



State of Texas
ITS Architectures and Deployment Plans

Amarillo Region

Regional ITS Architecture Report

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LIST OF ACRONYMS

| | |
|---------|--|
| AASHTO | American Association of State Highway and Transportation Officials |
| ASTM | American Society for Testing and Materials |
| ATIS | Advanced Travel Information System |
| ATMS | Advanced Traffic Management System |
| AVL | Automatic Vehicle Location |
| BRINSAP | Bridge Inventory Inspection System |
| CC | Control Center |
| CCTV | Closed-Circuit Television |
| CEA | Consumer Electronics Association |
| CPT | Common Public Transportation |
| CVO | Commercial Vehicle Operations |
| DARC | Data Radio Channel |
| DMS | Dynamic Message Sign |
| DOT | Department of Transportation |
| DPS | Department of Public Safety |
| DSRC | Dedicated Short Range Communication |
| EIA | Electronic Industries Association |
| EMC | Emergency Management Center |
| EOC | Emergency Operations Center |
| EV | Emergency Vehicle |
| FC | Fare Collection |
| FHWA | Federal Highway Administration |
| HAR | Highway Advisory Radio |
| HAZMAT | Hazardous Materials |
| HCRS | Highway Condition Reporting System |
| HRI | Highway-Rail Intersections |

LIST OF ACRONYMS

| | |
|----------|---|
| I/F | Interface |
| IEEE | Institute of Electrical and Electronic Engineers |
| IM | Incident Management |
| IMMS | Incident Management Message Sets |
| ISDN | Integrated Services Digital Network |
| ISP | Information Service Provider |
| ITE | Institute of Transportation Engineers |
| ITS | Intelligent Transportation System |
| MCM | Maintenance and Construction Management |
| MCV | Maintenance and Construction Vehicle |
| MOU | Memorandum of Understanding |
| MPO | Metropolitan Planning Organization |
| MS/ETMCC | Message Sets for External Traffic Management Center Communication |
| NEMA | National Electrical Manufacturers Association |
| NOAA | National Oceanic and Atmospheric Administration |
| NTCIP | National Transportation Communications for ITS Protocol |
| NW | Northwest |
| OB | Onboard |
| PEMSS | Panhandle Emergency Medical Services System |
| PI | Passenger Information |
| RWIS | Road Weather Information System |
| SAE | Society of Automotive Engineers |
| SCH | Scheduling/Runcutting |
| SDO | Standards Development Organization |
| SP | Spatial Representation |
| SR | State Route |
| STIC | Subcarrier Traffic Information Channel |

LIST OF ACRONYMS

| | |
|--------|--|
| TCIP | Transit Communication Interface Protocol |
| TEA-21 | Transportation Equity Act for the 21st Century |
| TM | Traffic Management |
| TMC | Transportation Management Center |
| TMDD | Traffic Management Data Dictionary |
| TOC | Traffic Operations Center |
| TxDOT | Texas Department of Transportation |
| TxDPS | Texas Department of Public Safety |
| USDOT | United States Department of Transportation |
| VIVDS | Video Image Vehicle Detection System |

SUMMARY

In January 2001, the Federal Highway Administration (FHWA) issued a final rule to implement Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21) requiring that Intelligent Transportation System (ITS) projects funded through the Highway Trust Fund conform to the National ITS Architecture and applicable standards.

To meet these requirements, in 2001 the Texas Department of Transportation (TxDOT) initiated the development of Regional ITS Architectures and Deployment Plans throughout the State of Texas. The Amarillo Region in the Texas Panhandle was the first in the series of Regional ITS Architectures to be prepared as part of this initiative.

The Amarillo Region is bordered by the states of New Mexico to the west and Oklahoma to the north and east. The Region corresponds to the 17-county TxDOT Amarillo District, and includes the cities Amarillo, Pampa, Dalhart, and Dumas. The Amarillo Region is predominantly rural in nature, and includes several major routes that provide for inter- and intra-state movement of people and goods.

The Architecture for the Amarillo Region followed a comprehensive process focused on stakeholder outreach and education, identifying market packages and interfaces tailored to the needs of the Amarillo Region, and developing a consensus-based architecture for the Region. This architecture provides a framework for ITS infrastructure to be deployed and integrated in the Amarillo Region over the next 20 years.

Stakeholders from throughout the Region participated in the development of the Regional ITS Architecture, including representatives from TxDOT, Federal Highway Administration, cities, counties, the Texas Department of Public Safety (TxDPS), transit agencies, police and fire, and BWXT Pantex. Stakeholders also included representatives from neighboring states and surrounding TxDOT Districts. These stakeholders provided input and review at key steps in the architecture development process, including a project kick-off meeting, architecture development and review workshops, and final review of the architecture documentation.

An inventory of planned and existing ITS infrastructure in the Region provided the basis for the architecture development. Stakeholder needs that could be addressed by ITS technologies guided the selection of market packages, data flows, and integration requirements. A diverse range of needs were identified by stakeholders in the Region. The highest priority needs focused on improving traveler information (particularly during hazardous weather and for closures of major routes), incident management, and enhancing coordination and communication among local and state agencies within the Region as well as with neighboring TxDOT Districts and states. This becomes increasingly important for incident management or snow closures on major routes, such as I-40, that could impact several jurisdictions or states. Unique to the Amarillo Region is the BWXT Pantex Plant located northeast of the City of Amarillo. Stakeholders identified several transportation and safety needs concerning Pantex that could potentially be addressed by ITS.

Market packages were selected that corresponded to the desired services and functions identified for the Region, and were customized for Amarillo Region agencies and equipment. These market packages included 'foundation' services and functions, such as network surveillance, surface street control, freeway control, and road weather data collection, as well as market packages to address coordination needs, including incident management system and regional traffic control and coordination. A new market package was developed for the Amarillo Region to address evacuation and emergency routing, particularly for incidents near the Pantex plant. Stakeholders then prioritized these market packages as

high, medium, and low. These priorities were used in the second phase of the project to develop the ITS Deployment Plan for the Amarillo Region.

An interconnect, or “Sausage Diagram” was developed for the Amarillo Region which provided a top-level overview of system functions and primary interconnects. More detailed interfaces were then developed which identified the connectivity between the systems and elements. Each element identified in the ITS architecture for the Amarillo Region was mapped to the other elements that it must interface with. These interfaces were further defined by architecture data flows between individual elements that specify the information to be exchanged. These data flows could include requests for information, alerts and messages, status requests, confirmations, and other information requirements.

Functional requirements for the Amarillo Region were identified through customized market packages and data flows, and the equipment packages that deliver specific capabilities. Equipment packages were identified and provided more detailed descriptions of functionality, and can be deployed incrementally. Standards that could apply to the Amarillo Region also were identified as part of the architecture development process.

An Operational Concept for the Amarillo Region was developed to illustrate how systems, components, and agencies will be integrated and function as a result of the framework provided by the Regional ITS Architecture. The purpose of the Operational Concept is to demonstrate the roles and responsibilities of the various stakeholders in the Amarillo Region. This is illustrated using two operational scenarios: a major incident caused by icy conditions on I-40, and emergency response in the event of a tornado. Potential agreements that could be required for maintenance and operations, data sharing (among agencies and with the private sector), or joint operations are listed.

The Regional ITS Architecture for the Amarillo Region is documented in the final report. In addition, a companion web site was developed that contains all of the architecture information, stakeholders, regional inventory, customized market packages, interfaces, and standards.

1. INTRODUCTION

1.1 Project Overview

In January 2001, FHWA issued a final rule to implement Section 5206(e) of the TEA-21. This rule required that ITS projects funded through the Highway Trust Fund conform to the National ITS Architecture and applicable standards. The rule requests that the National ITS Architecture be used to develop a local implementation of the National ITS Architecture, which is referred to as a “Regional ITS Architecture.”

In order to meet these requirements, TxDOT initiated the development of Regional ITS Architectures and Deployment Plans throughout the State of Texas. In addition to meeting the federal requirements for funding, the development of regional ITS architectures provides a framework for implementing ITS on a regional level, encourages interoperability and resource sharing, identifies applicable standards, and allows for cohesive long range planning among stakeholders in the Region. Although not required by the FHWA final rule, TxDOT sought to expand on the project sequence requirement and have an ITS deployment plan developed for each Region. An ITS deployment plan identifies and prioritizes projects that are needed to implement the ITS architecture on a short, medium, and long-term basis.

A key goal in the development of the regional ITS architectures was to develop a consensus-based architecture with as many stakeholders as possible involved. Each stakeholder had an equal voice in determining the direction of the architecture for the region. Stakeholders included representatives from federal, state and local transportation agencies, the metropolitan planning organization, transit, police, fire, emergency operations centers, and surrounding states. A series of five meetings were held with the ITS stakeholders to discuss the development and gather input into the Amarillo Regional ITS Architecture and Deployment Plan. In addition, a project web site was developed which contains all of the information on the Amarillo Regional ITS Architecture and provides stakeholders with an opportunity to review and comment on the architecture directly from the web.

The result is an ITS architecture that establishes a vision and direction for the Region. ITS needs of the Amarillo Region were established early in the project. Existing and planned elements of the architecture have been identified and the key agencies required to develop the ITS services, or market packages as they are referred to in the National ITS Architecture, for the Amarillo Region have been identified. An operational concept also has been developed that focuses on the roles and responsibilities of the various agencies involved in the Amarillo Region as well as any potential agreements that would be needed. A separate ITS Deployment Plan was developed that identifies projects in the Amarillo Region that are required to implement the architecture.

1.2 Document Overview

The Amarillo Regional ITS Architecture report is organized into five key sections:

Section 1 – Introduction

This section provides an overview of the State of Texas ITS Architectures and Deployment Plan Program, the ITS Architecture for the Amarillo Region, as well as an overview of some of the key features and stakeholders in the Amarillo Region.

Section 2 – Integration Strategy

This section discusses Amarillo Region stakeholder needs and issues, regional ITS initiatives and potential regional ITS programs, opportunities for integration to achieve regional goals and contribute to regional and national ITS interoperability.

Section 3 – Regional ITS Architecture Development Process

An overview of the key steps involved in developing the ITS architecture for the Amarillo Region is provided in this section. It includes a discussion of the methodology, stakeholder involvement, architecture workshops and architecture development process.

Section 4 – Conceptual Design

The Conceptual Design contains the key sections of the Amarillo Regional ITS Architecture. The inventory of existing and planned systems is presented in Section 4, and is sorted by both stakeholder as well as by entity for easy reference. The market packages that were selected for the Amarillo Region also are included in this section, as are the system functional requirements. The Amarillo Region interconnects are presented, including the “Sausage Diagram” showing the relationships of the key subsystems and elements in the Region, system interfaces, and the physical subsystem architecture flows. Standards that apply to the Amarillo Regional ITS Architecture also are listed.

Section 5 – Operational Concept

An Operational Concept has been prepared that discusses the key functions and services of the envisioned ITS for the Amarillo Region. As part of this concept, several operational scenarios are described and roles and responsibilities of stakeholders are discussed. Potential agreements that could potentially be required to support integration and information sharing are described.

The Amarillo Regional ITS Architecture also contains two appendices:

- Appendix A – Customized Market Packages; and
- Appendix B – Interface Diagrams.

A project web site has been established that contains the architecture documentation, inventories, interconnects, market packages, interfaces, and functional requirements. The web site provides hyperlinks to more detailed information about the Amarillo Regional ITS Architecture than what could feasibly be included in the printed document. In certain sections of the document, readers are referred to the project web site for additional information and details. At the time this report was published, the Amarillo Regional ITS Architecture web site was being hosted at www.consystem.com. The site can be accessed by selecting the link to Texas, and then the link to Amarillo. TxDOT plans to permanently host the site in the future at www.dot.state.tx.us/trf/its.

1.3 The Amarillo Region

1.3.1 Geographic Overview

The Amarillo Region is located in the Texas Panhandle. The ITS stakeholders defined the regional boundaries to correspond with the TxDOT Amarillo District, one of 25 Districts throughout the state. The Amarillo Region is bordered by New Mexico to the west, Oklahoma to the north and east, the TxDOT Childress District to the southeast, and the TxDOT Lubbock District to the south. **Figure 1** presents a geographic overview of the Amarillo Region.

There are 17 counties within this region:

- Armstrong;
- Carson;
- Dallam;
- Deaf Smith;
- Gray;
- Hansford;
- Hartley;
- Hemphill;
- Hutchinson;
- Lipscomb;
- Moore;
- Ochiltree;
- Oldham;
- Potter;
- Randall;
- Roberts; and
- Sherman.

Major cities in the Region include Amarillo, Pampa, Borger, Hereford, Dalhart, Dumas, Perryton, and Canyon. TxDOT partners with local governments for roadway construction, maintenance, and traffic operations support, and serves as the responsible agency for on-system roadways in cities with populations less than 50,000. The City of Amarillo, with a population of over 170,000, is currently the only city in the Amarillo Region with a population that exceeds TxDOT's threshold.

1.3.2 Roadway Infrastructure

As illustrated in **Figure 1**, the Amarillo Region has an extensive array of roadways. The primary facilities include I-40, I-27, US Highway 87/287, Loop 335, US 60, US 385, and US 83.

One of the most heavily traveled truck routes in the United States is I-40, which extends from Wilmington, North Carolina to Los Angeles, California. I-40 traverses the Panhandle and is an east/west, four-lane divided interstate highway, which expands to six lanes in the City of Amarillo. The effective operation of this highway is critical to the movement of goods and people. Major cities in neighboring states include Oklahoma City, Oklahoma and Albuquerque, New Mexico. Given the rural setting for most of I-40 outside these two cities, overnight and other traveler services facilities are very limited along the corridor. Knowing the road and travel conditions in neighboring states and having the ability to get this information to the motorist is an important issue for safe and efficient operations of the corridor. For example, if I-40 closes down east of Albuquerque due to a major incident or weather, motorists that are heading down that direction and are informed about the current conditions can make the decision to press forward or stop in Amarillo.

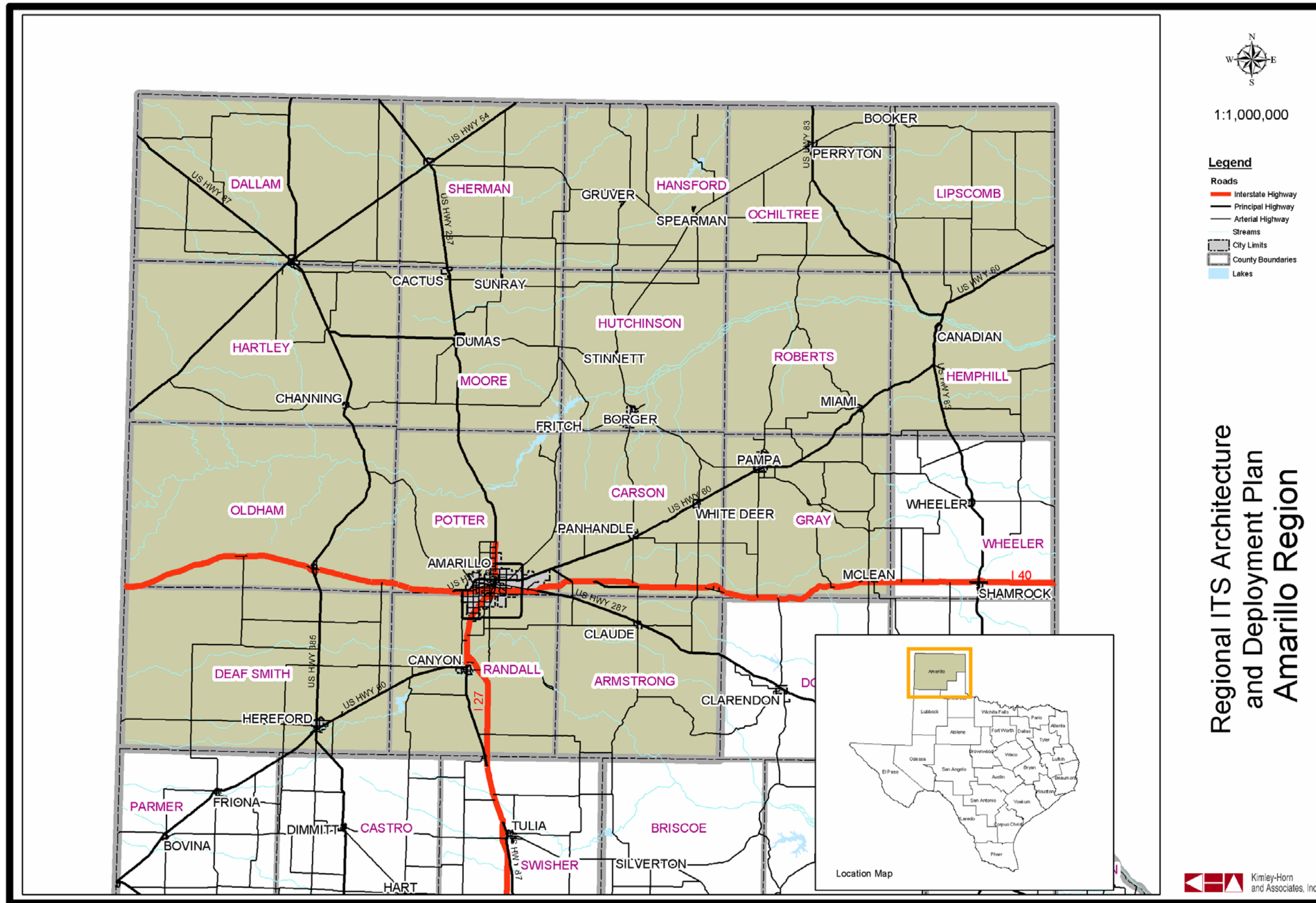


Figure 1 – Amarillo Region Map

Within the metropolitan area of Amarillo are several other roadway facilities. I-27 extends from downtown Amarillo south to Lubbock. Another major route through the city is US 87/287, which extends south through San Antonio and north past the New Mexico state line. US 287 is the primary route to the Dallas/Fort Worth area and extends to the City of Port Arthur on the Texas coast. To the north, this highway coexists with US 87 until Dumas where it splits from US 87 and extends northward to Denver, Colorado.

Encompassing the City of Amarillo is Loop 335. The majority of this roadway falls on an arterial street system with full access to adjacent property. Loop 335 is considered a primary alternate route for incidents on I-40, I-27, and US 87/287.

US 60 bisects the Amarillo Region from the southwest at the New Mexico state line to the northeast at the Oklahoma state line. This roadway connects Amarillo with the cities of Pampa and Hereford. The cross-section of this facility varies from two-lane undivided to four-lane divided.

Other primary roadways in the Amarillo Region include US 83 and US 385. US 83 is a north/south facility in the eastern half of the Region, and extends through Abilene to Laredo on the Texas/Mexico border. Numerous other state highways and farm-to-market roadways criss-cross the Region. US 385 is a north/south roadway facility in the western half of the Region which connects Hereford to Dalhart and crosses I-40 at Vega.

1.3.3 Amarillo Region ITS Plans

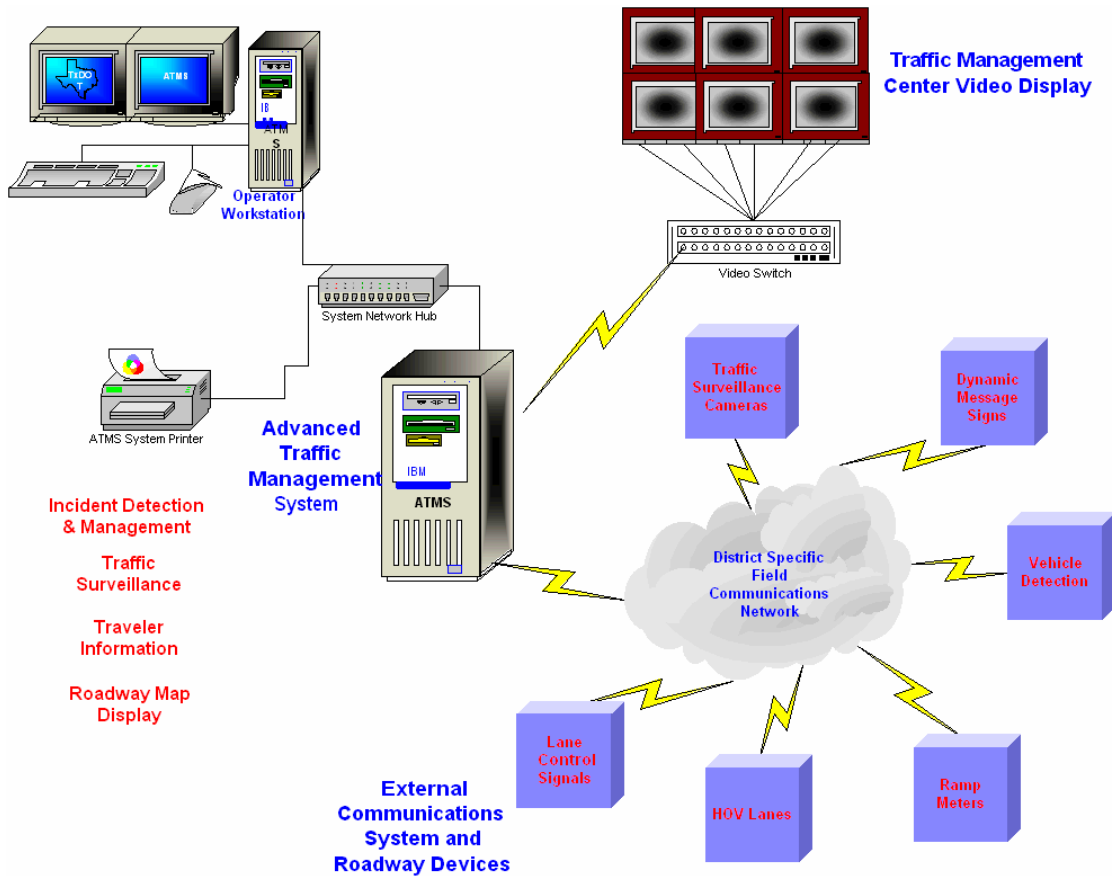
TxDOT and local agencies are in the process of implementing ITS throughout the Region. TxDOT's initial phase of ITS infrastructure in the Amarillo Region consists of Dynamic Message Signs (DMS), video surveillance cameras, Highway Advisory Radio (HAR), and a central control software system. These system elements along with future elements are illustrated in **Figure 2**. Phase I puts the basic ITS building blocks in place. The primary function of this system is the collection and dissemination of weather and roadway conditions for motorists. This system can also inform the motorist on highway construction or maintenance activities as well as roadway incidents or congestion. TxDOT completed Phase 1 of its ITS program in the fall of 2002.

Dynamic Message Signs

The TxDOT Amarillo District has installed five DMS at the following locations:

- I-40 east of Amarillo for the westbound direction (1);
- I-27 south of Amarillo for the northbound direction (1);
- I-40 west of Amarillo for both directions (2); and
- US 87/287 north of Amarillo for the northbound direction (1).

TxDOT utilizes these signs primarily to alert northbound and westbound motorists of severe weather and/or roadway conditions. In addition to conditions within the Amarillo Region, roadway conditions on major interstate routes in neighboring states can be disseminated to motorists via the DMS and HAR.



Source: Amarillo District Presentation

Figure 2 – Overview of Future TxDOT Amarillo District Traffic Management System

Video Surveillance

The second element of TxDOT Amarillo’s Phase 1 ITS was the deployment of ten video surveillance cameras. These cameras are strategically located at high accident and/or high traffic volume interchanges. The City of Amarillo also will be able to utilize the cameras to assist in fine-tuning the traffic signal timing plans. The location of each camera is listed below:

- I-40 at Cap Rock area (1);
- I-40 at US 385 (1);
- I-40 at Loop 335 (Soncy) (1);
- I-40 at Bell Street (1);
- I-40 at US 87/287 (2);
- I-40 at US 287 (1);
- I-27 at Loop 335 (1);
- US 87/287 in north Potter County (1); and
- US 87/287 in Moore County (1).

The Cap Rock area west of Amarillo has a substantial elevation change within a short distance. When this area receives ice or snow, travel is treacherous and accidents increase. A camera will help to identify weather conditions as well as verify reported accidents. The remaining cameras are located at high volume interchanges with the exception of the US 87/287 locations. The US 87/287 locations were placed in remote areas north of Amarillo for assessing weather conditions. Full-duplex communications to all of the cameras will be accommodated through ISDN dial-up telephone lines.

Highway Advisory Radio

Highway Advisory Radio utilizes the automobile's AM band for broadcasting en-route information about weather, roadway conditions, construction, closures, detours, and other information. TxDOT's HAR stations are strategically located at the outskirts of the City of Amarillo along I-40 (east side and west side), I-27 (south side), as well as US 87/287 (north side).

Traffic Management System

Combining these elements together is the TxDOT Amarillo District's Advanced Traffic Management System (ATMS) software package developed by TxDOT staff in the Austin Headquarters. The function of this software is to provide a platform for the integration of the various subsystems including the DMS, video surveillance, HAR, video detection, lane control signals, and ramp metering. ATMS was installed at the TxDOT Amarillo Traffic Management Center (TMC) as part of Phase 1.

TxDOT operates several closed-loop signal systems throughout the Amarillo Region. These closed-loop systems are interconnected by radio to a master controller at the TxDOT Amarillo signal shop. Video image vehicle detection system (VIVDS) also is located at several of the traffic signals.

The City of Amarillo currently has a Traffic Operations Center (TOC) which houses the central control system for the City's traffic signal control system. Signal preemption for fire and ambulance is in place, and VIVDS is planned for several intersections.

Emergency Management

The Amarillo/Randall/Potter Emergency Operation Center (EOC) coordinates resources for major emergencies in the Amarillo area. Key issues in the Region are weather related emergencies, as well as preparedness for potential incidents at the BWXT Pantex plant. BWXT Pantex includes an operations center that can provide emergency warnings through sirens at rest stops as well as alerts that are broadcast through radio and television. Every County in the Region also has an EOC that can be activated during emergencies.

Transit

Transit in the Amarillo Region is operated primarily by the City of Amarillo. ITS initiatives currently include the provision of schedules, hours and routes through a phone service, and on-board security cameras on buses. Panhandle Community Services provides demand-response transit services in the Region.

1.3.4 *Amarillo Stakeholders*

Stakeholder coordination and involvement is one of the key elements to the development of a regional ITS architecture and deployment plan. Because ITS often transcends traditional transportation infrastructure, it is important to involve non-traditional stakeholders in the architecture development and visioning process. Input from these stakeholders, both public and private, is a critical part of defining the interfaces, integration needs, and overall vision for ITS in the Amarillo Region. The geographic location of Amarillo also required input and participation from neighboring states, including New Mexico and Oklahoma.

The following is a list of stakeholders in the Amarillo Region who have participated in the project workshops or provided input to the study team as to the needs and issues that should be considered as part of the Amarillo Regional ITS Architecture:

- Amarillo MPO;
- Amarillo/Potter/Randall Department of Emergency Management;
- Arizona Department of Transportation;
- BWXT Pantex Plant (Department of Energy);
- City of Amarillo Fire;
- City of Amarillo Police;
- City of Amarillo Traffic Engineering;
- City of Amarillo Transit;
- City of Dalhart;
- Oldham County;
- FHWA, Texas Division;
- FHWA, Southern Resource Center;
- New Mexico State Highway and Transportation Department;
- Texas Department of Public Safety;
- TxDOT Amarillo District; and
- TxDOT Traffic Operations Division (Austin).

Representatives from other TxDOT Districts and Area Offices also attended the Amarillo kick-off meeting and provided input, but are not directly involved in the project. These included the Childress, Lubbock, and Wichita Falls Districts, and the Wellington Area Office (Childress District).

1.3.5 *Major Industries and Employers*

Among some of the key industry stakeholders in the Region are IBP, Inc. and BWXT Pantex – two of the five largest employers in the Amarillo Region. Both of these employers and their associated industries will benefit from an expanded ITS presence in the area. IBP's primary focus is in meat processing and transport. This industry includes several large-scale livestock feed lots, cattle ranches, the IBP meat processing plant, and an extensive trucking support system. The meat processing industry is a significant portion of the economy in the Texas Panhandle, and maximizing the efficiency of the transportation infrastructure is paramount to the success of the meat processing industry.

Pantex is another agency that will benefit from additional ITS infrastructure and the enhanced coordination that could be facilitated by ITS technologies. The Pantex complex is located in Carson County approximately 17 miles northeast of the City of Amarillo. The primary functions of the Pantex plant are weapons evaluation, assembly and disassembly, high explosive research and development, as well as interim plutonium pit storage. The safe and efficient transport of materials to and from the facility is highly important. In the event of a nuclear accident, coordination with emergency services and timely dissemination of information to the motoring public are critical.

2. INTEGRATION STRATEGY

2.1 Integration Purpose

The purpose of the integration strategy is to identify the needs, stakeholders, and strategy for regional integration in the Amarillo Region.

For each operating agency or stakeholder entity identified through the development of the Regional ITS Architecture, there are operations that currently exist as normal practice in order to accomplish the primary business goals and objectives for each stakeholder. As an example, a primary operation of the City of Amarillo TOC is the operation of arterial traffic signals. The integration of the City of Amarillo TOC with any of the other stakeholders will not change this primary function or disrupt its typical business practices. The integration of the City of Amarillo TOC with another agency such as the TxDOT TMC will require that the data exchanged between the two entities (such as the closure of an arterial street near a freeway interchange) meet certain requirements for that particular data type. Identifying the need for this connection between agencies and the opportunities for integration and interoperability in the Region are key purposes of this section.

While there are many examples of data exchanges that will take place under the Amarillo Regional ITS Architecture, they will not be discussed individually nor in totality in this section. This section will provide an overview of the major issues and stakeholders' needs within the Amarillo Region and the primary areas of concern that were uncovered in the preparation of the Amarillo Regional ITS Architecture. Additionally, this section will discuss the need for interregional communications with agencies external to the Amarillo Region, such as other states traversed by I-40.

A key step in developing any regional ITS architecture is the identification of major stakeholders in the Region. Key stakeholder agencies that participated in the development of the Amarillo Regional ITS Architecture are listed in **Table 1**. A number of other stakeholders were identified and invited to participate. In many cases, these stakeholders were not able to attend due to time constraints. Minutes of meetings, copies of reports, and access to the project web site was provided to these stakeholders to encourage their participation as much as possible.

2.2 Regional Needs

Needs from the Region were identified in the project kick-off meeting held on February 19, 2002. Stakeholders participating in that meeting identified the needs in the Region according to the eight user service areas defined in the National ITS Architecture. The needs identified in the project kick-off meeting are documented in **Table 2**.

Table 1 – Amarillo Stakeholders and Contacts

| Stakeholder Agency | Contact | Address | Phone Number | E-mail |
|--|-------------------|---|------------------------------|-------------------------------------|
| Amarillo MPO | Gary Holwick | P.O. Box 1971 Amarillo, Texas | (806) 378-3000, ext. 2219 | gary.holwick@ci.amarillo.tx.us |
| Amarillo/Randall/Potter Department of Emergency Management | Walt Kelley | P.O. Box 1971 Amarillo, Texas 79105 | (806) 378-3022 | walt.kelley@ci.amarillo.tx.us |
| Arizona Department of Transportation | Jeff Swan | 2407 East Navajo Boulevard Holbrook, Arizona 86025 | (520) 524-6801, ext. 208 | jswan@dot.state.az.us |
| BWXT Pantex (Dept. of Energy) | Alphonso Vaughn | P.O. Box 30020 Amarillo, Texas 79120 | (806) 477-5875 | avaughn@pantex.com |
| BWXT Pantex (Dept. of Energy) | Dennis Prather | Building 12132 P.O. Box 30030 Amarillo, Texas 79120 | (806) 477-3000 | dprather@pantex.com |
| BWXT Pantex (Dept. of Energy) | Ken Meyers | P.O. Box 30030 Amarillo, Texas 79120 | (806) 477-3178 | kemeyers@pantex.com |
| City of Amarillo Fire | Joe Neeley | 400 South Van Buren Street Amarillo, Texas 79101 | (806) 378-3061 | N/A |
| City of Amarillo Planning | Harold McDaniel | P.O. Box 1971 Amarillo, Texas 79105 | (806) 378-3022 | harold.mcdaniel@ci.amarillo.tx.us |
| City of Amarillo Police | Dean Coleman | 200 East 3 rd Avenue Amarillo, Texas 79101 | (806) 378-4250 | dean.coleman@ci.amarillo.tx.us |
| City of Amarillo Traffic Engineering | Taylor Withrow | P.O. Box 1971 Amarillo, Texas 79105 | (806) 378-4218 | taylor.withrow@ci.amarillo.tx.us |
| City of Amarillo Transit | Judy Phelps | P.O. Box 1971 Amarillo, Texas 79105 | (806) 378-3095 | judy.phelps@ci.amarillo.tx.us |
| City of Dalhart | Tom Morris | 110 Denrock Dalhart, Texas 79022 | (806) 244-5454 | dugsdad@hotmail.com |
| FHWA, Southern Resource Center | Daniel Grate, Jr. | 61 Forsyth Street, Suite 17T26 Atlanta, Georgia 30303-3104 | (404) 562-3912 | daniel.grate@fhwa.dot.gov |
| FHWA, Texas Division | Mark Olson | 300 East 8th Street, Room 826 Austin, Texas 78701 | (512) 536-5972 | mark.olson@fhwa.dot.gov |
| New Mexico State Highway and Transportation Department | Pamela Munn-Bell | 1120 Cerillos Road, SB1 Santa Fe, New Mexico 87501 | (505) 827-3259 | pamela.munn-bell@nmshtd.state.nm.us |
| New Mexico State Highway and Transportation Department | Terry Doyle | 7500 East Frontage Road Albuquerque, NM 87109 | (505) 841-2784 | terrence.doyle@nmshtd.state.nm.us |
| Oldham County | Judge Don Allred | P.O. Box 195 Vega, Texas 79092 | (806) 267-2607 | dnallred@amaonline.com |
| Texas Department of Public Safety | Rusty Davis | 4200 Canyon Drive Amarillo, Texas | (806) 468-1300 | rusty.davis@txdps.state.tx.us |
| Texas Department of Public Safety | Robert Byrd | P.O. Box 31960 Amarillo, Texas 79120 | (806) 468-1300 | robert.byrd@txdps.state.tx.us |
| TxDOT Amarillo District | Chris Freeman | 5715 Canyon Drive Amarillo, Texas 79105 | (806) 356-3290 | cfreema@dot.state.tx.us |
| TxDOT Amarillo District | Randy Hochstein | 5715 Canyon Drive Amarillo, Texas 79105 | (806) 356-3240 | rhochst@dot.state.tx.us |
| TxDOT Amarillo District | Mark Tomlinson | 5715 Canyon Drive Amarillo, Texas 79105 | (806) 356-3201 | mtomlin@dot.state.tx.us |

Table 1 – Amarillo Stakeholders and Contacts (continued)

| Stakeholder Agency | Contact | Address | Phone Number | E-mail |
|---|------------------|--|---------------------|--------------------------|
| TxDOT Amarillo District | Robin Frisk | 5715 Canyon Drive Amarillo, Texas 79105 | (806) 356-3292 | rfrisk@dot.state.tx.us |
| TxDOT Amarillo District | Michael Taylor | 5715 Canyon Drive Amarillo, Texas 79105 | (806) 356-3270 | mtaylor@dot.state.tx.us |
| TxDOT Amarillo District | Tonya Detten | 5715 Canyon Drive Amarillo, Texas 79105 | (806) 356-3256 | tdetten@dot.state.tx.us |
| TxDOT Amarillo District | David Miller | 5715 Canyon Drive Amarillo, Texas 79105 | (806) 356-3291 | dmiller@dot.state.tx.us |
| TxDOT Childress District | Terry Keener | 7599 US Highway 287 Childress, Texas 79201 | (940) 937-7147 | tkeener@dot.state.tx.us |
| TxDOT Childress District | Danny Brown | 7599 US Highway 287 Childress, Texas 79201 | (940) 937-7249 | dbrown3@dot.state.tx.us |
| TxDOT Childress District | Tracy Cain | 16215 FM 338 Wellington, Texas 79095 | (806) 447-5137 | tcain@dot.state.tx.us |
| TxDOT Childress District | Craig Clark | 7599 US Highway 287 Childress, Texas 79201 | (940) 937-7135 | ccclark3@dot.state.tx.us |
| TxDOT Childress District | Clyde Harper | 7599 US Highway 287 Childress, Texas 79201 | (940) 937-7185 | charper@dot.state.tx.us |
| TxDOT Lubbock District | Randy Hopmann | P.O. Box 771 Lubbock, Texas 79408 | (806) 745-4411 | rhopman@dot.state.tx.us |
| TxDOT Lubbock District | Ted Copeland | P.O. Box 771 Lubbock, Texas 79408 | (806) 748-4429 | tcopela@dot.state.tx.us |
| TxDOT Traffic Operations Division (Austin) | Bernie Walker | TRF-TM 125 E. 11 th Street Austin, Texas 78701-2483 | (512) 416-3467 | bwalker@dot.state.tx.us |
| TxDOT Traffic Operations Division (Austin) | Charles Brindell | TRF-TM 125 E. 11 th Street Austin, Texas 78701-2483 | (512) 416-3268 | cbrinde@dot.stat.tx.us |
| TxDOT Traffic Operations Division (Austin) | Janie Light | TRF-TM 125 E. 11 th Street Austin, Texas 78701-2483 | (512) 416-3258 | jlight@dot.state.tx.us |
| TxDOT Wichita Falls District | Davis Powell | 1601 Southwest Parkway Wichita Falls, Texas 76302 | (940) 720-7717 | dpowel2@dot.state.tx.us |

Table 2 – Amarillo Region: Summary of ITS Needs

| |
|---|
| <p style="text-align: center;">Amarillo Region Summary of ITS Needs Amarillo Regional ITS Architecture and Deployment Plan Kick-Off Meeting February 19, 2002</p> <p>Institutional Issues/Needs</p> <ul style="list-style-type: none">▪ Need coordination with neighboring states (NM and OK) to share information (closures, restrictions, etc.) <p>Traffic Management Needs</p> <ul style="list-style-type: none">▪ Need detours for weather and emergencies▪ Need road closure/detour plans – TxDOT has road closure plan for I-40 only▪ Need to know locations of trains when stopped▪ Need flood warning systems, especially for underpasses <p>Traveler Information Needs</p> <ul style="list-style-type: none">▪ Need to communicate better with travelers (for example, need a way to communicate to motorists about amenities, routes, and detours for major closures on I-40)▪ Need to identify next steps for 511 implementation▪ Need to reach travelers while en-route▪ Need more DMS – to use DMS for en-route information▪ Need to provide ramp closure information to travelers▪ Need to tie in with NOAA for most current weather information <p>Data Needs (Collecting, Sharing)</p> <ul style="list-style-type: none">▪ Need volume information in and out of specific areas▪ Need permanent count stations▪ Need to share road information interstate and interdistrict▪ Need to coordinate information on freeways and arterials▪ Need to push data to those that need it <p>Public Transportation Management Needs</p> <ul style="list-style-type: none">▪ Need for transit operators/agencies to have access to information about closures, maintenance, weather, etc.▪ Need AVL on vehicles▪ Need automated fare boxes▪ Need automated passenger counters▪ Need to make information available to transit passengers at stops as well as from home or office▪ Need to notify transit agencies of how many passengers are at stops <p>Commercial Vehicle Operations Needs</p> <ul style="list-style-type: none">▪ Need early notification and communication with CVO about closures, restrictions, etc. (just-in-time delivery has made this more critical)▪ Need Regional study for HAZMAT shipping and routing▪ Need to look at possibility of implementing some electronic screening – CVISN is under development |
|---|

Table 2 – Amarillo Region: Summary of ITS Needs (continued)

| |
|--|
| <p>Emergency Management Needs</p> <ul style="list-style-type: none"> ▪ Need a center like TranStar to collocate DPS/EOC/Transportation Dispatch ▪ Need centralized dispatch for Potter and Randall Counties ▪ Need a common radio frequency for emergency service providers (police, fire, ambulance, DPS, EOC, others) ▪ Need better access and use of CCTV camera systems for emergency agencies ▪ Need Total Station units for incident investigation in the City of Amarillo – DPS already uses ▪ Need a system like LifeLink to share video between ambulance and trauma centers <p>Maintenance and Construction Operations Needs</p> <ul style="list-style-type: none"> ▪ Need automatic guidance for snowplows ▪ Need speed warnings for work zones ▪ Need to coordinate Maintenance with Traffic Operations during closures <p>Other Needs</p> <ul style="list-style-type: none"> ▪ Need to look for opportunities to tie the Architecture and Deployment Plan into Homeland Defense/Security where possible ▪ Need a central, physical location for communications infrastructure sharing ▪ Need a Telecommunications Study to look at information sharing throughout the state and interstate |
|--|

A driving force for the need for integration in the Amarillo Region is the impact of snow closures on the transportation system. Severe snowstorms in Amarillo can cause extended closures of I-40 as well as I-27 and SR 287. A key goal of integration is to provide the TxDOT Amarillo District with the ability to notify other states, other TxDOT Districts, and motorists of a route closure in the Region.

The Amarillo Region also has a need to gather information from New Mexico and Oklahoma on closures of I-40 in those states. For example, as motorists travel west from Amarillo they encounter long stretches of highway with few or no facilities for extended stays. If New Mexico has closed its borders, it is crucial that the TxDOT Amarillo District have this information in order to update motorists before they leave Amarillo.

Another crucial need in Amarillo is the ability to integrate emergency service organizations in the event of a major weather event or an incident at the BWXT Pantex Plant. Emergency service organizations need to implement a common radio frequency to improve communications as well as have access to video images on arterials and freeways from the Amarillo TOC and the TxDOT TMC. Early notification to travelers and the general public in the event of emergencies is also a very important need in Amarillo.

2.3 Regional Integration and Interoperability

A vision for the Amarillo Region is to integrate systems both on an intra-regional and an inter-regional basis. Within the Amarillo Region, nearly every stakeholder identified is involved in emergency management. During major snow closures, public safety agencies, transportation agencies, transit agencies, and major employers must share information and resources in order to continue to operate the transportation system as smoothly as possible. Gathering closure information in one location and providing this information to the traveling public to reduce stranded motorists is a key goal.

Road closures due to maintenance or incidents also lead to a number of opportunities for improved operations through integration. TxDOT and other transportation agencies would like to be able to share this information throughout the Region so that as soon as one agency is aware of a closure, whether planned or not planned, other agencies can also be made aware of the closure and make appropriate plans.

Operators of the transportation system have many opportunities to improve performance through integration. The City of Amarillo Transit System can improve performance and schedule adherence by integrating closure information from operators of the transportation network.

In addition to the integration opportunities within the Amarillo Region, integrating the Amarillo Region with surrounding Regions and states offers great opportunity for improvements to the operations of the system.

Snow closures affect I- 40 throughout the Southwest. Integration of traveler information systems, between TxDOT Districts and between TxDOT and other State DOTs will lead to better informed motorists and a reduction in the number of stranded travelers.

Systems such as TxDOT's Highway Condition Reporting System (HCRS) provide an integrated method to gather consistent traveler information on a statewide basis. This type of system could eventually feed into a 511 traveler information number that would provide consistent traveler information throughout the state.

Integration of Emergency Operation Centers throughout the region and with the State EOC in Austin is also an opportunity to better utilize resources on a statewide basis and ensure the Amarillo Region's emergency preparedness.

One of the primary purposes of the development of an Amarillo Regional ITS Architecture is to ensure that while various agencies are deploying ITS components, there are some commonalities between them that will allow and facilitate the exchange of data fairly seamlessly and automatically. This is not to say that all technologies or media that are used by the various agencies will be the same, but that there is an acknowledgement that the data that is being collected and disseminated is valuable to many different agencies. Therefore, the integration strategy has to be implemented to ensure the data exchange is possible.

3. REGIONAL ITS ARCHITECTURE DEVELOPMENT PROCESS

Development of the Regional ITS Architecture and Deployment Plan for the Amarillo Region relied heavily on stakeholder input to ensure that the architecture reflected local needs. A series of five meetings was held with stakeholders to gather input, and a web site with the components of the regional architecture as well as hard copies of documents were made available to stakeholders for review and comment.

3.1 Amarillo Process

The process followed for the Amarillo Region was designed to ensure that stakeholders could provide input and review to the development of the Region’s ITS Architecture.

Prior to the first project kick-off meeting with the contractor and stakeholders, TxDOT identified relevant stakeholders in the Region to begin discussions on the development of a Regional ITS Architecture and Deployment Plan. Stakeholders signed a memorandum of understanding (MOU) stating that they would work together in the Region to develop the ITS architecture.

After selecting a contractor, the process shown in **Figure 3** was used to develop the Region’s ITS Architecture. In addition to the architecture, an ITS Deployment Plan for the Region also was developed to identify projects needed to implement the architecture.

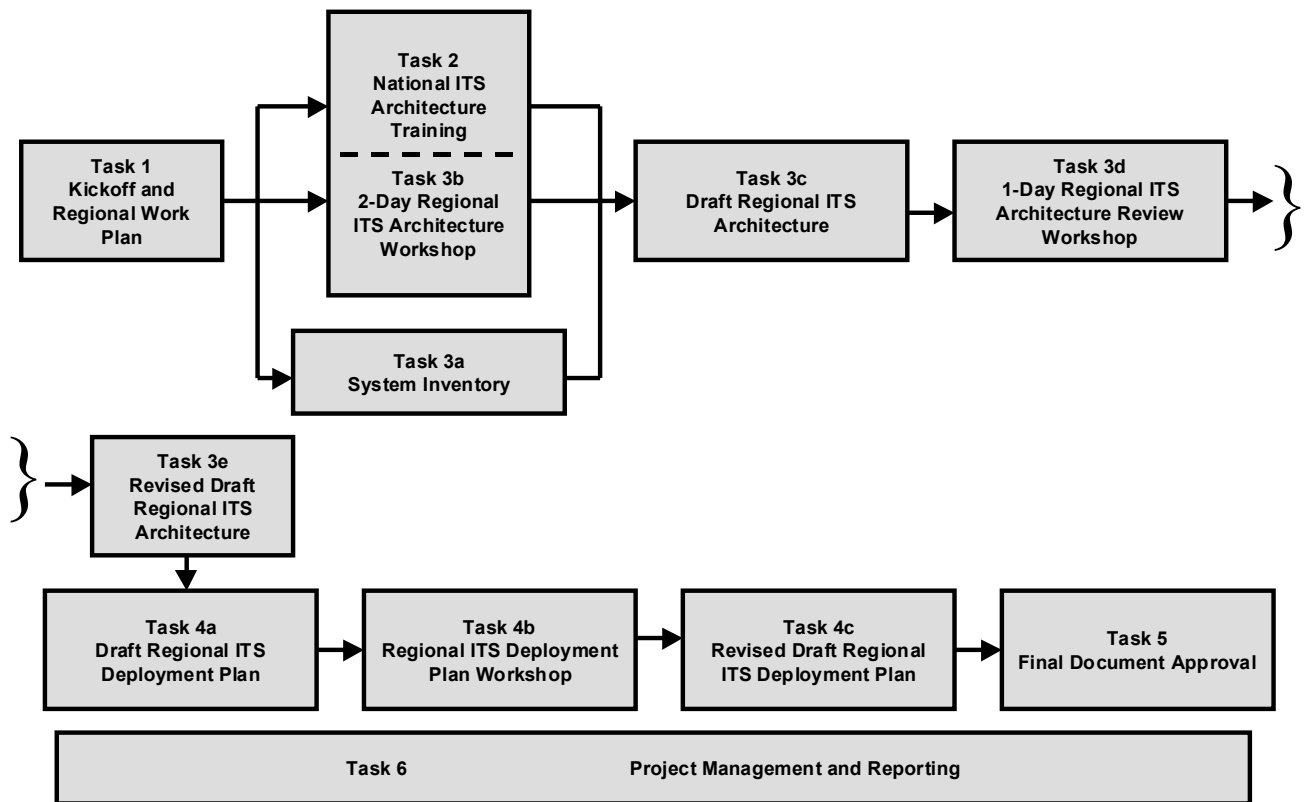


Figure 3 – Amarillo Regional ITS Architecture and Deployment Plan Development Process

A total of five meetings and workshops with stakeholders over a period of eleven months were used to develop the Amarillo Regional ITS Architecture and Deployment Plan. These meetings and workshops included:

- Kick-off and Regional Work Plan Meeting;
- 2-Day Regional ITS Architecture Workshop;
- 1-Day Regional ITS Architecture Review Workshop;
- ITS Deployment Plan Workshop; and
- Final Comment Resolution Meeting.

Key components of the process are described below:

Task 1 – Kick-Off and Regional Work Plan: Based on the initial stakeholder meeting and MOU that was signed, a number of key stakeholders were identified. Additional stakeholders that did not sign the initial MOU also were identified and invited to the project kick-off meeting. At this meeting, the regional work plan was presented to stakeholders for review and comment. Subsequent meeting dates were identified and agreed upon by the stakeholders.

As part of this meeting, a workshop was held with the stakeholders to identify three additional areas of information:

- Additional stakeholders to invite to participate in the process;
- Needs of the stakeholders in the Region; and
- Existing and planned ITS elements in the Region.

Task 2 – National ITS Architecture Training: Task 2 was the development and presentation of training on the National ITS Architecture. The purpose of the training was to familiarize stakeholders with the architecture terminology to the extent needed to allow them to provide input and review on the Amarillo Region’s ITS Architecture. The National ITS Architecture training was presented in conjunction with the 2-Day Regional ITS Architecture Workshop described in Task 3B.

Task 3A – System Inventory: Collecting information for the system inventory began at the kick-off meeting through the workshop with the stakeholders to determine existing and planned ITS elements in the Region. After the kick-off meeting, follow-up calls were conducted with a number of local stakeholders to gather additional input for the architecture. To complete the inventory, stakeholders were presented with the results of the inventory in the 2-Day Regional ITS Architecture Workshop described in Task 3B.

Task 3B – 2-Day Regional ITS Architecture Workshop: The purpose of the 2-Day Regional ITS Architecture Workshop was to review the inventory with stakeholders and begin the development of the Amarillo Regional ITS Architecture. Training on the National ITS Architecture also was integrated into the workshop so that key elements of the architecture, such as market packages, could be explained prior to the selection and editing of these elements. The result of the 2-Day Regional ITS Architecture Workshop was a Regional ITS Architecture for Amarillo, which included a system inventory, interconnect diagram, customized market packages, identification of functional requirements through process specifications, system interfaces, and relevant ITS standards.

Task 3C – Draft Regional ITS Architecture: After the 2-Day Regional ITS Architecture Workshop was completed, a web site (www.consys tec.com) was developed with a dedicated link to the Texas Regional ITS Architecture program. Stakeholders were asked to review the web site and provide comments through an email link set up on the site. A hard copy of the Draft Regional ITS Architecture for the Amarillo Region was sent to stakeholders prior to the 1-Day Regional ITS Architecture Review Workshop.

Task 3D – 1-Day Regional ITS Architecture Review Workshop: The 1-Day Regional ITS Architecture Review workshop was designed to allow stakeholders to review the draft architecture and provide comments. The primary focus of the workshop was to review the architecture flows between elements in the market packages. Training on architecture flows as well as ITS standards also was completed.

Task 3E – Revised Draft Regional ITS Architecture: Input from stakeholders in the 1-Day Regional ITS Architecture Review Workshop, as well as comments from stakeholders reviewing the web site and hard copy document, were used to revise the Draft Regional ITS Architecture. The revisions were incorporated into the web site as well as into the hard copy document. The Revised Draft Regional ITS Architecture was mailed to stakeholders for additional review.

Task 4A – Draft Regional ITS Deployment Plan: A Draft Regional ITS Deployment Plan was developed based on the prioritization of market packages and needs expressed by the stakeholders in the Region. The Draft Regional ITS Deployment Plan included a list of recommended projects in a 5-year, 10-year, and 20-year timeframe. Each project was linked to at least one or more market packages from the Amarillo Regional ITS Architecture.

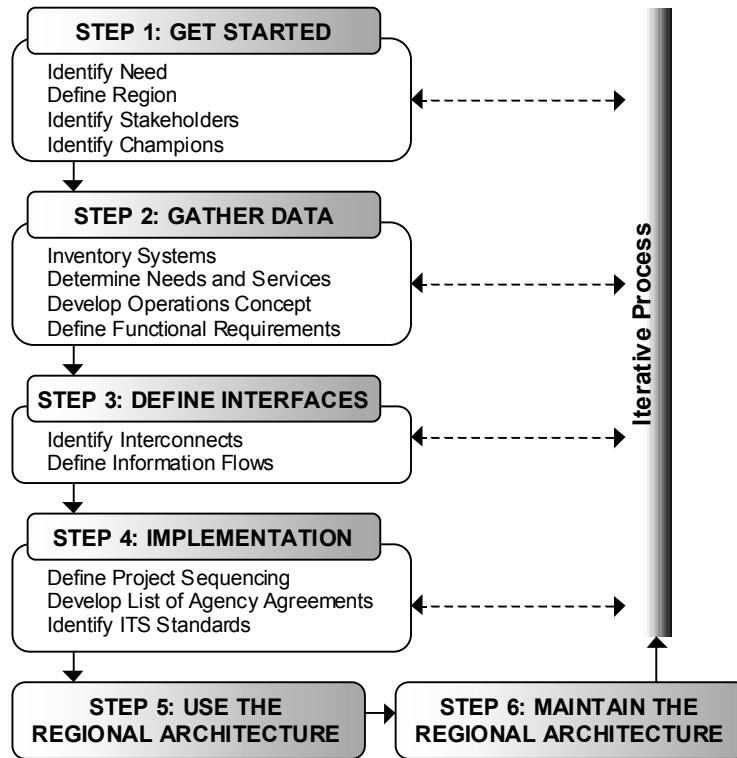
Task 4B – Regional ITS Deployment Plan Workshop: The Draft Regional ITS Deployment Plan was presented to stakeholders at the Regional ITS Deployment Plan Workshop. Stakeholders were asked to provide input on the recommended projects, priority, and deployment timeframe.

Task 4C – Revised Draft Regional ITS Deployment Plan: Based on the review and input from stakeholders at the Regional ITS Deployment Plan Workshop, as well as review comments received from stakeholders outside of the workshop, a Revised Draft Regional ITS Deployment Plan was developed and sent to stakeholders.

Task 5 – Final Document Approval: A final comment resolution meeting was held with stakeholders to review the Revised Draft Regional ITS Architecture and the Revised Draft Regional ITS Deployment Plan. Next steps for the Region were also discussed. Comments were incorporated and a final Regional ITS Architecture and Regional ITS Deployment Plan were developed.

3.2 USDOT Regional ITS Architecture Guidance

On October 12, 2001, the U.S. Department of Transportation (USDOT) issued guidance on development of a regional ITS architecture through the document “Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region.” **Figure 4** summarizes the guidance provided by the USDOT.



(Source: Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region, USDOT)

Figure 4 – USDOT Guidance on Regional ITS Architecture Development

The process used to develop the Amarillo Regional ITS Architecture and Deployment Plan follows Steps 1 through 4 of the guidance. Steps 5 and 6 are designed to provide guidance upon the completion of the development of the Regional ITS Architecture.

Step 1, Get Started, of the guidance was completed in Task 1 – Kick-off and Regional Work Plan, as well as preliminary work completed by TxDOT to identify initial stakeholders and the need to complete the architecture for the Amarillo Region. Through these efforts, the need for an architecture, appropriate stakeholders, and the Region was defined.

Step 2, Gather Data, was completed through Task 1 – Kick-off and Regional Work Plan, Task 3A – System Inventory, and Task 3B – 2-Day Regional ITS Architecture Workshop. These efforts allowed the inventory for the Amarillo Region to be completed, identified ITS needs in the Region, and led to the development of an operational concept and definition of functional requirements.

Step 3, Define Interfaces, was completed in Task 3B – 2-Day Regional ITS Architecture Workshop and Task 3D – 1-Day Regional ITS Architecture Review Workshop. These workshops engaged stakeholders in customizing Market Packages for the Region, which included identifying interconnects among elements in the architecture and reviewing and selecting data flows between elements.

Step 4, Implementation, was completed in Task 3D – 1-Day Regional ITS Architecture Review Workshop through the prioritization of market packages. Sequencing of projects began in this process and was completed in the ITS Deployment Plan. Applicable ITS standards to match the identified data flows also were identified through the 1-Day ITS Architecture Review Workshop. Based on the envisioned information exchanges and integration outlined in the Regional ITS Architecture, potential agreements were identified, both public-public and public-private.

4. CONCEPTUAL DESIGN

4.1 Systems Inventory

One of the key initial steps in the architecture development process is to establish an inventory of existing ITS elements. At the project kick-off meeting and through subsequent discussions with agency representatives throughout the Region, Amarillo Region stakeholders provided the team with a list of existing, planned, and future systems that would play a role in the Region's ITS architecture. "Planned" is defined as a system with funding identified, while "future" is defined as a system that does not yet have funding identified.

Existing, planned, and future systems in the Amarillo Region were identified in the following categories:

- **Travel and Traffic Management** – includes state and local traffic operations centers, traffic signal systems, detection systems, CCTV, fixed and portable dynamic message signs, travel information systems, and other related technologies.
- **Public Transportation Management** – includes transit dispatch and communications system, on-board security systems, and transit information systems.
- **Electronic Payment** – includes electronic fare payment for parking.
- **Commercial Vehicle Operations** – includes detection equipment at inspection stations, electronic permitting and credentials, and HAZMAT permitting.
- **Emergency Management** – includes dispatch for police, fire and other emergency services (two-way radio and computer-aided dispatch), emergency warning and notification systems, emergency operations/management centers, and mobile data units for emergency services.
- **Information Management** – includes electronic data management and archiving systems.
- **Maintenance and Construction Operations** – includes weather sensors and communications systems between maintenance vehicles and dispatch centers.

The System Inventory is a valuable task for several reasons. First, it provides a baseline of existing and planned ITS projects and systems in the Region. Second, it outlines which agencies are currently deploying and operating ITS, as well as those that are planning to implement ITS programs. Third, it provides a foundation for identifying needed elements or agency participation for the regional ITS, which will be important for subsequent tasks including the market package identification and prioritization, system interface and integration requirements in the Region, and ultimately the ITS Deployment Plan.

4.1.1 Subsystems and Terminators

Each identified system or component in the Amarillo Region ITS inventory was mapped to a subsystem or terminator in the National ITS Architecture. Subsystems and terminators are the 'entities' that represent systems in ITS. Subsystems are the highest level building blocks of the physical architecture, and the National ITS Architecture groups them into four major classes: Centers, Roadside, Vehicles and Travelers. Each of these major classes includes various subsystems that represent a set of transportation functions (or processes) that are likely to be collected together under one agency, jurisdiction, or location, and correspond to physical elements, such as traffic operations centers, traffic signals, vehicles, and so on. **Figure 5** shows the National ITS Architecture subsystems. This figure, also known as the

“sausage diagram” is a standard interconnect diagram, showing the relationships of the various subsystems within the architecture; a customized interconnect diagram for the Amarillo Region is included in Section 4.3.1 of this report. Communication functions between the subsystems are represented in the ovals. It should be noted that “wireline” communication refers to fixed-point to fixed-point communications, which include not only twisted pair and fiber optic technologies, but also such wireless technologies as microwave and spread spectrum.

Terminators are the people, systems, other facilities, and environmental conditions outside of ITS that need to communicate or interface with ITS subsystems. They help to define the boundaries of the National ITS Architecture as well as a regional system. Examples of terminators include drivers, traffic operations personnel, information service providers, weather effects (snow, rain, fog), telecommunications systems, and government reporting systems, among others.

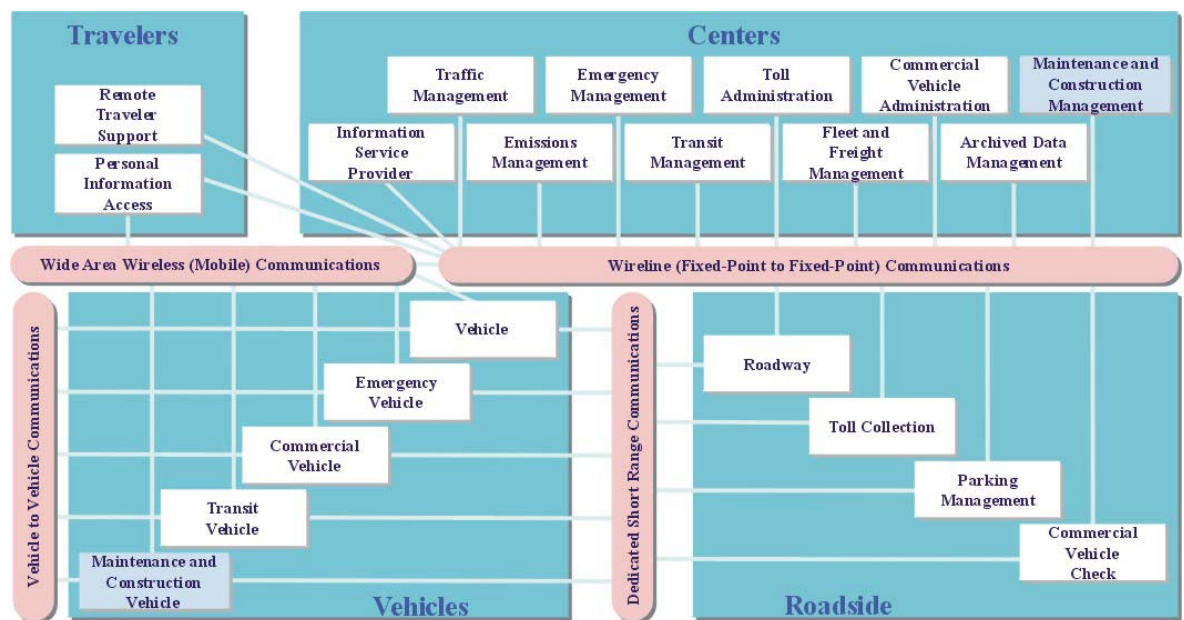


Figure 5 – Physical Subsystem Interconnect Diagram

4.1.2 Amarillo ITS Inventory by Entity

The Amarillo Regional ITS Architecture inventory is made up of the transportation and communications centers, the field equipment, the vehicles, and other systems in the regional transportation system. These components have been assigned to a subsystem or terminator as defined by the National ITS Architecture. **Table 3** presents the Amarillo Region inventory using the associated National ITS Architecture subsystem or terminator. This sorts elements that perform similar functions together, so elements of a particular type can be easily identified.

The information in **Table 3** also is included on the Amarillo ITS Architecture web site, which is accessible by selecting the link to the Inventory by Entity. Each element in the list contains a hyperlink to more detailed information, including status, description, stakeholder, and other elements within the inventory with which it interfaces. (At the time this report was published, the Amarillo Regional ITS Architecture web site was being hosted at

www.consystem.com. TxDOT plans to permanently host the site in the future at www.dot.state.tx.us/trf/its.)

4.1.3 Stakeholder Inventory

Each stakeholder is associated with one or more systems or elements (subsystems and terminators) that make up the transportation system in the Amarillo Region. **Table 4** sorts the inventory by stakeholder, so each stakeholder can easily identify and review all their relevant assets that are identified in the Amarillo Regional ITS Architecture. This inventory also can be accessed from the Amarillo Regional ITS Architecture web site by selecting Inventory by Stakeholder.

Table 3 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Entity)

| Entity | Element | Stakeholder | Status |
|------------------------------------|---|--|----------|
| Archived Data Management Subsystem | TxDOT Crash Record Information System | TxDOT | Existing |
| | TxDOT Traffic Count Archive | TxDOT Transportation Planning and Programming Division | Existing |
| Archived Data User Systems | TxDOT Amarillo TMC | TxDOT | Existing |
| Asset Management | BRINSAP – Bridge Inventory Inspection System | TxDOT | Existing |
| Care Facility | Regional Hospitals | Regional Hospitals | Existing |
| Commercial Vehicle Subsystem | Commercial Vehicles | Commercial Vehicle Operators | Existing |
| Emergency Management | Amarillo/Potter/Randall EOC | City of Amarillo | Existing |
| | City of Amarillo Fire Dispatch | City of Amarillo | Existing |
| | City of Amarillo Police Dispatch | City of Amarillo | Existing |
| | DPS Communications Service | DPS | Existing |
| | Local City/County EOC | Local City/County Public Safety Agency | Existing |
| | Local Law Enforcement Dispatch | Local Law Enforcement | Existing |
| | Other Public Safety Comm, Dispatch Centers and EOCs | NM and OK Public Safety Agencies | Existing |
| | Other States EMS | NM and OK Public Safety Agencies | Existing |
| | Panhandle Emergency Medical Services System (PEMSS) | NW Texas Healthcare System | Existing |
| | Pantex EOC | Pantex | Existing |
| | Prison Operations Centers | Texas Department of Criminal Justice | Existing |
| | Private Tow/Wrecker Dispatch | Private Tow/Wrecker | Existing |
| | Private Vehicle Emergency Systems | Private Mayday Providers | Existing |

Table 3 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)

| Entity | Element | Stakeholder | Status |
|-------------------------------------|--|---|----------|
| Emergency Management (continued) | State EOC | DPS Division of Emergency Management | Existing |
| | TxDOT Courtesy Service Patrol Dispatch | TxDOT | Future |
| Emergency Telecommunications System | Telco 911 Call Routing | Telcos | Existing |
| Emergency Vehicle Subsystem | City of Amarillo Fire Vehicles | City of Amarillo | Existing |
| | City of Amarillo Police Vehicles | City of Amarillo | Existing |
| | EMS Vehicles | Local Ambulance Services | Existing |
| | Highway Patrol Vehicles | DPS | Existing |
| | Local Law Enforcement Vehicles | Local Law Enforcement | Existing |
| | TxDOT Courtesy Service Patrol Vehicles | TxDOT | Future |
| Equipment Repair Facility | TxDOT District Shop | TxDOT | Existing |
| Event Promoters | Amarillo Convention and Visitors Bureau Scheduling | Amarillo Convention and Visitors Bureau | Existing |
| | Local Venue Event Scheduling System | Local Venue Promoters | Future |
| Fleet and Freight Management | Private Commercial Vehicle Fleet Management | Private Carriers | Existing |
| Information Service Provider | Amarillo City Communicator System | City of Amarillo | Existing |
| | Private Sector Traveler Information Services | Private ISPs | Future |
| | SchoolNet Web Server and Web Page | Local Media | Existing |
| | TxDOT Highway Condition Reporting System | TxDOT | Existing |
| | TxDOT Motor Carrier Routing Information | TxDOT Motor Carrier Division | Existing |
| | TxDOT TMC Amarillo District Web Page | TxDOT | Existing |

Table 3 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)

| Entity | Element | Stakeholder | Status |
|---|--|-------------------------------|----------|
| Maintenance and Construction Administrative Systems | TxDOT Amarillo District Office | TxDOT | Existing |
| | TxDOT Area Engineering | TxDOT | Existing |
| Maintenance and Construction Management | City of Amarillo Maintenance | City of Amarillo | Existing |
| | City of Amarillo Traffic Operations Center | City of Amarillo | Existing |
| | County Road and Bridge | County Road and Bridge | Existing |
| | Other States Maintenance Sections | Other State DOTs | Existing |
| | Private Maintenance Dispatchers | Private Maintenance Providers | Existing |
| | TxDOT Amarillo District Office | TxDOT | Existing |
| | TxDOT Amarillo TMC | TxDOT | Existing |
| | TxDOT Area Engineering | TxDOT | Existing |
| | TxDOT Rural Maintenance Sections | TxDOT | Existing |
| TxDOT Urban Maintenance Sections | TxDOT | Existing | |
| Maintenance and Construction Vehicles | City of Amarillo Maintenance Vehicles | City of Amarillo | Existing |
| | TxDOT Maintenance and Construction Vehicles | TxDOT | Existing |
| Media | Emergency Alerting System | Local Media | Existing |
| | Print and Broadcast Media | Local Media | Existing |
| Multimodal Transportation Service Provider | Amtrak Passenger Train Terminal | Amtrak | Future |
| Parking Management | City of Amarillo Airport Parking Management System | City of Amarillo | Future |
| Personal Information Access | Private Traveler Personal Computing Devices | Private Travelers | Existing |
| Rail Operations | Rail Operations | Railroad Operators | Existing |
| Remote Traveler Support | Rest Areas/Visitor Centers/Service Plaza Kiosks | TxDOT | Future |
| | Transit Kiosks | City of Amarillo | Future |

Table 3 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)

| Entity | Element | Stakeholder | Status |
|--|--|----------------------------------|----------|
| Roadway Subsystem | City of Amarillo Field Equipment | City of Amarillo | Existing |
| | Pantex Emergency Warning and Notification System | Pantex | Existing |
| | SchoolNet Weather Station | Local Media | Existing |
| | TxDOT Amarillo CCTV | TxDOT | Existing |
| | TxDOT Amarillo DMS | TxDOT | Existing |
| | TxDOT Amarillo Field Sensors | TxDOT | Existing |
| | TxDOT Amarillo HAR | TxDOT | Existing |
| | TxDOT Amarillo Traffic Signals | TxDOT | Existing |
| | TxDOT Flood Warning System | TxDOT | Future |
| | TxDOT Portable Field Devices | TxDOT | Future |
| | TxDOT Roadside Anti-Icing System | TxDOT | Future |
| Surface Transportation Weather Service | Private Weather Service | Private Weather Service Provider | Future |
| Traffic Management | City of Amarillo Traffic Operations Center | City of Amarillo | Existing |
| | Other States TMCs | Other State DOTs | Existing |
| | Other TxDOT District TMCs | Other TxDOT Districts | Existing |
| | SchoolNet Web Server and Web Page | Local Media | Existing |
| | TxDOT Amarillo TMC | TxDOT | Existing |
| Transit Management | Amarillo City Transit System Dispatch Center | City of Amarillo | Existing |
| | Amarillo Transit Information System | City of Amarillo | Future |
| | Independent School District Transit Dispatch | Independent School Districts | Existing |
| | Panhandle Transit Dispatch | Panhandle Transit | Existing |

Table 3 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)

| Entity | Element | Stakeholder | Status |
|----------------------------|-----------------------------------|------------------------------|---------------|
| Transit Vehicle Subsystem | Amarillo City Transit Vehicles | City of Amarillo | Existing |
| | Panhandle Transit Vehicles | Panhandle Transit | Existing |
| | School District Buses | Independent School Districts | Existing |
| Traveler Info Phone System | 511 System | TxDOT | Future |
| | Amarillo City Communicator System | City of Amarillo | Existing |
| Vehicle | Commercial Vehicles | Commercial Vehicle Operators | Existing |
| | Private Vehicles | Private Vehicle Owners | Existing |
| Weather Service | National Weather Service | NOAA | Existing |

Table 4 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Stakeholder)

| Stakeholder | Element | Entity | Status |
|--|--|--|----------|
| Amarillo Convention and Visitors Bureau | Amarillo Convention and Visitors Bureau Scheduling | Event Promoters | Existing |
| Amtrak | Amtrak Passenger Train Terminal | Multimodal Transportation Service Provider | Future |
| City of Amarillo | Amarillo City Communicator System | Traveler Info Phone System | Existing |
| | Amarillo City Communicator System | Information Service Provider | Existing |
| | Amarillo City Transit System Dispatch Center | Transit Management | Existing |
| | Amarillo City Transit Vehicles | Transit Vehicle Subsystem | Existing |
| | Amarillo Transit Information System | Transit Management | Future |
| | Amarillo/Potter/Randall EOC | Emergency Management | Existing |
| | City of Amarillo Airport Parking Management System | Parking Management | Future |
| | City of Amarillo Field Equipment | Roadway Subsystem | Existing |
| | City of Amarillo Fire Dispatch | Emergency Management | Existing |
| | City of Amarillo Fire Vehicles | Emergency Vehicle Subsystem | Existing |
| | City of Amarillo Maintenance | Maintenance and Construction Management | Existing |
| | City of Amarillo Maintenance Vehicles | Maintenance and Construction Vehicle | Existing |
| | City of Amarillo Police Dispatch | Emergency Management | Existing |
| | City of Amarillo Police Vehicles | Emergency Vehicle Subsystem | Existing |
| | City of Amarillo Traffic Operations Center | Traffic Management | Existing |
| City of Amarillo Traffic Operations Center | Maintenance and Construction Management | Existing | |
| Transit Kiosks | Remote Traveler Support | Future | |
| Commercial Vehicle Operators | Commercial Vehicles | Commercial Vehicle Subsystem | Existing |
| | Commercial Vehicles | Vehicle | Existing |
| County Road and Bridge | County Road and Bridge | Maintenance and Construction Management | Existing |

Table 4 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)

| Stakeholder | Element | Entity | Status |
|--|---|---|----------|
| DPS | DPS Communications Service | Emergency Management | Existing |
| | Highway Patrol Vehicles | Emergency Vehicle Subsystem | Existing |
| DPS Division of Emergency Management | State EOC | Emergency Management | Existing |
| Independent School Districts | Independent School District Transit Dispatch | Transit Management | Existing |
| | School District Buses | Transit Vehicle Subsystem | Existing |
| Local Ambulance Services | EMS Vehicles | Emergency Vehicle Subsystem | Existing |
| Local City/County Public Safety Agency | Local City/County EOC | Emergency Management | Existing |
| Local Law Enforcement | Local Law Enforcement Dispatch | Emergency Management | Existing |
| | Local Law Enforcement Vehicles | Emergency Vehicle Subsystem | Existing |
| Local Media | Emergency Alerting System | Media | Existing |
| | Print and Broadcast Media | Media | Existing |
| | SchoolNet Weather Station | Roadway Subsystem | Existing |
| | SchoolNet Web Server and Web Page | Information Service Provider | Existing |
| | SchoolNet Web Server and Web Page | Traffic Management | Existing |
| Local Venue Promoters | Local Venue Event Scheduling System | Event Promoters | Future |
| NM and OK Public Safety Agencies | Other Public Safety Comm, Dispatch Centers and EOCs | Emergency Management | Existing |
| | Other States EMS | Emergency Management | Existing |
| NOAA | National Weather Service | Weather Service | Existing |
| NW Texas Healthcare System | Panhandle Emergency Medical Services System (PEMSS) | Emergency Management | Existing |
| Other State DOTs | Other States Maintenance Sections | Maintenance and Construction Management | Existing |
| | Other States TMCs | Traffic Management | Existing |

Table 4 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)

| Stakeholder | Element | Entity | Status |
|--------------------------------------|--|---|----------|
| Other TxDOT Districts | Other TxDOT District TMCs | Traffic Management | Existing |
| Panhandle Transit | Panhandle Transit Dispatch | Transit Management | Existing |
| | Panhandle Transit Vehicles | Transit Vehicle Subsystem | Existing |
| Pantex | Pantex Emergency Warning and Notification System | Roadway Subsystem | Existing |
| | Pantex EOC | Emergency Management | Existing |
| Private Carriers | Private Commercial Vehicle Fleet Management | Fleet and Freight Management | Existing |
| Private ISPs | Private Sector Traveler Information Services | Information Service Provider | Future |
| Private Maintenance Providers | Private Maintenance Dispatchers | Maintenance and Construction Management | Existing |
| Private Mayday Providers | Private Vehicle Emergency Systems | Emergency Management | Existing |
| Private Weather Service Provider | Private Weather Service | Surface Transportation Weather Service | Future |
| Private Tow/Wrecker | Private Tow/Wrecker Dispatch | Emergency Management | Existing |
| Private Travelers | Private Traveler Personal Computing Devices | Personal Information Access | Existing |
| Private Vehicle Owners | Private Vehicles | Vehicle | Existing |
| Railroad Operators | Rail Operations | Rail Operations | Existing |
| Regional Hospitals | Regional Hospitals | Care Facility | Existing |
| Telcos | Telco 911 Call Routing | Emergency Telecommunications System | Existing |
| Texas Department of Criminal Justice | Prison Operations Centers | Emergency Management | Existing |
| TxDOT | 511 System | Traveler Info Phone System | Future |
| | BRINSAP – Bridge Inventory Inspection System | Asset Management | Existing |
| | Rest Areas/Visitor Centers/Service Plaza Kiosks | Remote Traveler Support | Future |
| | TxDOT Amarillo CCTV | Roadway Subsystem | Existing |
| | TxDOT Amarillo District Office | Maintenance and Construction Management | Existing |

Table 4 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)

| Stakeholder | Element | Entity | Status |
|----------------------------------|---|---|----------|
| TxDOT (continued) | TxDOT Amarillo District Office | Maintenance and Construction Administrative Systems | Existing |
| | TxDOT Amarillo DMS | Roadway Subsystem | Existing |
| | TxDOT Amarillo Field Sensors | Roadway Subsystem | Existing |
| | TxDOT Amarillo HAR | Roadway Subsystem | Existing |
| | TxDOT Amarillo TMC | Archived Data User Systems | Existing |
| | TxDOT Amarillo TMC | Maintenance and Construction Management | Existing |
| | TxDOT Amarillo TMC | Traffic Management | Existing |
| | TxDOT Amarillo Traffic Signals | Roadway Subsystem | Existing |
| | TxDOT Area Engineering | Maintenance and Construction Management | Existing |
| | TxDOT Area Engineering | Maintenance and Construction Administrative Systems | Existing |
| | TxDOT Courtesy Service Patrol Dispatch | Emergency Management | Future |
| | TxDOT Courtesy Service Patrol Vehicles | Emergency Vehicle Subsystem | Future |
| | TxDOT Crash Record Information System | Archived Data Management Subsystem | Existing |
| | TxDOT District Shop | Equipment Repair Facility | Existing |
| | TxDOT Flood Warning System | Roadway Subsystem | Future |
| | TxDOT Highway Condition Reporting System | Information Service Provider | Existing |
| | TxDOT Maintenance and Construction Vehicles | Maintenance and Construction Vehicle | Existing |
| | TxDOT Portable Field Devices | Roadway Subsystem | Future |
| | TxDOT Roadside Anti-Icing System | Roadway Subsystem | Future |
| TxDOT Rural Maintenance Sections | Maintenance and Construction Management | Existing | |

Table 4 – Amarillo Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)

| Stakeholder | Element | Entity | Status |
|--|---|---|---------------|
| TxDOT (continued) | TxDOT TMC Amarillo District Webpage | Information Service Provider | Existing |
| | TxDOT Urban Maintenance Sections | Maintenance and Construction Management | Existing |
| TxDOT Motor Carrier Division | TxDOT Motor Carrier Routing Information | Information Service Provider | Existing |
| TxDOT Transportation Planning and Programming Division | TxDOT Traffic Count Archive | Archived Data Management Subsystem | Existing |

4.2 Regional Market Packages

Upon completion of the system inventory, the next step in the development of the architecture was to identify the transportation services that are important to the Amarillo Region. In the National ITS Architecture, services are referred to as market packages. Market packages can include several stakeholders and elements that work together to provide a service in the Region. Examples of market packages from the National ITS Architecture include Network Surveillance, Traffic Information Dissemination, and Transit Vehicle Tracking. There are currently a total of 75 market packages identified in the National ITS Architecture.

In the Amarillo Region, the National ITS Architecture market packages were reviewed by the stakeholders and selected based on the relevance of the service that the market package could provide to the Region. The market packages that stakeholders in Amarillo selected for implementation in the Region are identified in **Table 5**, as well as the element (or system) in the Region that serves the key role in providing the market package service.

In several cases, there are multiple elements or systems in the Region that provide the same service at different levels. For example, Network Surveillance (ATMS01) is provided on freeways through the TxDOT Amarillo TMC and on arterials by the City of Amarillo TOC. Market packages also are identified as either existing or planned for the Region. In many cases, existing market packages may still need to be enhanced to increase the service that the market package provides. For example, the market package for Network Surveillance is listed as existing for the TxDOT Amarillo TMC. Although TxDOT may currently have this ability, additional cameras may be desired to increase the level of network surveillance on the freeways.

Upon selection of the market packages that were applicable for the Region, stakeholders then reviewed each market package and the elements that could be included to customize it for the Region. This customization is discussed further in Section 4.3.2.

Table 5 – Amarillo Region Selected Market Packages

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|-----------------------------------|--|--|---------------|
| ATMS01 | Network Surveillance | City of Amarillo Field Equipment City of Amarillo Traffic Operations Center TxDOT Amarillo CCTV TxDOT Amarillo Field Sensors TxDOT Amarillo TMC | City of Amarillo | Existing |
| | | | TxDOT Amarillo District | Existing |
| ATMS02 | Probe Surveillance | Commercial Vehicles TxDOT Amarillo Field Sensors TxDOT Amarillo TMC | TxDOT Amarillo District | Future |
| | | | | |
| ATMS03 | Surface Street Control | City of Amarillo Field Equipment City of Amarillo Traffic Operations Center TxDOT Amarillo CCTV TxDOT Amarillo Field Sensors TxDOT Amarillo TMC TxDOT Amarillo Traffic Signals | City of Amarillo | Existing |
| | | | TxDOT Amarillo District | Existing |
| ATMS04 | Freeway Control | TxDOT Amarillo CCTV TxDOT Amarillo Field Sensors TxDOT Amarillo TMC | TxDOT Amarillo District | Existing |
| | | | | |
| ATMS06 | Traffic Information Dissemination | Amarillo City Transit System Dispatch Center Amarillo/Potter/Randall EOC City of Amarillo Fire Dispatch City of Amarillo Maintenance City of Amarillo Police Dispatch City of Amarillo Traffic Operations Center County Road and Bridge DPS Communications Service Independent School District Transit Dispatch Local City/County EOC Local Law Enforcement Dispatch Other Public Safety Comm, Dispatch Centers and EOCs Panhandle Transit Dispatch Pantex EOC Print and Broadcast Media | TxDOT Amarillo District | Existing |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|--|--|--|---------------|
| ATMS06 (continued) | Traffic Information Dissemination (continued) | Prison Operations Centers State EOC TxDOT Amarillo DMS TxDOT Amarillo HAR TxDOT Amarillo TMC TxDOT Amarillo Traffic Signals TxDOT Courtesy Service Patrol Dispatch TxDOT Rural Maintenance Sections TxDOT TMC Amarillo District Webpage TxDOT Urban Maintenance Sections | | |
| ATMS07 | Regional Traffic Control and Coordination | City of Amarillo Traffic Operations Center Other States TMCs Other TxDOT District TMCs TxDOT Amarillo TMC | TxDOT Amarillo District | Future |
| ATMS08 | Incident Management System | Amarillo/Potter/Randall EOC City of Amarillo Fire Dispatch City of Amarillo Fire Vehicles City of Amarillo Maintenance City of Amarillo Police Dispatch City of Amarillo Police Vehicles City of Amarillo Traffic Operations Center County Road and Bridge DPS Communications Service Emergency Alerting System EMS Vehicles Highway Patrol Vehicles Local City/County EOC Local Law Enforcement Dispatch Local Venue Event Scheduling System Other Public Safety Comm, Dispatch Centers and EOCs Other States EMS | Emergency and Transportation Management Agencies | Future |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|---|--|--|---------------|
| ATMS08 (continued) | Incident Management System (continued) | Other States Maintenance Sections Other States TMCs Other TxDOT District TMCs Panhandle Emergency Medical Services System (PEMSS) Pantex Emergency Warning and Notification system Pantex EOC Print and Broadcast Media Prison Operations Centers Private Maintenance Dispatchers Private Sector Traveler Information Services Private Tow/Wrecker Dispatch Rail Operations State EOC TxDOT Amarillo District Office TxDOT Amarillo TMC TxDOT Area Engineering TxDOT Courtesy Service Patrol Dispatch TxDOT Highway Condition Reporting System TxDOT Rural Maintenance Sections TxDOT TMC Amarillo District Webpage TxDOT Urban Maintenance Sections | | |
| ATMS13 | Standard Railroad Grade Crossing | City of Amarillo Field Equipment City of Amarillo Traffic Operations Center Rail Operations TxDOT Amarillo TMC TxDOT Amarillo Traffic Signals | City of Amarillo | Existing |
| | | | TxDOT Amarillo District | Existing |
| | | | | |
| ATMS15 | Railroad Operations Coordination | City of Amarillo Field Equipment City of Amarillo Traffic Operations Center Rail Operations TxDOT Amarillo TMC TxDOT Amarillo Traffic Signals | City of Amarillo | Future |
| | | | TxDOT Amarillo District | Future |
| | | | | |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|-----------------------------|--|--|---------------|
| ATMS16 | Parking Facility Management | City of Amarillo Airport Parking Management System Financial Institution Private Sector Traveler Information Services Private Vehicles Traveler Card | City of Amarillo | Future |
| EM1 | Emergency Response | Amarillo City Transit System Dispatch Center Amarillo/Potter/Randall EOC City of Amarillo Fire Dispatch City of Amarillo Fire Vehicles City of Amarillo Maintenance City of Amarillo Police Dispatch City of Amarillo Police Vehicles City of Amarillo Traffic Operations Center County Road and Bridge DPS Communications Service Emergency Alerting System EMS Vehicles Highway Patrol Vehicles Independent School District Transit Dispatch Local City/County EOC Local Law Enforcement Dispatch Local Law Enforcement Vehicles Other Public Safety Comm, Dispatch Centers and EOCs Other States EMS Other States Maintenance Sections Other TxDOT District TMCs Panhandle Emergency Medical Services System (PEMSS) Pantex EOC Print and Broadcast Media Prison Operations Centers | Emergency and Transportation Management Agencies | Existing |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|-----------------------------------|---|--|---------------|
| EM1 (continued) | Emergency Response (continued) | Private Maintenance Dispatchers Private Tow/Wrecker Dispatch Private Vehicle Emergency Systems State EOC Telco 911 Call Routing TxDOT Amarillo TMC TxDOT Area Engineering TxDOT Courtesy Service Patrol Dispatch TxDOT Courtesy Service Patrol Vehicles TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | | |
| EM2 | Emergency Routing | City of Amarillo Field Equipment City of Amarillo Fire Dispatch City of Amarillo Maintenance City of Amarillo Traffic Operations Center EMS Vehicles Panhandle Emergency Medical Services System (PEMSS) Regional Hospitals TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | PEMSS/City of Amarillo Traffic | Future |
| | | | City of Amarillo Fire/City of Amarillo Traffic | Future |
| EM3 | Mayday Support | City of Amarillo Police Dispatch DPS Communications Service Local Law Enforcement Dispatch Panhandle Emergency Medical Services System (PEMSS) Private Traveler Personal Computing Devices Private Vehicle Emergency Systems Private Vehicles Rest Areas/Visitor Centers/Service Plaza Kiosks | DPS Communications Service | Future |
| | | | Local 911 | Future |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|--|---|--|---------------|
| EM4 | Roadway Service Patrols | TxDOT Amarillo TMC TxDOT Courtesy Service Patrol Dispatch TxDOT Courtesy Service Patrol Vehicles TxDOT TMC Amarillo District Webpage | TxDOT Courtesy Service Patrol | Future |
| EM5 | Emergency Evacuation and Detour | Amarillo/Potter/Randall EOC City of Amarillo Fire Dispatch City of Amarillo Police Dispatch DPS Communications Service Local City/County EOC Local Law Enforcement Dispatch Other Public Safety Comm, Dispatch Centers and EOCs Panhandle Emergency Medical Services System (PEMSS) Pantex EOC Prison Operations Centers Private Tow/Wrecker Dispatch Private Vehicle Emergency Systems State EOC TxDOT Courtesy Service Patrol Dispatch TxDOT Amarillo TMC Other TxDOT District TMCs Other States TMCs | Emergency and Transportation Management Agencies | Future |
| MC01 | Maintenance and Construction Vehicle Tracking | TxDOT Maintenance and Construction Vehicles TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections TxDOT District Shop | TxDOT Amarillo District | Future |
| MC02 | Maintenance and Construction Vehicle Maintenance | TxDOT Maintenance and Construction Vehicles TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections TxDOT District Shop | TxDOT Amarillo District | Future |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|---|---|--|---------------|
| MC03 | Road Weather Data Collection | National Weather Service Private Weather Service TxDOT Amarillo Field Sensors TxDOT Amarillo TMC TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | TxDOT Amarillo District | Future |
| MC04 | Weather Information Processing and Distribution | Amarillo City Transit System Dispatch Center Amarillo/Potter/Randall EOC City of Amarillo Fire Dispatch City of Amarillo Police Dispatch City of Amarillo Traffic Operations Center DPS Communications Service Independent School District Transit Dispatch Local City/County EOC Local Law Enforcement Dispatch National Weather Service Other Public Safety Comm, Dispatch Centers and EOCs Other States Maintenance Sections Other States TMCs Other TxDOT District TMCs Panhandle Emergency Medical Services System (PEMSS) Panhandle Transit Dispatch Pantex EOC Print and Broadcast Media Prison Operations Centers Private Tow/Wrecker Dispatch Private Weather Service State EOC TxDOT Amarillo TMC TxDOT Courtesy Service Patrol Dispatch | TxDOT Amarillo District | Future |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|-----------------------------|---|--|---------------|
| MC05 | Roadway Automated Treatment | TxDOT Amarillo DMS | TxDOT Amarillo District | Future |
| | | TxDOT Roadside Anti-Icing System TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | | |
| MC06 | Winter Maintenance | Amarillo City Transit System Dispatch Center | City of Amarillo | Future |
| | | Amarillo/Potter/Randall EOC City of Amarillo Fire Dispatch City of Amarillo Maintenance City of Amarillo Maintenance Vehicles City of Amarillo Police Dispatch City of Amarillo Traffic Operations Center County Road and Bridge DPS Communications Service Independent School District Transit Dispatch Local City/County EOC Local Law Enforcement Dispatch National Weather Service Other Public Safety Comm, Dispatch Centers and EOCs Other States Maintenance Sections Panhandle Emergency Medical Services System (PEMSS) Panhandle Transit Dispatch Pantex EOC Prison Operations Centers Private Maintenance Dispatchers Private Tow/Wrecker Dispatch Private Vehicle Emergency Systems Private Weather Service State EOC TxDOT Amarillo TMC TxDOT Courtesy Service Patrol Dispatch TxDOT Highway Condition Reporting System | TxDOT Amarillo District | Future |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|--------------------------------------|---|--|---------------|
| MC06 (continued) | Winter Maintenance (continued) | TxDOT Maintenance and Construction Vehicles TxDOT Rural Maintenance Sections TxDOT TMC Amarillo District Webpage TxDOT Urban Maintenance Sections | | |
| MC07 | Roadway Maintenance and Construction | Amarillo/Potter/Randall EOC City of Amarillo Field Equipment City of Amarillo Fire Dispatch City of Amarillo Maintenance City of Amarillo Police Dispatch City of Amarillo Traffic Operations Center DPS Communications Service Local City/County EOC Local Law Enforcement Dispatch Panhandle Emergency Medical Services System (PEMSS) Pantex EOC Private Tow/Wrecker Dispatch State EOC TxDOT Amarillo TMC TxDOT Amarillo Traffic Signals TxDOT Area Engineering TxDOT Courtesy Service Patrol Dispatch TxDOT Maintenance and Construction Vehicles TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | TxDOT Amarillo District | Future |
| | | | City of Amarillo | Future |
| MC08 | Work Zone Management | Amarillo/Potter/Randall EOC City of Amarillo Fire Dispatch City of Amarillo Maintenance City of Amarillo Police Dispatch City of Amarillo Traffic Operations Center DPS Communications Service Local City/County EOC | TxDOT Amarillo District | Future |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|--|---|--|---------------|
| MC08 (continued) | Work Zone Management (continued) | Local Law Enforcement Dispatch Other Public Safety Comm, Dispatch Centers and EOCs Other States Maintenance Sections Panhandle Emergency Medical Services System (PEMSS) Pantex EOC Prison Operations Centers Private Maintenance Dispatchers Private Tow/Wrecker Dispatch Private Vehicle Emergency Systems TxDOT Amarillo CCTV TxDOT Amarillo DMS TxDOT Amarillo TMC TxDOT Amarillo Traffic Signals TxDOT Area Engineering TxDOT Highway Condition Reporting System | | |
| MC09 | Work Zone Safety Monitoring | TxDOT Amarillo Field Sensors TxDOT Maintenance and Construction Vehicles TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | TxDOT Amarillo District | Future |
| | | | | |
| MC10 | Maintenance and Construction Activity Coordination | Amarillo City Transit System Dispatch Center Amarillo/Potter/Randall EOC BRINSAP – Bridge Inventory Inspection System City of Amarillo Fire Dispatch City of Amarillo Maintenance City of Amarillo Police Dispatch City of Amarillo Traffic Operations Center DPS Communications Service Independent School District Transit Dispatch Local City/County EOC Local Law Enforcement Dispatch | TxDOT Amarillo District | Future |
| | | | City of Amarillo | Future |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|--|--|--|---------------|
| MC10 (continued) | Maintenance and Construction Activity Coordination (continued) | Other Public Safety Comm, Dispatch Centers and EOCs Other States Maintenance Sections Panhandle Emergency Medical Services System (PEMSS) Panhandle Transit Dispatch Private Maintenance Dispatchers Private Sector Traveler Information Services Rail Operations TxDOT Amarillo TMC TxDOT Area Engineering TxDOT Highway Condition Reporting System TxDOT Motor Carrier Routing Information TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | | |
| APTS1 | Transit Vehicle Tracking | Amarillo City Transit System Dispatch Center | City of Amarillo | Future |
| | | Amarillo City Transit Vehicles | Independent School Districts | Future |
| | | Independent School District Transit Dispatch | Panhandle Transit | Future |
| | | Panhandle Transit Dispatch School District Buses | | |
| APTS2 | Transit Fixed-Route Operations | Amarillo City Transit System Dispatch Center | City of Amarillo | Existing |
| | | Amarillo City Transit Vehicles | Independent School Districts | Existing |
| | | City of Amarillo Maintenance City of Amarillo Traffic Operations Center County Road and Bridge Independent School District Transit Dispatch School District Buses TxDOT Amarillo TMC TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | | |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|---------------------------------------|--|--|---------------|
| APTS3 | Demand Response Transit Operations | Amarillo City Transit System Dispatch Center Amarillo City Transit Vehicles City of Amarillo Maintenance City of Amarillo Traffic Operations Center County Road and Bridge Panhandle Transit Dispatch Private Sector Traveler Information Services TxDOT Amarillo TMC TxDOT Rural Maintenance Sections TxDOT Urban Maintenance Sections | City of Amarillo | Existing |
| | | | Panhandle Transit | Existing |
| APTS4 | Transit Passenger and Fare Management | Amarillo City Transit System Dispatch Center Amarillo City Transit Vehicles Transit Kiosks Traveler Card | City of Amarillo | Future |
| | | | | |
| APTS5 | Transit Security | Amarillo City Transit System Dispatch Center Amarillo City Transit Vehicles City of Amarillo Police Dispatch DPS Communications Service Local Law Enforcement Dispatch Transit Kiosks | City of Amarillo | Future |
| | | | | |
| APTS8 | Transit Traveler Information | Amarillo City Transit System Dispatch Center Amarillo City Transit Vehicles Amarillo Transit Information System Private Traveler Personal Computing Devices Transit Kiosks | City of Amarillo | Future |
| | | | | |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|----------------|--------------------------------|---|---|----------|
| ATIS1 | Broadcast Traveler Information | Amarillo/Potter/Randall EOC | TxDOT Amarillo District Webpage | Future |
| | | City of Amarillo Airport Parking Management System | TxDOT Highway Condition Reporting System | Existing |
| | | City of Amarillo Fire Dispatch City of Amarillo Maintenance City of Amarillo Police Dispatch City of Amarillo Traffic Operations Center County Road and Bridge Local City/County EOC Local Venue Event Scheduling System National Weather Service Other Public Safety Comm, Dispatch Centers and EOCs Other States TMCs Other TxDOT District TMCs Pantex EOC Print and Broadcast Media Private Maintenance Dispatchers Private Sector Traveler Information Services Rest Areas/Visitor Centers/Service Plaza Kiosks SchoolNet Web Server and WebPage State EOC TxDOT Amarillo TMC TxDOT Courtesy Service Patrol Dispatch TxDOT Highway Condition Reporting System TxDOT Motor Carrier Routing Information TxDOT Rural Maintenance Sections TxDOT TMC Amarillo District Webpage TxDOT Urban Maintenance Sections | | |

Table 5 – Amarillo Region Selected Market Packages (continued)

| Market Package | Market Package Name | Elements Associated with Market Package | Primary Stakeholders Responsible for Implementation | Status |
|-----------------------|----------------------------|---|--|---------------|
| ATIS5 | ISP Based Route Guidance | Private Commercial Vehicle Fleet Management Private Traveler Personal Computing Devices TxDOT Highway Condition Reporting System TxDOT Motor Carrier Routing Information | TxDOT Motor Carrier Routing Information | Existing |
| AD1 | ITS Data Mart | Amarillo City Transit System Dispatch Center City of Amarillo Police Dispatch DPS Communications Service Local Law Enforcement Dispatch TxDOT Amarillo TMC TxDOT Crash Record Information System | TxDOT Crash Record Information System | Future |

4.3 Interconnections

4.3.1 Top Level Regional System Interconnect Diagram

A system interconnect diagram, or sausage diagram (shown previously in Section 4.1.1) shows the systems and primary interconnects in the Region. The National ITS Architecture interconnect diagram has been customized for the Amarillo Region based on the information gathered from the stakeholders and system inventory. **Figure 6** on the following page summarizes the existing, planned, and future ITS elements for the Amarillo Region in the context of a physical interconnect. Subsystems and elements specific to Amarillo are called out in the boxes surrounding the main interconnect diagram, and these are color-coded to the subsystem to which they are associated. The rectangles represent the architecture subsystems, and the terminators are represented by the rounded rectangles. Elements with an asterisk (*) are planned and future system elements.

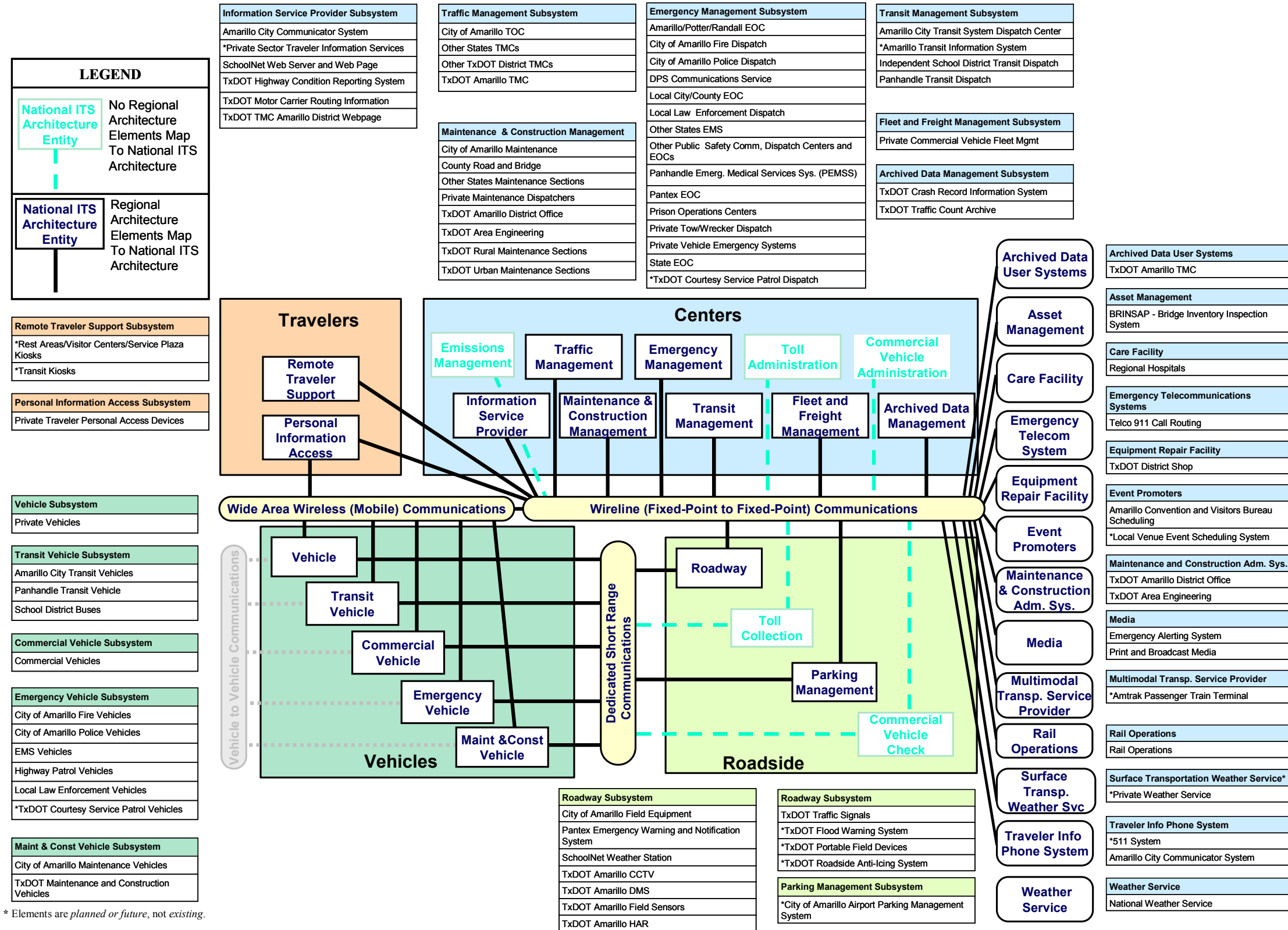


Figure 6 – Amarillo Regional System Interconnect Diagram

4.3.2 Customized Market Packages

The market packages in the National ITS Architecture were customized to reflect the unique systems, subsystems, and terminators in the Amarillo Region. Each market package is shown graphically, with the market package name, Amarillo-specific element, and with the unique agency and system identifiers within the subsystems and terminators. Equipment packages, where applicable, are also shown for each market package. An equipment package is a functional capability that may be deployed at a specific time. While the market packages represent a service that will be deployed as an integrated capability, the equipment packages make up those market packages and are the most basic functions that will be developed or bought by implementers.

Figure 7 is an example of an ATMS market package for Surface Street Control that has been customized for the Amarillo Region. This market package shows the two subsystems, Traffic Management and Roadway, and the associated entities (City of Amarillo TOC, and City of Amarillo Field Equipment and TxDOT Amarillo Traffic Signals, respectively) and equipment packages. The equipment packages are the rectangles inside of the subsystems, and represent the functions that deliver a particular service to support the market package. Data flows between the subsystems and the terminators (Other Roadway) indicate what information is being shared. The data flow lines are solid in this market package, which means that these are existing functions and information flows.

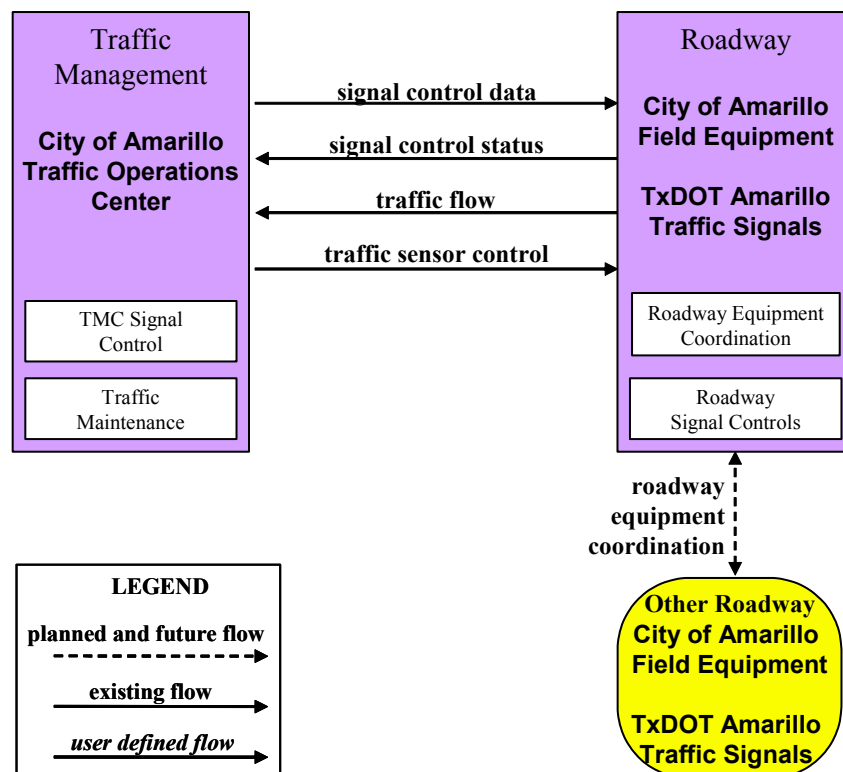


Figure 7 – Custom Market Package for Amarillo Surface Street Control

Market packages that were customized for the Amarillo Region are shown in **Appendix A**. These market packages also are included on the Amarillo Region Architecture web site by selecting the “Market Package” button. Market packages are grouped by functional area (Traffic Management, Maintenance and Construction, Public Transportation, etc.), and each of the customized market packages can be viewed by clicking on the Market Package Diagram icon under each area heading. It is important to note that while the market package table on the web site shows all of the available market packages from the National ITS Architecture, only those selected for the Amarillo Region are included in the diagrams. The selected market packages also are highlighted in the table with bold print, and are indicated as existing or planned.

4.3.3 Amarillo Architecture Interfaces

While it is important to identify the various systems and stakeholders as part of a regional ITS, a primary purpose of the architecture is to identify the *connectivity* between transportation systems in the Amarillo Region. The interconnect diagram shown previously in **Figure 6** showed the high-level relationships of the subsystems and terminators in the Amarillo Region and the associated local projects and systems. The customized market packages represent services that can be deployed as an integrated capability, and the market package diagrams show the information flows between the subsystems and terminators that are most important to the operation of the market packages. How these systems interface with each other is an integral part of the overall ITS architecture.

There are 81 different elements identified as part of the Amarillo Regional ITS Architecture. These elements include local and state traffic operations centers, transit vehicles, dispatch systems, emergency management agencies, media outlets, and others – essentially, all of the existing and planned physical components that contribute to the regional intelligent transportation system. Interfaces have been identified for each element in the Amarillo Regional ITS Architecture, and each element has been mapped to those other elements with which it must interface. For example, the City of Amarillo Traffic Operations Center has existing or planned interfaces with 30 other elements in the Amarillo Region, ranging from field equipment and dispatch centers to local media and TxDOT systems. Other interfaces are far less complex, such as the interface between City of Amarillo Fire Vehicles and City Field Equipment and Amarillo Fire Dispatch.

An example of one of the system interfaces is included as **Figure 8** on the following page. This graphic shows the TxDOT Amarillo DMS, and the interfaces with other elements throughout the Region. These interfaces are shown as existing, planned, or future. Interfaces defined as “planned” have funding identified, while “future” interfaces are desired by stakeholders but funding has not yet been identified.

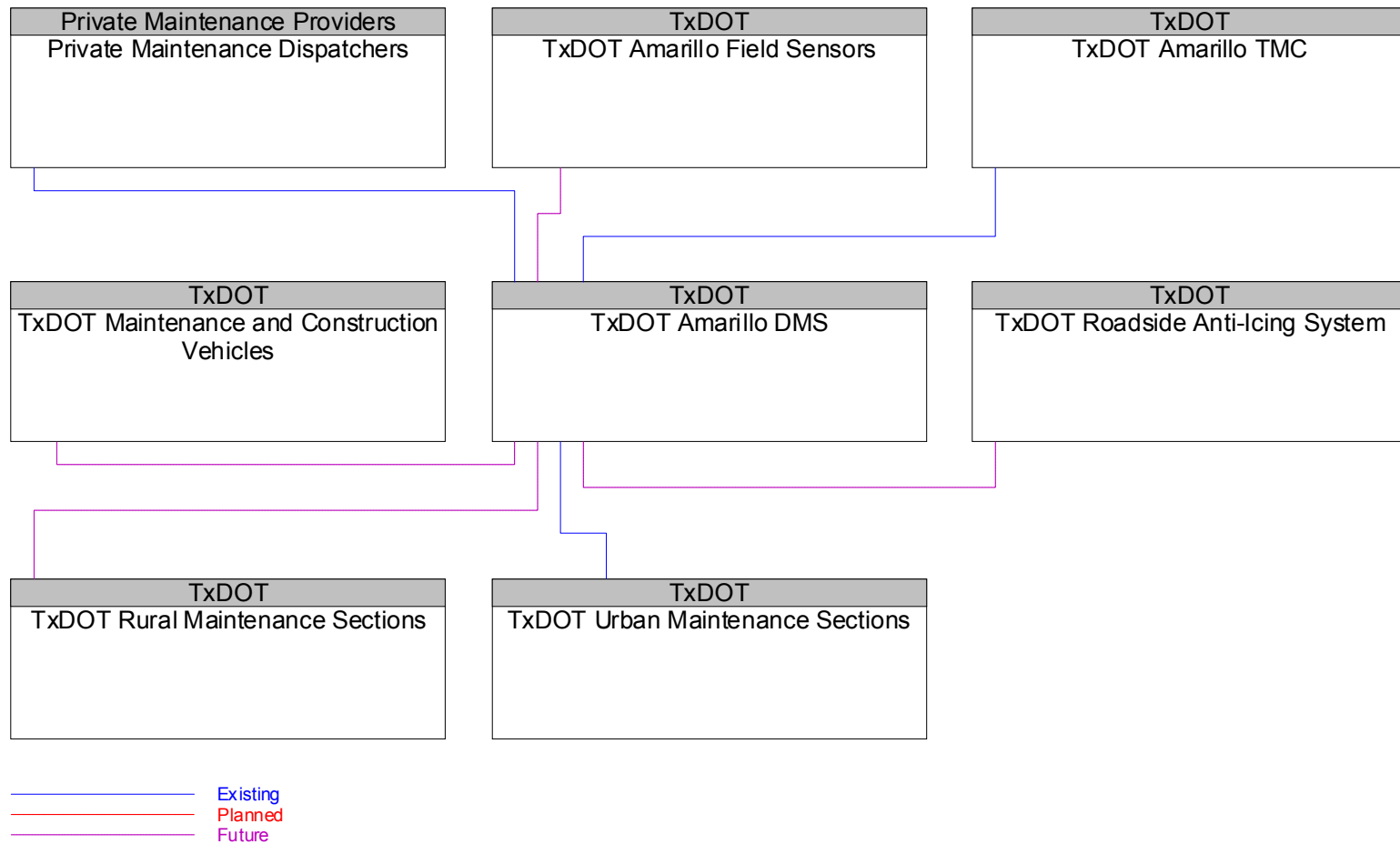


Figure 8 – TxDOT Amarillo DMS Interfaces

Each element and its defined interfaces are listed in **Appendix B**. Elements and their interfaces also are accessible via the Amarillo Region Architecture web site by clicking on the “Interfaces” button. Elements are listed alphabetically in the column on the left, and each entry in the Interfacing Element column on the right is a link to more detailed information about the particular interface. The architecture flows between the individual element interfaces are described in more detail in the following section.

4.3.4 Physical Subsystem Architecture Flows

Architecture flows between the subsystems and terminators define the specific information (data) that is exchanged between subsystems and terminators. Each architecture flow has one or more data flows that specify what information is exchanged and the direction of the exchange. These data flows could be requests for information, alerts and messages, status requests, broadcast advisories, event messages, confirmations, electronic credentials, and other key information requirements. These architecture flows define the interface requirements between the various elements in the Amarillo Regional ITS Architecture.

An example of the architecture flows between two elements is shown in **Figure 9**. In this interface, the flows between the City of Amarillo Traffic Operations Center and the Pantex Emergency Operations Center show information that must go from the TOC to the EOC, as well as information that the Amarillo TOC needs from Pantex Emergency Operations. Similar to the interfaces, architecture flows also are defined as existing, planned or future.

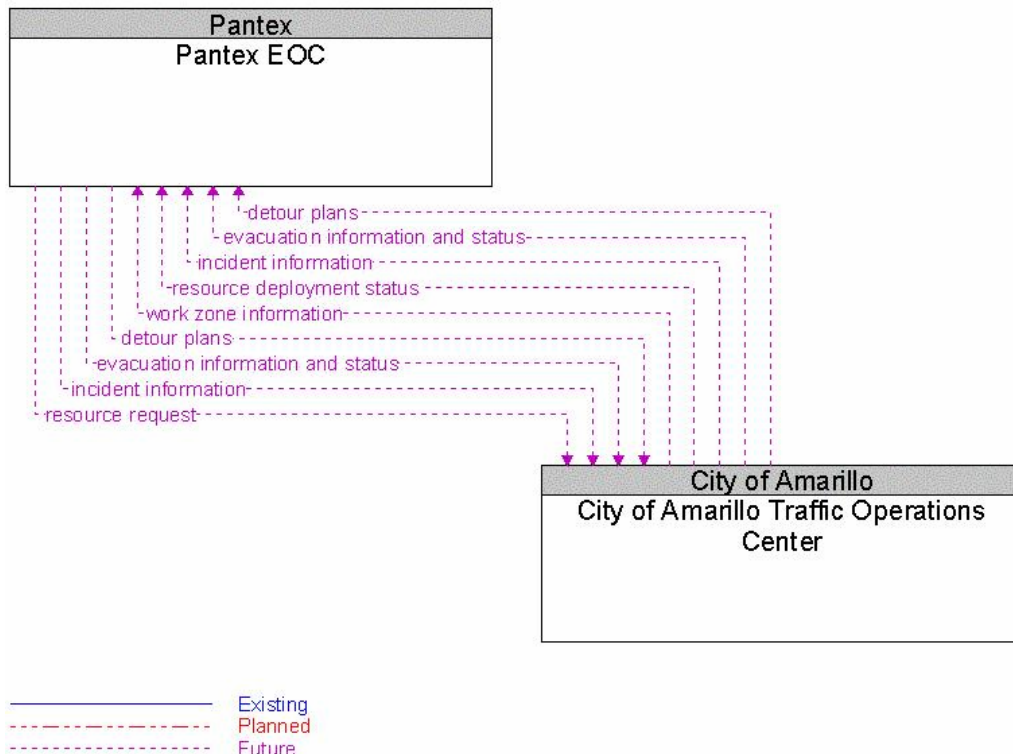


Figure 9 – City of Amarillo TOC to Pantex EOC Architecture Flows

Each of the individual element interfaces can be accessed on the Amarillo Regional ITS Architecture web site by clicking on the “Interfaces” button. Selecting any of the Interfacing Elements from the column on the right will display an interface diagram and architecture flows between two specific elements, similar to the diagram shown above in **Figure 9**. Each data flow is defined, and any standards associated with that data flow are noted. Standards as they apply to the Amarillo Region are discussed in more detail in Section 4.5.

4.4 Functional Requirements

Functions are a description of what the system has to do. In the National ITS Architecture, functions are defined at several different levels, ranging from general subsystem descriptions through somewhat more specific equipment package descriptions to Process Specifications that include substantial detail. Guidance from the USDOT on developing a Regional ITS Architecture recommends that each Region determine the level of detail of the functional requirements for their Region. In the Amarillo Region, it is recommended that the development of detailed functional requirements such as the “shall” statements included in Process Specifications for a system be developed at the project level. These detailed “shall” statements identify all functions that a project or system needs to perform.

For the Amarillo Regional ITS Architecture, functional requirements have been identified at two levels. The customized market packages, described in Section 4.3.2, describe the services that ITS needs to provide in the Region and the architecture flows between the elements. These market packages and data flows describe what the ITS system in Amarillo has to do and the data that needs to be shared among elements.

At a more detailed level, functional requirements for the Amarillo Region are also described in terms of equipment packages that are associated with one or more subsystems in the Amarillo Regional ITS Architecture as shown in **Table 6**. As described in Section 4.3.2, an equipment package is a functional capability that may be deployed at a specific time. Each equipment package can be linked in the National ITS Architecture to the Process Specifications that may be applicable. It is recommended that during the design concept stage of a project, the applicable equipment package and associated Process Specifications from the National ITS Architecture be reviewed by the implementer to determine the appropriate functional requirements for the project. A link for each equipment package is available on the Amarillo ITS Architecture web site under the Functions page.

Table 6 – Amarillo Region Equipment Packages

| Subsystem | Equipment Package |
|---|--|
| Archived Data Management Subsystem | Government Reporting Systems Support |
| | ITS Data Repository |
| | Traffic and Roadside Data Archival |
| Emergency Management | Emergency Call-Taking |
| | Emergency Data Collection |
| | Emergency Dispatch |
| | Emergency Environmental Monitoring |
| | Emergency Response Management |
| | Emergency Secure Area Surveillance |
| | Mayday Support |
| | Service Patrol Management |
| Emergency Vehicle Subsystem | On-board EV En Route Support |
| | On-board EV Incident Management Communication |
| Fleet and Freight Management | Fleet Administration |
| | Fleet Credentials and Taxes Management and Reporting |
| Information Service Provider | Basic Information Broadcast |
| | Infrastructure Provided Route Selection |
| | ISP Data Collection |
| Maintenance and Construction Management | MCM Automated Treatment System Control |
| | MCM Data Collection |
| | MCM Environmental Information Collection |
| | MCM Environmental Information Processing |
| | MCM Incident Management |
| | MCM Maintenance Decision Support |
| | MCM Roadway Maintenance and Construction |
| | MCM Speed Monitoring |
| | MCM Vehicle and Equipment Maintenance Management |
| | MCM Vehicle Tracking |
| | MCM Winter Maintenance Management |
| | MCM Work Activity Coordination |
| | MCM Work Zone Management |
| MCM Work Zone Safety Management | |

Table 6 – Amarillo Region Equipment Packages (continued)

| Subsystem | Equipment Package |
|--------------------------------------|---|
| Maintenance and Construction Vehicle | MCV Environmental Monitoring |
| | MCV Infrastructure Monitoring |
| | MCV Roadway Maintenance and Construction |
| | MCV Vehicle Location Tracking |
| | MCV Vehicle Safety Monitoring |
| | MCV Vehicle System Monitoring and Diagnostics |
| | MCV Winter Maintenance |
| | MCV Work Zone Support |
| Parking Management | Parking Electronic Payment |
| | Parking Management |
| | Parking Surveillance |
| Personal Information Access | Personal Interactive Information Reception |
| | Personal Location Determination |
| | Personal Mayday I/F |
| | Personal Provider-Based Route Guidance |
| Remote Traveler Support | Remote Basic Information Reception |
| | Remote Mayday I/F |
| | Remote Transit Information Services |
| | Secure Area Monitoring |
| Roadway Subsystem | Roadside Signal Priority |
| | Roadway Automated Treatment |
| | Roadway Basic Surveillance |
| | Roadway Environmental Monitoring |
| | Roadway Equipment Coordination |
| | Roadway Freeway Control |
| | Roadway Incident Detection |
| | Roadway Infrastructure Monitoring |
| | Roadway Probe Beacons |
| | Roadway Signal Controls |
| | Roadway Speed Monitoring |
| | Roadway Traffic Information Dissemination |
| | Roadway Work Zone Safety |
| | Roadway Work Zone Traffic Control |
| | Standard Rail Crossing |

Table 6 – Amarillo Region Equipment Packages (continued)

| Subsystem | Equipment Package |
|---------------------------|--|
| Traffic Management | Collect Traffic Surveillance |
| | HRI Traffic Management |
| | Rail Operations Coordination |
| | TMC Environmental Monitoring |
| | TMC Freeway Management |
| | TMC Incident Detection |
| | TMC Incident Dispatch Coordination/Communication |
| | TMC Multimodal Coordination |
| | TMC Probe Information Collection |
| | TMC Regional Traffic Control |
| | TMC Signal Control |
| | TMC Speed Monitoring |
| | TMC Traffic Information Dissemination |
| | TMC Work Zone Traffic Management |
| | Traffic Data Collection |
| | Traffic Maintenance |
| Transit Management | Transit Center Fare and Load Management |
| | Transit Center Fixed-Route Operations |
| | Transit Center Information Services |
| | Transit Center Multi-Modal Coordination |
| | Transit Center Paratransit Operations |
| | Transit Center Security |
| | Transit Center Tracking and Dispatch |
| | Transit Data Collection |
| | Transit Environmental Monitoring |
| | Transit Garage Operations |
| Transit Vehicle Subsystem | On-board Fixed Route Schedule Management |
| | On-board Paratransit Operations |
| | On-board Transit Fare and Load Management |
| | On-board Transit Information Services |
| | On-board Transit Security |
| | On-board Transit Signal Priority |
| | On-board Transit Trip Monitoring |

Table 6 – Amarillo Region Equipment Packages (continued)

| Subsystem | Equipment Package |
|-----------|--------------------------------|
| Vehicle | Vehicle Location Determination |
| | Vehicle Mayday I/F |
| | Vehicle Probe Support |
| | Vehicle Toll/Parking Interface |

4.5 Standards

Standards are an important tool that will allow efficient implementation of the elements in the Amarillo Regional ITS Architecture over time. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances, vendors change, and as new approaches evolve. The USDOT’s ITS Joint Program Office is supporting Standards Development Organizations (SDOs) with an extensive, multi-year program of accelerated, consensus-based standards development to facilitate successful ITS deployment in the United States. **Table 7** identifies each of the ITS standards that may apply to the Amarillo Regional ITS Architecture. These standards are based on the physical subsystem architecture flows identified in Section 4.3.4. The connection of each standard to the applicable architecture flows between elements can be viewed on the project web site (www.consystec.com) under the Interfaces or Standards pages.

Table 7 – Applicable ITS Standards for the Amarillo Region

| SDO | Document ID | Title | Type |
|-----------------|-------------|--|---------|
| AASHTO/ITE/NEMA | NTCIP 1201 | Global Object Definitions | Message |
| | NTCIP 1202 | Object Definitions for Actuated Traffic Signal Controller Units | Message |
| | NTCIP 1203 | Object Definitions for Dynamic Message Signs | Message |
| | NTCIP 1204 | Object Definitions for Environmental Sensor Stations and Roadside Weather Information System | Message |
| | NTCIP 1205 | Data Dictionary for Closed Circuit Television (CCTV) | Message |
| | NTCIP 1206 | Data Collection and Monitoring Devices | Message |
| | NTCIP 1207 | Ramp Meter Controller Objects | Message |
| | NTCIP 1208 | Object Definitions for Video Switches | Message |
| | NTCIP 1209 | Transportation System Sensor Objects | Message |
| | NTCIP 1210 | Objects for Signal Systems Master | Message |
| | NTCIP 1211 | Objects for Signal Control Priority | Message |
| | NTCIP 1301 | Message Set for Weather Reports | Message |
| | NTCIP 1401 | TCIP – Common Public Transportation (CPT) Business Area Standard | Message |

Table 7 – Applicable ITS Standards for the Amarillo Region (continued)

| SDO | Document ID | Title | Type |
|--------------------------------|----------------------|--|---------------|
| AASHTO/ITE/NEMA (continued) | NTCIP 1402 | TCIP – Incident Management (IM) Business Area Standard | Message |
| | NTCIP 1403 | TCIP – Passenger Information (PI) Business Area Standard | Message |
| | NTCIP 1404 | TCIP – Scheduling/Runcutting (SCH) Business Area Standard | Message |
| | NTCIP 1405 | TCIP – Spatial Representation (SP) Business Area Standard | Message |
| | NTCIP 1406 | TCIP – Onboard (OB) Business Area Standard | Message |
| | NTCIP 1407 | TCIP – Control Center (CC) Business Area Standard | Message |
| | NTCIP 1408 | TCIP – Fare Collection (FC) Business Area Standard | Message |
| | View List | NTCIP Center-to-Center Standards Group | Communication |
| | View List | NTCIP Center-to-Field Standards Group | Communication |
| ASTM | ASTM 5 GHz Data Link | Standard Specification for 5.9 GHz Data Link Layer | Communication |
| | ASTM 5 GHz Phys | Standard Specification for 5.9 GHz Physical Layer | Communication |
| | ASTM PS 105-99 | Specification for Dedicated Short Range Communication (DSRC) Data Link Layer: Medium Access and Logical Link Control | Communication |
| | ASTM PS 111-98 | Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz | Communication |
| EIA/CEA | CEA/EIA-794 | Data Radio Channel (DARC) System | Communication |
| | CEA/EIA-795 | Subcarrier Traffic Information Channel (STIC) System | Communication |
| IEEE | IEEE P1512.1 | Standard for Traffic Incident Management Message Sets for Use by EMCs | Message |
| | IEEE P1512.2 | Standard for Public Safety IMMS for use by EMCs | Message |
| | IEEE P1512.3 | Standard for Hazardous Material IMMS for use by EMCs | Message |
| | IEEE P1512.a | Standard for Emergency Management Data Dictionary | Data |
| | IEEE P1512-2000 | Standard for Common Incident Management Message Sets (IMMS) for use by EMCs | Message |
| | IEEE P1556 | Security/Privacy of Vehicle/RS Communications including Smart Card Communications | Communication |
| | IEEE Std 1455-1999 | Standard for Message Sets for Vehicle/Roadside Communications | Message |

Table 7 – Applicable ITS Standards for the Amarillo Region (continued)

| SDO | Document ID | Title | Type |
|-----|-------------|--|---------|
| ITE | ITE TM 1.03 | Standard for Functional Level Traffic Management Data Dictionary (TMDD) | Data |
| | ITE TM 2.01 | Message Sets for External TMC Communication (MS/ETMCC) | Message |
| | ITE TS 3.TM | TCIP – Traffic Management (TM) Business Area Standard | Message |
| SAE | SAE J1746 | ISP-Vehicle Location Referencing Standard | Data |
| | SAE J2313 | On-Board Land Vehicle Mayday Reporting Interface | Message |
| | SAE J2353 | Data Dictionary for Advanced Traveler Information System (ATIS) | Data |
| | SAE J2354 | Message Set for Advanced Traveler Information System (ATIS) | Message |
| | SAE J2369 | Standard for ATIS Message Sets Delivered Over Bandwidth Restricted Media | Message |
| | SAE J2529 | Rules for Standardizing Street Names and Route IDs | Message |
| | SAE J2540 | Messages for Handling Strings and Look-Up Tables in ATIS Standards | Message |

4.6 Phases of Implementation

The Regional ITS Architecture will be implemented through a series of projects led by both public sector and private sector agencies. Key foundation systems will need to be implemented in order to support other systems that have been identified in the Regional Architecture. The deployment of all of the systems required to achieve the final Regional ITS Architecture build out will occur over many years.

A sequence of projects and recommended time frames has been identified in the Amarillo Regional ITS Deployment Plan. These projects have been sequenced over a 20-year period, with projects identified for deployment in a 5-, 10-, and 20-year timeframe.

Some of the key market packages that will provide the functions of the key foundation systems in the Amarillo Region are listed below. Projects associated with these and other market packages identified for the Region have been included in the Amarillo Regional ITS Deployment Plan.

- Network Surveillance;
- Surface Street Control;
- Freeway Control;
- Road Weather Data Collections;
- Transit Vehicle Tracking; and
- Broadcast Traveler Information.

In addition to the above market packages, the implementation of an appropriate communications system in the Region to support ITS is critical for continued deployment of projects.

5. OPERATIONAL CONCEPT

The operational concept for the Amarillo Region provides a description of the stakeholders' roles and responsibilities in the operation of the systems that exist or that are being proposed. This operational concept provides an "executive summary" view of the way the Amarillo Region's systems will work together, and it documents the roles and responsibilities for each of the services that the intelligent transportation system will provide. The approach to describing the operational concept is to present specific operational scenarios that describe and define the stakeholders' general role in providing the services.

In addition to the operational scenarios that illustrate the roles and responsibilities of each agency, a list of the key agencies that are responsible for operations in the eight ITS areas is presented. This list will serve as a high level overview of the different roles and responsibilities in this operational concept. In addition, specific roles and coordination requirements for operations is illustrated through the customized market package diagrams presented in **Appendix A**.

With the integration, information sharing, and in some cases joint operations of systems, there will likely be a requirement for agency agreements. Descriptions of potential agreements that may be needed in the Amarillo Region are included in Section 5.3.

5.1 Operational Scenarios

Scenario 1

The first operational scenario describes how the integrated elements of the Amarillo Region's ITS program will function together in the event of a major incident caused by icy roadways on I-40. In this operational scenario, I-40 which traverses the Texas Panhandle from the New Mexico State line to the Oklahoma state line is instrumented with road weather information system stations (RWIS), some of which have CCTV cameras transmitting images from selected locations. DMS also exist at decision points along the route. In the urban area of Amarillo, vehicle detector stations, dynamic message signs, CCTV cameras and RWIS stations have been installed and provide information to the TxDOT TMC located in Amarillo. All the systems are continuously monitored using an integrated network of detection and monitoring systems providing real-time information to the TMC. At the TxDOT TMC, the surveillance information is assimilated and "packaged" so it can be effectively disseminated to the public through the Amarillo Region's travel information system.

A major snow and ice storm has hit the Texas Panhandle causing dangerous conditions along I-40. The TxDOT maintenance crews have been plowing the snow that has fallen and anti-icing systems are automatically spreading chemicals on bridges and other areas that are prone to freezing. The snow plow operators come upon a jack-knifed tractor-trailer rig on the opposite side of the roadway and immediately radio to TxDOT dispatchers the nature of the crash. A TxDOT TMC operator notifies TxDPS of the incident and the location, and an officer is dispatched immediately. The TxDOT TMC operator zooms in on the incident and surrounding area to monitor conditions so that the other agencies in the incident command can be kept apprised.

In parallel with this activity, a motorist with a cell phone called 911 and reached the TxDPS dispatch center and they recognized that these two notifications of an incident are in fact related to the same location.

Upon arrival at the scene, the TxDPS officer determines that the driver is injured and that the truck was hauling hazardous materials. The officer immediately notifies the TxDPS dispatcher of the details of the incident and the crash scene, and the resources that are needed. The TxDPS dispatcher then sets in motion an incident management strategy. TxDPS dispatch confirms the incident details with TxDOT via an automated alert that is received by the TMC operator who continues to monitor the scene using the CCTV cameras. Knowing that the incident will take several hours to clear, TxDOT immediately sends out HAZMAT crews and a maintenance crew to erect temporary barricades and detour signs to route traffic off of the freeway and on to a pre-determined detour route on Amarillo arterials. The TxDOT operator has activated the DMS and placed a message on the signs in advance of this location advising motorists of the closure of the roadway and the exits to use to leave the freeway. The HAZMAT and maintenance alert also is routed to the City of Amarillo TOC where an alarm notifies the TOC operator of the incident and that traffic from I-40 will be diverted onto city streets for several hours. The Amarillo TOC operator then implements a pre-determined signal timing plan on the primary arterials where freeway traffic is being diverted. Because of the shared use of TxDOT's cameras, the Amarillo TOC operator is able to view the camera images on I-40 to monitor traffic exiting the freeway onto the city arterials.

The same alert that was sent from DPS to TxDOT confirming the incident also was flagged with an emergency request that was automatically routed to the Amarillo Fire Department requesting immediate dispatch of an emergency medical team and vehicle to the scene. With the common radio frequency used by Amarillo emergency service and DPS, the officer on-scene was able to effectively direct the emergency vehicle driver as to the safest, fastest route to the scene.

Scenario 2

In the second operational scenario, it is spring and the recent stormy weather has alerted people that it is tornado season again. A tornado rips through a section of Dalhart completely destroying the local hospital and some neighboring residential areas. The local Dallam County Sheriff Deputies alert the Dallam County Sheriff's office and the neighboring Hartley County Sheriff's office that the tornado has struck and that there is considerable damage in the area. The Dallam County Sheriff arrives at the location of the damage and begins to assess resources that are needed. TxDOT is notified by the Sheriff's Office to send staff and equipment to the area to help clear US 54 that runs through the damaged area. The TxDOT Amarillo TOC coordinates the clean up efforts on the state routes and also updates travelers of road closures through the use of DMS and the TxDOT website. The Dallam County Sheriff Dispatcher places a call to the local EOC requesting additional help. The EOC sends an automated request to other local EOCs for additional resources, such as ambulances and medical teams to assist in moving the patients from the hospital to other facilities in the region. Fires begin to break out in the damaged area that are more than the local fire department can handle. The local EOC sends a request for additional fire vehicles. The Amarillo Fire Department, which had been put on alert by the Amarillo/Randall/Potter EOC, dispatches several fire trucks to the scene. Because all fire vehicles are equipped with AVL, the nearest vehicles to Dalhart with the appropriate equipment are quickly identified and dispatched. An automated alert is also sent from the local EOC to the Statewide EOC to notify them of the potential need for additional resources on a statewide basis. Throughout the emergency, the local incident command center that has been set up in Dalhart is able to coordinate with the Sheriff's Office, TxDOT, EOCs and fire vehicles through a common radio frequency.

5.2 Roles and Responsibilities

The operational scenarios described in the previous section illustrate the interagency cooperation and coordination that is required in two situations that might occur in the Amarillo Region. During any operational scenario, a number of agencies will be required to coordinate closely to perform their operational responsibilities. The key agencies that have a lead role or responsibility during operations are listed below for each ITS area. It is recognized that a number of other agencies will also need to be involved during a scenario in addition to the ones listed below, although it is not expected that these agencies will play as critical a role in operations.

Travel and Traffic Management

- City of Amarillo (Police, Traffic)
- County Road and Bridge
- Other State Departments of Transportation
- Other Texas Department of Transportation Districts
- Texas Department of Public Safety
- Texas Department of Transportation

Public Transportation Management

- City of Amarillo
- Independent School Districts
- Panhandle Transit

Electronic Payment

- Not Applicable

Commercial Vehicle Operations

- Texas Department of Public Safety
- Texas Department of Transportation

Emergency Management

- Amarillo/Potter/Randall Emergency Operations Center
- BWXT Pantex
- City of Amarillo (Police, Fire, Traffic)
- Local City/County EOCs
- Local County Sheriffs
- Local Law Enforcement
- Panhandle Emergency Medical Services System
- Texas Department of Public Safety
- Texas Department of Transportation

Information Management

- Amarillo MPO
- Texas Department of Transportation

Maintenance and Construction Operations

- City of Amarillo
- County Road and Bridge
- Texas Department of Transportation

5.3 Amarillo Agreements

The Regional ITS Architecture for the Amarillo Region has identified several agency interfaces, information exchanges, and integration strategies that would be needed to provide the ITS services and systems identified by the stakeholders in the Region. Interfaces and data flows among public and private entities in the Amarillo Region will require agreements among agencies that establish parameters for sharing agency information to support traffic management, incident management, provide traveler information, and other functions identified in the Regional ITS Architecture.

Currently, there are few formal agreements in place in the Amarillo Region. Stakeholders indicated that while there is a high degree of cooperation among agencies, there hasn't been a need for formal agreements to facilitate multi-jurisdictional resource sharing, cooperation or mutual aid. With the implementation of ITS technologies, integrating systems from one or more agencies, and the anticipated level of information exchange identified in the architecture, it is likely that more formal agreements will be needed. These agreements, while perhaps not requiring a financial commitment from agencies in the Region, should outline specific roles, responsibilities, data exchanges, levels of authority, and other facets of regional operations. Some agreements also will outline specific funding responsibilities, where appropriate and applicable.

Table 8 provides a list of potential agreements for the Amarillo Region based on the interfaces identified in the Regional Architecture. It is important to note that as ITS services and systems are implemented in the Region, part of the planning and review process for those projects should include a review of potential agreements that would be needed for implementation or operations.

Table 8 – Potential Agreements for the Amarillo Region

| Agreement and Agencies | Status | Agreement Description | Considerations |
|---|---|--|--|
| Municipal Maintenance Agreements | Existing (in process of being revised) | TxDOT Amarillo has municipal maintenance agreements with 34 cities and towns in the Region. These are for roadway maintenance for state highways and routes within city limits. These agreements cover such items as snowplowing, sweeping, signing, and repairs. | These agreements are strictly for roadway maintenance activities. |
| Signal Agreements TxDOT and City of Amarillo | Existing | TxDOT and the City of Amarillo have an existing agreement whereby TxDOT reimburses the City for maintaining the traffic signals at freeway interchanges. | This agreement covers interchange signals only, and is only with the City of Amarillo. |
| Data Sharing and Usage (Public) TxDOT Amarillo District and Public Agencies within the Region | Future | This agreement would define the parameters, guidelines and policies for inter- and intra-agency ITS data sharing. This data sharing would support regional activities related to traffic management, incident management, and traveler information, and other functions. 'Data' also would include video images from CCTV cameras. The terms of this agreement should generally address such items as: <ul style="list-style-type: none"> ▪ Agency as information source ▪ Types of data and information to be shared ▪ Repository for information (i.e., TxDOT Amarillo TMC as central hub) ▪ How the information will be used (traffic incident management, displayed on web site for travel information, distributed to private media, etc.) ▪ Parameters for data format, quality, security | These agreements are typically zero-dollar agreements, in that there is no charge among agencies for the actual data, although there might be some cost incurred for infrastructure, systems or fiber to enable communications between agencies. |

Table 8 – Potential Agreements for the Amarillo Region

| Agreement and Agencies | Status | Agreement Description | Considerations |
|--|---------------------|---|--|
| <p>Data Sharing and Usage (Public-Private)</p> <p>TxDOT Amarillo District and Private Media/Information Service Providers</p> | Future | <p>This agreement would define the parameters, guidelines and policies for private media use of regional ITS-related information from TxDOT Amarillo. This type of agreement is recommended between TxDOT (data provider) and the media (data user) to define terms of use for broadcasting public-agency information regarding traffic conditions, closures, restrictions, as well as video images. Agreements can also include requirements for the media to 'source' the information (i.e., using the TxDOT logo on all video images broadcast).</p> | <p>These agreements can be zero-dollar agreements, although some agencies have stipulated identifying the information, public service announcements by the media, or other requirements as a term of use. The private media entity is typically responsible for paying any necessary costs for access (i.e., communications infrastructure to link to the TxDOT database or video switch). These agreements also typically include a sunset clause to allow the agency to periodically review the agreement and make any modifications prior to renewal.</p> |
| <p>Shared Video Monitoring (Public)</p> <p>TxDOT, TxDPS, BWXT Pantex, Amarillo Police, Amarillo Fire, Amarillo/Randall/Potter EOC</p> | Future | <p>This agreement would enable shared video monitoring of TxDOT CCTV cameras by public safety and emergency services agencies in the Amarillo Region for incident management purposes. This agreement would define the parameters and policies for public safety agencies to access video images via the TxDOT video switch. It is recommended that the agreement include any TxDOT policies relating to video images (including archiving, privacy, disclaimers, use of video and redistribution) as well as processes for agency requests for specific views. Shared video monitoring does not address shared use or shared control of video equipment functions.</p> | <p>These agreements are typically zero-dollar agreements, in that there is no charge among agencies for the actual data, although there might be some cost incurred for infrastructure, systems or fiber to enable communications between agencies, particularly with the high bandwidth required for transmitting live video images.</p> |
| <p>Mutual Aid Agreements (Public)</p> <p>TxDPS, BWXT Pantex, Amarillo Fire, Amarillo Police, EOCs, TxDOT, PEMSS</p> | Existing (Informal) | <p>Mutual aid agreements currently exist as informal arrangements in the Amarillo Region, although they are a routine practice among public safety and emergency services agencies. Formal mutual aid agreements will become more important as agencies integrate systems and capabilities, particularly automated dispatch and notification.</p> | <p>These agreements are typically zero-dollar agreements, although there might be some funding required to support regional incident management activities. The agreement also would outline resource commitments that would be part of any mutual aid arrangement (personnel, equipment, facilities, etc.).</p> |

Table 8 – Potential Agreements for the Amarillo Region

| Agreement and Agencies | Status | Agreement Description | Considerations |
|---|---------------|---|--|
| <p>Joint Operations/Shared Control Agreements (Public)</p> <p>TxDOT, City of Amarillo, TxDPS (potential)</p> | <p>Future</p> | <p>These agreements are formal arrangements to allow joint operations or control of certain systems and equipment. The agreement would need to define the terms of this arrangement, such as hours of operation and time of day/time of week where shared control would take effect, circumstances or incidents where shared control would take effect, notification procedures between the agencies agreeing to shared control arrangements, etc. Additional agencies (such as TxDPS) could be part of a joint operations/shared control agreement for certain types of devices.</p> | <p>Joint operations/shared control agreements could consider some form of mutual funding for certain system elements, primarily communication links.</p> |