State of Texas
Regional ITS Architectures and Deployment Plans

San Angelo Region

Regional ITS Deployment Plan

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REGIONAL ITS DEPLOYMENT PLAN

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LIST OF ACRONYMS

ATIS	Advanced Travel Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
CAD	Computer-Aided Dispatch
CCTV	Closed-Circuit Television
COG	Council of Governments
DMS	Dynamic Message Sign
DPS	Department of Public Safety
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
GIS	Geographic Information System
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HCRS	Highway Condition Reporting System
HRI	Highway-Rail Intersections
ISP	Information Service Provider
ITS	Intelligent Transportation System
MDT	Mobile Data Terminal
MPO	Metropolitan Planning Organization
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
PTZ	Pan/Tilt/Zoom
RFID	Radio Frequency Identification
RWIS	Road Weather Information System
TEA-21	Transportation Equity Act for the 21st Century
TMC	Transportation Management Center

LIST OF ACRONYMS

TOC	Traffic Operations Center Transit Operations Center
TxDOT	Texas Department of Transportation
USGS	United States Geological Survey
VIVDS	Video Image Vehicle Detector 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 the Texas Department of Transportation (TxDOT) initiated the development of regional ITS architectures and deployment plans throughout the State of Texas. Although not required by the FHWA final rule, TxDOT took the opportunity to also develop an ITS deployment plan for each Region. The San Angelo Regional ITS Architecture and Regional ITS Deployment Plan were prepared as part of this initiative.

The San Angelo Regional ITS Deployment Plan outlines a vision for ITS deployment, and identifies and prioritizes projects that are needed to implement the ITS architecture on a short-, medium-, and long-term basis. In doing so, this plan also helps the Region to prioritize funding decisions. As infrastructure is incrementally built-out over a 20-year horizon, integration among key foundation systems in the Region can occur as the system grows and expands.

Stakeholders from throughout the Region participated in the development of the Regional ITS Deployment Plan. Participants included representatives from TxDOT, cities, counties, transit agencies, the metropolitan planning organization and council of governments, and federal agencies.

Building on the dialogue, consensus, and vision outlined in the Regional ITS Architecture, stakeholders in the San Angelo Region prioritized market packages and potential ITS projects for deployment in the Region. Projects were identified to correspond to the needs and priorities identified by the regional stakeholders, and were categorized into 5-year, 10-year, and 20-year timeframes.

The majority of ITS projects recommended for the San Angelo Region were identified in the following key areas:

- Travel and Traffic Management;
- Emergency Management; and
- Public Transportation Management.

Recommended ITS projects in the 5-year, 10-year, and 20-year deployment timeframes were summarized in tables for each deployment horizon. This summary included the project name and a brief description, primary responsible agency, a planning level estimate of probable cost, an indication of whether or not funding had been identified for that project, as well as an estimated duration for implementation. For each recommended ITS project, more detailed project descriptions were developed which mapped each project back to applicable market packages and also identified any prerequisite project requirements.

With the substantial amount of effort invested by stakeholders in the San Angelo Region to develop both the Regional ITS Architecture and the Deployment Plan, developing a plan for maintaining these important tools was a key component of the process.

1. INTRODUCTION

1.1 Project Overview

The FHWA final rule to implement Section 5206(e) of the TEA-21 requires 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, the TxDOT initiated the development of regional ITS architectures and deployment plans throughout the State of Texas. Although not required by the FHWA final rule, TxDOT sought to have an ITS deployment plan developed for each Region. The ITS Deployment Plan outlines a vision for ITS deployment in the Region and identifies and prioritizes projects that are needed to implement the ITS architecture on a short- medium- and long-term basis. In doing so, this plan also helps the Region to prioritize funding decisions by having a comprehensive, phased approach to the regional ITS programs, so that the infrastructure can be incrementally built-out over a 20-year horizon, and integration among key foundation systems in the Region can occur as the system grows and expands.

The San Angelo Regional ITS Deployment Plan was developed using the Regional ITS Architecture developed in 2004. Through the architecture development process, stakeholders reached consensus on the transportation needs in the Region that could be addressed with ITS, worked with the architecture team to customize and prioritize market packages that formed the basis for the ITS Deployment Plan, and identified the required interfaces to provide the desired level of integration of systems and agencies within the San Angelo Region.

The San Angelo Regional ITS Architecture provided the framework and prioritized the key functions and services desired by stakeholders in the Region. The ITS Deployment Plan builds on the architecture by outlining specific ITS project recommendations and strategies for the Region, and identifying deployment timeframes so that the recommended projects and strategies can be implemented over time. Agency responsibilities for implementing and operating the systems also are a key component of the ITS Deployment Plan.

1.2 Document Overview

The San Angelo Regional ITS Deployment Plan is organized into four key sections:

Section 1 – Introduction

This section provides a brief overview of the San Angelo Regional ITS Deployment Plan, as well as an overview of some of the key features and stakeholders in the San Angelo Region.

Section 2 – Prioritization of Market Packages

Section 2 contains the prioritized market packages for the San Angelo Region. Included in this section is an overview of the prioritization process and detailed descriptions of the high, medium and low priority market packages.

Section 3 – Prioritization of Projects

Project recommendations have been developed for the San Angelo Region to provide an incremental, phased build-out of the Region's ITS. These projects are categorized into 5-year, 10-year, and 20-year deployment timeframes. Each project recommendation includes a brief description, responsible agency, associated market packages, pre-requisite projects or systems, and an estimate of probable cost.

Section 4 – Maintaining the Regional ITS Architecture and Deployment Plan

A procedure for maintaining the ITS Deployment Plan and submitting new projects to add to the plan is recommended in this section.

1.3 The San Angelo Region

1.3.1 Geography and Regional Characteristics

The San Angelo Region is bordered by the TxDOT Abilene District to the north, the TxDOT Laredo and San Antonio Districts to the south, the TxDOT Brownwood and Austin Districts to the east, and the TxDOT Odessa District to the west. For the San Angelo Regional ITS Architecture and Deployment Plan, the study area included all 15 counties that comprise the TxDOT San Angelo District.

The counties included in the San Angelo Region area are:

- Coke;
- Concho;
- Crockett;
- Edwards;
- Glasscock;
- Irion;
- Kimble;
- Menard;
- Reagan;
- Real;
- Runnels;
- Schleicher;
- Sterling;
- Sutton; and
- Tom Green.

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 San Angelo is the only city in the project Region with a population that exceeds the 50,000 threshold.

1.3.2 Transportation Infrastructure

The San Angelo Region has an extensive transportation infrastructure. The primary roadway facilities include I-10, US-67, US-83, US-87, US-190, US-277, and US-377.

I-10 is an east-west, divided interstate highway. The effective operation of this highway is critical to the movement of goods and people through the State of Texas and the United States. I-10 starts in Jacksonville, Florida at I-95 and ends in Santa Monica, California at the Pacific Ocean. Blockages along I-10 can have serious implications for drive-time for commercial vehicles and motorists alike due to the lack of obvious alternate routes. Knowing the road and travel conditions within this transportation corridor and having the ability to disseminate this information to motorists are important elements for this project. For example, if I-10 has been closed due to a major incident or weather, and motorists are informed of the closure in advance, they can alter their travel plans with an alternate route or wait to begin their travels.

San Angelo is served by the Texas Pacifico Nuevo Railroad, a shortline railroad operating between the major U.S. railroads in Fort Worth and the U.S./Mexico border crossing at Presidio, Texas and Ojinaga, Mexico in the State of Chihuahua.

The San Angelo Street Railroad Company is operated by the City of San Angelo. In addition, San Angelo is served by two motor bus lines with direct schedules to all major cities in Texas and the nation, which include Kerrville Bus Lines and Sunset Stages. Concho Coaches provides daily van service to the Midland-Odessa Airport.

1.3.3 Existing ITS in the San Angelo Region

Within the San Angelo Region there are currently several ITS applications in place. TxDOT has several portable dynamic message signs (DMS) that are utilized primarily for displaying construction and delay information.

Video Image Vehicle Detection Systems (VIVDS) have been installed at two intersections in the Region by TxDOT.

Signal preemption for emergency vehicles is in place within the City of San Angelo for fire and police vehicles and several emergency management agencies are utilizing computer aided dispatch systems.

1.3.4 San Angelo 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 San Angelo Region.

The following is a list of stakeholders in the San Angelo 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 San Angelo Regional ITS Architecture and Deployment Plan:

- Angelo State University;
- City of Fort Stockton;
- City of San Angelo;
- Concho County;
- Concho Valley Council of Governments;
- Concho Valley Rural Transit District;
- Goodfellow Air Force Base;
- Irion County;
- Kimble County;
- National Weather Service;
- San Angelo Community Medical Center;
- San Angelo Metropolitan Planning Organization;
- Tom Green County;
- TxDOT Odessa District;
- TxDOT Public Transportation Division;
- TxDOT San Angelo District;
- TxDOT San Antonio District;
- TxDOT Traffic Operations Division; and
- US Geological Survey.

Stakeholder agencies that are participating in the development of the San Angelo Regional ITS Deployment Plan are listed in **Table 1** along with contact information for agency representatives that have participated.

Table 1 – San Angelo Stakeholder Agencies and Contacts

Stakeholder Agency	Contact	Address	Phone Number	E-Mail
Angelo State University	James Adams	1905 S. Johnson San Angelo, Texas 76904	325-942-2071	james.adams@angelo.edu
City of Fort Stockton	Daniel Valenzuela	121 West 2nd Street Fort Stockton, Texas 79735	432-336-8525	N/A
City of San Angelo	Alonzo Carrasco	1729-B St. Ann Street San Angelo, Texas 76905	325-657-4377	sasignal@wcc.net
City of San Angelo	Noe Flores	700 E. Ave. K San Angelo, Texas 76903	325-657-4281	N/A
City of San Angelo Police Department	Mark Englert	401 E Beauregard San Angelo, Texas 76903	325-657-4464	mark.englert@sanangelopolice.org

Table 1 – San Angelo Stakeholder Agencies and Contacts (continued)

Stakeholder Agency	Contact	Address	Phone Number	E-Mail
Concho County	Allen Amos	152 N. Roberts Avenue Paint Rock, Texas 76866	325-732-4321	conchojudge@yahoo.com
Concho Valley Council of Governments	Hilda Arredondo-Garibay	5002 Knickerbocker Road San Angelo, Texas 76904	325-944-9666	hilda@cvcog.org
Concho Valley Council of Governments	Jeffery Sutton	5002 Knickerbocker Road San Angelo, Texas 76904	325-944-9666	jsutton@cvcog.org
Concho Valley Rural Transit District	Robert Stephens	5002 Knickerbocker Road San Angelo, Texas 76904	325-944-9666	rob@cvcog.org
Goodfellow AFB	James Creighton	460 E Kearney Blvd San Angelo, Texas 76908	325-654-5718	james.creighton@goodfellow.af.mil
Irion County	Leon Standard	209 N. Park View Mertzon, Texas 76941	325-835-4361	leon.standard@co.irion.tx.us
Kimble County	Delbert Roberts	501 Main Junction, Texas 76849	325-446-2724	N/A
National Weather Service	Hector Guerrero	San Angelo Weather Forecast Office 7654 Knickerbocker Road San Angelo, Texas 76904	325-944-3030	hector.guerrero@noaa.gov
National Weather Service	Jason Johnson	San Angelo Weather Forecast Office 7654 Knickerbocker Road San Angelo, Texas 76904	325-944-3030	jason.johnson@noaa.gov
National Weather Service	Curt Kockx	San Angelo Weather Forecast Office 7654 Knickerbocker Road San Angelo, Texas 76904	325-944-3030	curt.kockx@noaa.gov
San Angelo Community Medical Center	Samuel Feazell	3501 Knickerbocker Road San Angelo, Texas 76904	325-949-9511	N/A
San Angelo Metropolitan Planning Organization	Alicia Ramirez	P.O. Box 1751 San Angelo, Texas 76902	325-657-4210	aramirez@sanangelompo.org
San Angelo Metropolitan Planning Organization	E'Lisa Smetana	P.O. Box 1751 San Angelo, Texas 76902	325-657-4210	smetanae@sanangelompo.org
Tom Green County	Michael Brown	112 W Beauregard San Angelo, TX 76903	325-653-3318	mike.brown@co.tom-green.tx.us
TxDOT Odessa District	Robert Martinez	3901 E. Hwy 80 Odessa, Texas 79761	432-498-4748	N/A
TxDOT Public Transportation Division	Ben Herr	125 E. 11th Street Austin, Texas 78701-2483	512-416-2812	lherr@dot.state.tx.us
TxDOT San Angelo District	John DeWitt	4502 Knickerbocker Road San Angelo, Texas 76904	325-947-9265	jdewitt@dot.state.tx.us
TxDOT San Angelo District	Juan Flores	2802 Armstrong San Angelo, Texas 76903	325-653-5811	jflore2@dot.state.tx.us

Table 1 – San Angelo Stakeholder Agencies and Contacts (continued)

Stakeholder Agency	Contact	Address	Phone Number	E-Mail
TxDOT San Angelo District	Donna Hill	4502 Knickerbocker Road San Angelo, Texas 76904	325-947-9206	dhill1@dot.state.tx.us
TxDOT San Angelo District	Edwin Kloboucnik	4502 Knickerbocker Road San Angelo, Texas 76904	325-947-9213	eklobou@dot.state.tx.us
TxDOT San Angelo District	Walter McCullough	4502 Knickerbocker Road San Angelo, Texas 76904	325-944-1501	wmccull@dot.state.tx.us
TxDOT San Angelo District	Angie Ortegon	4502 Knickerbocker Road San Angelo, Texas 76904	325-947-9211	aortego@dot.state.tx.us
TxDOT San Angelo District	Donald Peterson	2802 Armstrong San Angelo, Texas 76903	325-653-5811	dpeters@dot.state.tx.us
TxDOT San Angelo District	Tommy Robinson	4502 Knickerbocker Road San Angelo, Texas 76904	325-944-1501	trobins@dot.state.tx.us
TxDOT San Angelo District	Hilario Rodarte	708 US 277 North Sonora, Texas 76950	325-387-3166	hrodart@dot.state.tx.us
TxDOT San Angelo District	Diane Weishuhn	4502 Knickerbocker Road San Angelo, Texas 76904	325-947-9285	dweishu@dot.state.tx.us
TxDOT San Angelo District	Dennis Wilde	4502 Knickerbocker Road San Angelo, Texas 76904	325-944-1501	dwilde@dot.state.tx.us
TxDOT San Antonio District	David Rodrigues	3500 NW Loop 410 San Antonio, Texas 78229	210-738-0111	drodri@dot.state.tx.us
TxDOT Traffic Operations Division	Alesia Gamboa	Attn: TRF-Cedar Park #51 125 East 11th Street Austin, Texas 78701-2483	512-506-5154	agamboa@dot.state.tx.us
USGS	Dave Holmes	3010 Buchanan Wichita Falls, Texas 76308	940-692-4283	dholmes@usgs.gov
USGS	Jimmy Pond	944 Arroyo Drive San Angelo, Texas 76903	325-944-4600	jgpond@usgs.gov

2. PRIORITIZATION OF MARKET PACKAGES

2.1 Prioritization Process

Of the 75 available market packages in the National ITS Architecture Version 4.0, 34 were selected and customized for deployment in the San Angelo Region. Stakeholders were asked to prioritize the market packages into high, medium, and low priorities, based on regional needs, feasibility and likelihood of deployment, and overall contribution of the market package to the goals and vision for ITS functionality in the Region. A summary of these prioritized market packages is shown in **Table 2**.

The market package prioritization was a key factor in developing recommendations for ITS deployment and integration in the San Angelo Region. These priorities identified the key needs and services that are desired in the San Angelo Region, as well as the interfaces that need to be established to provide integrated functionality and establish communication between elements.

This section includes detailed descriptions of the prioritized market packages for the San Angelo Region. The market packages are organized into high, medium, and low priorities. It is important to note that the high, medium, and low prioritization does not necessarily correspond to any specific time frame (such as five, ten, or twenty year deployment horizon). For example, a market package can be a high priority, but because of funding or prerequisite project requirements, it might not be feasible for deployment for several years. Maturity and availability of technology were other factors for prioritizing the market packages. Other considerations included whether or not the market package was better suited for private deployment and operations rather than public. As an example, Internet Service Provider (ISP)-based Route Guidance might be viewed as a valuable traveler information service for motorists in the Region, but stakeholders felt this market package was best suited for deployment by a private service provider, and as such, deemed it a low priority for agencies in the Region.

Each market package in the following subsections includes:

- A brief definition of the market package (which has been modified from the National ITS Architecture definitions);
- Any existing infrastructure from that market package that is already existing in the San Angelo Region;
- Agencies currently operating or maintaining systems that apply to that market package;
- Planned projects that will address some or all of the services that are contained in the market package; and
- Any additional needs to bring the market package to the desired level of deployment or functionality.

Table 2 – Summary of Prioritized Market Packages for the San Angelo Region

High Priority	Medium Priority	Low Priority
▪ Network Surveillance ▪ Surface Street Control ▪ Traffic Information Dissemination ▪ Regional Traffic Control ▪ Incident Management System ▪ Emergency Response ▪ Emergency Vehicle Routing ▪ Road Weather Data Collection ▪ Weather Information Processing and Distribution ▪ Work Zone Safety Monitoring ▪ Maintenance and Construction Activity Coordination ▪ Transit Vehicle Tracking ▪ Transit Fixed-Route Operations ▪ Demand Response Transit Operations ▪ Multi-modal Coordination ▪ Transit Traveler Information ▪ HAZMAT Management ▪ Broadcast Traveler Information Systems ▪ ITS Data Mart	▪ Standard Railroad Grade Crossing ▪ Railroad Operations Coordination ▪ Speed Monitoring ▪ Red Light Running ▪ Maintenance and Construction Vehicle Maintenance ▪ Roadway Maintenance and Construction ▪ Work Zone Management ▪ Transit Passenger and Fare Management ▪ Transit Security ▪ Transit Maintenance ▪ ITS Data Warehouse	▪ Probe Surveillance ▪ Maintenance and Construction Vehicle Tracking ▪ Winter Maintenance ▪ ISP Based Route Guidance

2.2 High Priority Market Packages

Market packages that were selected as high priorities for the San Angelo Region are listed and described in **Table 3**. These market packages typically represent systems or functions that serve as foundations on which to build regional ITS programs. Listed in this section are market packages that address baseline control, monitoring and coordination technologies for surface streets and freeways, road/weather conditions data gathering, transit, incident management and emergency response.

Many of these high priority market packages have components that are in various stages of deployment and operation in the San Angelo Region; that is, there are already systems and technologies deployed to deliver some of these high priority services and functions. For example,

the City of San Angelo closed loop signal systems have already been deployed and these are key components of the Surface Street Control market package. Although these devices are in place, this market package is still listed as a high priority. There are additional capabilities and functionality contained in this market package that are planned for implementation in the near-term, thus building on the existing infrastructure and expanding the services of this particular market package in the San Angelo Region.

Table 3 – High Priority Market Packages for the San Angelo Region

Network Surveillance (ATMS01)	**High Priority**
This market package includes traffic detectors, other surveillance equipment, the supporting field equipment, and wireline communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally or remotely. The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect equipment faults, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem.	
Existing Infrastructure ▪ TxDOT San Angelo VIVDS ▪ TxDOT San Angelo TMC	**Agency** ▪ TxDOT
Planned Projects ▪ TxDOT ATMS Implementation	
Additional Needs ▪ City of San Angelo CCTV Camera Implementation ▪ City of San Angelo Closed Loop Signal System Implementation Phase 1 ▪ City of San Angelo Closed Loop Signal System Implementation Phase 2 ▪ City of San Angelo Closed Loop Signal System Implementation Phase 3 ▪ City of San Angelo Flood Detection ▪ City of San Angelo Rail Crossing Warning System ▪ City of San Angelo TOC Enhancements ▪ City of San Angelo VIVDS ▪ TxDOT CCTV Camera Implementation ▪ TxDOT Closed Loop Signal System Implementation Phase 1 ▪ TxDOT Closed Loop Signal System Implementation Phase 2 ▪ TxDOT Closed Loop Signal System Implementation Phase 3 ▪ TxDOT Flood Detection ▪ TxDOT RWIS Stations ▪ TxDOT San Angelo District TMC Upgrades ▪ TxDOT VIVDS	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Surface Street Control (ATMS03)	**High Priority**
This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. A range of traffic signal control systems are represented by this market package ranging from static pre-timed control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This market package is consistent with typical urban traffic signal control systems.	
Existing Infrastructure ▪ TxDOT San Angelo TMC ▪ TxDOT VIVDS ▪ TxDOT Closed Loop Signal System ▪ TxDOT Overheight Truck Detection ▪ City of San Angelo Closed Loop Signal System	**Agency** ▪ TxDOT ▪ City of San Angelo
Planned Projects None identified at this time	
Additional Needs ▪ City of San Angelo CCTV Camera Implementation ▪ City of San Angelo Closed Loop Signal System Implementation Phase 1 ▪ City of San Angelo Closed Loop Signal System Implementation Phase 2 ▪ City of San Angelo Closed Loop Signal System Implementation Phase 3 ▪ City of San Angelo Rail Crossing Warning System ▪ City of San Angelo School Zone Flasher Pager System ▪ City of San Angelo TOC Enhancements ▪ City of San Angelo VIVDS ▪ Evacuation/Detour Route Planning ▪ TxDOT CCTV Camera Implementation ▪ TxDOT Closed Loop Signal System Implementation Phase 1 ▪ TxDOT Closed Loop Signal System Implementation Phase 2 ▪ TxDOT Closed Loop Signal System Implementation Phase 3 ▪ TxDOT Emergency Vehicle Traffic Signal Preemption Implementation ▪ TxDOT San Angelo District TMC Upgrades ▪ TxDOT School Zone Flasher Pager System ▪ TxDOT VIVDS	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Traffic Information Dissemination (ATMS06)	**High Priority**
This market package allows traffic information and road/bridge closures due to construction, maintenance, and weather, to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers.	
Existing Infrastructure ▪ TxDOT HCRS	**Agency** ▪ TxDOT
Planned Projects ▪ TxDOT ATMS Implementation ▪ TxDOT Center-to-Center Communication ▪ TxDOT HCRS Enhancements	
Additional Needs ▪ City of San Angelo DMS ▪ City of San Angelo Public Safety Communications/City of San Angelo TOC Communications Connection ▪ City of San Angelo Rail Crossing Warning System ▪ City of San Angelo TOC/TxDOT TMC Communications Connection ▪ City of San Angelo TOC Enhancements ▪ Media Liaison and Coordination ▪ Regional 511 Advanced Traveler Information System Server ▪ San Angelo Regional EOC/City of San Angelo TOC Communications Connection ▪ San Angelo Regional EOC/TxDOT San Angelo TMC Communications Connection ▪ San Angelo Street Railroad Company/City of San Angelo TOC Communications Connection ▪ Thunderbird Transit/City of San Angelo TOC Communications Connection ▪ Thunderbird Transit/TxDOT TMC Communications Connection ▪ TxDOT Additional DMS ▪ TxDOT Additional Portable DMS ▪ TxDOT DMS on I-10 ▪ TxDOT Highway Advisory Radio ▪ TxDOT Rest Area Kiosks Phase 1 ▪ TxDOT Rest Area Kiosks Phase 2 ▪ TxDOT San Angelo District TMC Upgrades ▪ TxDOT San Angelo District Website Customization and Enhancement	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Regional Traffic Control (ATMS07)	**High Priority**
This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. This package relies on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. The extent of information and control sharing is determined through working arrangements between jurisdictions.	
Existing Infrastructure None identified	**Agency**
Planned Projects ▪ TxDOT ATMS Implementation ▪ TxDOT Center-to-Center Communication	
Additional Needs ▪ City of San Angelo TOC Enhancements ▪ City of San Angelo TOC/TxDOT TMC Communications Connection ▪ TxDOT San Angelo District TMC Upgrades	

Incident Management System (ATMS08)	**High Priority**
This market package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The market package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management, and emergency management centers as well as weather service entities and event promoters. Information from these diverse sources is collected and correlated by this market package to detect and verify incidents and implement an appropriate response. The response may include traffic control strategy modifications or resource coordination between center subsystems. The coordination with emergency management might be through a computer-aided dispatch (CAD) system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination, Broadcast Traveler Information, or Interactive Traveler Information market packages.	
Existing Infrastructure ▪ NOAA Emergency Weather Condition Notification ▪ City of San Angelo EOC ▪ County Emergency Management Plans	**Agency** ▪ NOAA ▪ City of San Angelo ▪ Counties
Planned Projects ▪ Emergency Call Out System ▪ Mobile Command Centers for Emergency Operations ▪ TxDOT ATMS Implementation ▪ TxDOT Center-to-Center Communication ▪ TxDOT HCRS Enhancements	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Incident Management System (ATMS08) (continued)	High Priority
Additional Needs	
▪ City of San Angelo CCTV Camera Implementation ▪ City of San Angelo DMS ▪ City of San Angelo Public Safety Communications/City of San Angelo TOC Communications Connection ▪ City of San Angelo TOC/TxDOT TMC Communications Connection ▪ City of San Angelo TOC Enhancements ▪ Evacuation/Detour Route Planning ▪ HAZMAT Incident Notification System ▪ Media Liaison and Coordination ▪ Regional 511 Advanced Traveler Information System Server Implementation ▪ San Angelo Regional EOC/City of San Angelo TOC Communications Connection ▪ San Angelo Regional EOC/TxDOT San Angelo TMC Communications Connection ▪ TxDOT Additional DMS ▪ TxDOT Additional Portable DMS ▪ TxDOT CCTV Camera Implementation ▪ TxDOT DMS on I-10 ▪ TxDOT Emergency Vehicle Traffic Signal Preemption Implementation ▪ TxDOT Highway Advisory Radio ▪ TxDOT San Angelo District TMC Upgrades ▪ TxDOT San Angelo District Webpage Customization and Enhancement	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Emergency Response (EM01)	**High Priority**
This market package includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification and coordinated response between agencies.	
Existing Infrastructure ▪ City of San Angelo Public Safety Central Dispatch/Communications with CAD System ▪ City of San Angelo Emergency Vehicles AVL and MDTs ▪ DPS Computer Aided Dispatch	**Agency** ▪ City of San Angelo ▪ DPS
Planned Projects ▪ Emergency Call Out System ▪ Mobile Command Centers for Emergency Operations	
Additional Needs ▪ City of San Angelo Public Safety Communications/City of San Angelo TOC Communications Connection ▪ HAZMAT Incident Notification System ▪ Rural Fire Department AVL and MDTs	

Emergency Vehicle Routing (EM02)	**High Priority**
This market package supports automated vehicle location and dynamic routing of emergency vehicles. The service also supports coordination with the Traffic Management Subsystem, collecting detailed road network conditions and requesting special priority or other specific emergency traffic control strategies on the selected route(s). The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.	
Existing Infrastructure ▪ City of San Angelo Emergency Vehicle Signal Preemption ▪ City of San Angelo Emergency Vehicles AVL and MDTs	**Agency** ▪ City of San Angelo
Planned Projects None identified at this time	
Additional Needs ▪ City of San Angelo Public Safety Communications/City of San Angelo TOC Communications Connection ▪ Rural Fire Department AVL and MDTs ▪ TxDOT Emergency Vehicle Traffic Signal Preemption Implementation	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Road Weather Data Collection (MC03)	**High Priority**
This market package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway. In addition to fixed road weather information system (RWIS) stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on Maintenance and Construction Vehicles. The collected environmental data is used by the Weather Information Processing and Distribution Market Package to process the information and help operators make decisions on operations.	
Existing Infrastructure None identified	**Agency**
Planned Projects ▪ TxDOT ATMS Implementation	
Additional Needs ▪ City of San Angelo Flood Detection ▪ TxDOT Flood Detection ▪ TxDOT RWIS Stations	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Weather Information Processing and Distribution (MC04)	**High Priority**
This market package processes and distributes the environmental information collected from the Road Weather Data Collection market package. This market package uses the environmental data to detect environmental hazards such as icy road conditions, high winds, and dense fog, so system operators and decision support systems can make decisions on corrective actions to take. The continuing updates of road condition information and current temperatures can be used by system operators to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers using the Traffic Information Dissemination market package, and aid operators in scheduling work activity.	
Existing Infrastructure ▪ NOAA Emergency Weather Condition Notification ▪ TxDOT HCRS	**Agency** ▪ NOAA ▪ TxDOT
Planned Projects ▪ Emergency Call-Out System ▪ TxDOT ATMS Implementation ▪ TxDOT Center-to-Center Communication ▪ TxDOT HCRS Enhancements	
Additional Needs ▪ City of San Angelo Low Water Crossing Flashing Beacon Warning Signs ▪ Media Liaison and Coordination ▪ Regional 511 Advanced Traveler Information System Server Implementation ▪ TxDOT Low Water Crossing Flashing Beacon Warning Signs ▪ TxDOT Rest Area Kiosks Phase 1 ▪ TxDOT Rest Area Kiosks Phase 2 ▪ TxDOT San Angelo District/NOAA Communications Connection ▪ TxDOT San Angelo District/USGS Communications Connection	

Work Zone Safety Monitoring (MC09)	**High Priority**
This market package includes systems and strategies to improve work crew safety and reduce collisions between the motoring public and maintenance vehicles and activities. Included in this market package is detection for vehicle intrusions to the work zone and warning systems to alert workers and drivers of potential safety hazards. This market package support both stationary and mobile work zones.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ TxDOT Work Zone Intrusion Detection System	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Maintenance and Construction Activity Coordination (MC10)	**High Priority**
This market package supports the dissemination of maintenance and construction activity information to centers which can utilize it as part of their operations, or to the Information Service Providers who can provide the information to travelers.	
Existing Infrastructure ▪ TxDOT HCRS	**Agency** ▪ TxDOT
Planned Projects ▪ TxDOT Center-to-Center Communication ▪ TxDOT HCRS Enhancements	
Additional Needs ▪ Media Liaison and Coordination ▪ Regional 511 Advanced Traveler Information System Server Implementation ▪ TxDOT Highway Advisory Radio ▪ TxDOT San Angelo District Webpage Customization and Enhancement	

Transit Vehicle Tracking (APTS1)	**High Priority**
This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ San Angelo Street Railroad Company AVL and MDTs ▪ Thunderbird Transit AVL and MDTs ▪ Thunderbird Transit Central Dispatch with CAD System	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Transit Fixed-Route Operations (APTS2)	**High Priority**
This market package performs vehicle routing and scheduling, as well as automatic driver assignment and system monitoring for fixed-route transit services. This service determines current schedule performance using AVL data and provides information displays for the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.	
Existing Infrastructure ▪ San Angelo Street Railroad Company Central Dispatch	**Agency** ▪ San Angelo Street Railroad Company
Planned Projects None identified at this time	
Additional Needs ▪ Multi-modal Coordination ▪ San Angelo Street Railroad Company AVL and MDTs ▪ San Angelo Street Railroad Company Electronic Fare Payment ▪ San Angelo Street Railroad Company On-board Security Cameras ▪ San Angelo Street Railroad Company Smart Bus Stops ▪ San Angelo Street Railroad Company Vehicle Maintenance System ▪ San Angelo Street Railroad Company/City of San Angelo TOC Communications Connection ▪ San Angelo Street Railroad/Thunderbird Transit Communications Connection	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Demand Response Transit Operations (APTS3)	**High Priority**
This market package performs vehicle routing and scheduling as well as automatic driver assignment and monitoring for demand responsive transit services. This package monitors the current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. This service includes the capability for a traveler request for personalized transit services to be made through the ISP Subsystem.	
Existing Infrastructure ▪ San Angelo Street Railroad Company Central Dispatch	**Agency** ▪ San Angelo Street Railroad Company
Planned Projects None identified at this time	
Additional Needs ▪ Multi-modal Coordination ▪ San Angelo Street Railroad Company AVL and MDTs ▪ San Angelo Street Railroad Company Electronic Fare Payment ▪ San Angelo Street Railroad Company On-board Security Cameras ▪ San Angelo Street Railroad Company Paratransit Online Trip Reservations ▪ San Angelo Street Railroad Company Vehicle Maintenance System ▪ San Angelo Street Railroad Company/City of San Angelo TOC Communications Connection ▪ San Angelo Street Railroad/Thunderbird Transit Communications Connection ▪ Thunderbird Central Dispatch with CAD System ▪ Thunderbird Transit AVL and MDTs ▪ Thunderbird Transit Electronic Fare Payment ▪ Thunderbird Transit Online Trip Reservations ▪ Thunderbird Transit Vehicle Maintenance System ▪ Thunderbird Transit/City of San Angelo TOC Communications Connection ▪ Thunderbird Transit/TxDOT TMC Communications Connection ▪ Thunderbird Transit On-board Security Cameras	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

Multi-modal Coordination (APTS7)	**High Priority**
This market package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Multimodal coordination between transit agencies can increase traveler convenience at transfer points and also improve operating efficiency. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. More limited local coordination between the transit vehicle and the individual intersection for signal priority is also supported by this package.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ Multi-modal Coordination ▪ San Angelo Street Railroad Company/City of San Angelo TOC Communications Connection ▪ San Angelo Street Railroad/Thunderbird Transit Communications Connection ▪ Thunderbird Transit/TxDOT TMC Communications Connection ▪ Thunderbird Transit/City of San Angelo TOC Communication Connection	

Transit Traveler Information (APTS8)	**High Priority**
This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ San Angelo Street Railroad Company Paratransit Online Trip Reservations ▪ San Angelo Street Railroad Company Smart Bus Stops ▪ Thunderbird Transit AVL and MDTs ▪ Thunderbird Transit Online Trip Reservations	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

HAZMAT Management (CVO10)	**High Priority**
This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT materials and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Subsystem. The Emergency Management Subsystem is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ HAZMAT Incident Notification System	

Broadcast Traveler Information (ATIS1)	**High Priority**
This market package collects traffic conditions, advisories, general public transportation information, toll and parking information, incident information, air quality and weather information, and broadly disseminates this information through existing infrastructure and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). This market package differs from the Traffic Information Dissemination market package, which provides localized highway advisory radio (HAR) and DMS information capabilities. The information may be provided directly to travelers by an ISP or other traveler service providers so that they can better inform travelers of conditions. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles, or other sources.	
Existing Infrastructure ▪ TxDOT HCRS	**Agency** ▪ TxDOT
Planned Projects ▪ Emergency Call-Out System ▪ TxDOT HCRS Enhancements	
Additional Needs ▪ Media Liaison and Coordination ▪ Regional 511 Advanced Traveler Information System Server Implementation ▪ TxDOT San Angelo District Webpage Customization and Enhancement	

Table 3 – High Priority Market Packages for the San Angelo Region (continued)

ITS Data Mart (AD1)	High Priority
This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides general query and report access to archive data users.	
Existing Infrastructure ▪ TxDOT Traffic Count Database ▪ GIS Mapping Database	**Agency** ▪ TxDOT ▪ Concho Valley COG
Planned Projects None identified at this time	
Additional Needs ▪ San Angelo Automated Crash Record Database	

2.3 Medium Priority Market Packages

Table 4 outlines market packages that were deemed medium priority by stakeholders in the San Angelo Region. These market packages were identified as useful and desirable services and functions for the Region, although very few of these market packages have existing infrastructure in place or planned over the next few years. The feasibility of funding for these market packages was a factor in the prioritization. Availability and maturity of technology also was a consideration, particularly for the maintenance and construction management market packages. Many of these market packages were recently developed and added to the National ITS Architecture, and are not yet widely deployed.

Table 4 – Medium Priority Market Packages for the San Angelo Region

Standard Railroad Grade Crossing/ Railroad Operations Coordination (ATMS13/ATMS15)	**Medium Priority**
This market package manages highway traffic at highway-rail intersections (HRIs) where rail operational speeds are less than 80 miles per hour. Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. These traditional Highway-Rail Intersections (HRI) warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem. The Railroad Operations Coordination component provides an additional level of strategic coordination between rail operations and traffic management centers. Rail operations provides train schedules, maintenance schedules, and any other forecast events that will result in HRI closures. This information is used to develop forecast HRI closure times and durations that may be used in advanced traffic control strategies or to enhance the quality of traveler information.	
Existing Infrastructure ▪ TxDOT Railroad Traffic Signal Preemption	**Agency** ▪ TxDOT
Planned Projects None identified at this time	
Additional Needs ▪ City of San Angelo Rail Crossing Warning System ▪ Railroad Operations Coordination	

Table 4 – Medium Priority Market Packages for the San Angelo Region (continued)

Speed Monitoring (ATMS19)	**Medium Priority**
This market package monitors the speeds of vehicles traveling through a roadway system. If the speed is determined to be excessive, roadside equipment can suggest a safe driving speed. Environmental conditions may be monitored and factored in to the safe speed advisories that are provided to the motorist. This service can also support notifications to an enforcement agency to enforce the speed limit on a roadway system.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs None identified at this time	

Red Light Running (ATMS22)	**Medium Priority**
This market package provides the communications and roadside equipment to support red light running automated enforcement. This market package also includes the capability to coordinate with law enforcement agencies for ticketing.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs None identified at this time	

Maintenance and Construction Vehicle Maintenance (MC02)	**Medium Priority**
This market package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle maintenance.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ County Automated Maintenance Vehicle Maintenance Tracking ▪ TxDOT Automated Maintenance Vehicle Maintenance Tracking	

Table 4 – Medium Priority Market Packages for the San Angelo Region (continued)

Roadway Maintenance and Construction (MC07)	**Medium Priority**
This market package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services would include landscape maintenance, hazard removal, routine maintenance activities, and repair and maintenance of both ITS and non-ITS equipment on the roadway. Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.	
Existing Infrastructure None identified	**Agency**
Planned Projects ▪ TxDOT HCRS Enhancements	
Additional Needs ▪ City of San Angelo Flood Detection ▪ TxDOT Flood Detection ▪ TxDOT RWIS Stations	

Work Zone Management (MC08)	**Medium Priority**
This market package directs activity in work zones, controlling traffic through portable DMS and informing other groups of activity (e.g., ISP, TM, other maintenance and construction centers) for better coordination management. Work zone speeds and delays are provided to the motorist prior to the work zones.	
Existing Infrastructure ▪ TxDOT HCRS ▪ TxDOT Portable DMS	**Agency** ▪ TxDOT
Planned Projects ▪ TxDOT Center-to-Center Communications ▪ TxDOT HCRS Enhancements	
Additional Needs ▪ City of San Angelo DMS ▪ TxDOT Additional DMS ▪ TxDOT Additional Portable DMS ▪ TxDOT DMS on I-10	

Table 4 – Medium Priority Market Packages for the San Angelo Region (continued)

Transit Passenger and Fare Management (APTS4)	**Medium Priority**
This market package manages passenger loading and fare payments on-board vehicles using electronic means. It allows transit users to use a traveler card or other electronic payment device. Sensors mounted on the vehicle permit the driver and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ San Angelo Street Railroad Company Electronic Fare Payment ▪ Thunderbird Transit Electronic Fare Payment	

Transit Security (APTS5)	**Medium Priority**
This market package provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Public areas (e.g. stops, park and ride lots, stations) are also monitored. Information is communicated to the Transit Management Subsystem using wireless or wireline infrastructure. Security related information is also transmitted to the Emergency Management Subsystem when an emergency is identified that requires an external response. Incident information is communicated to the Information Service Provider.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ San Angelo Street Railroad Company On-board Security Cameras ▪ San Angelo Street Railroad Company Security Cameras at Bus Depot ▪ San Angelo Street Railroad Company Silent Alarms ▪ Thunderbird Transit On-board Security Cameras ▪ Thunderbird Transit Silent Alarms	

Table 4 – Medium Priority Market Packages for the San Angelo Region (continued)

Transit Maintenance (APTS6)	**Medium Priority**
This market package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules preventative and corrective maintenance.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ San Angelo Street Railroad Company Vehicle Maintenance System ▪ Thunderbird Transit Vehicle Maintenance System	

ITS Data Warehouse (AD2)	**Medium Priority**
This market package includes all of the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow the collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional data management features that are necessary so that all the data can be managed in a single repository. The potential for large volumes of carried data suggests additional on-line analysis and data mining features that are also included in this market package in addition to the basic query and reporting user access features offered by the ITS Data Mart.	
Existing Infrastructure None identified	**Agency**
Planned Projects None identified at this time	
Additional Needs ▪ San Angelo MPO Data Warehouse	

2.4 Low Priority Market Packages

Four of the market packages that were identified and customized for the San Angelo Region were ranked as low priority by stakeholders. These market packages are listed in **Table 5**. The services contained in these lower priority market packages were deemed useful and desirable for the Region, but stakeholders did not feel that public agencies should put a strong focus on these market packages in the near-term. These market packages were included as part of the Regional ITS Architecture so as not to preclude them from future deployment in the Region.

Some of these market packages were identified as candidates for private sector deployment and operations, such as ISP-Based Route Guidance. Others, such as Maintenance and Construction Vehicle Tracking, are just more feasible for future implementation.

Table 5 – Low Priority Market Packages for the San Angelo Region

Market Package Name	Description	Comments
Probe Surveillance (ATMS02)	This market package provides an alternative approach for surveillance of the roadway network. Two general implementation paths are supported by this market package: 1) wide-area wireless communications between the vehicle and Information Service Provider is used to communicate current vehicle location and status and 2) dedicated short range communications between the vehicle and roadside is used to provide equivalent information directly to the Traffic Management Subsystem. It requires either wide area or short-range communications equipment, roadside beacons and wireline communications for the short-range communications option, data reduction software, and utilizes wireline links between the Traffic Management Subsystem and Information Service Provider Subsystem to share the collected information. Both “Opt out” and “Opt in” strategies are available to ensure that the user has the ability to turn off the probe functions to ensure individual privacy.	This may be appropriate for future implementation in the Region, but at this time is not something that the Region is interested in.
Maintenance and Construction Vehicle Tracking (MC01)	This market package will track the location of maintenance vehicles and other equipment to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.	This market package is more appropriate for future applications. There may be institutional issues that need to be worked out regarding this market package.

Table 5 – Low Priority Market Packages for the San Angelo Region (continued)

Market Package Name	Description	Comments
Winter Maintenance (MC06)	This market package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.	In the future as technology becomes more developed, the Region may want to consider employing features of this market package. At this time, automating winter maintenance is not a concern for the Region.
ISP-Based Route Guidance (ATIS5)	This market package offers the user pre-trip route planning and turn-by-turn route guidance services, which are generated by an ISP. Routes may be based on static information or reflect real time network conditions. This approach simplifies the user equipment requirements and can provide the infrastructure better information on which to predict future traffic. The package includes two way data communications and optionally also equips the vehicle with the databases, location determination capability, and display technology to support turn by turn route guidance.	This market package is likely the primary responsibility of the private sector, with minimal public sector support.

3. PRIORITIZATION OF PROJECTS

In order to achieve the vision of the Regional ITS Architecture, a Region must deploy carefully developed projects that provide the functionality and interoperability identified in the architecture. A key step toward that vision is the development of an ITS Deployment Plan that identifies specific projects, timeframes, and responsible agencies.

Input from all stakeholders is required in order for the stakeholders to have ownership of the ITS Deployment Plan and also to be sure that the plan has realistically identified projects and timeframes for the Region. Cost is another important factor. Cost can vary a great deal for many ITS elements, depending on the level of deployment, maturity of the technology, type of communications, etc. For example, freeway network surveillance could be adequately achieved for one Region by the deployment of still frame closed-circuit television (CCTV) cameras only at freeway interchanges. In another Region, there may be a desire for full motion cameras deployed at one mile intervals to provide complete coverage of the freeway. The infrastructure and telecommunications costs for these two projects would vary a great deal, yet either one could be suitable for a particular Region.

In order to achieve input from stakeholders, a workshop was held in the San Angelo Region on April 1, 2004 to present the draft Regional ITS Deployment Plan and discuss potential projects. Each project recommended for the Regional ITS Deployment Plan was discussed, and consensus was reached by the stakeholders on the project description and the timeframe for implementation.

In the following sections, projects are categorized into short-term projects (5-year deployment timeframe), mid-term projects (10-year deployment timeframe), and long-term projects (20-year deployment timeframe). For each timeframe, a summary table has been included that provides a brief project description, responsible agency, probable cost, an indication as to whether funding has been identified, and an estimated duration for the project to be designed and implemented. The agency identified as the responsible agency will be responsible for implementation, operations, and maintenance unless otherwise noted.

Following each table, a more detailed description of individual projects is included. This section also lists the market packages associated with each project and any pre-requisite projects that are required.

3.1 Short-Term Projects (5-Year)

Table 6 provides a description of projects for the San Angelo Region in the 5-year timeframe. These projects represent the highest priority for the Region and should be strongly considered for implementation in the short-term. Immediately following **Table 6** are project descriptions for each of the short-term recommendations.

3.2 Mid-Term Projects (10-Year)

Table 7 provides a description of projects in the 10-year timeframe. Several of these projects are continuations of projects that will begin in the 5-year timeframe. These projects are important to the Region, but will need further review at the time of their deployment to ensure they are still a priority for the Region. Immediately following **Table 7** are project descriptions for each of the mid-term recommendations.

3.3 Long-Term Projects (20-Year)

Table 8 provides a description of projects in the 20-year timeframe. While these projects represent market packages and anticipated future needs identified for the Region, they will need to be closely reviewed prior to implementation. It is expected that a major update to the Region's ITS Deployment Plan will occur prior to year 10 which would allow stakeholders to reassess these long-term projects to be sure that they are still feasible for the Region. Immediately following **Table 8** are project descriptions for each of the long-term recommendations.

Table 6 – Short-Term Projects (5-Year)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Travel and Traffic Management					
TxDOT DMS on I-10	Implement dynamic message signs (DMS) along I-10 for traffic information dissemination in Junction, Sonora and Ozona	TxDOT	$400,000 ($100,000/sign)	No	1 year
TxDOT ATMS Implementation	Implement the TxDOT Advanced Traffic Management System (ATMS) in the TxDOT San Angelo Traffic Management Center (TMC)	TxDOT	N/A	Yes	2 years
TxDOT Center-to-Center Communication	Enhance coordination with other TxDOT Districts through implementation of center-to-center communications between TxDOT TMCs	TxDOT	N/A	Yes	1 year
TxDOT San Angelo District TMC Upgrades	Expand and upgrade the capabilities of the TxDOT San Angelo TMC. Expansion includes the implementation of end equipment to allow video feeds from video image vehicle detection (VIVDS) and closed-circuit television (CCTV) camera as well as pan/tilt/zoom (PTZ) for CCTV.	TxDOT	$200,000	No	1 year
TxDOT Closed Loop Signal System Implementation Phase 1	Implement a closed loop signal system at signalized intersections throughout the San Angelo District. Also includes the implementation of VIVDS. Phase 1 will be for a frontage road signal system in San Angelo.	TxDOT	$25,000/ intersection	No	2 years
TxDOT VIVDS	Implement VIVDS at existing signalized intersections in the San Angelo District	TxDOT	$100,000 ($20,000/ intersection)	No	2 years
TxDOT Rest Area Kiosks Phase 1	Provide traveler information and roadway conditions reports to travelers through kiosks at rest areas in the San Angelo District. Phase 1 includes 5 kiosks.	TxDOT	$100,000	No	1 year
City of San Angelo Closed Loop Signal System Implementation Phase 1	Expand the City of San Angelo closed loop signal system at signalized intersections in the City. Also includes the implementation of VIVDS.	City of San Angelo	$25,000/ intersection	No	2 years
City of San Angelo VIVDS	Implement VIVDS at signalized intersections in the City of San Angelo	City of San Angelo	$20,000/ intersection	No	1 year

Table 6 – Short-Term Projects (5-Year) (continued)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Emergency Management					
Emergency Call-Out System	Implement an emergency call out system/reverse 911 for the 13 county Council of Governments (COG) service area to disseminate information in an emergency situation	Concho Valley COG	$150,000 plus annual maintenance costs	Yes	1 year
Mobile Command Centers for Emergency Operations	Purchase two mobile command centers for use in emergency situations	Concho Valley COG	$100,000	Yes	1 year
Evacuation/Detour Route Planning	Develop evacuation routes for major population centers in the Region in case of natural or man-made disaster. Also includes development of detour routes in case major roadways are closed due to an incident.	TxDOT	$100,000	No	2 years
Maintenance and Construction Management					
TxDOT RWIS Station	Implement road weather information systems (RWIS) sites in the TxDOT San Angelo District to monitor road weather conditions	TxDOT	$25,000/site	No	1 year
TxDOT Additional Portable DMS	Procure additional portable DMS for use in work zones in the San Angelo District that have cell phone communication capabilities	TxDOT	$180,0000 ($30,000/each)	No	6 months
TxDOT HCRS Enhancements	Implement enhancements to the Highway Condition Reporting System (HCRS)	TxDOT	N/A	Yes (statewide initiative)	1 year
TxDOT Work Zone Intrusion Detection System	Implement portable work zone safety monitoring equipment at work zones in the San Angelo District	TxDOT	To Be Determined	No	1 year
TxDOT San Angelo District/NOAA Communications Connection	Establish a communications connection between the TxDOT San Angelo District and the National Oceanic and Atmospheric Administration for sharing of weather data and road condition information	TxDOT/NOAA	To Be Determined	No	1 year

Table 6 – Short-Term Projects (5-Year) (continued)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Public Transportation Management					
San Angelo Street Railroad Company Paratransit Online Trip Reservations	Implement website for online paratransit trip reservations and route planning	City of San Angelo	To Be Determined	No	1 year
San Angelo Street Railroad/Thunderbird Transit Communications Connection	Establish a communications connection between San Angelo Street Railroad and Thunderbird Transit for transit coordination	City of San Angelo/Thunderbird Transit	To Be Determined	No	1 year
San Angelo Street Railroad Company AVL and MDTs	Implement automated vehicle location (AVL) and mobile data terminals (MDTs) to provide location information and enable communication	City of San Angelo	$10,000-$15,000/vehicle	No	6 months
San Angelo Street Railroad Company Silent Alarms	Implement silent alarms on San Angelo Street Railroad Company vehicles	City of San Angelo	To Be Determined	No	6 months
Thunderbird Transit Central Dispatch with CAD System	Establish a central dispatch center with computer aided dispatch (CAD) system for Thunderbird Transit	Thunderbird Transit	$100,000	No	1 year
Thunderbird Transit AVL and MDTs	Implement AVL and MDTs to provide vehicle location information to dispatchers and enable communication	Thunderbird Transit	$10,000-$15,000/vehicle	No	6 months
Thunderbird Transit Silent Alarms	Implement silent alarms on Thunderbird Transit vehicles	Thunderbird Transit	To Be Determined	No	6 months
Thunderbird Transit Online Trip Reservations	Implement website for online paratransit trip reservations and route planning	Thunderbird Transit	$250,000	No	1 year
Multi-modal Coordination	Implement connections necessary for transit agencies in the Region to coordinate with one another for regional schedule coordination for transfers	City of San Angelo/Thunderbird Transit/San Angelo Airport	To Be Determined	Yes	6 months
Commercial Vehicle Operations					
HAZMAT Incident Notification System	Implement incident notification system for vehicles carrying hazardous materials	DPS/Municipal Public Safety Dispatch/County Public Safety Dispatch	To Be Determined	No	1 year

*Agency listed is responsible for implementation, operations, and maintenance unless otherwise noted.

**The design has not been undertaken and thus this is only an opinion of probable cost for planning purposes.

San Angelo Region
Short-Term Projects (5-Year)

Travel and Traffic Management

TxDOT DMS on I-10

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Work Zone Management (MC08)

Prerequisite Projects: None

Description: This project consists of the deployment of permanent DMS along I-10 for purposes of traffic information dissemination and incident management in Junction, Sonora, and Ozona.

The estimated cost per sign is approximately $100,000.

TxDOT ATMS Implementation

Associated Market Packages:

- Network Surveillance (ATMS01)
- Traffic Information Dissemination (ATMS06)
- Regional Traffic Control (ATMS07)
- Incident Management System (ATMS08)
- Road Weather Data Collection (MC03)
- Weather Information Processing and Distribution (MC04)

Prerequisite Projects: None

Description: This project involves the implementation of ATMS software to facilitate control of DMS, CCTV cameras and other TxDOT field equipment.

The TxDOT ATMS is a software and hardware based platform developed by the TxDOT Traffic Operations Division. The function of this software is to provide a platform for the integration of various subsystems. The high level functions of the TxDOT ATMS include:

- Collect traffic information (e.g., speed, incidents, lane closures) through a variety of collection methods such a loops, video image detection, etc.;
- Data archiving;
- Graphical map with traffic information;
- Status information, command and control for DMS, ramp metering and CCTV;
- Video switching; and
- User ID/password provided with each transaction for tracking use and establishing device control authority.

Future development efforts include software modules to provide status information and command/control of HAR and environmental sensors (such as flood detection systems). An integrated maintenance database management module is also under development. Lastly, several modules are currently being upgraded to support recently approved National Transportation Communications for ITS Protocol (NTCIP) standards for CCTV, Center-to-Center Communications, and data collection devices.

This ATMS implementation project will include the software and hardware necessary to have an operational central system to routinely poll devices, monitor, and control the DMS, and support archiving of data.

TxDOT Center-to-Center Communication

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Regional Traffic Control and Coordination (ATMS07)
- Incident Management System (ATMS08)
- Weather Information Processing and Distribution (MC04)
- Work Zone Management (MC08)
- Maintenance and Construction Activity Coordination (MC10)

Prerequisite Projects: TxDOT ATMS Implementation

Description: The Center-to-Center Communications project will enhance coordination with TxDOT Districts through connection to the statewide center-to-center core infrastructure. A communication backbone must be developed with sufficient capacity between the TxDOT San Angelo District Office and existing center-to-center infrastructure. Determination of whether the backbone should be TxDOT owned, leased, or a combination thereof will be determined at a later date. The software required to support center-to-center communications is integrated with the TxDOT developed ATMS, so significant software development efforts are not anticipated. Resources will be required to oversee installation of the communications backbone between the TxDOT San Angelo District Office and statewide center-to-center facilities. As part of connecting to the statewide center-to-center infrastructure, the San Angelo Region will provide data to the statewide web server and statewide data archiving database. In return, access to information from other TxDOT Districts (and potentially other agencies) will be available to enhance operations throughout the Region.

TxDOT San Angelo District TMC Upgrades

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)
- Traffic Information Dissemination (ATMS06)
- Regional Traffic Control (ATMS07)
- Incident Management System (ATMS08)

Prerequisite Projects: None

Description: This project includes the expansion and upgrade of the capabilities of the TxDOT San Angelo TMC. Currently, the TMC is used primarily to monitor the operations of the controllers and detectors at signalized intersections. Additionally, VIVDS video images are not currently being transmitted to the TMC. The planned expansion of the TMC would include the implementation of end equipment to allow the transmission of the video feed from the VIVDS in the field back to the TMC. This project would also include the capabilities to control the VIVDS remotely from the TMC as well as control of the PTZ of the planned CCTV cameras.

The estimated cost associated with this expansion is $200,000.

TxDOT Closed Loop Signal System Implementation Phase 1

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: None

Description: Implement a closed loop signal system for TxDOT owned signalized intersections throughout the San Angelo District. Phase 1 will be for a frontage road signal system in San Angelo. This project also includes the installation of VIVDS.

The estimated cost associated with this project is approximately $25,000 per intersection.

TxDOT VIVDS

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: None

Description: Implement VIVDS at signalized intersections in the San Angelo District. By installing cameras and processors that can determine change in gray scale over a predetermined detection zone within the field of vision, VIVDS will provide TxDOT with increased flexibility to determine traffic detector placement at signalized intersections. Typically a camera is mounted approximately 20 to 30

feet above the roadway and is positioned to look at oncoming vehicles. A processor is then connected to the traffic signal controller and as detection zones are activated, the controller recognizes the inputs as traditional induction loops. Many agencies operating closed loop signal systems install VIVDS and do not transport that data or video to a central location. As sufficient communications bandwidth becomes available at VIVDS field locations, both raw (without detection zones) and processed (with detection zones) video could be sent to the TxDOT TMC to provide information to support better operational decisions, enhanced traveler information, and improved signal maintenance.

The estimated cost associated with this project is $20,000 per intersection.

TxDOT Rest Areas Kiosks Phase 1

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Weather Information Processing and Distribution (MC04)

Prerequisite Projects: None

Description: Implement kiosks at rest areas to provide motorists with roadway information including incident and/or delay notification, construction information, and weather conditions. Phase 1 includes five kiosks.

The estimated cost associated with this project is $100,000.

City of San Angelo Closed Loop Signal System Implementation Phase 1

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: None

Description: Expand the closed loop signal system in the City of San Angelo by adding 20 intersections to the closed loop system. This project also includes the implementation of VIVDS.

The estimated cost associated with this project is approximately $25,000 per intersection.

City of San Angelo VIVDS

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: None

Description: Implement VIVDS at signalized intersections in the City of San Angelo. By installing cameras and processors that can determine change in gray scale over a predetermined detection zone

within the field of vision, VIVDS will provide San Angelo with increased flexibility to determine traffic detector placement at signalized intersections. Typically a camera is mounted approximately 20 to 30 feet above the roadway and is positioned to look at oncoming vehicles. A processor is then connected to the traffic signal controller and as detection zones are activated, the controller recognizes the inputs as traditional induction loops. Many agencies operating closed loop signal systems install VIVDS and do not transport that data or video to a central location. As sufficient communications bandwidth becomes available at VIVDS field locations, both raw (without detection zones) and processed (with detection zones) video could be sent to the City of San Angelo Traffic Operations Center (TOC) to provide information to support better operational decisions, enhanced traveler information, and improved signal maintenance.

This project includes the implementation at least two signalized intersections. The estimated cost per intersection is $20,000.

Emergency Management

Emergency Call-Out System

Associated Market Packages:

- Incident Management System (ATMS08)
- Emergency Response (EM01)
- Weather Information Processing and Distribution (MC04)
- Broadcast Traveler Information (ATIS1)

Prerequisite Projects: None

Description: Establish an emergency call-out system to notify the public of emergency events in the Region. The system would call every household in an area and play a recorded message with details of action required on the part of the resident. This could be information regarding a tornado, hazardous materials spill, or other incidents where a large segment of the community needs to be made aware of an emergency condition.

The estimated cost of this project is $150,000 plus $57,000 per county participating.

Mobile Command Centers for Emergency Operations

Associated Market Packages:

- Incident Management (ATMS08)
- Emergency Response (EM01)

Prerequisite Projects: None

Description: This project provides for supplying two mobile command centers for emergency operations. These mobile command centers will provide telephone and radio communication capability for county sheriff's office, TxDOT, local police and fire departments, and the Department of Public Safety (DPS).

The estimated cost per command center is $50,000.

Evacuation/Detour Route Planning

Associated Market Packages:

- Surface Street Control (ATMS03)
- Incident Management (ATMS08)

Prerequisite Projects: None

Description: This project will develop evacuation routes for major population centers in the case of natural or man-made disasters. This project will also identify detour routes for the interstate, state, and local arterials to be used during times of major incidents on the respective roadways. Once an incident has been detected and verified, the San Angelo District TMC can post a message to a DMS or portable DMS along the subject roadway providing information not only on the incident (expected duration and delay) but also provide potential alternate routes. Additionally, if the detour routes are designated, the owning agency can provide alternate signal timing (from the typical timing plans) that will help move detoured traffic efficiently through the detour route.

The estimated cost associated with this project is $100,000.

Maintenance and Construction Management

TxDOT RWIS Stations

Associated Market Packages:

- Network Surveillance (ATMS01)
- Road Weather Data Collection (MC03)
- Roadway Maintenance and Construction (MC07)

Prerequisite Projects: None

Description: Install RWIS stations in the San Angelo Region. The RWIS will be remotely monitored by the TxDOT San Angelo District. Real time weather information improves response time, increases winter maintenance efficiency, and minimizes the traveling public's exposure to hazardous weather related roadway conditions. Archived RWIS information also provides valuable historic information for planning purposes. Data including temperature (atmospheric and pavement), precipitation, wind, humidity, visibility (heavy fog) and even pavement surface conditions (i.e., snow, chemical) are collected by sensors placed at the roadside (typically on a 30 foot tower) and embedded in the roadway. Remote processing units placed along the roadway communicate with various types of road and weather sensors. Data from the units are transmitted to the central ATMS server, via dial-up modem or other low bandwidth telecommunications methods, which will be located at the TxDOT San Angelo District Traffic Office. A future module for the ATMS software will support environmental sensor data and provides collection, archiving, and distribution of the data.

The estimated cost for one site is $25,000. The District is interested in installing 12-15 sites.

TxDOT Additional Portable DMS

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Work Zone Management (MC08)

Prerequisite Projects: None

Description: Portable DMS are a valuable tool to communicate existing and future closures, restrictions, detours, alternate routes, and other important information to motorists while they are en-route. The TxDOT San Angelo District currently has three portable DMS. These signs can be used at or near work zones to notify motorists of activity and appropriate measures to take (i.e., detour, slow down), but also can be mobilized at specific locations as conditions warrant, such as flooding or other closures. Portable DMS can be stand-alone signs or mounted to the back of a maintenance vehicle. Programming is typically done manually at the sign or remotely by cell phone.

This project will procure six additional portable DMS for use in the TxDOT San Angelo District. The estimated cost is $30,000 a sign.

TxDOT HCRS Enhancements

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Weather Information Processing and Distribution (MC04)
- Roadway Maintenance and Construction (MC07)
- Work Zone Management (MC08)
- Maintenance and Construction Activity Coordination (MC10)
- Broadcast Traveler Information (ATIS1)

Prerequisite Projects: None

Description: TxDOT's Highway Condition Reporting System (HCRS) will be enhanced on a statewide basis. The HCRS will use data from the San Angelo District Office; both automated (ATMS) and manually entered. It is envisioned that the ATMS software will enhance the data collection and consolidation processes for automated information. This is a statewide effort; the San Angelo District will be affected by this project, and will contribute information to the HCRS, but will not be responsible for funding the enhancements or for the implementation schedule.

TxDOT Work Zone Intrusion Detection System

Associated Market Packages:

- Work Zone Safety Monitoring (MC09)

Prerequisite Projects: None

Description: This project will include the use of advanced warning systems to detect unauthorized vehicles that have entered the perimeter of a work zone. The intent of such systems is to help decrease the number of accidents in work zones due to motorists getting too close to workers or their equipment. Intrusion detection devices can alert construction workers and the motorist that the motorist has entered the safe zone and should take evasive action. It is anticipated that this project will be conducted on, and possibly required by TxDOT, on a per-project basis.

TxDOT San Angelo District/NOAA Communications Connection

Associated Market Packages:

- Weather Information Processing and Distribution (MC04)

Prerequisite Projects: None

Description: Implementation of a communication link between NOAA and the TxDOT San Angelo District to incorporate weather data into the HCRS. This weather data may include:

- Temperature;
- Dew point;
- Humidity;
- Rainfall;
- Wind speed;
- Wind direction;
- Wind chill; and
- Barometric pressure.

In addition, weather forecasts can be provided to the HCRS. NOAA has software available to provide the communication link that could be applied for use in the San Angelo Region.

Public Transportation Management

San Angelo Street Railroad Company Paratransit Online Trip Reservations

Associated Market Packages:

- Demand Response Transit Operations (APTS3)
- Transit Traveler Information (APTS8)

Prerequisite Projects: None

Description: This project will include implementing an internet based paratransit trip reservation system on the San Angelo Street Railroad Company website. Users of the system will be able to enter their origination and destination addresses and the system will schedule a paratransit vehicle to accommodate the requested trip. This project will build on the existing Engraph software the San Angelo Street Railroad Company is currently using.

The cost to add this additional capability will be dependent on the extent of customization that must be done to the software and the website to meet the needs of the transit agency.

San Angelo Street Railroad/Thunderbird Transit Communication Connection

Associated Market Packages:

- Transit Fixed-Route Operations (APTS2)
- Demand-Response Transit Operations (APTS3)
- Multi-Modal Coordination (APTS7)

Prerequisite Projects: None

Description: Implement a communications link between the San Angelo Street Railroad Company and Thunderbird Transit to provide the transit agencies with the ability to share schedules and real time information.

San Angelo Street Railroad Company AVL and MDTs

Associated Market Packages:

- Transit Vehicle Tracking (APTS1)
- Transit Fixed-Route Operations (APTS2)
- Demand-Response Transit Operations (APTS3)

Prerequisite Projects: None

Description: Install AVL and MDT units on San Angelo Street Railroad Company vehicles. The transit agency currently has five buses and seven paratransit vehicles. The AVL system will convey information regarding real-time vehicle location to the Transit Operations Center, which will allow for enhanced system monitoring, scheduling, routing (or re-routing), as well as provide for precise bus location information in the event of a breakdown or emergency situation. AVL systems measure actual, real-time position of transit vehicles, and relay that information back to a transit operations center. Used

with a geographic information system map, bus locations can be displayed for any vehicles in the fleet equipped with the on-board AVL unit. AVL, in conjunction with CAD, allows for improved bus tracking capability, as well as archiving and managing historical data. AVL systems also can be equipped with additional features, including tie-ins to alarm/security systems, vehicle component monitoring, and automated passenger counter and fare payment systems. Information from the AVL/CAD system can be used by transit managers for real-time operations and management as well as for transit traveler information. In areas where AVL technology has been installed on buses, agencies report a 5-25 percent increase in on-time performance, which translates directly to improved efficiency and operations.

MDTs allow bus operators to send and receive digital messages. MDTs can be used by dispatchers to notify drivers of adverse conditions, route changes, or other impacts to the route. MDTs can also transmit information from the driver to the dispatch center, including status, disruptions, or silent alarms. An additional feature that can be built-in to the MDT is the ability for vehicle-to-vehicle digital communications, in addition to the vehicle-to-center communications.

Cost will vary depending on the number of vehicles equipped with AVL/MDT systems, as well as the functions and features designed into the systems (above the basic location and digital communication functions).

The estimated cost is $10,000-15,000 per vehicle.

San Angelo Street Railroad Company Silent Alarms

Associated Market Packages:

- Transit Security (APTS5)

Prerequisite Projects: None

Description: This project will install silent alarms on San Angelo Street Railroad Company. If the driver feels there is a threat on the bus, the bus has been involved in an accident, or any other situation occurs where the driver may need assistance, he or she can activate the alarm. The alarm notifies the dispatch center of the potential problem so that help can be dispatched.

Thunderbird Transit Central Dispatch with CAD System

Associated Market Packages:

- Transit Vehicle Tracking (APTS1)
- Demand-Response Transit Operations (APTS3)

Prerequisite Projects: None

Description: Implement a central dispatch and CAD system for Thunderbird transit services. Upgrading to CAD will streamline communications between dispatchers and drivers. Used in conjunction with AVL and MDTs, dispatchers can assess vehicle locations, status, route adherence, as well as communicate with vehicles that are in the field. A CAD system also improves the system reporting functions, by automatically logging all communications between the dispatch center and the driver, including time, vehicle/driver, nature of the communication, and response. Local dispatch will still occur in some counties in coordination with central dispatch.

The estimated cost of this project is $100,000.

Thunderbird Transit AVL and MDTs

Associated Market Packages:

- Transit Vehicle Tracking (APTS1)
- Demand-Response Transit Operations (APTS3)
- Transit Traveler Information (APTS8)

Prerequisite Projects: None

Description: Install AVL and MDT units on Thunderbird Transit vehicles. The AVL system will convey information regarding real-time vehicle location to the Transit Operations Center, which will allow for enhanced system monitoring, scheduling, routing (or re-routing), as well as provide for precise bus location information in the event of a breakdown or emergency situation. AVL systems measure actual, real-time position of transit vehicles, and relay that information back to a transit operations center. Used with a geographic information system map, bus locations can be displayed for any vehicles in the fleet equipped with the on-board AVL unit. AVL, in conjunction with CAD, allows for improved bus tracking capability, as well as archiving and managing historical data. AVL systems also can be equipped with additional features, including tie-ins to alarm/security systems, vehicle component monitoring, and automated passenger counter and fare payment systems. Information from the AVL/CAD system can be used by transit managers for real-time operations and management as well as for transit traveler information. In areas where AVL technology has been installed on buses, agencies report a 5-25 percent increase in on-time performance, which translates directly to improved efficiency and operations.

MDTs allow bus operators to send and receive digital messages. MDTs can be used by dispatchers to notify drivers of adverse conditions, route changes, or other impacts to the route. MDTs can also transmit information from the driver to the dispatch center, including status, disruptions, or silent alarms. An additional feature that can be built-in to the MDT is the ability for vehicle-to-vehicle digital communications, in addition to the vehicle-to-center communications.

Cost will vary depending on the number of vehicles equipped with AVL/MDT systems, as well as the functions and features designed into the systems (above the basic location and digital communication functions).

The estimated cost is $10,000-$15,000 per vehicle.

Thunderbird Transit Silent Alarms

Associated Market Packages:

- Transit Security (APTS5)

Prerequisite Projects: None

Description: This project will install silent alarms on Thunderbird Transit vehicles. If the driver feels there is a threat on the bus, the bus has been involved in an accident, or any other situation occurs where the driver may need assistance, he or she can activate the alarm. The alarm notifies the dispatch center of the potential problem so that help can be dispatched.

Thunderbird Transit Online Trip Reservations

Associated Market Packages:

- Demand Response Transit Operations (APTS3)
- Transit Traveler Information (APTS8)

Prerequisite Projects: Thunderbird Transit Central Dispatch and CAD System

Description: This project will include implementing an internet based paratransit trip reservation system on the Thunderbird Transit website. Users of the system will be able to enter their origination and destination addresses and the system will schedule a paratransit vehicle to accommodate the requested trip.

The estimated cost associated with this project is $250,000.

Multi-modal Coordination

Associated Market Packages:

- Transit Fixed Route Operations (APTS2)
- Demand Response Transit Operations (APTS3)
- Multi-modal Coordination (APTS7)

Prerequisite Projects: None

Description: Implement connections necessary for San Angelo Region transit agencies to coordinate with each other for regional schedule coordination, especially to facilitate passenger transfers. It is envisioned that by linking the CAD systems and electronic schedules, that a passenger traveling through the Region that needed to use multiple agencies to complete their trip could arrange those transfers by contacting one of the agencies who would be able to request the necessary transfers through the CAD system.

Commercial Vehicle Operations

HAZMAT Incident Notification System

Associated Market Packages:

- Incident Management System (ATMS08)
- Emergency Response (EM01)
- HAZMAT Management (CVO10)

Prerequisite Projects: None

Description: Implement incident notification system for vehicles carrying hazardous materials. When an incident occurs in which a vehicle carrying hazardous materials was involved a notice is sent to the local public safety office that monitors the area in which the incident occurred. The message contains information regarding the materials being transported by the commercial vehicle to the emergency response agency so that emergency personnel can understand what types of material they will be encountering and the best and safest method to use in the clean-up.

Table 7 – Mid-Term Projects (10-Year)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Travel and Traffic Management					
TxDOT San Angelo District Webpage Customization and Enhancement	Customize and enhance the San Angelo District webpage on the TxDOT Expressway website to provide traffic information that will include information on current roadway conditions	TxDOT	$100,000	No	1 year
TxDOT Additional DMS	Implement DMS on additional roadways in the San Angelo Region. Potential facilities include US 87, US 83, US 277, and US 158	TxDOT	$100,000/sign	No	2 years
TxDOT CCTV Camera Implementation	Implement CCTV cameras along interstate and arterial routes in the San Angelo District for traffic monitoring and incident detection	TxDOT	$20,000-$25,000/site	No	1 year
TxDOT Highway Advisory Radio	Implement a highway advisory radio (HAR) system in the San Angelo District for traffic information dissemination	TxDOT	To Be Determined	No	2 years
TxDOT Closed Loop Signal System Implementation Phase 2	Expand the TxDOT closed loop signal system at signalized intersections throughout the San Angelo District. Also includes the implementation of VIVDS.	TxDOT	$25,000/ Intersection	No	2 years
TxDOT School Zone Flasher Pager System	Implement a school zone flasher pager control system to control flasher timing plans remotely	TxDOT/School Districts	$50,000	No	1 year
City of San Angelo School Zone Flasher Pager System	Implement a school zone flasher pager control system to control flasher timing plans remotely	City of San Angelo	$50,000	No	1 year
TxDOT Rest Area Kiosks Phase 2	Provide traveler information and roadway conditions reports to travelers through kiosks at rest areas in the San Angelo District. Phase 2 includes two kiosks.	TxDOT	$40,000	No	1 year
City of San Angelo TOC/TxDOT TMC Communications Connection	Implement a communications connection between the City of San Angelo Traffic Operations Center (TOC) and the TxDOT TMC to share traffic data, roadway conditions and incident information	City of San Angelo/TxDOT	To Be Determined	No	1 year
City of San Angelo DMS	Implement DMS signs on major arterials in the City of San Angelo for traffic information dissemination	City of San Angelo	$80,000/sign	No	1 year

Table 7 – Mid-Term Projects (10-Year) (continued)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Travel and Traffic Management (continued)					
City of San Angelo Closed Loop Signal System Implementation Phase 2	Expand the City of San Angelo closed loop signal system at signalized intersections in the City. Also includes the implementation of VIVDS.	City of San Angelo	$25,000/ intersection	No	2 years
City of San Angelo TOC Enhancements	Upgrade the capabilities of the City of San Angelo TOC by replacing the central closed loop signal system software	City of San Angelo	$150,000	No	1 year
City of San Angelo Rail Crossing Warning System	Implement warning system to alert drivers of approaching trains and expected wait times	City of San Angelo/Railroad operators	$500,000	No	1 year
Railroad Operations Coordination	Improve coordination between traffic management and railroad through sharing of schedules and other relevant operations information	City of San Angelo/TxDOT/Railroad operators	To Be Determined	No	1 year
Regional 511 Advanced Traveler Information System Server Implementation	Implement advanced traveler information system server in the TxDOT San Angelo District TMC that will collect, consolidate, and distribute traveler information to a 511 phone based system, web, and private Information Service Providers (ISPs)	TxDOT	To Be Determined	No	1 year
Media Liaison and Coordination	Develop agreements/enhanced coordination with local media to improve information sharing and dissemination. Provide CCTV camera feeds to media.	TxDOT/City of San Angelo	N/A	N/A	6 months
Emergency Management					
San Angelo Regional EOC/TxDOT San Angelo TMC Communications Connection	Establish a communications connection between the San Angelo Regional Emergency Operations Center (EOC) and the TxDOT San Angelo TMC for sharing of incident information and roadway conditions	San Angelo Regional EOC/TxDOT	To Be Determined	No	1 year
San Angelo Regional EOC/City of San Angelo TOC Communications Connection	Establish a communications connection between the San Angelo Regional EOC and the City of San Angelo TOC for sharing of incident information and roadway conditions	San Angelo Regional EOC/City of San Angelo	To Be Determined	No	1 year

Table 7 – Mid-Term Projects (10-Year) (continued)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Emergency Management (continued)					
City of San Angelo Public Safety Communications/City of San Angelo TOC Communications Connection	Establish a communications connection between City of San Angelo Public Safety Communications and the City of San Angelo TOC for sharing of incident information and roadway conditions	City of San Angelo	To Be Determined	No	1 year
Maintenance and Construction Management					
TxDOT San Angelo District/USGS Communications Connection	Establish a communications connection between the TxDOT San Angelo District and the USGS for sharing of weather data	TxDOT/USGS	To Be Determined	No	1 year
TxDOT Flood Detection	Implement flood detection at locations prone to flooding in Kimball, Edwards and Real counties	TxDOT	$25,000/each	No	1 year
TxDOT Low Water Crossing Flashing Beacon Warning Signs	Implement low water crossing flashing beacon warning signs at select low water crossings	TxDOT	$5,000/sign	No	1 year
City of San Angelo Flood Detection	Install flood detection stations in areas of the City of San Angelo that are prone to flooding	City of San Angelo	$25,000/each	No	6 months
City of San Angelo Low Water Crossing Flashing Beacon Warning Signs	Implement low water crossing flashing beacon warning signs at select low water crossings	City of San Angelo	$5,000/sign	No	6 months
Public Transportation Management					
San Angelo Street Railroad Company Electronic Fare Payment	Implement electronic fare collection for the San Angelo Street Railroad Company	City of San Angelo	To Be Determined	No	6 months
San Angelo Street Railroad Company/City of San Angelo TOC Communications Connection	Establish a communications connection between the City of San Angelo Street Railroad Company and City of San Angelo TOC for sharing of roadway condition and traffic information	City of San Angelo	To Be Determined	No	1 year
Thunderbird Transit Electronic Fare Payment	Implement electronic fare collection for Thunderbird Transit	Thunderbird Transit	To Be Determined	No	6 months

Table 7 – Mid-Term Projects (10-Year) (continued)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Public Transportation Management (continued)					
Thunderbird Transit/City of San Angelo TOC Communications Connection	Establish a communications connection between the City of San Angelo TOC and Thunderbird Transit Operations Center for sharing of roadway condition and traffic information	Thunderbird Transit/City of San Angelo	To Be Determined	No	1 year
Thunderbird Transit/TxDOT TMC Communications Connection	Establish a communications connection between the TxDOT TMC and Thunderbird Transit Operations Center for sharing of roadway condition and traffic information	Thunderbird Transit/TxDOT	To Be Determined	No	1 year
Archived Data					
San Angelo MPO Data Warehouse	Implement a data warehouse to archive data from cities and transit agencies in the San Angelo MPO service area	San Angelo MPO	$100,000	No	3 years
San Angelo Automated Crash Record Database	Using police department MDTs as the data source, create an automated crash record database where crash data is automatically archived directly from the reporting officer's MDT	City of San Angelo Police Department	$200,000	No	1 year

*Agency listed is responsible for implementation, operations, and maintenance unless otherwise noted.

**The design has not been undertaken and thus this is only an opinion of probable cost for planning purposes.

San Angelo Region
Mid-Term Projects (10-Year)

Travel and Traffic Management

TxDOT San Angelo District Webpage Customization and Enhancement

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Maintenance and Construction Activity Coordination (MC10)
- Broadcast Traveler Information (ATIS1)

Prerequisite Projects: TxDOT ATMS Implementation

Description: Customize and enhance the San Angelo District webpage on the TxDOT Expressway website to provide information on traffic, current roadway conditions, construction and any weather advisories.

The estimated cost for completing these enhancements is $100,000.

TxDOT Additional DMS

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Work Zone Management (MC08)

Prerequisite Projects: TxDOT DMS

Description: This project continues the deployment of permanent DMS at locations along roadways in the San Angelo Region for purposes of traffic information dissemination and incident management. Potential facilities include US 87, US 83, US 277, and US 158.

The estimated cost per sign is approximately $100,000.

TxDOT CCTV Camera Implementation

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)
- Incident Management (ATMS08)

Prerequisite Projects: None

Description: This project includes the deployment of CCTV cameras along key segments of roadway in the San Angelo Region. The CCTV cameras can be used for incident detection and verification, to monitor congestion and to aid in the dispatch of emergency vehicles. The information gathered by the CCTV cameras (video feed) can be shared with the area emergency management agencies.

The estimated cost per site is between $20,000 and $25,000.

TxDOT Highway Advisory Radio

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Maintenance and Construction Activity Coordination (MC10)

Prerequisite Projects: None

Description: This project will implement HAR transmitters at sites throughout the Region. HAR will allow operators at the San Angelo District Office to record travel advisory messages related to traffic, incidents, and weather for transmission at the roadside to vehicles traveling in the vicinity of the HAR transmitter(s).

The estimated cost per transmitter is $30,000. The cost of the project phase will depend on the number of transmitters installed as well as the cost and number of accompanying beacon signs that will be needed.

TxDOT Closed Loop Signal System Implementation Phase 2

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: TxDOT Closed Loop Signal System Expansion Phase 1

Description: Expand the closed loop signal system by integrating additional signals and implementing VIVDS at select TxDOT intersections throughout the Region.

The estimated cost associated with this project is approximately $25,000 per intersection.

TxDOT School Zone Flasher Pager System

Associated Market Package:

- Surface Street Control (ATMS03)

Prerequisite Projects: None

Description: This project implements a school zone flasher paging system for use in programming school zone flashers. The project includes installing a paging and central system(s) to allow remote control of school flashers for schools in rural areas. Two-way paging systems are available for programming and troubleshooting school zone time clocks (AC or solar powered). A two-way paging system will allow programming of times for the new school year, special events, and even turn flashers in the system on during emergencies from a central location. Two-way paging also provides acknowledgement that the flasher received the message and provides routine diagnostic/operational status messages. The main benefit of a paging system is eliminating costly trips to the field to reprogram units or manually operate flashers.

The estimated cost associated with this project is $50,000.

City of San Angelo School Zone Flasher Pager System

Associated Market Packages:

- Surface Street Control (ATMS03)

Prerequisite Projects: None

Description: This project implements a school zone flasher paging system for use in programming school zone flashers. The project includes installing a paging and central system(s) to allow remote control of school flashers for schools in San Angelo. Two-way paging systems are available for programming and troubleshooting school zone time clocks (AC or solar powered). A two-way paging system will allow programming of times for the new school year, special events, and even turn flashers in the system on during emergencies from a central location. Two-way paging also provides acknowledgement that the flasher received the message and provides routine diagnostic/operational status messages. The main benefit of a paging system is eliminating costly trips to the field to reprogram units or manually operate flashers.

The estimated cost associated with this project is $50,000.

TxDOT Rest Area Kiosks Phase 2

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Weather Information Processing and Distribution (MC04)

Prerequisite Projects: None

Description: Implement two additional kiosks at rest areas to provide motorists with roadway information including incident and/or delay notification, construction information, and weather conditions.

The estimated cost associated with this project is $40,000.

City of San Angelo TOC/TxDOT TMC Communications Connection

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Regional Traffic Control (ATMS07)
- Incident Management System (ATMS08)

Prerequisite Projects: None

Description: Install a connection between the City of San Angelo TOC and the TxDOT San Angelo District Traffic Office to allow video sharing, traffic data sharing and other joint functions. The type of connection (fiber, wireless, leased line) will need to be determined prior to implementation of this project based on desired band width and cost of technologies available.

City of San Angelo DMS

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Work Zone Management (MC08)

Prerequisite Projects: None

Description: This project consists of the deployment of permanent DMS on major arterials in the City of San Angelo for traffic information dissemination and incident management.

The estimated cost per sign is approximately $80,000.

City of San Angelo Closed Loop Signal System Implementation Phase 2

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: City of San Angelo Closed Loop Signal System Expansion Phase 1

Description: Continue to expand the closed loop signal system at 20 signalized intersections in the City of San Angelo. This project includes the implementation of VIVDS.

The estimated cost associated with this project is approximately $25,000 per intersection.

City of San Angelo TOC Enhancements

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)
- Traffic Information Dissemination (ATMS06)
- Regional Traffic Control (ATMS07)
- Incident Management System (ATMS08)

Prerequisite Projects: None

Description: This project includes upgrading the City of San Angelo TOC by replacing the central closed loop signal system software.

The estimated cost associated with this enhancement is $150,000.

City of San Angelo Rail Crossing Warning System

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)
- Traffic Information Dissemination (ATMS06)
- Standard Railroad Grade Crossing (ATMS13)
- Railroad Operations Coordination (ATMS15)

Prerequisite Projects: None

Description: This project will include highway/rail intersection warning systems that will alert motorists of arriving trains, amount of time the train will occupy the crossing, and the length of time a motorist can expect to be delayed. The deployment of instrumentation will be along roadways at railroad grade crossings. Information will be gathered either directly from the railroad operators or from sensors placed along the railroad right-of-way that monitor train length and speed. Data will be transferred from the

field sensors to the City of San Angelo TOC where operators can make decisions regarding changes in signal operations to facilitate flow around the closed crossing or to clear traffic once the train has passed the crossing.

The estimated cost for this project is $500,000.

Railroad Operations Coordination

Associated Market Packages:

- Railroad Operations Coordination (ATMS15)

Prerequisite Projects: None

Description: This project will improve coordination between traffic management and railroad through sharing of schedules and other relevant operations information.

Regional 511 Advanced Traveler Information System Server Implementation

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Weather Information Processing and Distribution (MC04)
- Maintenance and Construction Activity Coordination (MC10)
- Broadcast Traveler Information (ATIS1)

Prerequisite Projects: TxDOT ATMS Implementation, TxDOT Center-to-Center Communications, TxDOT Highway Condition Reporting System Enhancements

Description: Install a server dedicated to ATIS in the TxDOT San Angelo District Office. This server would be installed as part of a statewide 511 rollout in Texas and would provide a gateway for public and private entities to access current conditions, closures, restrictions, weather, and other valuable travel information. Relevant data from the ATMS and HCRS would be sent to the ATIS server where it would be consolidated and 'packaged' for distribution via phone (511) and also web and to private partners who desire access to information in the San Angelo Region. These private partners could include local media and information service providers, which would link to the ATIS server to download information, or obtain real-time feeds, depending on the link provided by the private partner. Appropriate security measures and firewalls could be designed into the server to allow or restrict access to registered, authorized users. By fusing various types of data from a variety of sources (traffic management, incident management, and others), this data can be converted to usable information for travelers as well as other agencies.

Media Liaison and Coordination

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Weather Information Processing and Distribution (MC04)
- Maintenance and Construction Activity Coordination (MC10)
- Broadcast Traveler Information (ATIS1)

Prerequisite Projects: None

Description: Develop stronger liaison and coordination with local media to disseminate traveler information. Develop a link for local media to tap into CCTV camera images for dissemination of traffic and weather advisories to the public via television and radio news broadcasts. Most television and radio stations typically already have microwave licenses and infrastructure in place to support wireless transmission of video. Therefore, TxDOT and the City of San Angelo should provide a connection point at their traffic offices for media providers (e.g., video switch including video images and traffic conditions map), but not design and install the entire connection between their traffic offices and the media. An initial task in the project will be to meet with interested news providers to determine information needs to support media interface design activities. Each agency that will be sharing information directly with the media will likely need an agreement or policy in place to determine what type of information will be shared. A subgroup of the stakeholders will need to work on the process of sharing data with the media and what broadcasts will be allowed to attempt to provide similar data to the media from each individual stakeholder.

<u>Emergency Management</u>

San Angelo Regional EOC/TxDOT San Angelo TMC Communications Connection

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)

Prerequisite Projects: None

Description: Install telecommunications connection between the San Angelo Regional EOC and TxDOT San Angelo TMC to allow for shared incident information and roadway conditions.

Cost of this connection will be determined based on the communications method chosen.

San Angelo Regional EOC/City of San Angelo TOC Communications Connection

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)

Prerequisite Projects: None

Description: Install telecommunications connection between the San Angelo Regional EOC and City of San Angelo TOC to allow for shared incident information and roadway conditions.

Cost of this connection will be determined based on the communications method chosen.

City of San Angelo Public Safety Communications/City of San Angelo TOC Communications Connection

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Incident Management System (ATMS08)
- Emergency Response (EM01)
- Emergency Routing (EM02)

Prerequisite Projects: None

Description: Install telecommunications connection and end equipment from the City of San Angelo Public Safety Communications to the City of San Angelo TOC to share incident information and road conditions that could assist with incident/emergency management.

The cost for this project will depend on the communications used to implement the connection (i.e., fiber connection or leased lines).

Maintenance and Construction Management

TxDOT San Angelo District/USGS Communications Connection

Associated Market Packages:

- Weather Information Processing and Distribution (MC04)

Prerequisite Projects: None

Description: Implementation of a communication link between the USGS and the TxDOT San Angelo District to incorporate weather data into the HCRS. This weather data may include:

- Temperature;
- Dewpoint;
- Humidity;

- Rainfall;
- Wind speed;
- Wind direction;
- Wind chill; and
- Barometric pressure.

TxDOT will also share any flood detection or RWIS weather data with the USGS.

The cost for this project will depend on the communications used to implement the connection.

TxDOT Flood Detection

Associated Market Packages:

- Network Surveillance (ATMS01)
- Road Weather Data Collection (MC03)
- Roadway Maintenance and Construction (MC07)

Prerequisite Projects: None

Description: Implement flood detection systems at locations prone to flooding in the San Angelo District. This will enable faster response times by maintenance crews to close flooded or near flooded roadway segments as necessary. The typical flood detection station is composed of a stream gauge, a rain gauge, a temperature sensor, a wind speed sensor, and a wind direction sensor and remote communications support. Other upgrades that may support operational decision making include sensors to measure relative humidity, soil moisture content, solar radiation, and air and water quality. The flood detection systems will be monitored from the TxDOT San Angelo District Office. Communications between the flood detection stations and the District Office can be achieved through a variety of wireless and wireline telemetry methods. There is a future module of the ATMS software planned to support environmental sensors, and development of this module could be extended to include the needs of flood detection stations.

The estimated cost per system is $25,000.

TxDOT Low Water Crossing Flashing Beacon Warning Signs

Associated Market Packages:

- Weather Information Processing and Distribution (MC04)

Prerequisite Projects: None

Description: Implement low water crossing flashing beacon warning signs at flood prone locations in the San Angelo District. In conjunction with flood detection, the warning signs would flash warning beacons when flood conditions were detected and water was obstructing the roadway to warn motorists.

The estimated cost per sign with flasher is $5,000.

City of San Angelo Flood Detection

Associated Market Packages:

- Network Surveillance (ATMS01)
- Road Weather Data Collection (MC03)
- Roadway Maintenance and Construction (MC07)

Prerequisite Projects: None

Description: Implement flood detection systems on flood-prone segments of streets in the City of San Angelo. This will enable faster response times by maintenance crews to close flooded or near flooded roadway segments as necessary. The typical flood detection station is composed of a stream gauge, a rain gauge, a temperature sensor, a wind speed sensor, and a wind direction sensor and remote communications support. Other upgrades that may support operational decision making include sensors to measure relative humidity, soil moisture content, solar radiation, and air and water quality. The flood detection systems will be monitored from the City of San Angelo TOC. Communications between the flood detection stations and the City of San Angelo TOC can be achieved through a variety of wireless and wireline telemetry methods.

The estimated cost per site is $25,000.

City of San Angelo Low Water Crossing Flashing Beacon Warning Signs

Associated Market Packages:

- Weather Information Processing and Distribution (MC04)

Prerequisite Projects: None

Description: Implement low water crossing flashing beacon warning signs at flood prone locations in the City of San Angelo. In conjunction with flood detection, the warning signs would flash warning beacons when flood conditions were detected and water was obstructing the roadway.

The estimated cost per flasher sign is $5,000.

Public Transportation Management

San Angelo Street Railroad Company Electronic Fare Payment

Associated Market Packages

- Transit Fixed Route Operations (APTS2)
- Demand Response Transit Operations (APTS3)
- Transit Passenger and Fare Management (APTS4)

Prerequisite Projects: None

Description: Implement electronic fare collection for the San Angelo Street Railroad Company. There are three primary benefits of these collection systems. The first is enhanced revenue collection ability.

The second is increased security by not having large amounts of cash or tokens on the vehicle. The third is the increased convenience and security for the transit patron. These systems are often implemented in conjunction with AVL or MDTs, or are implemented as an add-on to those systems. To enable automated fare collection, fare boxes would need to be upgraded to accept smart cards (i.e., cards with passive radio frequency identification (RFID) technology or a magnetic information strip, such as a credit card) with rider and account information. Electronic fare payment and passenger information technology is rapidly advancing, and there will be several technological considerations will need to be examined, such as standards for smart cards and interoperability issues.

San Angelo Street Railroad Company/City of San Angelo TOC Communications Connection

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Transit Fixed-Route Operations (APTS2)
- Demand-Response Transit Operations (APTS3)
- Multi-modal Coordination (APTS7)

Prerequisite Projects: None

Description: Implement communications link between the City of San Angelo TOC and San Angelo Street Railroad Company. This center-to-center connection will support coordination with the traffic operations center to obtain near real-time traffic conditions on transit routes in order to generate optimum schedules and alternate routes when necessary. In addition, information on service/fleet performance and transit incident information and schedules will be provided to the TOC.

The extent to which information and coordination are shared between the centers will be determined through working arrangements among the agencies/jurisdictions involved.

The cost for this project will depend on the communications used to implement the connection.

Thunderbird Transit Electronic Fare Payment

Associated Market Packages

- Demand Response Transit Operations (APTS3)
- Transit Passenger and Fare Management (APTS4)

Prerequisite Projects: None

Description: Implement electronic fare collection for Thunderbird Transit. There are three primary benefits of these collection systems. The first is enhanced revenue collection ability. The second is increased security by not having large amounts of cash or tokens on the vehicle. The third is the increased convenience and security for the transit patron. These systems are often implemented in conjunction with AVL or MDTs, or are implemented as an add-on to those systems. To enable automated fare collection, fare boxes would need to be upgraded to accept smart cards (i.e., cards with passive RFID technology or a magnetic information strip, such as a credit card) with rider and account information. Electronic fare payment and passenger information technology is rapidly advancing, and

several technological considerations will need to be examined, such as standards for smart cards and interoperability issues.

Thunderbird Transit/City of San Angelo TOC Communications Connection

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Demand-Response Transit Operations (APTS3)
- Multi-modal Coordination (APTS7)

Prerequisite Projects: None

Description: Implement communications link between the City of San Angelo TOC and Thunderbird Transit. This center-to-center connection will support coordination with the traffic operations center to obtain near real-time traffic conditions on transit routes in order to generate optimum schedules and alternate routes when necessary. In addition, information on service/fleet performance and transit incident information and schedules will be provided to the TOC.

The extent to which information and coordination are shared between the centers will be determined through working arrangements among the agencies/jurisdictions involved.

The cost for this project will depend on the communications used to implement the connection.

Thunderbird Transit/TxDOT TMC Communications Connection

Associated Market Packages:

- Traffic Information Dissemination (ATMS06)
- Demand-Response Transit Operations (APTS3)
- Multi-Modal Coordination (APTS7)

Prerequisite Projects: None

Description: Implement communications link between the TxDOT San Angelo District Traffic Management Center and Thunderbird Transit. This center-to-center application area will support coordination with the traffic management centers to obtain near real-time traffic conditions on transit routes in order to generate optimum schedules and alternate routes when necessary.

The extent to which information and coordination are shared between the centers will be determined through working arrangements among the agencies/jurisdictions involved.

The cost for this project will depend on the communications used to implement the connection.

Archived Data Management

San Angelo MPO Data Warehouse

Associated Market Packages:

- ITS Data Warehouse (AD2)

Prerequisite Projects: None

Description: Implement a system to collect, store and process transportation data from selected locations. This project will design the frequency, quantity, and quality of data to be collected and stored. User interfaces will be required at each local agency to be able to access, search, and upload archived data as needed. The interface will likely be web-based.

The estimated cost of this project is $100,000.

San Angelo Automated Crash Record Database

Associated Market Packages:

- ITS Data Mart (AD1)

Prerequisite Projects: None

Description: Create an automated crash record database for San Angelo using data from police department MDTs. This project will implement a system to collect, store and process the data downloaded from the MDTs. This project will design the frequency, quantity, and quality of data to be collected and stored. It will be necessary to work in coordination with the police department and potential database users (traffic department, etc.) to determine the appropriate accident report format to collect all needed information.

The estimated cost of this project is $200,000.

Table 8 – Long-Term Projects (20-Year)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Travel and Traffic Management					
TxDOT Closed Loop Signal System Implementation Phase 3	Expand the TxDOT closed loop signal system at signalized intersections throughout the San Angelo District. Also includes the implementation of VIVDS.	TxDOT	$25,000/ intersection	No	2 years
City of San Angelo CCTV Cameral Implementation	Implement CCTV cameras along major arterials in the City of San Angelo. Project will also include the implementation of end equipment at the TOC to allow video feed for VIVDS and CCTV camera as well as PTZ for CCTV.	City of San Angelo	$20,000-$25,000/site	No	1 year
City of San Angelo Closed Loop Signal System Implementation Phase 3	Expand the City of San Angelo closed loop signal system at signalized intersections in the City. Also includes the implementation of VIVDS.	City of San Angelo	$25,000/ intersection	No	2 years
Emergency Management					
TxDOT Emergency Vehicle Traffic Signal Preemption Implementation	Implement signal pre-emption at TxDOT Signals for emergency vehicles in cities as needed. Project includes equipment for emergency vehicles in cities other than San Angelo	TxDOT	$8,000-10,000/ intersection $1,000/vehicle	No	1 year
Rural Fire Department AVL and MDTs	Implement AVL and MDTs on rural fire vehicles for real-time location information and communications capabilities	Rural Fire Departments	$10,000/vehicle (Includes software)	No	2 years
Maintenance and Construction Management					
TxDOT Automated Maintenance Vehicle Maintenance Tracking	Implement a system to monitor the maintenance status of TxDOT maintenance vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled	TxDOT	To Be Determined	No	1 year
County Automated Maintenance Vehicle Maintenance Tracking	Implement a system to monitor the maintenance status of County maintenance vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled	Counties	To Be Determined	No	1 year

Table 8 – Long-Term Projects (20-Year) (continued)

Program Area/Project	Description	Responsible Agency*	Probable Cost**	Funding Identified	Estimated Project Duration
Public Transportation Management					
San Angelo Street Railroad Company Security Cameras at Bus Depot	Install CCTV cameras at the San Angelo Street Railroad Bus Depot for surveillance	City of San Angelo	$50,000	No	6 months
San Angelo Street Railroad Company On-board Security Cameras	Install security cameras on buses and paratransit vehicles	City of San Angelo	$15,000/vehicle	No	6 months
San Angelo Street Railroad Company Vehicle Maintenance System	Implement a system to monitor the maintenance status of San Angelo Street Railroad Transit vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled	City of San Angelo	To Be Determined	No	1 year
San Angelo Street Railroad Company Smart Bus Stops	Implement technology at bus stops that will provide transit information to waiting passengers including schedule information and real time bus location information	City of San Angelo	$30,000/bus stop	No	2 years
Thunderbird Transit On-board Security Cameras	Install security cameras on Thunderbird Transit vehicles	Thunderbird Transit	$15,000/vehicle	No	6 months
Thunderbird Transit Vehicle Maintenance System	Implement a system to monitor the maintenance status of Thunderbird Transit vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled	Thunderbird Transit	To Be Determined	No	1 year

*Agency listed is responsible for implementation, operations, and maintenance unless otherwise noted.

**The design has not been undertaken and thus this is only an opinion of probable cost for planning purposes.

San Angelo Region
Long-Term Projects (20-Year)

Travel and Traffic Management

TxDOT Closed Loop Signal System Implementation Phase 3

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: TxDOT Closed Loop Signal System Implementation Phase 1, TxDOT Closed Loop Signal System Implementation Phase 2

Description: Expand the closed loop signal system by integrating additional signals and implementing VIVDS at select TxDOT intersections throughout the Region.

The estimated cost associated with this project is approximately $25,000 per intersection.

City of San Angelo CCTV Camera Implementation

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)
- Incident Management System (ATMS08)

Prerequisite Projects: None

Description: This project includes the deployment of CCTV cameras at selected intersections in the City of San Angelo. The CCTV cameras can be used to monitor congestion associated with recurring events and signal control adjusted according to the vehicular demand. The information gathered by the CCTV cameras (video feed) can be shared with the TxDOT TMC for shared or after-hours viewing/monitoring. This project will also include the implementation of end equipment at the City of San Angelo TOC to allow video feeds for VIVDS and CCTV cameras as well as pan/tilt/zoom for CCTV.

The estimated cost per site is $20,000 to $25,000.

City of San Angelo Closed Loop Signal System Implementation Phase 3

Associated Market Packages:

- Network Surveillance (ATMS01)
- Surface Street Control (ATMS03)

Prerequisite Projects: City of San Angelo Closed Loop Signal System Implementation Phase 1, City of San Angelo Closed Loop Signal System Implementation Phase 2

Description: Continue to expand the closed loop signal system in the City of San Angelo. This project also includes the implementation of VIVDS.

The estimated cost associated with this project is approximately $25,000 per intersection.

Emergency Management

TxDOT Emergency Vehicle Traffic Signal Preemption Implementation

Associated Market Packages:

- Surface Street Control (ATMS03)
- Incident Management System (ATMS08)
- Emergency Routing (EM02)

Prerequisite Projects: None

Description: Equip TxDOT traffic signals in municipalities in the San Angelo Region with traffic signal preemption equipment. Typical installations include mounting hardware at the intersection and on each vehicle authorized to preempt the signal. The intersection equipment includes a detector(s) positioned at the intersection approach(es) connected to the traffic signal controller. As a vehicle equipped with a preemption emitter approaches an intersection, the detector activates a change in signal timing to allow fast and safe passage. Preemption systems have proven to improve safety of emergency personnel and vehicles en-route to an incident. The local municipalities will be responsible for the vehicle equipment.

The cost of this project per intersection is $8,000-$10,000 and $1,000 per vehicle.

Rural Fire Department AVL and MDTs

Associated Market Packages:

- Emergency Response (EM01)
- Emergency Vehicle Routing (EM02)

Prerequisite Projects: None

Description: Install AVL and MDTs on rural fire department vehicles. The AVL system will convey information regarding real-time vehicle location to the dispatch centers, which will allow for enhanced dispatch, routing (or re-routing), as well as provide for precise vehicle location information in the event

of a breakdown or emergency situation. AVL systems measure actual, real-time position of vehicles, and relay that information back to a dispatch center, usually via global positioning system.

MDTs allow the fire department to send and receive digital messages. MDTs can be used by dispatchers to notify drivers of adverse conditions and recommended routes. MDTs can also transmit information from the driver to the dispatch center, including status, disruptions, or silent alarms. An additional feature that can be built-in to the MDT is the ability for vehicle-to-vehicle digital communications, in addition to the vehicle to dispatch communications.

Costs will vary depending on the number of vehicles equipped with the units. For planning purposes, it is estimated that the cost per vehicle is approximately $10,000.

Maintenance and Construction Management

TxDOT Automated Maintenance Vehicle Maintenance Tracking

Associated Market Packages:

- Maintenance and Construction Vehicle Maintenance (MC02)

Prerequisite Projects: None

Description: Implement a system to monitor the maintenance status of TxDOT vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled. Such a system will enable maintenance issues to be addressed as soon as possible, hopefully preventing a break down and unplanned down time for a maintenance vehicle.

County Automated Maintenance Vehicle Maintenance Tracking

Associated Market Packages:

- Maintenance and Construction Vehicle Maintenance (MC02)

Prerequisite Projects: None

Description: Implement a system to monitor the maintenance status of county vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled. Such a system will enable maintenance issues to be addressed as soon as possible, hopefully preventing a break down and unplanned down time for a maintenance vehicle.

Public Transportation Management

San Angelo Street Railroad Company Security Cameras at Bus Depot

Associated Market Packages:

- Transit Security (APTS5)

Prerequisite Projects: None

Description: This project will include the installation of security cameras at San Angelo Street Railroad Bus Depot. Cameras will record, but will also likely be monitored at the Transit Dispatch. Video will be stored for a pre-determined amount of time via video tape or emerging digital video recording technology. The main objective of this project will be to provide increased security for transit patrons waiting at bus depots.

The estimated cost of this project is $50,000.

San Angelo Street Railroad Company On-board Security Cameras

Associated Market Packages:

- Transit Fixed Route Operations (APTS2)
- Demand Response Transit Operations (APTS3)
- Transit Security (APTS5)

Prerequisite Projects: None

Description: This project will install security cameras on San Angelo Street Railroad vehicles. These security cameras could provide a video feed from the buses to the transit operations center for monitoring.

The estimated cost associated with this project is approximately $15,000 per vehicle.

San Angelo Street Railroad Company Vehicle Maintenance System

Associated Market Packages:

- Transit Fixed-Route Operations (APTS2)
- Demand-Response Transit Operations (APTS3)
- Transit Maintenance (APTS6)

Prerequisite Projects: None

Description: Implement a system to monitor the maintenance status of San Angelo Street Railroad Company vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled. Such a system will enable maintenance issues to be addressed as soon as possible, hopefully preventing a break down and unplanned down time for a transit vehicle.

San Angelo Street Railroad Company Smart Bus Stops

Associated Market Packages:

- Transit Fixed Route Operations (APTS2)
- Transit Traveler Information (APTS8)

Prerequisite Projects: San Angelo Street Railroad Company AVL and MDTs

Description: Equip bus stops with signs to provide enhanced passenger route and schedule information, including a detailed bus system map to assist customers with their trip planning. Imminent arrival signs will also be used to inform customers at bus stops of the estimated time of arrival of their bus.

Costs will vary depending on the number of bus stops equipped with the proposed technologies. For planning purposes, $30,000 per bus stop is used.

Thunderbird Transit On-board Security Cameras

Associated Market Packages:

- Demand-Response Transit Operations (APTS3)
- Transit Security (APTS5)

Prerequisite Projects: None

Description: This project will install security cameras on Thunderbird Transit vehicles. These security cameras could provide a video feed from the buses to the transit operations center for monitoring.

The estimated cost associated with this project is approximately $15,000 per vehicle.

Thunderbird Transit Vehicle Maintenance System

Associated Market Packages:

- Demand-Response Transit Operations (APTS3)
- Transit Maintenance (APTS6)

Prerequisite Projects: None

Description: Implement a system to monitor the maintenance status of Thunderbird Transit vehicles and alert the driver and dispatch center when maintenance is required or preventative maintenance needs to be scheduled. Such a system will enable maintenance issues to be addressed as soon as possible, hopefully preventing a break down and unplanned down time for a transit vehicle.

4. MAINTAINING THE REGIONAL ITS ARCHITECTURE AND DEPLOYMENT PLAN

The San Angelo Regional ITS Deployment Plan is a living document. The recommended projects and their timeframes for implementation reflect the needs of the Region at the time the plan was developed. It is expected that the needs of the Region will change as ITS deployments are put into place, population, and travel patterns change, and as new technology is developed. In order for the ITS Deployment Plan to remain a useful document for Regional stakeholders, the plan must be updated over time.

TxDOT will serve as the lead agency for maintaining both the San Angelo Regional ITS Architecture and the ITS Deployment Plan; however, these plans will continue to be driven by stakeholder consensus rather than a single stakeholder.

At the ITS Deployment Plan Meeting in April 2004, stakeholders recommended that the group meet every two years to correspond with the Transportation Improvement Plan update process to review the Regional ITS Architecture and Deployment Plan. Any new market packages that have been added to the National Architecture should be reviewed to see if they are applicable to the San Angelo Region. Data flows in existing market packages should also be reviewed to determine if any planned/future flows have been implemented. The Deployment Plan will also be updated at that time to reflect projects that have been deployed, new projects that are necessary, and to reprioritize projects currently shown in the plan. Projects that are added to the ITS Deployment Plan should also be reviewed closely to determine if they fit into the ITS Architecture for the San Angelo Region. If a new project does not fit into the ITS Architecture, then the ITS Architecture will need to be revised to include the necessary links and data flows for the project. Any changes to the geographic scope of the Region should be agreed upon by the stakeholders.

Both the San Angelo Regional ITS Architecture and the ITS Deployment Plan were developed with a consensus approach from the stakeholders. In order for these documents to continue to reflect the needs of the Region, changes in the documents will need to be driven by consensus of all of the stakeholders.