take control of traffic signals controlled by another jurisdiction but will coordinate suggested signal timing patterns.

The DalTrans system will share field device operational status as part of the information coordination with other agencies. This information coordination will allow the external systems to determine which equipment can be used as part of an incident response plan. Remote control access to the DalTrans system will allow external agencies to perform video switching and camera control. During off-hours and/or emergency situations, external agencies would have access to the DalTrans incident management system but would only be able to execute pre-approved equipment commands. Center-to-center control access will be allowable at certain times and restricted at other times as scheduled by a DalTrans administrator.

Coordination with airports will only concern the airport's ground transportation system.

4.3.9 AD1 – ITS Data Mart

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

The DalTrans tailored ITS Data Mart market package is shown in Figure 17.

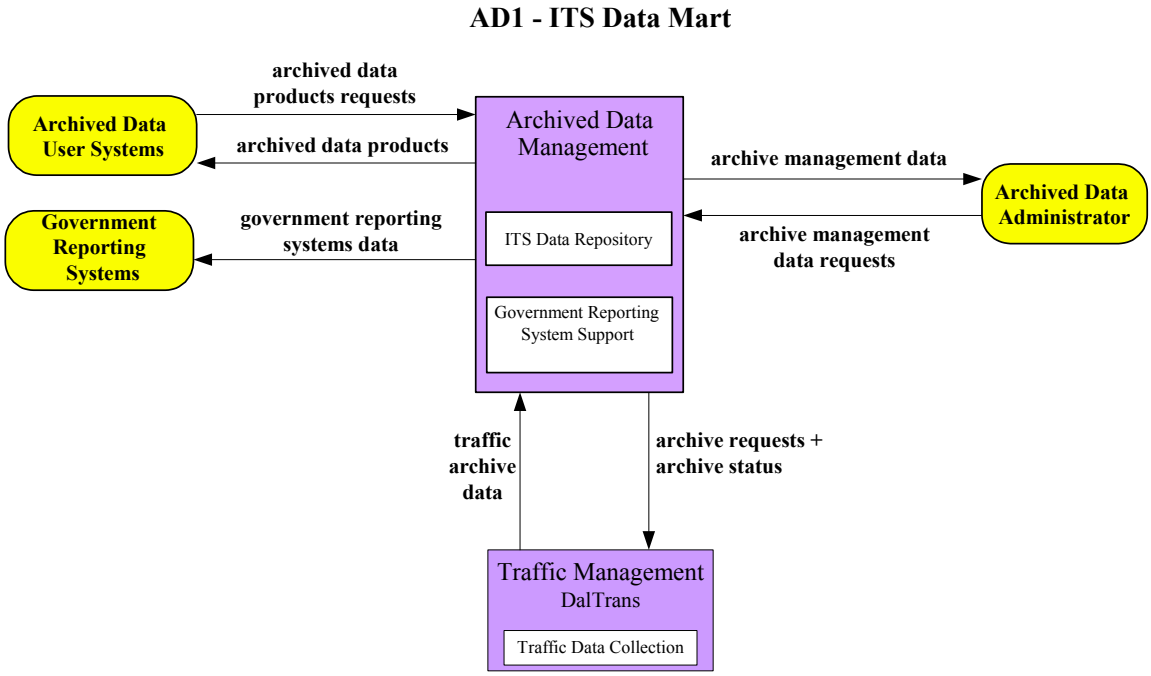

Figure 17. AD1 - ITS Data Mart market package

The DalTrans system will perform data archiving at the project level. Systems that are integrated within the DalTrans TMC will archive data to the same data store. Data that is archived at the project level will not be accessible to external systems since it will be accessible at the regional level from the North Central Texas Council of Governments (NCTCOG).

The project level data archive will be flexible enough to allow different data formats and will be dynamically configurable by a DalTrans Administrator. The system will log major system events and will also log operator activity to allow accountability.

4.3.10 AD2 – ITS Data Warehouse

This market package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this market package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

The DalTrans tailored ITS Data Warehouse market package is shown in Figure 18.

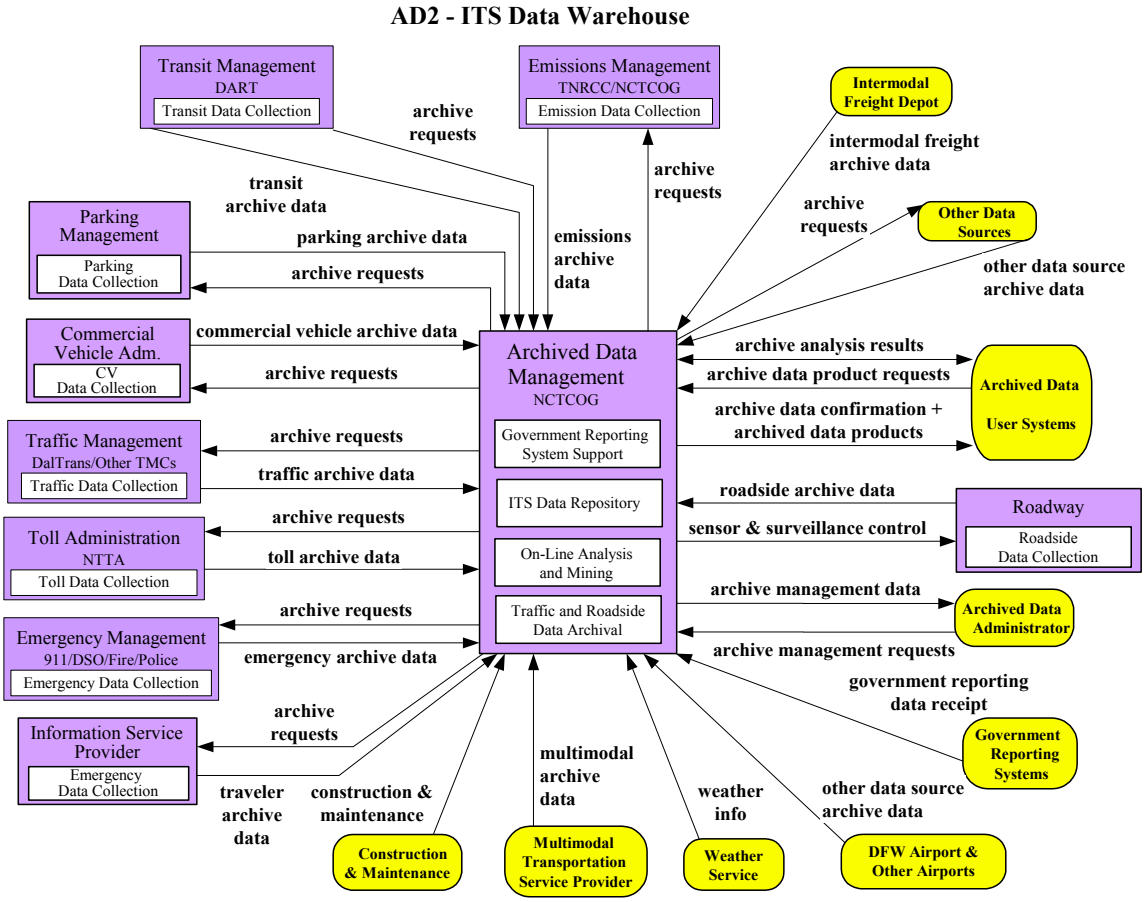

Figure 18. AD2 – ITS Data Warehouse market package

The NCTCOG will be responsible for archived data management at the North Central Texas regional level. The NCTCOG will request the project level archived data described in section 4.3.9 from the DalTrans system for inclusion into the regional data archive. This market package diagram represents an idealized view of the regional data archiving performed by the NCTCOG. DalTrans does not impose any requirements on the NCTCOG to provide all requests and services shown.

4.3.11 EM1 – Emergency Response

This market package provides the computer-aided dispatch systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification and coordinated response between agencies. Existing wide area wireless communications would be utilized between the Emergency Management Subsystem and an Emergency Vehicle to enable an incident command system to be established and supported at the emergency location. The Emergency Management Subsystem would include hardware and software for tracking the emergency vehicles. Public safety, traffic management, and many other allied agencies may each participate in the coordinated response managed by this package.

The DalTrans tailored Emergency Response market package is shown in Figure 19.

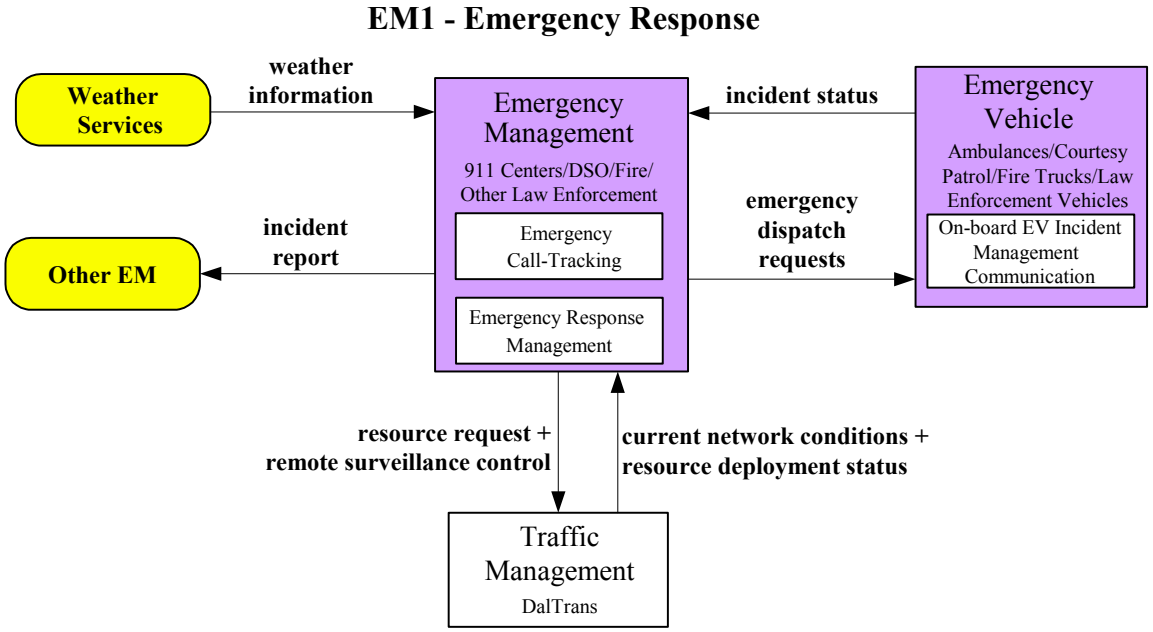

Figure 19. EM1 – Emergency Response market package

The DalTrans system will use the center-to-center interface to coordinate emergency response with the 911 Centers, DSO, Fire Department, and other law enforcement agencies. The emergency management centers could be given control of surveillance video to assist in the coordination of the emergency response. The centers may also utilize DalTrans traffic information to assist in route selection for emergency vehicles. The DalTrans system will coordinate with local enforcement agencies to handle any hazardous material spills. The local enforcement agencies are able to handle some non-toxic materials but will be responsible for coordinating with HAZMAT if required. The Other EM terminator in the diagram represents other emergency management centers such as HAZMAT, Wrecker Companies, etc.

4.3.12 ATMS18 – Road Weather Information System

This market package monitors current and forecast road and weather conditions using a combination of weather service information and data collected from environmental sensors deployed on and about the roadway. The collected road weather information is monitored and analyzed to detect and forecast environmental hazards such as icy road conditions, dense fog, and approaching severe weather fronts. This information can be used to more effectively deploy road maintenance resources, issue general traveler advisories, and support location specific warnings to drivers using the Traffic Information Dissemination Market Package.

The DalTrans tailored Road Weather Information market package is shown in Figure 20.

ATMS18 - Road Weather Information System

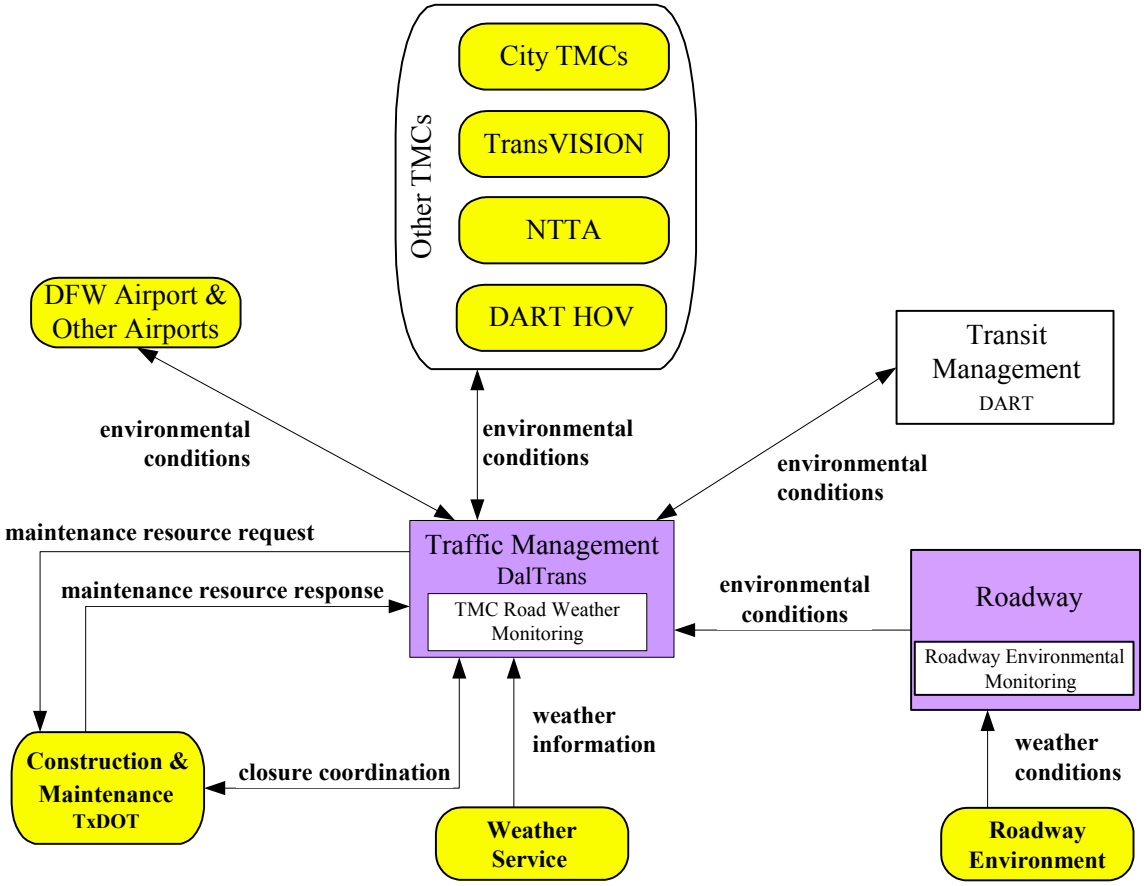

Figure 20. ATMS18 – Road Weather Information System market package

The DalTrans system uses the following sources of environmental condition data to disseminate weather information to the traveling public:

- Environmental Sensor Stations along the roadway
- Environmental condition data from other centers
- Satellite and Doppler Radar images from the National Weather Service
- Coordination with the DART Transit Management Center that obtains weather condition reports from bus drivers.

This information is also used to coordinate any maintenance activities necessary to respond to the weather conditions. Construction and Maintenance personnel will coordinate directly with the DalTrans TMC if an emergency lane closure is required due to inclement weather conditions or if a crew will need to alter the construction schedule for the day due to weather conditions.

4.3.13 ATMS02 – Probe Surveillance

This market package provides an alternative approach for surveillance of the roadway network. The general implementation path supported by this market package is dedicated short-range communications between the vehicle and roadside to provide information back to the Traffic Management Subsystem. This approach utilizes vehicle equipment that supports toll collection, in-vehicle signing, and other short range communications applications identified within the architecture. The market package enables traffic managers to monitor road conditions, identify incidents, analyze and reduce the collected data, and make it available to users. It requires roadside beacons and wireline communications for the short range communications option and data reduction software. Due to the large volume of data collected by probes, data reduction techniques are required in this market package, which include the ability to identify and filter out-of-bounds, or extreme data reports.

The DalTrans tailored Probe Surveillance Information market package is shown in Figure 21.

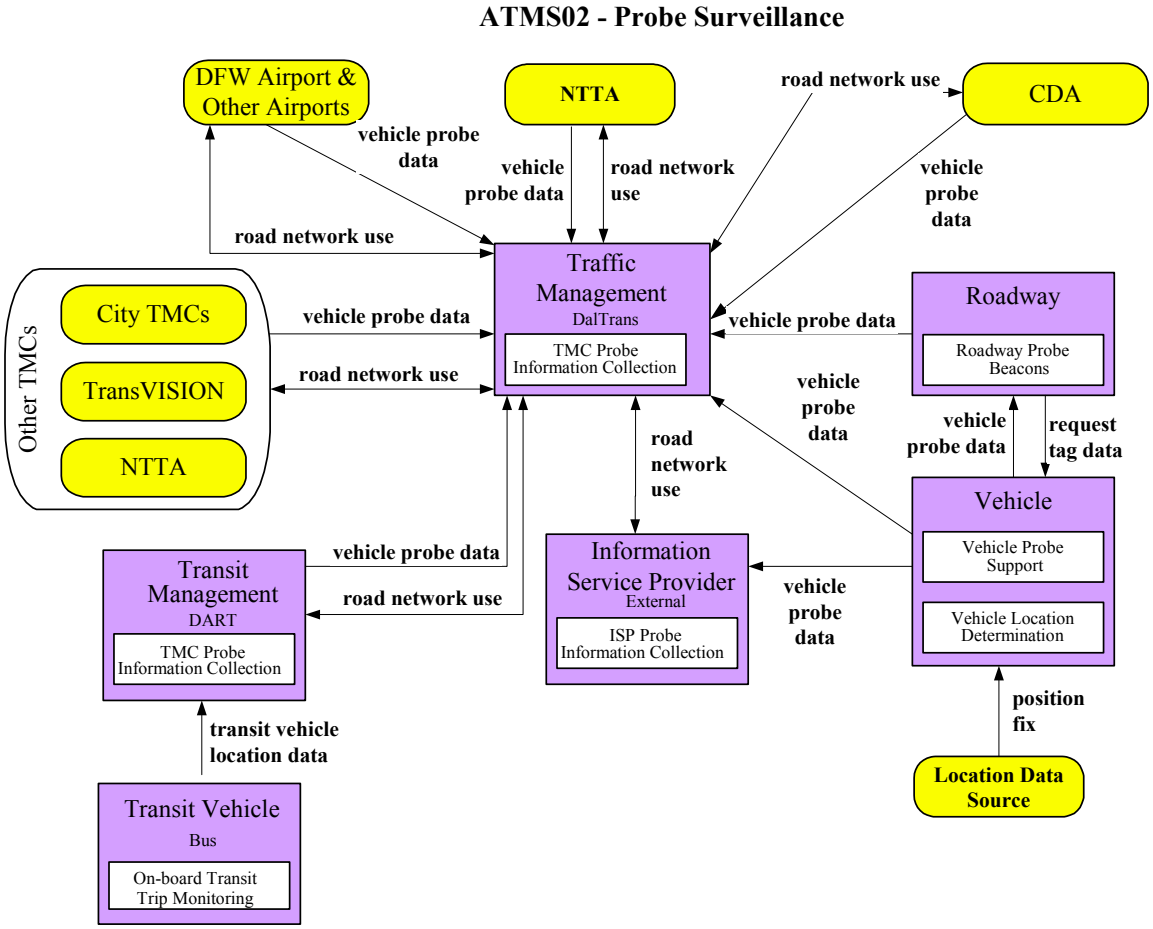

Figure 21. ATMS02 – Probe Surveillance market package

The DalTrans system uses vehicle probe data to supplement speed data obtained by loop detectors and VIVDs for use in incident detection. The DalTrans system obtains vehicle probe data from the following sources:

- Roadway – Tag readers installed along the roadway.
- Vehicle – Potential use of cellular phones as probes.
- Other Agencies – Probe data collected from other agencies. This allows a regional monitoring of the road network use.

The DalTrans system may eventually be supplied road network use information from an ISP that gathers cellular phone location data. It is possible that this data would be obtained from 911 calls.

4.3.14 ATMS11 – Emissions Monitoring and Management

This market package monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the emissions management subsystem for processing. Both individual detection and identification of vehicles that exceed emissions standards and general area-wide monitoring of air quality are supported by this market package. For area wide monitoring, this market package measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. For point emissions monitoring, this market package measures tail pipe emissions and identifies vehicles that exceed emissions standards. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations.

The DalTrans tailored Emissions Monitoring and Management market package is shown in Figure 22.

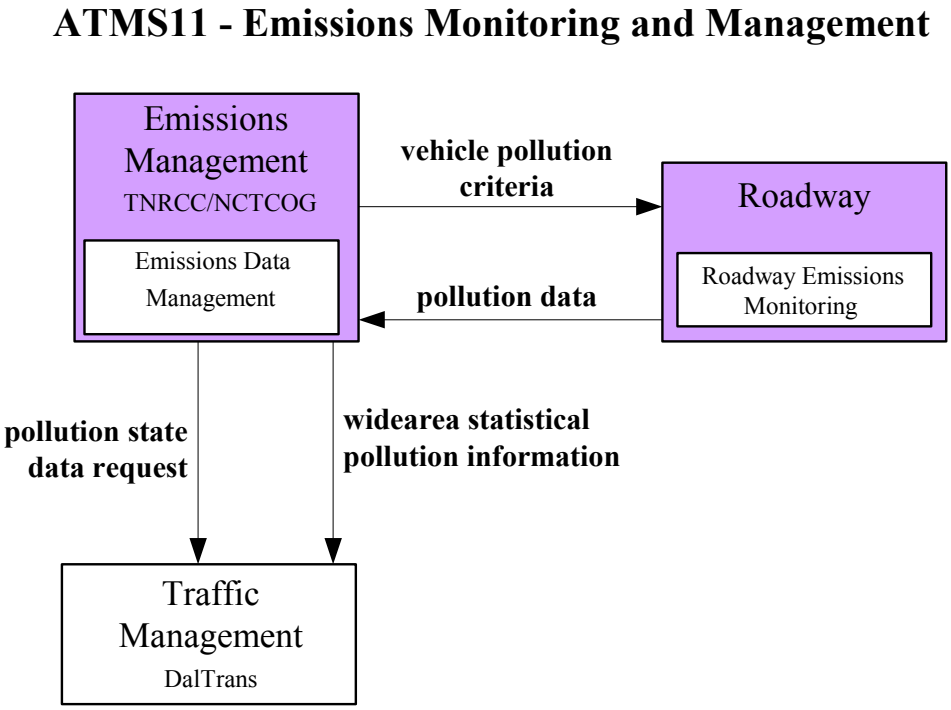

Figure 22. ATMS11 – Emissions Monitoring and Management market package

The TNRCC and the NCTCOG are responsible for emissions monitoring and management in the Dallas area. These agencies supply pollution information upon request to the DalTrans TMC for use in issuing public health advisories and air quality action days.

4.3.15 Performance Characteristics

The DalTrans system will be optimized to perform incident management quickly and accurately. The primary performance considerations will be in the timeliness and accuracy of the detection and verification of incidents. It is equally important that the response plan is generated quickly and is easily modifiable to allow minimal time between verification and response execution.

Another critical performance consideration will be the load capability and performance of the DalTrans web site. The site must be able to distribute accurate information quickly to many travelers to be able to withstand the load accompanying an emergency situation.

4.3.16 Quality Attributes

The DalTrans system will possess the following quality attributes to maximize the cost/benefit ratio of the system.

4.3.16.1 Availability

The availability of the system will be maximized to ensure optimal benefit to travelers in the Dallas area. Upgrades and repairs to critical system components will occur at non-operational hours or during off-peak hours. The DalTrans system will be operable from a single workstation for times when it is necessary to bring it down for maintenance. The DalTrans system will follow the guidelines for reliability and fault tolerance defined in the TxDOT Statewide Core Technology Architecture.

4.3.16.2 Survivability

The DalTrans system will have server level redundancy to ensure uninterrupted system operation in the event of a failure of a critical centralized process. Operator workstations will not be redundant; however, in the event of a workstation failure, all incidents assigned to the operator will be transferred to another available operator. If there are no operators available to manage the incidents, they will be stored and assigned to the first operator to log onto the system.

4.3.16.3 Efficiency

The DalTrans system will utilize the incident management system described in Section 4.3.3 to maximize efficiency. Advanced algorithms will be used to minimize the number of false alarms in incident detection. These features will allow an operator to accurately detect, verify, and quickly respond to an incident.

4.3.16.4 Expandability

The DalTrans system will continually be expanding in size and functionality to provide additional ITS services to the Dallas-area travelers. Field equipment will be able to be added, modified, or deleted without the need for restarting the system. The DalTrans software will be dynamically configurable to allow environment changes to occur without the need to restart.

The DalTrans system will make use of a wireless LAN to allow additional computers to serve as operator workstations if needed. These computers will most likely be laptops that have other primary purposes but will allow a quick expansion in user capacity to assist in emergency situations.

A map displaying real-time traffic conditions and field equipment data will serve as the primary interface for the DalTrans operators. The map will be generated from GIS data available from the NCTCOG.

4.3.16.5 Flexibility

The DalTrans system will be flexible enough to allow the entire system to run on a single computer if needed. In production mode, the system will run on multiple computers to balance the workload. An Administrator will be able to configure the system as needed to balance the computer resources.

4.3.16.6 Reusability

The DalTrans system will make use of reusable components where possible. All new software components will be developed with TxDOT statewide ITS reuse in mind.

4.3.16.7 Portability

The DalTrans system will be integrated and developed using platform independent components as much as possible.

4.3.16.8 Interoperability

The DalTrans system will utilize the TxDOT Statewide C2C software to allow interoperability with other TMCs.

4.3.16.9 Usability

The DalTrans system will be used by a wide variety of users including traffic management operators, system administrators, maintenance personnel, DART HOV operators, and Internet users. Each respective user interface will be tailored to meet the specific needs of the particular user class for which it is intended. Internet users will use a web-based interface that is compatible with the most currently used browsers. The DalTrans web site must be intuitive and accurate as it will be used by many users and must present accurate information quickly and in a manner that requires minimal training.

Operators will use a map-based interface to perform incident and freeway management. Administrators will use an appropriate GUI to perform system administration tasks. DART HOV operators will use the TxDOT HOV Lane Management user interface. All user interfaces will be as intuitive as possible while maintaining the capability needed to perform the specific functions for which they are designed. User interfaces will contain context sensitive help. Training will be provided for all non-Internet users.

4.3.16.10 Maintainability

TxDOT maintenance personnel will perform maintenance on the DalTrans field equipment and equipment within the DalTrans TMC that is used for field equipment communication. DalTrans system administration personnel will perform maintenance on computer and network components within the DalTrans TMC. An Administrator will also perform routine software maintenance such as restarting software processes when needed, database administration, archiving system logs, etc. The TxDOT Information Services Division (ISD) will provide support and perform upgrades for computer equipment when possible. In order to maintain a common configuration within the DalTrans network, it is the intent that all computer equipment involved in the operation of the facility would be maintained by a common contract funded by the financial partners. Maintenance activity for equipment within the DalTrans center that is owned by another agency will be funded by that agency. External equipment owned by another agency will be maintained by that agency.

TxDOT Statewide software components will be maintained by the TxDOT Statewide Integrator and distributed according to the Statewide Configuration Management Plan. DalTrans localized software will be maintained by a local integrator. Maintenance activity for software components that are used within the DalTrans center but are owned by another agency will be funded by that agency.

4.3.16.11 Security

The DalTrans system will implement a network security policy in accordance with the TxDOT Statewide Security Plan and coordination with the DART security system that will protect the DalTrans Local Area Network (LAN) from intrusion and compromise.

4.3.16.12 Documentation

The following documents will be created and continually kept up-to-date for the DalTrans system. Each document is followed with a brief description of the document's primary content and purpose.

- Operational Concept Document (OCD): This document is the DalTrans OCD. OCDs are often referred to as Concept of Operations (ConOps) documents. An OCD is a user oriented document that gives a high level overview of the system's capabilities and characteristics.
- System Requirements Specification (SRS): The SRS details "what" a system should perform. This document is sometime called a "functional requirements" document by some organizations. The SRS is important because it provides the details as to what a system (not how) should do; this document will serve as the baseline description of the functionality that is to be implemented.
- System Design Document (SDD): The SDD is a detailed description of how a system is implemented. This document needs to include a description of both the hardware (custom and commercial-off-the-shelf) and software that comprises the system.
- Acceptance Test Plan (ATP): The ATP is the document that the client (i.e. TxDOT) will utilize to accept (i.e. buy-off or sign-off) the system. The ATP should be a series of detailed test steps that demonstrate that the requirements (from the SRS) have been properly implemented. The client should review and agree to the ATP prior to the system being completed and then the ATP should be "executed" when the contractor states the system is ready.
- Version Description Document (VDD): A VDD should be provided by the system developer each time a software release is delivered (which also implies an ATP should be executed for each release). The VDD contains detailed installation instructions as well as providing a detailed list of changes since the previous release of the software.
- Software User's Manual (SUM): The SUM provides a description on how to use the system. A SUM is primarily provided when a system has a user interface that is utilized to operate the system. The SUM should be detailed enough so that new employees can use the SUM (as well as some formal training) to learn how to use a system.
- Interface Control Document (ICD): An ICD describes an interface to a software system. It describes in detail the data exchange mechanism and the data types that will be used to exchange information between two systems or subsystems.

4.4 Modes of operation

The DalTrans system will operate in the following modes:

- Normal – This is the normal operational mode of the system in which all services available. The TMC will operate on normal business hours with a set operational staffing plan.
- Maintenance – This operational mode will be used when system upgrades or repairs are taking place. The system will more than likely be run from a single workstation in this mode.
- Simulation/training mode – This operational mode will be used periodically for the training of a new operator. This user interaction involved in this mode is described in Section 4.5.1.4.

- Emergency – This operational mode will involve the coordination of the DalTrans system and personnel with many external emergency management agencies and the media. There will be other users (possibly not all TxDOT) that will be logging into and using the DalTrans system for emergency management information and control coordination. TxDOT will staff the TMC appropriately until the emergency situation has subsided.

4.5 User classes and other involved personnel

The following sections describe the users of the DalTrans system.

4.5.1 Production system users

Figure 23 shows the user hierarchy for the DalTrans production system. Descriptions of each user class follow the diagram.

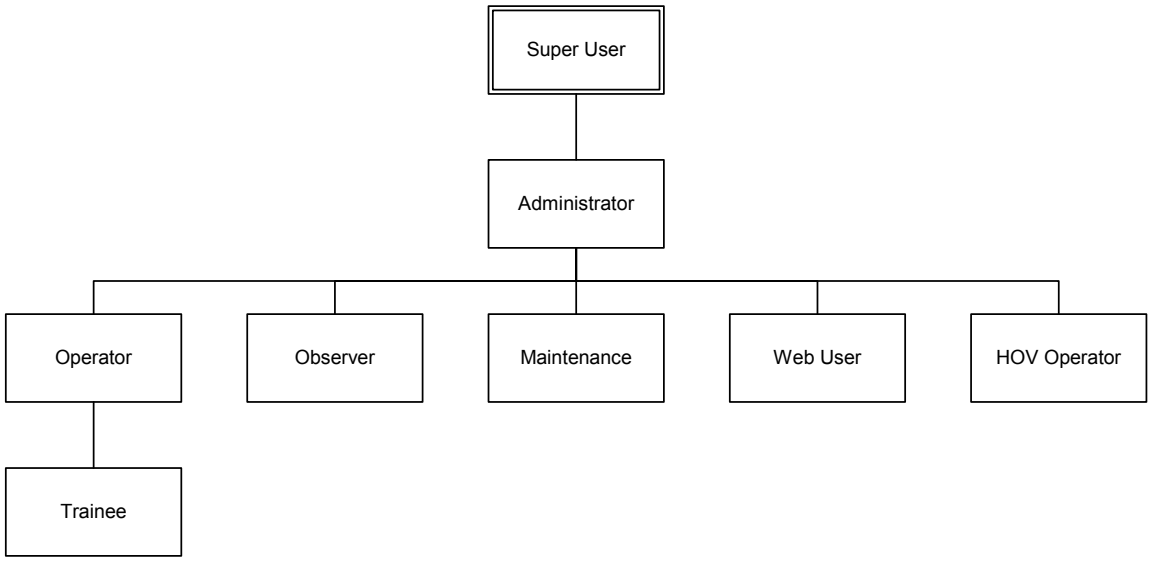

Figure 23. DalTrans production system user hierarchy

4.5.1.1 Super User

The Super User class will have the same capabilities as an Administrator but will be able to add, modify, and remove Administrators.

4.5.1.2 Administrator

The Administrator class will have access to all system functionality except that reserved for the Super User. An Administrator user will be able to configure the software, manage users, monitor system performance, and perform various other system administration functions.

4.5.1.3 Operator

The primary responsibility of the DalTrans operator will be incident management. This position requires a high school diploma and operator training described in Section 4.5.1.4. Operators will detect and verify incidents and then build and execute a response plan to manage the incident. DalTrans operators will use wireless headsets to communicate with other operators and external sources.

There will be two shifts of operators during the day. During peak hours, there will be more operators using the DalTrans system than during non-peak hours. The morning and afternoon shift will be slightly overlapped to allow a transitional period for the operators. The morning operators will brief

the afternoon operators on information regarding incidents that have occurred and ones that are still active along with any contact information and DalTrans responsibilities that is pertinent.

4.5.1.4 Trainee

The Trainee is a user that will eventually be an operator after a certain training period. The trainee will work with one or more operators during his/her training to gain the skills necessary to perform effective incident management.

The trainee will initially work on a separate system running in a simulation mode. As an operator receives incidents, the trainee assigned to that operator will receive an identical incident. The trainee will build an incident response plan in parallel to the operator and compare. When the trainee has gained a sufficient understanding of incident management, he/she will be managing real incidents not in simulation mode. During this training phase, the operator will approve incident response plans before the commands are sent to the field equipment. When the operator feels that the trainee has gained the skills necessary to perform incident management by themselves, the trainee will be promoted to an operator.

4.5.1.5 HOV Operator

The HOV Operator will be a DART employee that will monitor and control field equipment specifically for HOV lanes. The HOV Operator will use the HOV lane management software integrated into the DalTrans system.

4.5.1.6 Observer

An Observer user will be able to control cameras and will be able to view incident status information and other traffic conditions data. The Observer will most often be an employee of an external agency and will only want to "observe" traffic conditions to assist in some other function such as 911 dispatching, etc.

4.5.1.7 Maintenance

Maintenance personnel will access the DalTrans system to manage field equipment work orders, manage inventory, and create reports.

4.5.1.8 Web User

Users of the DalTrans web site will vary greatly in educational background. The DalTrans web site will not allow control access to field equipment. The DalTrans Web User will only have access to the web site. Security policies are discussed in Section 4.3.16.11.

4.5.2 Event Notification and Logging

Users of the DalTrans system will be able to select events for which they would like to be notified. They will also be able to specify the notification method for each event such as email, pager, instant message, or a combination of the methods. A DalTrans Administrator will be able to specify at a system level which events will be logged and the logging mechanism.

4.6 Support environment

Software support including maintenance on existing components and the integration of new components is covered in Section 4.3.16.10. At least one operator workstation will be available for the use of the local integrator.

Hardware and software components will be replaced when those items are deemed incapable of satisfying the business needs of the DalTrans system. Systems developed and maintained by the TxDOT Statewide Integrator will have preference over the development and integration of new

systems. If it is required that a new system is to be developed, DalTrans personnel will coordinate closely with the Statewide Integrator to ensure reusability in other TMCs.

4.7 Goals and Guidelines

During the requirements analysis for the DalTrans system, goals were identified and are documented in the System Requirements Specification under the requirement type of GOAL.

5.0 OPERATIONAL SCENARIOS

The interaction between the system and its users and other external interfaces are captured in a Unified Modeling Language (UML) Model. This model will serve as the basis for further design of the system software. The model will be developed using Rational Rose, which is the TxDOT standard software design tool. Prior to the design phase, the model will consist of use case diagrams that describe the functionality available to the different users of the system and sequence diagrams, which capture the sequence of events that occur under normal system operation.

6.0 SUMMARY OF IMPACTS

The following sections describe the impacts of the new system on the users, developers, and the support and maintenance organizations.

6.1 Operational impacts

The DalTrans system will have additional functionality to the existing system that will assist operators in performing their tasks. This additional functionality will help the operators in the long run but will require training. The operators will be trained on the new system prior to using it. The software will be developed in a flexible manner to allow policy decisions to change without requiring the software to be modified. The addition of new personnel, equipment, and functionality will require a larger operational budget. These operational impacts will be considered and minimized during the development of the new DalTrans system.

6.2 Organizational impacts

The primary organizational impact will be the need for additional staff to operate and maintain the new system. The training for users of the new system is described in Section 4.5. Table 1 identifies the current staff and the future staff needed to operate and maintain the DalTrans system.

	TxDOT		DART		DSO	
	CURRENT STAFFING	ADDITIONAL FUTURE STAFFING	CURRENT STAFFING	ADDITIONAL FUTURE STAFFING	CURRENT STAFFING	ADDITIONAL FUTURE STAFFING
Supervisor	1		1			
Asst Supervisor	1			1		
Administrative Asst	1		1			
Designers	3	1				
Systems Analyst	1					
Construction/Maint.	3	2				
Operators	4	6	2	2		
TMC Supervisor		1				
Public Information		1		1		
Informational Resource		1		1		
Security Personnel		2				
Receptionist		1				
Dispatcher					2	2
	14	15	4	5	2	2
	29		9		4	

Table 1. DalTrans Staffing Needs

The DalTrans operators will handle the other responsibilities within the DalTrans center as needed.

6.3 Impacts during development

The following sections explain the system development cycle and the impacts that the development of the new DalTrans system will have.

6.3.1 System Development Cycle

The DalTrans system will be developed using an iterative development cycle. Each iteration of the system will involve the following phases:

1. **Operational Concept** – The operational concept will be defined in the first phase and continually updated and refined in subsequent phases. During the first iteration of the system, this phase will consist of planning meetings focused on the creation of the Operational Concept Document (OCD). Future iterations will update the document as needed to describe the new business needs and desired changes in functionality.

   Inputs: New business needs; Desired changes in functionality

   Outputs: new/updated OCD

2. **Requirements** – The requirements will be derived from the OCD and defined in the System Requirements Specification (SRS). The SRS will be a living document similar in nature to the OCD and will be continually refined and kept up to date through each phase of each system iteration.

   Inputs: new/updated OCD

   Outputs: new/updated SRS

3. **Functionality Evaluation** – This phase will involve the evaluation of existing systems to identify potential areas of reuse and to gather ideas to further refine the OCD and SRS. During the first iteration of the system, this phase will consist of an evaluation tour of various existing transportation management centers. Notes and ideas on potential reuse will be captured in an evaluation report. This phase will also involve the definition of the use cases for the system describing the areas of functionality available to the various system users. This phase will also include the creation/modification of the operational scenarios for the system. These operational scenarios describe the sequence of events involved in normal operational activities and are often described using high-level sequence diagrams. The use cases and operational scenarios will be captured in the design model for the system as they serve as a transition from requirements into design. Future iterations of the system development will involve continued evaluation of functionality being deployed statewide. The use cases and operational scenarios will also be continually refined in each iteration similar to the SRS and the OCD.

   Inputs: new/updated OCD and SRS

   Outputs: new/updated OCD, SRS, Use Cases, Operational Scenarios, Functionality Evaluation report

4. **High-Level Design** – The high-level system design will be created from the resulting documentation from the first three phases. This will encompass the high-level design for hardware and software. The design will be captured in the System Design Documentation (SDD).

   Inputs: updated documentation from previous phases

   Outputs: new/updated documentation from previous phases, new/updated SDD

5. **Detailed Reuse Evaluation** – Using the documentation from the previous phases, software will be obtained from existing systems to be evaluated in detail for possible reuse. Each software component that is evaluated will be identified as reusable without modifications, reusable if modified, and not reusable. If a component is identified as reusable if modified, the modifications required will be described. This detailed software reuse evaluation will be captured in a Reuse Evaluation Report.

Inputs: updated documentation from previous phases

Outputs: new/updated documentation from previous phases, Reuse Evaluation Report

6. **Detailed Design** – The detailed design of the communications system and the software will be created and captured in the SDD. Existing design documentation for software components that have been chosen for reuse will be modified if necessary and incorporated into the SDD. Design documentation for the communications system that can be reused from existing systems will also be modified if necessary and included appropriately. This phase will involve prototyping user interfaces during the user interface design and will involve some proof of concept work for the software and communications system.

   Inputs: updated documentation from previous phases

   Outputs: new/updated documentation from previous phases, new/updated SDD, prototyped software, and proof of concept material

7. **Implementation/Integration** – The detailed design and reuse evaluation report will guide the implementation and integration phase. Components that do not exist or could not be reused from another system will be implemented from scratch. If a component was identified as a reuse candidate given certain modifications, the modifications will be performed. Other components that can be reused without modifications will be integrated appropriately.

   Inputs: updated documentation from previous phases

   Outputs: new/updated documentation from previous phases, system components (hardware and software), Version Description Document (VDD), and a System User's Manual (SUM)

8. **Deployment/Acceptance Testing** – Once the system has been implemented and has passed integration testing, it will be deployed and then acceptance tested to ensure it meets the requirements in an operational environment. In future iterations this phase will involve acceptance testing enhancements and fixes made to the previous version of the system. It will also involve regression testing all affected components to ensure the integrity of the system. Once the system has been accepted it will be placed under configuration management as the latest release version.

   Inputs: updated documentation from previous phases, integrated system components

   Outputs: new/updated documentation from previous phases, signed Acceptance Test Plan (ATP)

9. **Operation/Maintenance** – Upon the completion of the acceptance testing and deployment phase, the system will begin normal operation. The system will be maintained as described in Section 4.3.16.10. As new business needs arise and enhancements are desired, this development cycle will iterate as needed. Iterations after the first will be much shorter in duration as they will normally involve fixing/enhancing the existing system. It is very important that the documentation developed in the previous phases be kept up to date for the system.

   Inputs: updated documentation from previous phases, signed ATP

   Outputs: system retirement

6.3.2 Personnel

During the development and integration of the new DalTrans system, personnel from the TxDOT Dallas District, TxDOT Traffic Operations Division in Austin, Texas Transportation Institute, Dallas Area Rapid Transit, North Central Texas Council of Governments, and the TxDOT Statewide ITS developer and integration will be required periodically for meetings. These meetings will include but are not limited to the following:

- Project status
- Evaluation of existing software
- Design reviews
- Documentation reviews
- Acceptance testing

Personnel from other TxDOT districts may be required occasionally as the development of the DalTrans system will involve the identification and development of reusable software components around the state.

6.3.3 Parallel operation

In the final stages of system integration testing, the new DalTrans center will operate in parallel with the existing Traffic Management Satellite until the new system is determined stable enough to take primary control of the system full-time. This parallel operation will require operators to staff both locations.

6.3.4 System Testing

The testing of the new DalTrans system will impact operations of the existing system. In the early stages of integration and testing, only subsets of field equipment will be required occasionally for limited periods of time. When the system is in the latter stages of integration testing, the entire system will be required for full operational testing. This testing will be scheduled around events that would require the system to be fully operational and available for use. The bulk of this testing may be scheduled for late night, early morning, and weekend hours.

7.0 ANALYSIS OF THE PROPOSED SYSTEM

The following sections provide an analysis of the proposed system.

7.1 Summary of improvements

The new DalTrans system will have the following improvements and benefits.

- The system will be comprised of reusable components. The goal for the DalTrans system is to contain as much reusable software as possible. This will allow software components to be deployed and used statewide which will increase the stability and the integrity of the software. If a defect is found, it will be fixed once and redistributed to all appropriate locations. This will help eliminate the duplication of effort in developing and maintaining software statewide.
- The system will have enhanced event management capabilities. The system will have the ability to generate event response plans and retrieve previously executed response plans. The response plans can be prioritized and scheduled, and they will be able to be executed and cleared with one operator action. The system will have the ability to use multiple algorithms to detect incidents and facilities to analyze the performance of an algorithm and modify the algorithm if needed.
- The system will be able to distribute the event management workload. Lead operators will be responsible for certain sections of the roadway network and will work with other operators to manage events that occur in that section.
- The system will have integrated asset management software. The maintenance system software will work with the traffic management software to identify equipment failures and issue work orders to maintenance personnel. The maintenance system will then assist in tracking the work order to closure. The system inventory will also be manageable from the integrated maintenance system.
- The system will be able to archive data at the project level and also export data to be archived at the regional level.
- The system will be able to notify personnel of certain events using a variety of notification mechanisms.
- The system will be able to control and monitor more types of roadway devices.

7.2 Challenges

The new DalTrans system will have the following challenges.

- The system will reuse existing software around the state when possible. This implies that the software system will consist of components that are implemented in different languages, designed using different tools and methodologies, and documented using different documentation standards. All components will have to be brought together to form one system that will be operable and maintainable.
- Configuration management of many independent software components developed by different districts will be a challenge. The DalTrans system will adhere to the practices of the statewide configuration management plan for assistance in this area.

7.3 Alternatives and trade-offs considered

As the system is developed and integrated, advantages and limitations such as those discussed in the previous sections will be considered to provide the maximum cost-benefit for the entire system lifecycle. As these items are considered, they will be documented here appropriately.

8.0 NOTES

Under Section 4.5.1.3 Operator, the mechanism for a lead operator to approve an incident response plan generated by a trainee is discussed. However, the document does not address how the methodology for the response plan will be approved. What qualifications are required to approve the generation mechanism for incident response plans?

APPENDIX A - Glossary, Terms, and Acronyms

AM – Amplitude Modulated

ATM – Asynchronous Transfer Mode

C2C – Center-to-Center communication link developed by the TxDOT Statewide Integrator

CAD – Computer Aided Dispatch

CDA – Central Dallas Association

CCTV – Closed Circuit Television

CVO – Commercial Vehicle Operations

DalTrans – Dallas Transportation management Center

DART – Dallas Area Rapid Transit

DFW – Dallas/Fort Worth

DMS – Dynamic Message Signs – Message signs placed along the freeway that display dynamic content to the driver.

DSO – Dallas Sheriff's Office

Dynamic Signs – Message signs with beacons that are placed along the roadway to alert drivers to a HAR message that is available.

EM – Emergency Management

EMS – Emergency Management Services

ETMCC – External Traffic Management Center Communications

Event - A traffic element that represents the singular occurrence of any abnormal condition that adversely effects traffic operations. Events maybe unplanned (i.e. a multi-vehicle roadway accident) or planned, (i.e. a maintenance lane closure).

GUI – Graphical User Interface

HAR – Highway Advisory Radio

HAZMAT – Office of Hazardous Materials Safety

HOV – High Occupancy Vehicle

Incident - An unplanned randomly occurring traffic event that adversely effects normal traffic operations. For example, a multi-vehicle roadway accident is an incident.

ISD – Information Services Division

ISDN – Integrated Services Digital Network

ISP – Information Service Provider

ITS – Intelligent Transportation Systems

LAN – Local Area Network

LCS – Lane Control Signal

LCU – Local Control Unit

NCTCOG – North Central Texas Council of Governments

NTTA – North Texas Tollway Authority

OCD – Operational Concept Document

SRS – System Requirements Specification

SwRI - Southwest Research Institute

TBD – To Be Determined

TCP/IP – Transmission Control Protocol/Internet Protocol

TDM – Traffic Demand Management

TMC – Transportation Management Center

TMDD – Traffic Management Data Dictionary

TMS - DalTrans Transportation Management Satellite – The existing DalTrans Transportation Management Center

TNRCC – Texas Natural Resources Conservation Council

TransVISION – Fort Worth's Traffic Management Center

TRF – TxDOT Austin Traffic Operations Division

TTI – Texas Transportation Institute

TxDOT – Texas Department of Transportation

VIVDS – Video Imaging Vehicle Detection System

XML – eXtensible Markup Language