



State of Texas  
Regional ITS Architectures and Deployment Plans  
**Permian Basin Region**

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## Regional ITS Architecture Report

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# TABLE OF CONTENTS

## REGIONAL ITS ARCHITECTURE REPORT

SUMMARY .....	vi
<b>1. INTRODUCTION .....</b>	<b>1-1</b>
<b>1.1 Project Overview.....</b>	<b>1-1</b>
<b>1.2 Document Overview.....</b>	<b>1-1</b>
<b>1.3 The Permian Basin Region.....</b>	<b>1-3</b>
1.3.1 Geographic Overview .....	1-3
1.3.2 Transportation Infrastructure .....	1-3
1.3.3 Permian Basin Region ITS Plans .....	1-5
1.3.4 Stakeholders.....	1-6
<b>2. INTEGRATION STRATEGY .....</b>	<b>2-1</b>
<b>2.1 Integration Purpose .....</b>	<b>2-1</b>
<b>2.2 Regional Needs.....</b>	<b>2-3</b>
<b>2.3 Regional Integration and Interoperability.....</b>	<b>2-5</b>
<b>3. REGIONAL ITS ARCHITECTURE DEVELOPMENT PROCESS.....</b>	<b>3-1</b>
<b>3.1 Permian Basin Process.....</b>	<b>3-1</b>
<b>3.2 USDOT Regional ITS Architecture Guidance.....</b>	<b>3-4</b>
<b>4. CONCEPTUAL DESIGN .....</b>	<b>4-1</b>
<b>4.1 Systems Inventory.....</b>	<b>4-1</b>
4.1.1 Subsystems and Terminators.....	4-1
4.1.2 Permian Basin ITS Inventory by Stakeholder.....	4-2
4.1.3 Permian Basin ITS Inventory by Entity.....	4-3
<b>4.2 Regional Market Packages.....</b>	<b>4-18</b>
<b>4.3 Interconnections.....</b>	<b>4-35</b>
4.3.1 Top Level Regional System Interconnect Diagram .....	4-35
4.3.2 Customized Market Packages .....	4-35
4.3.3 Permian Basin Architecture Interfaces.....	4-37
4.3.4 Physical Subsystem Architecture Flows.....	4-38
<b>4.4 Functional Requirements .....</b>	<b>4-40</b>
<b>4.5 Standards.....</b>	<b>4-44</b>
<b>4.6 Phases of Implementation .....</b>	<b>4-46</b>
<b>5. OPERATIONAL CONCEPT.....</b>	<b>5-1</b>
<b>5.1 Operational Scenarios .....</b>	<b>5-1</b>
<b>5.2 Roles and Responsibilities .....</b>	<b>5-2</b>
<b>5.3 Permian Basin Agreements .....</b>	<b>5-3</b>

### APPENDIX A – CUSTOMIZED MARKET PACKAGES

### APPENDIX B – INTERFACE DIAGRAMS

## TABLE OF CONTENTS

### REGIONAL ITS ARCHITECTURE REPORT

### LIST OF FIGURES

Figure 1 – Permian Basin Region Map.....	1-4
Figure 2 – Permian Basin Regional ITS Architecture and Deployment Plan Development Process .....	3-1
Figure 3 – USDOT Guidance on Regional ITS Architecture Development .....	3-4
Figure 4 – Physical Subsystem Interconnect Diagram .....	4-2
Figure 5 – Permian Basin Regional System Interconnect Diagram.....	4-36
Figure 6 – Custom Market Package for Surface Street Control .....	4-37
Figure 7 – TxDOT Odessa District Traffic Signals Interfaces .....	4-39
Figure 8 – TxDOT Odessa District TMC to Other Texas District TMCs Architecture Flows .....	4-40

### LIST OF TABLES

Table 1 – Permian Basin Stakeholder Agencies and Contacts .....	2-1
Table 2 – Permian Basin Region: Summary of ITS Needs.....	2-4
Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) .....	4-4
Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity).....	4-11
Table 5 – Permian Basin Region Selected Market Packages .....	4-18
Table 6 – Permian Basin Region Equipment Packages .....	4-41
Table 7 – Applicable ITS Standards for the Permian Basin Region .....	4-44
Table 8 – Potential Agreements for the Permian Basin Region .....	5-4

## LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society for Testing and Materials
ATIS	Advanced Travel Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
BCBP	Bureau of Customs and Border Protection
BRINSAP	Bridge Inventory Inspection System
CAD	Computer Aided Dispatch
CC	Control Center
CCTV	Closed-Circuit Television
CEA	Consumer Electronics Association
CPT	Common Public Transportation
CV	Commercial Vehicle
DARC	Data Radio Channel
DMS	Dynamic Message Sign
DPS	Department of Public Safety
DSRC	Dedicated Short Range Communications
EIA	Electronic Industries Association
EMC	Emergency Management Center
EMS	Emergency Medical Services
EOC	Emergency Operations Center
ETMCC	External TMC Communication
EV	Emergency Vehicle
FC	Fare Collection
FHWA	Federal Highway Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HCRS	Highway Condition Reporting System
HRI	Highway-Rail Intersections

## LIST OF ACRONYMS

I/F	Interface
IEEE	Institute of Electrical and Electronics Engineers
IM	Incident Management
IMMS	Incident Management Message Sets
ISP	Information Service Provider
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
MCM	Maintenance and Construction Management
MCV	Maintenance and Construction Vehicle
MDT	Mobile Data Terminal
MORTS	Midland-Odessa Regional Transportation Study
MOTRAN	Midland-Odessa Transportation Alliance
MOU	Memorandum of Understanding
MS	Message Sets
NEMA	National Electrical Manufacturers Association
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
OB	On-board
PI	Passenger Information
PSAP	Public Safety Answering Point
PTMS	Public Transportation Management System
PWD	Public Works Department
SAE	Society of Automotive Engineers
SDO	Standards Development Organization
SP	Spatial Representation
STIC	Subcarrier Traffic Information Channel
TCIP	Transit Communication Interface Protocol
TEA-21	Transportation Equity Act for the 21st Century
TM	Traffic Management

## LIST OF ACRONYMS

TMC	Traffic Management Center
TMDD	Traffic Management Data Directory
TOC	Traffic Operations Center
TxDOT	Texas Department of Transportation
USDOT	United States Department of Transportation
VIVDS	Video Image Vehicle Detection Systems
WIM	Weigh-in-Motion

## SUMMARY

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

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

The Permian Basin Region is located in west Texas. The Permian Basin Region is bordered by the TxDOT Lubbock District to the north, the TxDOT Laredo District to the south, the TxDOT San Angelo and Abilene Districts to the east, and the TxDOT El Paso District to the west.

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

Stakeholders from throughout the Region participated in the development of the Regional ITS Architecture, including representatives from TxDOT, cities, public safety, transit agencies, and planning organizations. These stakeholders provided input and review at key steps in the architecture development process, including a project kick-off meeting, architecture development and review workshops, and final review of the architecture documentation.

An inventory of existing and planned ITS infrastructure in the Region provided the basis for the architecture development. Stakeholder needs that could be addressed by ITS technologies guided the selection of market packages, data flows, and integration requirements. A diverse range of needs were identified by stakeholders in the Region. High priority needs focused on traffic management, traffic information dissemination, and incident management. Emergency vehicle signal preemption was also identified as a priority.

Market packages were selected that corresponded to the desired services and functions identified for the Region, and were customized for Permian Basin Region agencies and equipment. These market packages included high priority ‘foundation’ services and functions, such as network surveillance and traveler information, as well as market packages to address coordination needs, including incident management and regional emergency response. Stakeholders then prioritized these market packages as high, medium, and low. These priorities were used in the second phase of the project to develop the ITS Deployment Plan for the Permian Basin Region.

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

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

An Operational Concept for the Permian Basin Region was developed to illustrate how systems, components, and agencies will be integrated and function as a result of the framework provided by the Regional ITS Architecture. The purpose of the Operational Concept is to demonstrate the roles and responsibilities of the various stakeholders in the Permian Basin Region. Potential agreements that could be required for maintenance and operations, data sharing (among agencies and with the private sector), or joint operations are listed.

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



## 1. INTRODUCTION

### 1.1 Project Overview

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

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

A key goal in the development of the regional ITS architectures was to develop a consensus-based architecture with as many stakeholders as possible involved. Each stakeholder had an equal voice in determining the direction of the architecture for the Region. Stakeholders included representatives from TxDOT, cities, public safety, transit agencies, and planning organizations. A series of five meetings were held with the ITS stakeholders to discuss the development and gather input into the Permian Basin Regional ITS Architecture and Deployment Plan. In addition, a project web site was developed which contains all of the information on the Permian Basin Regional ITS Architecture and provides stakeholders with an opportunity to review and comment on the architecture directly from the web.

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

### 1.2 Document Overview

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

#### Section 1 – Introduction

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

## **Section 2 – Integration Strategy**

This section discusses Permian Basin Region stakeholder needs and issues, regional ITS initiatives and potential regional ITS programs, and opportunities for integration to achieve regional goals and contribute to regional and national ITS interoperability. Stakeholders and their contact information are also included.

## **Section 3 – Regional ITS Architecture Development Process**

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

## **Section 4 – Conceptual Design**

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

## **Section 5 – Operational Concept**

An Operational Concept has been prepared that discusses the key functions and services of the envisioned ITS for the Permian Basin Region. As part of this concept, operational scenarios are described and roles and responsibilities of stakeholders are discussed. Potential public-public and public-private agreements also have been identified.

The Permian Basin Regional ITS Architecture also contains two appendices:

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

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

## 1.3 The Permian Basin Region

### 1.3.1 Geographic Overview

The Permian Basin Region is bordered by the TxDOT Lubbock District to the north, the TxDOT Laredo District to the south, the TxDOT San Angelo and Abilene Districts to the east, and the TxDOT El Paso District to the west. For the Permian Basin Regional ITS Architecture and Deployment Plan, the study area included all 12 counties that comprise the TxDOT Odessa District. The geographic boundaries of the Permian Basin Region are highlighted in **Figure 1**.

The counties included in the Permian Basin Region area are:

- Andrews;
- Crane;
- Ector;
- Loving;
- Martin;
- Midland;
- Pecos;
- Reeves;
- Terrell;
- Upton;
- Ward; and
- Winkler.

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 Cities of Midland and Odessa are the only cities in the project Region with populations that exceed the 50,000 threshold.

### 1.3.2 Transportation Infrastructure

As illustrated in **Figure 1**, the Permian Basin Region has an extensive transportation infrastructure. The primary roadway facilities include I-10, I-20, US-67, US-285, and US-385.

I-10 and I-20 are east-west divided interstate highways. Their effective operation is critical to the movement of goods and people through the State of Texas and the United States. Blockages along I-10 and I-20 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-20 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.

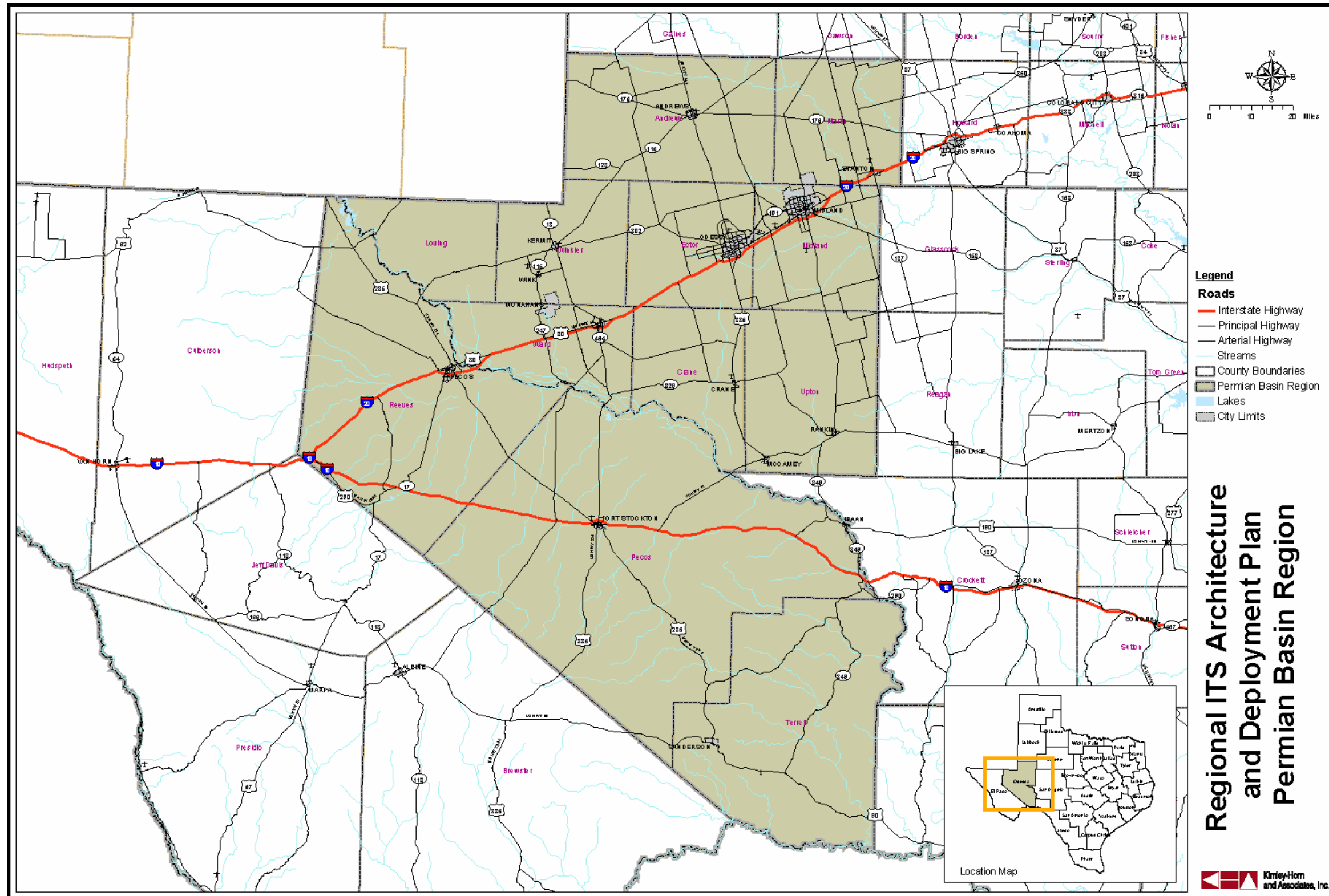


Figure 1 – Permian Basin Region Map

### 1.3.3 Permian Basin Region ITS Plans

There are several agencies in the Permian Basin Region that have already deployed ITS components. It is important to recognize the initial deployment of ITS infrastructure in a Region because in order for that Region to receive federal funding for ITS projects, the United States Department of Transportation (USDOT) requires that the Region have an ITS architecture by April 2005. This requirement is only for Regions with existing ITS infrastructure deployed. For Regions that do not have any ITS infrastructure deployed, the USDOT requires that they have an ITS architecture within four years of their first ITS project entering final design. As the Permian Basin Region pursues funding opportunities for proposed projects, it will be necessary to show that the proposed project fits within the architecture developed for the Region as part of this project.

Currently, the Permian Basin Region has several ITS components deployed in the field including closed loop signal systems with video image vehicle detection systems (VIVDS), signal preemption for emergency vehicles, computer aided dispatch (CAD), and portable dynamic message signs (DMS). The following sections discuss these deployments.

#### ***Video Detection***

TxDOT, the City of Midland, and the City of Odessa are using VIVDS at several intersections within the Region. Unlike loop detection, VIVDS will not be affected by paving operations and the detection zone of a VIVDS can be quickly changed to accommodate lane shifts during construction. VIVDS can detect vehicles approaching or stopping at a signalized intersection, and, under actuated conditions, place a call for the service of the appropriate phase for that vehicle.

#### ***Signal Preemption for Emergency Vehicles***

Currently, the Cities of Midland and Odessa have signal preemption installed at intersections within the city limits for fire vehicles and ambulances. Emergency vehicle preemption works when a vehicle equipped with a preemption emitter approaches an intersection and the detector activates a change in signal timing to allow fast and safe passage.

#### ***Computer Aided Dispatch***

Several emergency management agencies in the Region have implemented CAD systems. CAD systems enhance dispatch capabilities and allow dispatch records and any incident information entered by the dispatcher to be saved for future reference in a dispatch log.

#### ***Portable Dynamic Message Signs***

TxDOT currently has several portable DMS in the Permian Basin Region. These are controlled by the TxDOT Odessa District and are used to display incident and construction related messages.

#### 1.3.4 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 Permian Basin Region.

The following is a list of stakeholders in the Permian Basin 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 Permian Basin Regional ITS Architecture.

- City of Balmorhea;
- City of Fort Stockton;
- City of Midland;
- City of Odessa;
- City of Pecos;
- EZ Rider;
- Midland-Odessa Regional Transportation Study (MORTS);
- Midland-Odessa Transportation Alliance (MOTRAN);
- Permian Basin Regional Planning Commission;
- Texas Department of Public Safety;
- TxDOT El Paso District – Pecos Area Office;
- TxDOT Odessa District;
- TxDOT Traffic Operations Division (Austin); and
- West Texas Opportunities, Inc. - Permian Basin Rural Transit District.

## 2. INTEGRATION STRATEGY

### 2.1 Integration Purpose

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

For each operating agency or stakeholder entity identified through the development of the Regional ITS Architecture, there are operations that currently exist as a normal practice in order to accomplish the primary business goals and objectives for each stakeholder. As an example, a primary operation of the City of Midland Police Department dispatch is to dispatch emergency personnel to the appropriate locations when a call for help is placed within the city. The integration of the dispatch with any of the other stakeholders will not change this primary function of the dispatch or disrupt typical business practices. The integration of the Midland 911 Public Safety Answering Point (PSAP) with another agency, such as the TxDOT Odessa District, will require that the data that will be exchanged between the two entities (such as the blockage of a lane of traffic due to a crash) meet certain requirements for that particular data type. Identifying the need for this connection between agencies and the opportunities for integration and interoperability in the Region are key purposes of this section.

This section will provide an overview of the major issues and stakeholders' needs within the Permian Basin Region and the primary areas of concern that were uncovered in the preparation of the Permian Basin Regional ITS Architecture. This section will also discuss the need for interregional integration with agencies external to the Permian Basin Region, such as the need for integration with other TxDOT Districts.

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

**Table 1 – Permian Basin Stakeholder Agencies and Contacts**

Stakeholder Agency	Contact	Address	Phone Number	E-Mail
City of Balmorhea	Lois Conteras	P.O. Box 323 Balmorhea, Texas 79718	(432) 325-2307	Elmeez67918@yahoo.com
City of Balmorhea	Ruben Fuentes	PO Box 7 Balmorhea, Texas	(432) 375-0207	N/A
City of Balmorhea	Mary Garcia	P.O. Box 323 Balmorhea, Texas 79718	(432) 375-2307	citybalm@overland.net
City of Ft. Stockton	Brad Newton	PO Box 100 Ft. Stockton, Texas 79735	(432) 336-8525	bnewton@ci.fort-stockton.tx.us
City of Midland	Mark Barnes	PO Box 1152 Midland, Texas 79702	(432) 685-7292	mbarnes@mail.ci.midland.tx.us

**Table 1 – Permian Basin Stakeholder Agencies and Contacts (continued)**

<b>Stakeholder Agency</b>	<b>Contact</b>	<b>Address</b>	<b>Phone Number</b>	<b>E-Mail</b>
City of Midland	Gary Saunders	P.O. Box 1152 Midland, Texas 79702	(432) 685-7280	gsaunders@mail.ci.midland.tx.us
City of Midland Police Department	Rick Lewis	601 N Loraine Midland, Texas 79701	(432) 685-7172	rlewis@mail.ci.midland.tx.us
City of Odessa	Hal Feldman	P.O. Box 4398 Odessa, Texas 79762	(432) 335-3239	hfeldman@ci.odessa.tx.us
City of Odessa	Matt Squyres	411 West 8 <sup>th</sup> Street Odessa, Texas 79761	(432) 335-3244	msquyres@ci.odessa.tx.us
City of Odessa Fire Department	Steve Pollock	411 West 8 <sup>th</sup> Street Odessa, Texas 79761	(432) 335-3318	spollock@ci.odessa.tx.us
City of Odessa Fire Department	Charlie Smith	P.O. Box 4398 Odessa, Texas 79760	(432) 335-4654	csmith@ci.odessa.tx.us
City of Odessa Police Department	JD Echols	205 N. Grant Odessa, Texas 79761	(432) 335-3336	jechols@ci.odessa.tx.us
City of Odessa Police Department	Bob Forbus	205 N. Grant Odessa, Texas 79761	(432) 335-5756	bforbus@ci.odessa.tx.us
City of Odessa Police Department	Mike Sims	205 N Grant Odessa, Texas 79761	(432) 335-3355	N/A
City of Pecos	Joseph Torres	P.O. Box 929 Pecos, Texas 79772	(432) 445-2421	pecossec@classicnet.net
City of Pecos Police Department	Clay McKinney	510 South Oak Pecos, Texas 79772	(432) 445-2424	N/A
EZ Rider	Nelson Kirby	8007 E Hwy 80 Odessa, Texas 79765	(432) 561-8058	nkirby@netwest.com
MORTS	Robert Cox	P.O. Box 60660 ATS Midland, Texas 79701	(432) 563-1061	planning@pbrpc.org
MOTRAN	James Beauchamp	PO Box 60816 Midland, Texas 79711	(432) 563-6240	james@motran.org
Permian Basin Regional Planning Commission	Abel Gamez	2910 La Force Blvd Midland, Texas 79711	(432) 563-1061	bforbus@ci.odessa.tx.us
Texas Department of Public Safety	Glen Adamson	2405 South Loop 250 West Midland, Texas 79702	(432) 332-6100	N/A
Texas Department of Public Safety	Shannon Gray	1910 IH-20 West Odessa, TX 79763	(432) 332-6100	shannon.gray@txdps.state.tx.us
Texas Department of Public Safety	Terry Truett	1910 IH-20 West Odessa, Texas 79763	(432) 332-6100	terry.truett@txdps.state.tx.us
TxDOT El Paso District – Pecos Area Office	Kelli Williams	2100 W Third Pecos, Texas 79772	(432) 445-3800	kwillia@dot.state.tx.us
TxDOT Odessa District	Nolberto Aguirre	3901 E. Highway 80 Odessa, Texas 79761	(432) 498-4682	taguirre@dot.state.tx.us



**Table 1 – Permian Basin Stakeholder Agencies and Contacts (continued)**

Stakeholder Agency	Contact	Address	Phone Number	E-Mail
TxDOT Odessa District	Dan Dalager	3901 East Highway 80 Odessa, Texas 79761	(432) 498-4770	ddalage@dot.state.tx.us
TxDOT Odessa District	Doug Eichorst	5100 West IH-20 Midland, Texas 79703	(432) 694-2195	deichor@dot.state.tx.us
TxDOT Odessa District	Lauren Garduno	3901 East Highway 80 Odessa, Texas 79761	(432) 498-4711	lgardun@dot.state.tx.us
TxDOT Odessa District	Alfredo Gonzales	3901 East Highway 80 Odessa, Texas 79761	(432) 498-4766	agonza8@dot.state.tx.us
TxDOT Odessa District	Glen Larum	3901 East Highway 80 Odessa, Texas 79761	(432) 498-4746	glarum@dot.state.tx.us
TxDOT Odessa District	Robert Martinez	3901 East Highway 80 Odessa, Texas 79761	(432) 498-4748	rmarti1@dot.state.tx.us
TxDOT Odessa District	Mike McAnally	3901 East Highway 80 Odessa, Texas 79761	(432) 498-4740	mmcanal@dot.state.tx.us
TxDOT Odessa District	Mohammed Moabed	P.O. Box 97 Ft. Stockton, TX 79703	(432) 366-3671	mmoabed@dot.state.tx.us
TxDOT Odessa District	Ajay Shakyaver	3901 E. Highway 80 Odessa, Texas 79761	(432) 498-4753	ashakya@dot.state.tx.us
TxDOT Odessa District	Heather Sinclair	5100 West IH-20 Midland, Texas 79703	(432) 694-2195	N/A
TxDOT Odessa District	Cody Woodard	3901 E. Highway 80 Odessa, Texas 79761	(432) 498-4681	cwooda1@dot.state.tx.us
TxDOT Traffic Operations Division	Alex Power	Attn: TRF- Cedar Park #51 125 East 11th Street Austin, Texas 78701-2483	(512) 506-5153	apower@dot.state.tx.us
West Texas Opportunities, Inc. – Permian Basin Rural Transit District	Richard Jones	603 N 4 <sup>th</sup> Street Lamesa, Texas 79331-1308	(806) 872-8354	wtotrans@pics.net
West Texas Opportunities, Inc. – Permian Basin Rural Transit District	Fred Mustain	603 N 4 <sup>th</sup> Street Lamesa, Texas 79331-1308	(806) 872-8354	wtotrans@pics.net

## 2.2 Regional Needs

Needs from the Region were identified in the project kick-off meeting held on January 27, 2004. Stakeholders participating in that meeting identified the needs in the Region according to the eight user service areas defined in the National ITS Architecture. The needs identified in the project kick-off meeting are documented in **Table 2**.

**Table 2 – Permian Basin Region: Summary of ITS Needs**

<p style="text-align: center;"><b>Permian Basin Region</b> <b>Summary of ITS Needs</b> <b>Permian Basin Regional ITS Architecture and Deployment Plan Kick-Off Meeting</b> <b>January 27, 2004</b></p> <p><b>Travel and Traffic Management Needs</b></p> <ul style="list-style-type: none"><li>■ Need dynamic message sign (DMS) on I-10 and I-20</li><li>■ Need traveler information kiosks at rest areas</li><li>■ Need TxDOT Traffic Management Center (TMC)</li><li>■ Need to bring VIVDS back to TxDOT TMC and Midland Traffic Operations Center (TOC)</li><li>■ Need CCTV cameras on interstate and arterials</li><li>■ Need advanced railroad warnings/tracking</li><li>■ Need improved inter-agency coordination for sharing of traffic and weather data</li><li>■ Need district wide communications plan and system upgrade</li><li>■ Need center-to-center communication</li><li>■ Need to bring signal data from cities back to their respective TOCs</li><li>■ Need a TOC for the City of Odessa</li><li>■ Need VIVDS detection</li><li>■ Need closed loop signal system expansion in Midland</li><li>■ Need electronic toll collection</li></ul> <p><b>Public Transportation Management Needs</b></p> <ul style="list-style-type: none"><li>■ Need signal priority/scheduling for EZ Rider buses</li><li>■ Need on-board video cameras</li><li>■ Need Automated Vehicle Location (AVL) and Mobile Data Terminals (MDTs)</li><li>■ Need on-board weather alerts for Permian Basin Rural Transit District</li><li>■ Need Americans with Disabilities Act compliant stop annunciation for EZ Rider</li><li>■ Need smart card electronic fare collection</li><li>■ Need on-board distress button for EZ Rider</li><li>■ Need kiosks with real-time transit information</li><li>■ Need common communications system among Permian Basin Rural Transit District and with emergency management</li></ul> <p><b>Electronic Payment Needs</b></p> <p>None Identified</p> <p><b>Commercial Vehicle Operations Needs</b></p> <p>None identified</p> <p><b>Emergency Management Needs</b></p> <ul style="list-style-type: none"><li>■ Need AVL for police and fire in City of Odessa</li><li>■ Need 900 MHz data transfer capability</li><li>■ Need MDTs for City of Odessa Fire</li><li>■ Need AVL for Midland Police</li><li>■ Need MDT upgrade for Midland Police</li></ul> <p><b>Advanced Vehicle Safety Systems Needs</b></p> <p>None Identified</p>
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**Table 2 – Permian Basin Region: Summary of ITS Needs (continued)**

<p><b>Information Management Needs (Data Archiving)</b> None identified</p> <p><b>Maintenance and Construction Management Needs</b></p> <ul style="list-style-type: none"> <li>▪ Need road weather information systems</li> <li>▪ Need weigh-in-motion for pavement management</li> <li>▪ Need flood detection and driver notification at low water crossings</li> <li>▪ Need high wind/low visibility warning system</li> <li>▪ Need AVL on TxDOT maintenance vehicles</li> <li>▪ Need AVL on City of Odessa and Midland maintenance vehicles</li> </ul>
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### 2.3 Regional Integration and Interoperability

A vision for the Permian Basin Region is to integrate systems both on an intra-regional and an inter-regional basis. Within the Permian Basin Region, nearly every stakeholder identified is involved in emergency management. Incidents that occur on major roadways either in the Permian Basin Region or on roadways that could impact the movement of people and goods in the Permian Basin Region should be shared. The integration of the State Emergency Operations Center (EOC) and the local EOCs can facilitate the clearing of such an incident more efficiently. As an example, a chemical spill along I-20 between Midland and Odessa would require a major clean-up in addition to other emergency personnel on site. Coordination between the EOCs could identify the closest clean-up crew that could respond to the spill and dispatch them to the scene. Similarly, once on scene, the response team could provide the State EOC and the local EOCs status reports on the clean-up and potential timing for return to normal operations.

The Permian Basin Region is bordered by five other TxDOT Districts. Improved coordination with these surrounding Districts for incident management and roadway closures is a very important need in the Permian Basin.

Road closures due to maintenance or incidents also lead to a number of opportunities for improved operations through integration. TxDOT and other transportation agencies would like to be able to share this information throughout the Region so that as soon as one agency is aware of a closure, whether planned or unplanned, other agencies can also be made aware of the closure and make appropriate plans.

Operators of the transportation system have many opportunities to improve performance through integration. EZ Rider and the Permian Basin Rural Transit District can improve performance and schedule adherence by integrating closure information from operators of the transportation network.

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

The headquarters of TxDOT maintains a database of traffic counts and accident records for roadways throughout the State of Texas. On occasion, agencies within the Permian Basin Region will need access to these databases either to retrieve data or supply data to the database. These

data exchanges also will require integrating the agencies' data flows such that neither of the agencies' normal business operations is disturbed to share these data.

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

### 3. REGIONAL ITS ARCHITECTURE DEVELOPMENT PROCESS

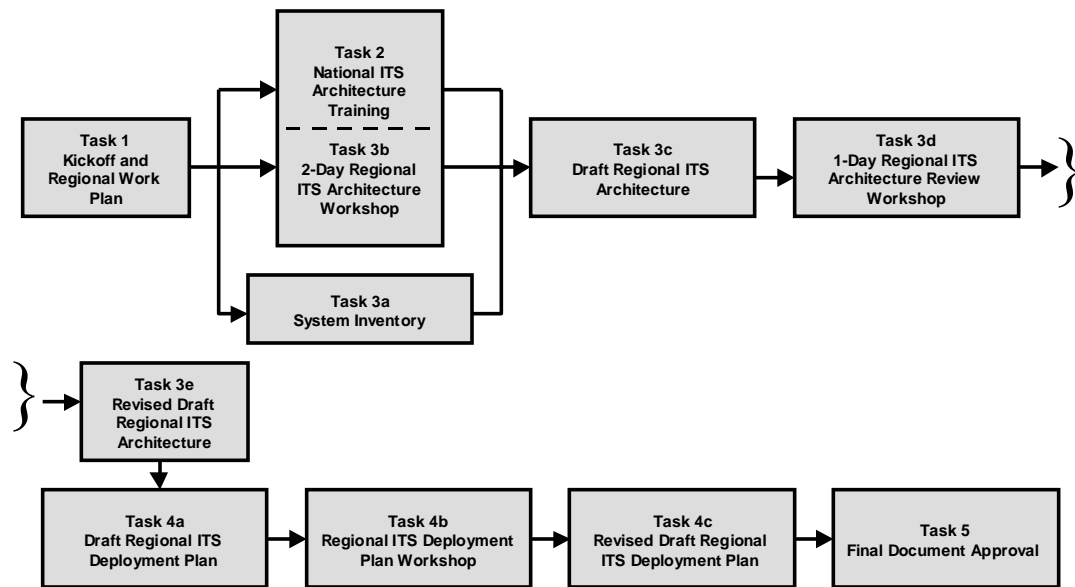
Development of the Regional ITS Architecture and Deployment Plan for the Permian Basin Region relied heavily on stakeholder input to ensure that the architecture reflected local needs. A series of five meetings was held with stakeholders to gather input, and a web site with the components of the regional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

#### 3.1 Permian Basin Process

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

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

After selecting a contractor, the process shown in **Figure 2** was used to develop the Region’s ITS Architecture. In addition to the architecture, an ITS Deployment Plan for the Region also was developed to identify projects needed to implement the architecture.



**Figure 2 – Permian Basin Regional ITS Architecture and Deployment Plan Development Process**

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

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

Key components of the process are described below:

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

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

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

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

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

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

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

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

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

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

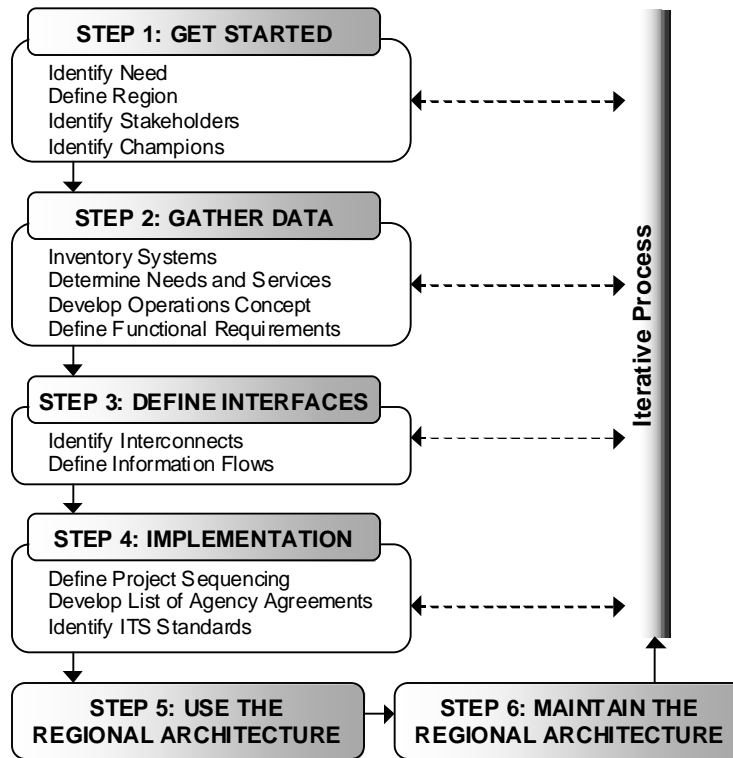
**Task 4B – Regional ITS Deployment Plan Workshop:** The Draft Regional ITS Deployment Plan was presented to stakeholders at the Regional ITS Deployment Plan Workshop. Stakeholders were asked to provide input on the recommended projects, priority, and deployment timeframe.

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

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

### 3.2 USDOT Regional ITS Architecture Guidance

On October 12, 2001, the USDOT issued guidance on development of a regional ITS architecture through the document “Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region.” **Figure 3** summarizes the guidance provided by the USDOT.



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

**Figure 3 – USDOT Guidance on Regional ITS Architecture Development**

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

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

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



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

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

## 4. CONCEPTUAL DESIGN

### 4.1 Systems Inventory

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

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

- ***Travel and Traffic Management*** – includes the TxDOT Odessa TMC, center-to-center links, detection systems, closed-circuit television (CCTV), fixed and portable dynamic message signs, broadcast traveler information, and other related technologies.
- ***Public Transportation Management*** – includes transit and paratransit automated vehicle location, and transit travel information systems.
- ***Commercial Vehicle Operations*** – includes weigh-in-motion and coordination with TexView (CVISN) efforts.
- ***Emergency Management*** – includes emergency operations/management centers and improved information sharing among traffic and emergency services.
- ***Information Management*** – includes electronic data management and archiving systems.
- ***Maintenance and Construction Management*** – includes maintenance and construction vehicle tracking, roadway maintenance and construction information, and work zone management.

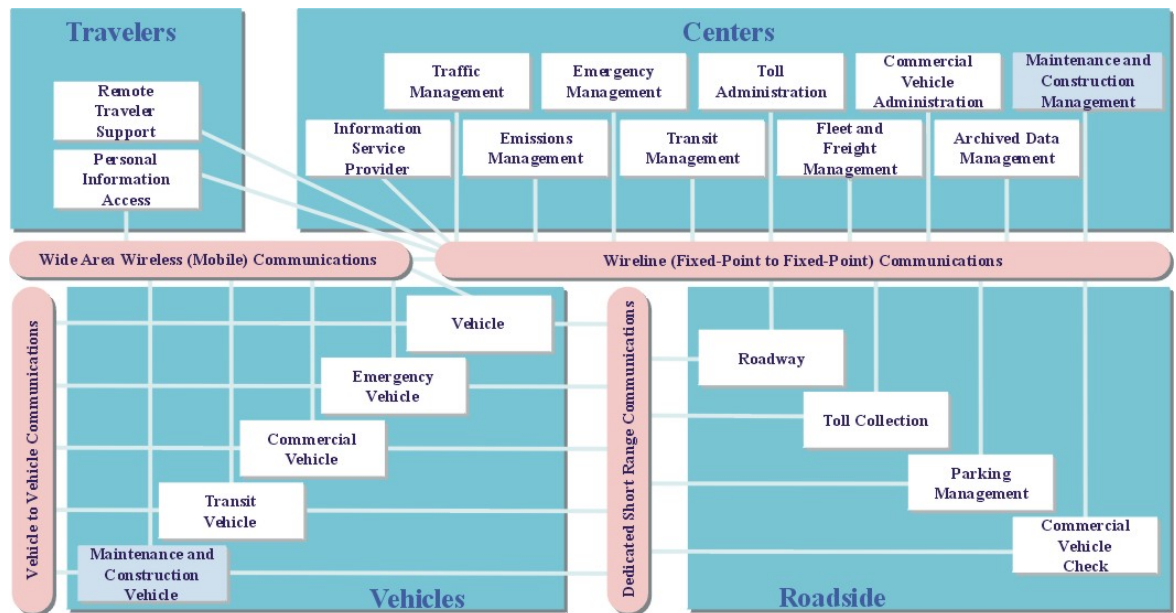
The System Inventory is a valuable task for several reasons. First, it provides a baseline of existing and planned ITS projects and systems in the Region. Second, it outlines which agencies are currently deploying and operating ITS, as well as those that are planning to implement ITS programs. Third,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

#### 4.1.1 Subsystems and Terminators

Each identified system or component in the Permian Basin Regional ITS inventory was mapped to a subsystem or terminator in the National ITS Architecture. Subsystems and terminators are the 'entities' that represent systems in ITS. Subsystems are the highest level building blocks of the physical architecture, and the National ITS Architecture groups them into four major classes: Centers, Roadside, Vehicles, and Travelers. Each of these major classes includes various subsystems that represent a set of transportation functions (or processes) that are likely to be collected together under one agency, jurisdiction, or location, and correspond to physical elements, such as traffic operations centers, traffic signals, vehicles, and so on. **Figure 4** shows the National ITS Architecture subsystems. This figure, also known as the "sausage diagram" is a standard interconnect diagram, showing the

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

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



**Figure 4 – Physical Subsystem Interconnect Diagram**

#### 4.1.2 Permian Basin ITS Inventory by Stakeholder

Each stakeholder is associated with one or more systems or elements (subsystems and terminators) that make up the transportation system in the Permian Basin Region. **Table 3** sorts the inventory by stakeholder, so each stakeholder can easily identify and review all their relevant assets that are identified in the Permian Basin Regional ITS Architecture.

The information in **Table 3** also is included on the Permian Basin ITS Architecture web site, which is accessible by selecting the link to the Texas Regional ITS Architecture, the Permian Basin Region, and then selecting the “Inventory by Stakeholder” button which will open the stakeholder list. Each element in the list contains a hyperlink to more detailed information, including status, description, stakeholder, and other elements within the inventory with which it interfaces. (At the time this report was published, the Permian

Basin Regional ITS Architecture web site was being hosted at [www.consystec.com](http://www.consystec.com). TxDOT plans to permanently host the site in the future at [www.dot.state.tx.us/trf/its](http://www.dot.state.tx.us/trf/its).)

#### 4.1.3 *Permian Basin ITS Inventory by Entity*

The Permian Basin Regional ITS Architecture inventory is made up of the transportation and communications centers, the field equipment, the vehicles, and other systems in the regional transportation system. These components have been assigned to an entity (subsystem or terminator) as defined by the National ITS Architecture. **Table 4** presents the Permian Basin Region inventory using the associated National ITS Architecture subsystem or terminator. This sorts elements that perform similar functions together, so elements of a particular type can be easily identified. This inventory also can be accessed from the Permian Basin Regional ITS Architecture web site by selecting the “Inventory by Entity” button.

**Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder)**

Stakeholder	Element	Entity	Status
Amtrak	AMTRAK Station	Multimodal Transportation Service Provider	Future
Army/State Guard	National Guard/State Guard Office	Emergency Management Subsystem	Existing
Bureau of Customs and Border Protection (BCBP)	Bureau of Customs and Border Protection Office	Emergency Management Subsystem	Existing
City of Midland	City of Midland Accident Database	Archived Data Management Subsystem	Existing
	City of Midland Development Services Dispatch	Maintenance and Construction Management Subsystem	Existing
	City of Midland Development Services Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
	City of Midland Equipment Repair	Equipment Repair Facility	Existing
	City of Midland Field Equipment	Roadway Subsystem	Existing
	City of Midland Fire and EMS Vehicles	Emergency Vehicle Subsystem	Existing
	City of Midland HAR	Remote Traveler Support Subsystem	Future
	City of Midland Police Vehicles	Emergency Vehicle Subsystem	Existing
	City of Midland Public Information Office	Information Service Provider Subsystem	Existing
	City of Midland Public Safety Communications	Emergency Management Subsystem	Existing
	City of Midland Public Safety Communications	Enforcement Agency	Existing
	City of Midland School Pager System	Roadway Subsystem	Existing
	City of Midland Traffic Operations Center	Traffic Management Subsystem	Existing
	City of Midland Traffic Signal Shop	Maintenance and Construction Management Subsystem	Existing
	City of Midland Website	Information Service Provider Subsystem	Existing
Midland International Airport	Multimodal Transportation Service Provider	Existing	
City of Odessa	City of Odessa Accident Database	Archived Data Management Subsystem	Existing
	City of Odessa Equipment Services	Equipment Repair Facility	Existing
	City of Odessa Field Equipment	Roadway Subsystem	Existing
	City of Odessa Fire and EMS Vehicles	Emergency Vehicle Subsystem	Existing

**Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)**

Stakeholder	Element	Entity	Status
City of Odessa (continued)	City of Odessa HAR	Remote Traveler Support Subsystem	Future
	City of Odessa Police Vehicles	Emergency Vehicle Subsystem	Existing
	City of Odessa Public Information Office	Information Service Provider Subsystem	Future
	City of Odessa Public Safety Communications	Emergency Management Subsystem	Existing
	City of Odessa Public Works Dispatch	Maintenance and Construction Management Subsystem	Existing
	City of Odessa Public Works Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
	City of Odessa School Pager System	Roadway Subsystem	Future
	City of Odessa Traffic Engineering	Maintenance and Construction Management Subsystem	Existing
	City of Odessa Traffic Operations Center	Traffic Management Subsystem	Future
	City of Odessa Web Site	Information Service Provider Subsystem	Existing
Commercial Vehicle Operators	Commercial Vehicles	Commercial Vehicle Subsystem	Existing
	Private Fleet Management Systems	Fleet and Freight Management Subsystem	Future
Correctional Facilities	Correctional Facilities Operations	Emergency Management Subsystem	Existing
County Emergency Management Agencies	County EOC	Emergency Management Subsystem	Existing
	District Disaster Committee	Emergency Management Subsystem	Future
County Road and Bridge	County Road and Bridge	Maintenance and Construction Management Subsystem	Existing
	County Road and Bridge Equipment Repair	Equipment Repair Facility	Existing
	County Road and Bridge Field Equipment	Roadway Subsystem	Existing
	County Road and Bridge Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
County Sheriff	County Public Safety Dispatch	Emergency Management Subsystem	Existing
	County Public Safety Dispatch	Enforcement Agency	Existing

**Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)**

Stakeholder	Element	Entity	Status
DPS	DPS Administration	Emergency Management Subsystem	Existing
	DPS Communications Service	Emergency Management Subsystem	Existing
	DPS Division of Emergency Management	Emergency Management Subsystem	Existing
	DPS Electronic Screening Stations	Commercial Vehicle Check Subsystem	Future
	DPS Emergency Vehicles	Emergency Vehicle Subsystem	Existing
	DPS License and Weights Division	Enforcement Agency	Future
	DPS Weigh in Motion	Commercial Vehicle Check Subsystem	Future
	Statewide Crash Records Information System	Archived Data Management Subsystem	Existing
DPS Division of Emergency Management	State EOC	Emergency Management Subsystem	Existing
Ector County	Ector County EOC	Emergency Management Subsystem	Existing
Financial Institution	Financial Institutions	Financial Institution	Existing
Independent School Districts	Ector County Independent School District Police	Emergency Management Subsystem	Existing
	Independent School District Buses	Transit Vehicle Subsystem	Existing
	Independent School District Dispatch	Transit Management Subsystem	Existing
	Midland Independent School District Police	Emergency Management Subsystem	Existing
Local Media	Local Print and Broadcast Media	Media	Existing
Midland County	Midland County EOC	Emergency Management Subsystem	Existing
Midland-Odessa Urban Transit District	EZ Rider Demand Response Vehicles	Transit Vehicle Subsystem	Existing
	EZ Rider Fixed Route Transit Vehicles	Transit Vehicle Subsystem	Existing
	EZ Rider Maintenance Facility	Equipment Repair Facility	Existing
	EZ Rider Transit Dispatch	Transit Management Subsystem	Existing
	EZ Rider Transit Kiosks	Remote Traveler Support Subsystem	Future
	EZ Rider Transit Point of Sale / Customer Information Systems	Remote Traveler Support Subsystem	Future
	EZ Rider Transit Ridership Database	Archived Data Management Subsystem	Existing
	EZ Rider Transit Transfer Stations	Remote Traveler Support Subsystem	Future

**Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)**

Stakeholder	Element	Entity	Status
Midland-Odessa Urban Transit District (continued)	EZ Rider Website	Information Service Provider Subsystem	Future
	Regional Transit Card	Traveler Card	Future
	Transit Database Users	Archived Data User Systems	Existing
Municipal or County Government	Municipal Websites	Information Service Provider Subsystem	Existing
Municipal or County Public Safety	County Emergency Vehicles	Emergency Vehicle Subsystem	Existing
	Municipal Emergency Vehicles	Emergency Vehicle Subsystem	Existing
	Municipal ITS Field Equipment	Roadway Subsystem	Future
	Municipal Public Safety Dispatch	Emergency Management Subsystem	Existing
	Municipal Public Safety Dispatch	Enforcement Agency	Existing
	Other County Public Safety Dispatch	Emergency Management Subsystem	Future
	Other Municipal Public Safety Dispatch	Emergency Management Subsystem	Future
Municipal Public Works Department	Municipal PWD	Maintenance and Construction Management Subsystem	Existing
	Municipal PWD Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
NOAA	Permian Basin National Weather Service Office	Weather Service	Existing
Other States	Other States Credentials Administration and Safety Systems	Other CVAS	Future
Other Transit System Providers	Other Transit Systems	Transit Management Subsystem	Existing
Permian Basin Rural Transit District	Permian Basin Rural Public Transportation Dispatch	Transit Management Subsystem	Existing
	Permian Basin Rural Transit Vehicles	Transit Vehicle Subsystem	Existing
	Permian Basin Transit Ridership Database	Archived Data Management Subsystem	Future
Pipeline Companies	Pipeline Company Systems	Maintenance and Construction Management Subsystem	Existing
Private Information Service Providers	Private Sector Traveler Information Services	Information Service Provider Subsystem	Future
	West Texas Opportunities Website	Information Service Provider Subsystem	Future
Private Taxi Providers	Private Taxi Provider Dispatch	Transit Management Subsystem	Existing



**Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)**

Stakeholder	Element	Entity	Status
Private Tow/Wrecker Providers	Private Tow/Wrecker Dispatch	Emergency Management Subsystem	Existing
Private Transit Providers	Private Transit Facility Maintenance Operations	Equipment Repair Facility	Existing
	Private Transit Systems	Transit Management Subsystem	Existing
Private Travelers	Private Travelers Personal Computing Devices	Personal Information Access Subsystem	Existing
	Private Vehicles	Vehicle Subsystem	Existing
Rail Operators	Rail Operations Centers	Rail Operations	Existing
	Rail Operators Wayside Equipment	Wayside Equipment	Existing
	Rail Police/Security	Emergency Management Subsystem	Existing
Regional Chambers of Commerce	Regional Chambers of Commerce	Event Promoters	Future
Regional Emergency and Public Safety Agencies	Crash Records Users	Archived Data User Systems	Future
	Permian Basin Regional Incident and Mutual Aid Network	Other EM	Future
Regional Event Promoter	Regional Event Promoters	Event Promoters	Future
Regional Medical Center	Regional Medical Centers	Care Facility	Existing
State of Texas	Service Agencies	Information Service Provider Subsystem	Existing
Texas Forest Service	Texas Forest Service Permian Basin	Emergency Management Subsystem	Existing
TxDOT	Other TxDOT District Maintenance Sections	Maintenance and Construction Management Subsystem	Existing
	Other TxDOT Districts TMCs	Traffic Management Subsystem	Existing
	Trans Vista TMC	Traffic Management Subsystem	Existing
	TxDOT 511 System	Information Service Provider Subsystem	Future
	TxDOT BRINSAP	Asset Management	Existing
	TxDOT Credentials Administration and Safety Information Exchange	Commercial Vehicle Administration Subsystem	Future
	TxDOT Fort Worth TMC (TransVision)	Traffic Management Subsystem	Existing
	TxDOT Highway Conditions Reporting System	Information Service Provider Subsystem	Existing

**Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)**

Stakeholder	Element	Entity	Status
TxDOT (continued)	TxDOT Highway Conditions Reporting System	Maintenance and Construction Management Subsystem	Existing
	TxDOT Motor Carrier Routing Information	Information Service Provider Subsystem	Existing
	TxDOT Odessa District Area Engineers Office	Maintenance and Construction Administrative Systems	Existing
	TxDOT Odessa District Area Engineers Office	Maintenance and Construction Management Subsystem	Existing
	TxDOT Odessa District CCTV	Roadway Subsystem	Future
	TxDOT Odessa District DMS	Roadway Subsystem	Future
	TxDOT Odessa District Equipment Shop	Equipment Repair Facility	Existing
	TxDOT Odessa District Field Sensors	Roadway Subsystem	Existing
	TxDOT Odessa District Maintenance Sections	Maintenance and Construction Management Subsystem	Existing
	TxDOT Odessa District Maintenance Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
	TxDOT Odessa District Pavement Management System	Archived Data Management Subsystem	Existing
	TxDOT Odessa District Pavement Management System	Asset Management	Existing
	TxDOT Odessa District Pavement Management System Users	Archived Data User Systems	Existing
	TxDOT Odessa District Public Information Office	Information Service Provider Subsystem	Existing
	TxDOT Odessa District Public Transportation Management System (PTMS)	Archived Data Management Subsystem	Existing
	TxDOT Odessa District School Pager System	Roadway Subsystem	Existing
	TxDOT Odessa District TMC	Maintenance and Construction Management Subsystem	Existing
	TxDOT Odessa District TMC	Traffic Management Subsystem	Existing
TxDOT Odessa District Traffic Signal Shop	Maintenance and Construction Management Subsystem	Existing	

**Table 3 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)**

Stakeholder	Element	Entity	Status
TxDOT (continued)	TxDOT Odessa District Traffic Signals	Roadway Subsystem	Existing
	TxDOT Odessa District Web Page	Information Service Provider Subsystem	Existing
	TxDOT Odessa District Work Zone Equipment	Roadway Subsystem	Existing
	TxDOT Public Transportation Division	Archived Data User Systems	Existing
	TxDOT Rest Area/Visitor Center/Service Plaza/Truck Stop Kiosks	Remote Traveler Support Subsystem	Future
	TxDOT Statewide Pavement Management System	Archived Data Management Subsystem	Existing
University/College	University/College Police Force	Emergency Management Subsystem	Existing
US Bureau of Customs and Border Protection	US BCBP Customs Product Manifest System	Commercial Vehicle Administration Subsystem	Future
	US BCBP Electronic Clearance System	Commercial Vehicle Check Subsystem	Future
	US BCBP Electronic Clearance System	Commercial Vehicle Check Subsystem	Future
Utility Services	Utility Dispatch	Maintenance and Construction Management Subsystem	Existing
	Utility Dispatch	Maintenance and Construction Management Subsystem	Existing

**Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity)**

Entity	Element	Stakeholder	Status
Archived Data Management Subsystem	City of Midland Accident Database	City of Midland	Existing
	City of Odessa Accident Database	City of Odessa	Existing
	EZ Rider Transit Ridership Database	Midland-Odessa Urban Transit District	Existing
	Permian Basin Transit Ridership Database	Permian Basin Rural Transit District	Future
	Statewide Crash Records Information System	DPS	Existing
	TxDOT Odessa District Pavement Management System	TxDOT	Existing
	TxDOT Odessa District Public Transportation Management System (PTMS)	TxDOT	Existing
	TxDOT Statewide Pavement Management System	TxDOT	Existing
Archived Data User Systems	Crash Records Users	Regional Emergency and Public Safety Agencies	Future
	Transit Database Users	Midland-Odessa Urban Transit District	Existing
	TxDOT Odessa District Pavement Management System Users	TxDOT	Existing
	TxDOT Public Transportation Division	TxDOT	Existing
Asset Management	TxDOT BRINSAP	TxDOT	Existing
	TxDOT Odessa District Pavement Management System	TxDOT	Existing
Care Facility	Regional Medical Centers	Regional Medical Center	Existing
Commercial Vehicle Administration Subsystem	TxDOT Credentials Administration and Safety Information Exchange	TxDOT	Future
	US BCBP Customs Product Manifest System	US Bureau of Customs and Border Protection	Future
Commercial Vehicle Check Subsystem	DPS Electronic Screening Stations	DPS	Future
	DPS Weigh in Motion	DPS	Future
	US BCBP Electronic Clearance System	US Bureau of Customs and Border Protection	Future
Commercial Vehicle Subsystem	Commercial Vehicles	Commercial Vehicle Operators	Existing

**Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)**

Entity	Element	Stakeholder	Status
Emergency Management Subsystem	Bureau of Customs and Border Protection Office	Bureau of Customs and Border Protection (BCBP)	Existing
	City of Midland Public Safety Communications	City of Midland	Existing
	City of Odessa Public Safety Communications	City of Odessa	Existing
	Correctional Facilities Operations	Correctional Facilities	Existing
	County EOC	County Emergency Management Agencies	Existing
	County Public Safety Dispatch	County Sheriff	Existing
	District Disaster Committee	County Emergency Management Agencies	Future
	DPS Administration	DPS	Existing
	DPS Communications Service	DPS	Existing
	DPS Division of Emergency Management	DPS	Existing
	Ector County EOC	Ector County	Existing
	Ector County Independent School District Police	Independent School Districts	Existing
	Midland County EOC	Midland County	Existing
	Midland Independent School District Police	Independent School Districts	Existing
	Municipal Public Safety Dispatch	Municipal or County Public Safety	Existing
	National Guard/State Guard Office	Army/State Guard	Existing
	Other County Public Safety Dispatch	Municipal or County Public Safety	Future
	Other Municipal Public Safety Dispatch	Municipal or County Public Safety	Future
	Private Tow/Wrecker Dispatch	Private Tow/Wrecker Providers	Existing
	Rail Police/Security	Rail Operators	Existing
State EOC	DPS Division of Emergency Management	Existing	
Texas Forest Service Permian Basin	Texas Forest Service	Existing	
University/College Police Force	University/College	Existing	

**Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)**

Entity	Element	Stakeholder	Status
Emergency Vehicle Subsystem	City of Midland Fire and EMS Vehicles	City of Midland	Existing
	City of Midland Police Vehicles	City of Midland	Existing
	City of Odessa Fire and EMS Vehicles	City of Odessa	Existing
	City of Odessa Police Vehicles	City of Odessa	Existing
	County Emergency Vehicles	Municipal or County Public Safety	Existing
	DPS Emergency Vehicles	DPS	Existing
	Municipal Emergency Vehicles	Municipal or County Public Safety	Existing
Enforcement Agency	City of Midland Public Safety Communications	City of Midland	Existing
	County Public Safety Dispatch	County Sheriff	Existing
	DPS License and Weights Division	DPS	Future
	Municipal Public Safety Dispatch	Municipal or County Public Safety	Existing
Equipment Repair Facility	City of Midland Equipment Repair	City of Midland	Existing
	City of Odessa Equipment Services	City of Odessa	Existing
	County Road and Bridge Equipment Repair	County Road and Bridge	Existing
	EZ Rider Maintenance Facility	Midland-Odessa Urban Transit District	Existing
	Private Transit Facility Maintenance Operations	Private Transit Providers	Existing
	TxDOT Odessa District Equipment Shop	TxDOT	Existing
Event Promoters	Regional Chambers of Commerce	Regional Chambers of Commerce	Future
	Regional Event Promoters	Regional Event Promoter	Future
Financial Institution	Financial Institutions	Financial Institution	Existing
Fleet and Freight Management Subsystem	Private Fleet Management Systems	Commercial Vehicle Operators	Future
Information Service Provider Subsystem	City of Midland Public Information Office	City of Midland	Existing
	City of Midland Website	City of Midland	Existing
	City of Odessa Public Information Office	City of Odessa	Future
	City of Odessa Web Site	City of Odessa	Existing

**Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)**

Entity	Element	Stakeholder	Status
Information Service Provider Subsystem (continued)	EZ Rider Website	Midland-Odessa Urban Transit District	Future
	Municipal Websites	Municipal or County Government	Existing
	Private Sector Traveler Information Services	Private Information Service Providers	Future
	Service Agencies	State of Texas	Existing
	TxDOT 511 System	TxDOT	Future
	TxDOT Highway Conditions Reporting System	TxDOT	Existing
	TxDOT Motor Carrier Routing Information	TxDOT	Existing
	TxDOT Odessa District Public Information Office	TxDOT	Existing
	TxDOT Odessa District Web Page	TxDOT	Existing
	West Texas Opportunities Website	Private Information Service Providers	Future
Maintenance and Construction Administrative Systems	TxDOT Odessa District Area Engineers Office	TxDOT	Existing
Maintenance and Construction Management Subsystem	City of Midland Development Services Dispatch	City of Midland	Existing
	City of Midland Traffic Signal Shop	City of Midland	Existing
	City of Odessa Public Works Dispatch	City of Odessa	Existing
	City of Odessa Traffic Engineering	City of Odessa	Existing
	County Road and Bridge	County Road and Bridge	Existing
	Municipal PWD	Municipal Public Works Department	Existing
	Other TxDOT District Maintenance Sections	TxDOT	Existing
	Pipeline Company Systems	Pipeline Companies	Existing
	TxDOT Highway Conditions Reporting System	TxDOT	Existing
	TxDOT Odessa District Area Engineers Office	TxDOT	Existing
	TxDOT Odessa District Maintenance Sections	TxDOT	Existing
	TxDOT Odessa District TMC	TxDOT	Existing

**Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)**

Entity	Element	Stakeholder	Status
Maintenance and Construction Management Subsystem (continued)	TxDOT Odessa District Traffic Signal Shop	TxDOT	Existing
	Utility Dispatch	Utility Services	Existing
Maintenance and Construction Vehicle Subsystem	City of Midland Development Services Vehicles	City of Midland	Existing
	City of Odessa Public Works Vehicles	City of Odessa	Existing
	County Road and Bridge Vehicles	County Road and Bridge	Existing
	Municipal PWD Vehicles	Municipal Public Works Department	Existing
	TxDOT Odessa District Maintenance Vehicles	TxDOT	Existing
Media	Local Print and Broadcast Media	Local Media	Existing
Multimodal Transportation Service Provider	AMTRAK Station	Amtrak	Future
	Midland International Airport	City of Midland	Existing
Other CVAS	Other States Credentials Administration and Safety Systems	Other States	Future
Other EM	Permian Basin Regional Incident and Mutual Aid Network	Regional Emergency and Public Safety Agencies	Future
Personal Information Access Subsystem	Private Travelers Personal Computing Devices	Private Travelers	Existing
Rail Operations	Rail Operations Centers	Rail Operators	Existing
Remote Traveler Support Subsystem	City of Midland HAR	City of Midland	Future
	City of Odessa HAR	City of Odessa	Future
	EZ Rider Transit Kiosks	Midland-Odessa Urban Transit District	Future
	EZ Rider Transit Point of Sale / Customer Information Systems	Midland-Odessa Urban Transit District	Future
	EZ Rider Transit Transfer Stations	Midland-Odessa Urban Transit District	Future
	TxDOT Rest Area/Visitor Center/Service Plaza/Truck Stop Kiosks	TxDOT	Future
Roadway Subsystem	City of Midland Field Equipment	City of Midland	Existing
	City of Midland School Pager System	City of Midland	Existing



**Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)**

Entity	Element	Stakeholder	Status
Roadway Subsystem (continued)	City of Odessa Field Equipment	City of Odessa	Existing
	City of Odessa School Pager System	City of Odessa	Future
	County Road and Bridge Field Equipment	County Road and Bridge	Existing
	Municipal ITS Field Equipment	Municipal or County Public Safety	Future
	TxDOT Odessa District CCTV	TxDOT	Future
	TxDOT Odessa District DMS	TxDOT	Future
	TxDOT Odessa District Field Sensors	TxDOT	Existing
	TxDOT Odessa District School Pager System	TxDOT	Existing
	TxDOT Odessa District Traffic Signals	TxDOT	Existing
	TxDOT Odessa District Work Zone Equipment	TxDOT	Existing
Traffic Management Subsystem	City of Midland Traffic Operations Center	City of Midland	Existing
	City of Odessa Traffic Operations Center	City of Odessa	Future
	Other TxDOT Districts TMCs	TxDOT	Existing
	Trans Vista TMC	TxDOT	Existing
	TxDOT Fort Worth TMC (TransVision)	TxDOT	Existing
	TxDOT Odessa District TMC	TxDOT	Existing
Transit Management Subsystem	EZ Rider Transit Dispatch	Midland-Odessa Urban Transit District	Existing
	Independent School District Dispatch	Independent School Districts	Existing
	Other Transit Systems	Other Transit System Providers	Existing
	Permian Basin Rural Public Transportation Dispatch	Permian Basin Rural Transit District	Existing
	Private Taxi Provider Dispatch	Private Taxi Providers	Existing
	Private Transit Systems	Private Transit Providers	Existing
Transit Vehicle Subsystem	EZ Rider Demand Response Vehicles	Midland-Odessa Urban Transit District	Existing
	EZ Rider Fixed Route Transit Vehicles	Midland-Odessa Urban Transit District	Existing
	Independent School District Buses	Independent School Districts	Existing

**Table 4 – Permian Basin Inventory of Regional Subsystems/Terminators (sorted by Entity) (continued)**

<b>Entity</b>	<b>Element</b>	<b>Stakeholder</b>	<b>Status</b>
Transit Vehicle Subsystem (continued)	Permian Basin Rural Transit Vehicles	Permian Basin Rural Transit District	Existing
Traveler Card	Regional Transit Card	Midland-Odessa Urban Transit District	Future
Vehicle Subsystem	Private Vehicles	Private Travelers	Existing
Wayside Equipment	Rail Operators Wayside Equipment	Rail Operators	Existing
Weather Service	Permian Basin National Weather Service Office	NOAA	Existing

## 4.2 Regional Market Packages

Upon completion of the system inventory, the next step in the development of the architecture was to identify the transportation services that are important to the Permian Basin Region. In the National ITS Architecture, services are referred to as market packages. Market packages could include several stakeholders and elements that work together to provide a service in the Region. Examples of market packages from the National ITS Architecture include Network Surveillance, Traffic Information Dissemination, and Transit Vehicle Tracking. There are currently a total of 75 market packages identified in the National ITS Architecture Version 4.0.

In the Permian Basin Region, the National ITS Architecture market packages were reviewed by the stakeholders and selected based on the relevance of the service that the market package could provide to the Region. All of the market packages that stakeholders in the Permian Basin Region selected for implementation in the Region are identified in **Table 5**, as well as the elements in the Region that serve a role in providing the market package service and the primary stakeholders responsible for implementing the market packages.

In several cases, there are multiple stakeholders in the Region that provide the same service at different levels. For example, Surface Street Control (ATMS03) could be provided on arterials by the City of Odessa and by TxDOT on highways throughout the Odessa District. The market package status is identified as existing, planned, or future for each of the primary stakeholders in the Region. In many cases market packages classified as existing might still need to be enhanced to increase the service that the market package provides and establish all of the elements associated with it.

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

**Table 5 – Permian Basin Region Selected Market Packages**

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Market Package Status
ATMS01	Network Surveillance	City of Midland Field Equipment	City of Midland	Existing
		City of Midland Traffic Operations Center	City of Odessa	Existing
		City of Midland Website	TxDOT Odessa District	Existing
		City of Odessa Field Equipment		
		City of Odessa Traffic Operations Center		
		City of Odessa Web Site		
		Private Sector Traveler Information Services		
		TxDOT 511 System		
		TxDOT Odessa District CCTV		
		TxDOT Odessa District Field Sensors		
		TxDOT Odessa District TMC		
		TxDOT Odessa District Web Page		

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
ATMS02	Probe Surveillance	Commercial Vehicles Private Vehicles TxDOT Odessa District Field Sensors TxDOT Odessa District TMC	TxDOT Odessa District	Future
ATMS03	Surface Street Control	City of Midland Field Equipment City of Midland School Pager System City of Midland Traffic Operations Center City of Odessa Field Equipment City of Odessa School Pager System City of Odessa Traffic Operations Center TxDOT Odessa District CCTV TxDOT Odessa District Field Sensors TxDOT Odessa District School Pager System TxDOT Odessa District TMC TxDOT Odessa District Traffic Signals TxDOT Odessa District Web Page	City of Midland	Existing
			City of Odessa	Existing
			TxDOT Odessa District	Existing
ATMS04	Freeway Control	TxDOT Odessa District CCTV TxDOT Odessa District Field Sensors TxDOT Odessa District TMC	TxDOT Odessa District	Future
ATMS06	Traffic Information Dissemination	City of Midland Development Services Dispatch City of Midland Field Equipment City of Midland Public Safety Communications City of Midland Traffic Operations Center City of Midland Website City of Odessa Field Equipment City of Odessa Public Safety Communications City of Odessa Public Works Dispatch City of Odessa Traffic Operations Center City of Odessa Web Site County Public Safety Dispatch County Road and Bridge DPS Communications Service EZ Rider Transit Dispatch Independent School District Dispatch Local Print and Broadcast Media	City of Midland	Future
			City of Odessa	Future
			TxDOT Odessa District	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
ATMS06 (continued)	Traffic Information Dissemination (continued)	Municipal Public Safety Dispatch Other Transit Systems Permian Basin Rural Public Transportation Dispatch Private Sector Traveler Information Services Private Transit Systems TxDOT 511 System TxDOT Odessa District DMS TxDOT Odessa District Maintenance Sections TxDOT Odessa District Public Information Office TxDOT Odessa District TMC TxDOT Odessa District Web Page		
ATMS07	Regional Traffic Control	City of Midland Traffic Operations Center City of Odessa Traffic Operations Center Other TxDOT Districts TMCs Trans Vista TMC TxDOT Fort Worth TMC (TransVision) TxDOT Odessa District TMC	TxDOT Odessa District	Future
ATMS08	Incident Management System	City of Midland Development Services Dispatch City of Midland Field Equipment City of Midland Fire and EMS Vehicles City of Midland Police Vehicles City of Midland Public Safety Communications City of Midland Traffic Operations Center City of Odessa Field Equipment City of Odessa Fire and EMS Vehicles City of Odessa Police Vehicles City of Odessa Public Information Office City of Odessa Public Safety Communications City of Odessa Public Works Dispatch City of Odessa Traffic Operations Center County Emergency Vehicles County EOC County Public Safety Dispatch County Road and Bridge	Transportation and Emergency Management Agencies	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
ATMS08 (continued)	Incident Management System (continued)	DPS Communications Service DPS Emergency Vehicles Ector County EOC EZ Rider Transit Dispatch Independent School District Dispatch Midland County EOC Municipal Emergency Vehicles Municipal Public Safety Dispatch Municipal PWD Other Transit Systems Other TxDOT District Maintenance Sections Permian Basin National Weather Service Office Permian Basin Rural Public Transportation Dispatch Rail Operations Centers Regional Chambers of Commerce Regional Event Promoters TxDOT Highway Conditions Reporting System TxDOT Odessa District Field Sensors TxDOT Odessa District Maintenance Sections TxDOT Odessa District Public Information Office TxDOT Odessa District TMC		
ATMS13	Standard Railroad Grade Crossing	City of Midland Field Equipment City of Midland Traffic Operations Center City of Odessa Field Equipment City of Odessa Traffic Operations Center Rail Operations Centers Rail Operators Wayside Equipment TxDOT Odessa District TMC TxDOT Odessa District Traffic Signals	City of Midland	Existing
			City of Odessa	Existing
			TxDOT Odessa District	Existing
ATMS14	Advanced Railroad Grade Crossing	City of Midland Field Equipment City of Midland Traffic Operations Center City of Odessa Field Equipment City of Odessa Traffic Operations Center Rail Operations Centers	City of Midland	Future
			City of Odessa	Future
			TxDOT Odessa District	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
ATMS14 (continued)	Advanced Railroad Grade Crossing (continued)	Rail Operators Wayside Equipment TxDOT Odessa District TMC TxDOT Odessa District Traffic Signals		
ATMS15	Railroad Operations Coordination	City of Midland Traffic Operations Center City of Odessa Traffic Operations Center Rail Operations Centers TxDOT Odessa District TMC	City of Midland	Future
			City of Odessa	Future
			TxDOT Odessa District	Future
ATMS21	Roadway Closure Management	City of Midland Public Safety Communications City of Odessa Public Safety Communications DPS Communications Service EZ Rider Transit Dispatch Municipal Public Safety Dispatch Other TxDOT Districts TMCs Permian Basin Rural Public Transportation Dispatch Trans Vista TMC TxDOT Odessa District DMS TxDOT Odessa District Maintenance Sections TxDOT Odessa District Public Information Office TxDOT Odessa District TMC	TxDOT Odessa District	Future
EM01	Emergency Response	Bureau of Customs and Border Protection Office City of Midland Public Safety Communications City of Odessa Public Safety Communications Correctional Facilities Operations County EOC County Public Safety Dispatch District Disaster Committee DPS Communications Service DPS Division of Emergency Management Ector County EOC Ector County Independent School District Police Midland County EOC Midland Independent School District Police	Emergency Management Agencies	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
EM01 (continued)	Emergency Response (continued)	Municipal Public Safety Dispatch National Guard/State Guard Office Permian Basin Regional Incident and Mutual Aid Network Private Tow/Wrecker Dispatch Rail Police/Security State EOC Texas Forest Service Permian Basin University/College Police Force		
EM02	Emergency Routing	City of Midland Field Equipment City of Midland Fire and EMS Vehicles City of Midland Police Vehicles City of Midland Public Safety Communications City of Midland Traffic Operations Center City of Odessa Field Equipment City of Odessa Fire and EMS Vehicles City of Odessa Public Safety Communications City of Odessa Traffic Operations Center County Emergency Vehicles County Public Safety Dispatch DPS Communications Service DPS Emergency Vehicles Municipal Emergency Vehicles Municipal Public Safety Dispatch Regional Medical Centers	Transportation and Emergency Management Agencies	Future
EM10	Evacuation Management	City of Midland Public Information Office City of Midland Public Safety Communications City of Midland Traffic Operations Center City of Odessa Public Information Office City of Odessa Traffic Operations Center County EOC County Public Safety Dispatch DPS Communications Service Ector County EOC EZ Rider Transit Dispatch Independent School District Dispatch Midland County EOC	Transportation and Emergency Management Agencies	Future



**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
EM10 (continued)	Evacuation Management (continued)	Permian Basin Rural Public Transportation Dispatch State EOC TxDOT Odessa District TMC		
MC01	Maintenance and Construction Vehicle Tracking	City of Midland Development Services Dispatch City of Midland Development Services Vehicles City of Odessa Public Works Dispatch City of Odessa Public Works Vehicles County Road and Bridge County Road and Bridge Vehicles Municipal PWD Municipal PWD Vehicles TxDOT Odessa District Maintenance Sections TxDOT Odessa District Maintenance Vehicles	City of Midland	Future
			City of Odessa	Future
			County Road and Bridge	Future
			Municipalities	Future
			TxDOT Odessa District	Future
MC02	Maintenance and Construction Vehicle Maintenance	City of Midland Development Services Dispatch City of Midland Development Services Vehicles City of Midland Equipment Repair City of Odessa Equipment Services City of Odessa Public Works Dispatch City of Odessa Public Works Vehicles County Road and Bridge County Road and Bridge Equipment Repair County Road and Bridge Vehicles TxDOT Odessa District Equipment Shop TxDOT Odessa District Maintenance Sections TxDOT Odessa District Maintenance Vehicles	City of Midland	Future
			City of Odessa	Future
			County Road and Bridge	Future
			TxDOT Odessa District	Future
MC03	Road Weather Data Collection	TxDOT Odessa District Field Sensors TxDOT Odessa District Maintenance Sections TxDOT Odessa District TMC	TxDOT Odessa District	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Market Package Status
MC04	Weather Information Processing and Distribution	City of Midland Development Services Dispatch City of Midland Public Safety Communications City of Midland Traffic Operations Center City of Odessa Public Safety Communications City of Odessa Public Works Dispatch City of Odessa Traffic Operations Center County Public Safety Dispatch County Road and Bridge DPS Communications Service EZ Rider Transit Dispatch Independent School District Dispatch Local Print and Broadcast Media Municipal Public Safety Dispatch Municipal PWD Other Transit Systems Permian Basin National Weather Service Office Permian Basin Rural Public Transportation Dispatch TxDOT Highway Conditions Reporting System TxDOT Odessa District Maintenance Sections TxDOT Odessa District TMC	National Weather Service	Future
			TxDOT Odessa District	Future
MC05	Roadway Automated Treatment	TxDOT Odessa District Field Sensors TxDOT Odessa District Maintenance Sections	TxDOT Odessa District	Future
MC06	Winter Maintenance	City of Midland Development Services Dispatch City of Midland Public Information Office City of Midland Public Safety Communications City of Midland Traffic Operations Center City of Midland Website City of Odessa Public Information Office City of Odessa Public Safety Communications City of Odessa Public Works Dispatch City of Odessa Traffic Operations Center	City of Midland	Future
			City of Odessa	Future
			TxDOT Odessa District	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
MC06 (continued)	Winter Maintenance (continued)	City of Odessa Web Site County Public Safety Dispatch County Road and Bridge DPS Communications Service EZ Rider Transit Dispatch Independent School District Dispatch Local Print and Broadcast Media Municipal Public Safety Dispatch Municipal PWD Other Transit Systems Other TxDOT District Maintenance Sections Other TxDOT District TMCs Permian Basin National Weather Service Office Permian Basin Rural Public Transportation Dispatch TxDOT Odessa District Maintenance Sections TxDOT Odessa District Maintenance Vehicles TxDOT Odessa District Public Information Office TxDOT Odessa District TMC TxDOT Odessa District Web Page		
MC07	Roadway Maintenance and Construction	City of Midland Development Services Vehicles	City of Midland	Future
		City of Midland Field Equipment	City of Odessa	Future
		City of Midland Traffic Operations Center	County Road and Bridge	Future
		City of Midland Traffic Signal Shop	Municipalities	Future
		City of Odessa Field Equipment	TxDOT Odessa District	Future
		City of Odessa Public Works Vehicles		
City of Odessa Traffic Engineering				
City of Odessa Traffic Operations Center				
County Road and Bridge				
County Road and Bridge Field Equipment				
County Road and Bridge Vehicles				
Municipal PWD				
Municipal PWD Vehicles				
TxDOT BRINSAP				
TxDOT Odessa District CCTV				

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Market Package Status
MC07 (continued)	Roadway Maintenance and Construction (continued)	TxDOT Odessa District DMS TxDOT Odessa District Field Sensors TxDOT Odessa District Maintenance Sections TxDOT Odessa District Maintenance Vehicles TxDOT Odessa District Pavement Management System TxDOT Odessa District School Pager System TxDOT Odessa District TMC TxDOT Odessa District Traffic Signal Shop TxDOT Odessa District Traffic Signals TxDOT Odessa District Work Zone Equipment		
MC08	Work Zone Management	City of Midland Development Services Dispatch	City of Midland	Future
		City of Midland Development Services Vehicles	City of Odessa	Future
		City of Midland Field Equipment	County Road and Bridge	Future
		City of Midland Public Safety Communications	Municipalities	Future
		City of Midland Traffic Operations Center	TxDOT Odessa District	Future
City of Odessa Field Equipment				
City of Odessa Public Safety Communications				
City of Odessa Public Works Dispatch				
City of Odessa Public Works Vehicles				
City of Odessa Traffic Operations Center				
County EOC				
County Public Safety Dispatch				
County Road and Bridge				
County Road and Bridge Field Equipment				
County Road and Bridge Vehicles				
DPS Communications Service				
EZ Rider Transit Dispatch				
Independent School District Dispatch				
Municipal Public Safety Dispatch				
Municipal PWD				
Municipal PWD Vehicles				
Other TxDOT District Maintenance Sections				

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Market Package Status
MC08 (continued)	Work Zone Management (continued)	Permian Basin Rural Public Transportation Dispatch Private Tow/Wrecker Dispatch State EOC TxDOT Highway Conditions Reporting System TxDOT Odessa District Area Engineers Office TxDOT Odessa District Maintenance Sections TxDOT Odessa District Maintenance Vehicles TxDOT Odessa District Public Information Office TxDOT Odessa District TMC TxDOT Odessa District Web Page TxDOT Odessa District Work Zone Equipment Utility Dispatch		
MC09	Work Zone Safety Monitoring	City of Midland Development Services Dispatch	City of Midland	Future
		City of Midland Development Services Vehicles	City of Odessa	Future
		City of Midland Field Equipment	County Road and Bridge	Future
		City of Odessa Field Equipment	Municipalities	Future
		City of Odessa Public Works Dispatch	TxDOT Odessa District	Future
		City of Odessa Public Works Vehicles County Road and Bridge County Road and Bridge Field Equipment County Road and Bridge Vehicles Municipal ITS Field Equipment Municipal PWD Municipal PWD Vehicles TxDOT Odessa District Maintenance Sections TxDOT Odessa District Maintenance Vehicles TxDOT Odessa District Work Zone Equipment		

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Market Package Status
MC10	Maintenance and Construction Activity Coordination	City of Midland Development Services Dispatch	City of Midland	Future
		City of Midland Public Information Office	City of Odessa	Future
		City of Midland Public Safety Communications	County Road and Bridge	Future
		City of Midland Traffic Operations Center	Municipalities	Future
		City of Midland Website	TxDOT Odessa District	Future
		City of Odessa Public Information Office		
		City of Odessa Public Safety Communications		
		City of Odessa Public Works Dispatch		
		City of Odessa Traffic Operations Center		
		City of Odessa Web Site		
		County Public Safety Dispatch		
		County Road and Bridge		
		DPS Communications Service		
		EZ Rider Transit Dispatch		
		Independent School District Dispatch		
		Municipal Public Safety Dispatch		
		Municipal PWD		
		Municipal Websites		
		Other Transit Systems		
		Other TxDOT District Maintenance Sections		
		Permian Basin Rural Public Transportation Dispatch		
Pipeline Company Systems				
Private Sector Traveler Information Services				
Private Tow/Wrecker Dispatch				
TxDOT Highway Conditions Reporting System				
TxDOT Odessa District Area Engineer's Office				
TxDOT Odessa District Maintenance Sections				
TxDOT Odessa District Public Information Office				
TxDOT Odessa District TMC				
TxDOT Odessa District Web Page				
Utility Dispatch				

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Market Package Status
APTS1	Transit Vehicle Tracking	EZ Rider Demand Response Vehicles EZ Rider Fixed Route Transit Vehicles EZ Rider Transit Dispatch Independent School District Buses Independent School District Dispatch Permian Basin Rural Public Transportation Dispatch Permian Basin Rural Transit Vehicles	EZ Rider	Future
			Independent School Districts	Future
			Permian Basin Rural Transit District	Future
APTS2	Transit Fixed-Route Operations	City of Midland Development Services Dispatch City of Midland Traffic Operations Center City of Midland Website City of Odessa Public Works Dispatch City of Odessa Traffic Operations Center City of Odessa Web Site County Road and Bridge EZ Rider Fixed Route Transit Vehicles EZ Rider Transit Dispatch EZ Rider Website Independent School District Buses Independent School District Dispatch Municipal PWD Private Sector Traveler Information Services TxDOT 511 System TxDOT Odessa District Maintenance Sections TxDOT Odessa District TMC	EZ Rider	Future
			Independent School Districts	Future
			APTS3	Demand Response Transit Operations
Permian Basin Rural Transit District	Future			

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
APTS3 (continued)	Demand Response Transit Operations (continued)	TxDOT 511 System TxDOT Highway Conditions Reporting System TxDOT Odessa District TMC West Texas Opportunities Website		
APTS4	Transit Passenger and Fare Management	EZ Rider Fixed Route Transit Vehicles EZ Rider Transit Dispatch EZ Rider Transit Point of Sale/Customer Information Systems Financial Institutions Permian Basin Rural Public Transportation Dispatch Permian Basin Rural Transit Vehicles Regional Transit Card Service Agencies	EZ Rider	Future
			Permian Basin Rural Transit District	Future
APTS5	Transit Security	City of Midland Public Safety Communications City of Odessa Public Safety Communications County Public Safety Dispatch EZ Rider Demand Response Vehicles EZ Rider Fixed Route Transit Vehicles EZ Rider Transit Dispatch EZ Rider Transit Transfer Stations Municipal Public Safety Dispatch Other County Public Safety Dispatch Other Municipal Public Safety Dispatch Permian Basin Rural Public Transportation Dispatch Permian Basin Rural Transit Vehicles	EZ Rider	Future
			Permian Basin Rural Transit District	Future
APTS6	Transit Maintenance	EZ Rider Demand Response Vehicles EZ Rider Fixed Route Transit Vehicles EZ Rider Maintenance Facility EZ Rider Transit Dispatch Permian Basin Rural Public Transportation Dispatch Permian Basin Rural Transit Vehicles Private Transit Vehicle Maintenance Facility	EZ Rider	Future
			Permian Basin Rural Transit District	Future



**Table 5 – Permian Basin Region Selected Market Packages (continued)**

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Market Package Status
APTS7	Multi-modal Coordination	AMTRAK Station City of Midland Field Equipment City of Midland Traffic Operations Center City of Odessa Field Equipment City of Odessa Traffic Operations Center EZ Rider Fixed Route Transit Vehicles EZ Rider Transit Dispatch Midland International Airport Other Transit Systems Permian Basin Rural Public Transportation Dispatch Permian Basin Rural Transit Vehicles Private Taxi Provider Dispatch Private Transit Systems	EZ Rider	Future
			Permian Basin Rural Transit District	Future
APTS8	Transit Traveler Information	EZ Rider Transit Dispatch EZ Rider Transit Kiosks EZ Rider Website Permian Basin Rural Public Transportation Dispatch Private Travelers Personal Computing Devices TxDOT Public Transportation Website TxDOT Rest Areas/Visitor Centers/Service/Truck Stops/Plaza Kiosks West Texas Opportunities Website	EZ Rider	Future
			Permian Basin Rural Transit District	Future
CVO03	Electronic Clearance	Commercial Vehicles DPS Electronic Screening Stations DPS License and Weights Division Other States Credentials Administration and Safety Systems Private Fleet Management Systems TxDOT Credentials Administration and Safety Information Exchange US BCBP Customs Product Manifest System US BCBP Electronic Clearance System	Department of Public Safety	Future
			US Customs	Future
CVO06	Weigh-In-Motion	Commercial Vehicles DPS License and Weights Division DPS Weigh in Motion TxDOT Credentials Administration and Safety Information Exchange	Department of Public Safety	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
CVO10	HAZMAT Management	City of Midland Public Safety Communications City of Odessa Public Safety Communications Commercial Vehicles County Public Safety Dispatch DPS Communications Service Municipal Public Safety Dispatch Private Fleet Management Systems	Private Fleets	Future
ATIS1	Broadcast Traveler Information	City of Midland Development Services Dispatch City of Midland HAR City of Midland Public Information Office City of Midland Traffic Operations Center City of Midland Website City of Odessa HAR City of Odessa Public Information Office City of Odessa Public Works Dispatch City of Odessa Traffic Operations Center City of Odessa Web Site Local Print and Broadcast Media Private Travelers Personal Computing Devices TxDOT 511 System TxDOT Odessa District Area Engineers Office TxDOT Odessa District Maintenance Sections TxDOT Odessa District Public Information Office TxDOT Odessa District TMC TxDOT Odessa District Web Page TxDOT Rest Areas/Visitor Centers/Service/Truck Stops/Plaza Kiosks TxDOT Traveler Information Website	City of Odessa	Future
			City of Midland	Future
			TxDOT Odessa District	Future
ATIS5	ISP Based Route Guidance	Private Fleet Management Systems TxDOT Motor Carrier Routing Information TxDOT Odessa District Maintenance Sections TxDOT Odessa District TMC TxDOT Rest Areas/Visitor Centers/Service/Truck Stops/Plaza Kiosks	TxDOT	Future

**Table 5 – Permian Basin Region Selected Market Packages (continued)**

<b>Market Package</b>	<b>Market Package Name</b>	<b>Elements Associated with Market Package</b>	<b>Primary Stakeholders Responsible for Implementation</b>	<b>Market Package Status</b>
AD1	ITS Data Mart	City of Midland Accident Database	City of Midland	Existing
		City of Midland Public Safety Communications	City of Odessa	Existing
		City of Odessa Accident Database	EZ Rider	Future
		City of Odessa Public Safety Communications	Permian Basin Rural Transit District	Future
		Crash Records Users	TxDOT Odessa District	Existing
		DPS Administration		
		EZ Rider Transit Dispatch		
		EZ Rider Transit Ridership Database		
		Municipal Public Safety Dispatch		
		Permian Basin Rural Public Transportation Dispatch		
		Other Transit Systems		
		Permian Basin Transit Ridership Database		
		Statewide Crash Records Information System		
		Transit Database Users		
		TxDOT Odessa District Maintenance Sections		
		TxDOT Odessa District Pavement Management System		
		TxDOT Odessa District Pavement Management System Users		
		TxDOT Odessa District Public Transportation Management System (PTMS)		
		TxDOT Public Transportation Division		
		TxDOT Statewide Pavement Management System		
		TxDOT Statewide Public Transportation Management System (PTMS)		

## 4.3 Interconnections

### 4.3.1 Top Level Regional System Interconnect Diagram

A system interconnect diagram, or sausage diagram (shown previously in **Figure 4**), shows the systems and primary interconnects in the Region. The National ITS Architecture interconnect diagram has been customized for the Permian Basin Region based on the information gathered from the stakeholders and system inventory. **Figure 5** summarizes the existing, planned, and future ITS elements for the Permian Basin Region in the context of a physical interconnect. Subsystems and elements specific to Permian Basin are called out in the boxes surrounding the main interconnect diagram, and these are color-coded to the subsystem to which they are associated.

### 4.3.2 Customized Market Packages

The market packages in the National ITS Architecture were customized to reflect the unique systems, subsystems, and terminators in the Permian Basin Region. Each market package is shown graphically, with the market package name, Permian Basin-specific element, and with the unique agency and system identifiers within the subsystems and terminators. Market packages represent a service that will be deployed as an integrated capability. Market packages often are comprised of one or more equipment packages, which are functional capabilities that could be deployed at a specific time. Equipment packages are the most basic functions that will be developed or bought by implementers.

**Figure 6** is an example of an ATMS market package for Surface Street Control that has been customized for the Permian Basin Region. This market package shows the two subsystems, Traffic Management and Roadway, and the associated entities (TxDOT Odessa District Traffic Signals, TxDOT Odessa District Field Sensors, etc.) for the TxDOT Odessa District signal system. Data flows between the subsystems indicate what information is being shared.

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

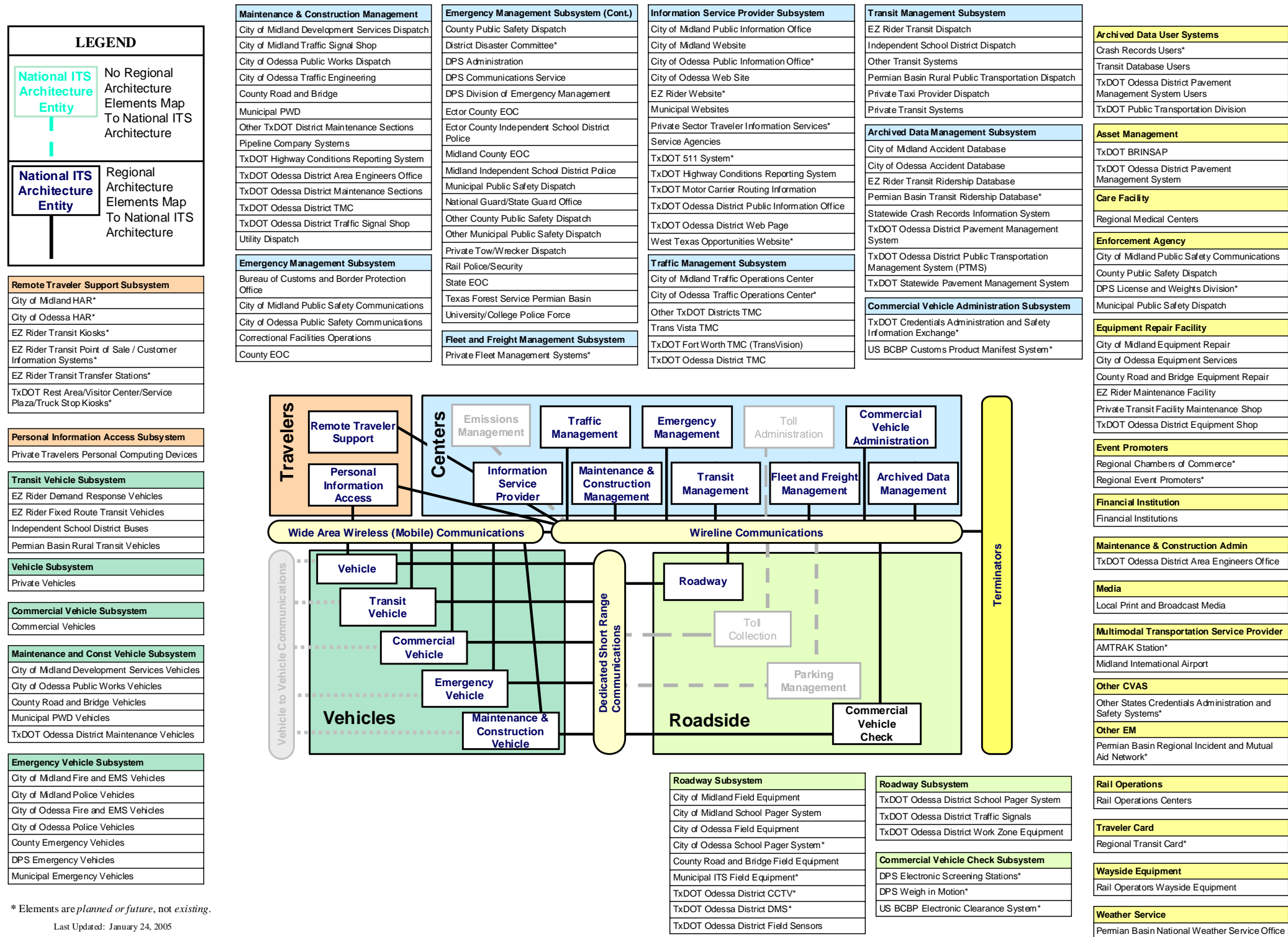
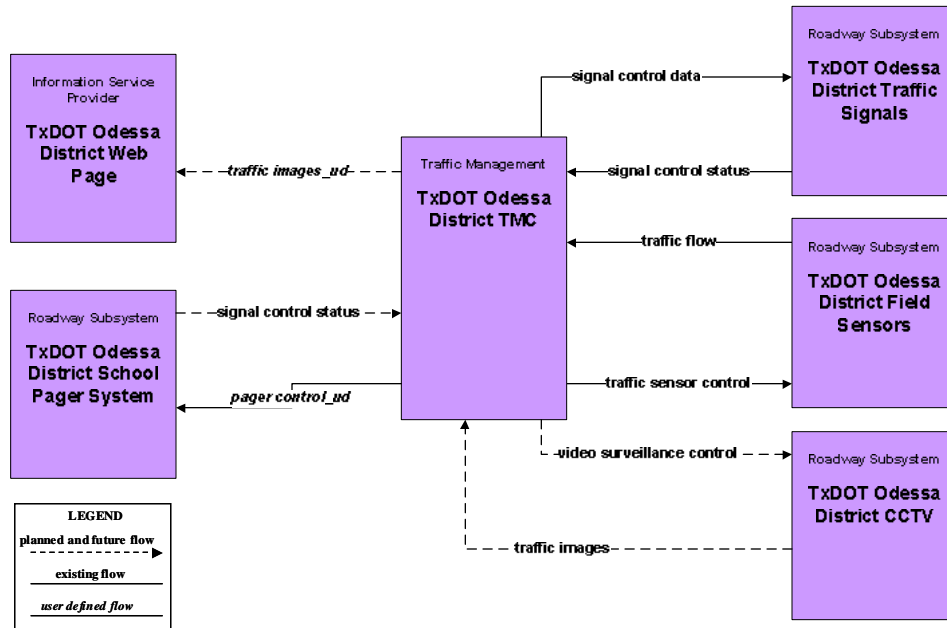


Figure 5 – Permian Basin Regional System Interconnect Diagram



**Figure 6 – Custom Market Package for Surface Street Control**

#### 4.3.3 Permian Basin Architecture Interfaces

While it is important to identify the various systems and stakeholders as part of a regional ITS, a primary purpose of the architecture is to identify the connectivity between transportation systems in the Permian Basin Region. The interconnect diagram shown previously in **Figure 5** showed the high-level relationships of the subsystems and terminators in the Permian Basin Region and the associated local projects and systems. The customized market packages represent services that can be deployed as an integrated capability, and the market package diagrams show the information flows between the subsystems and terminators that are most important to the operation of the market packages. How these systems interface with each other is an integral part of the overall ITS architecture.

There are 137 different elements identified as part of the Permian Basin Regional ITS Architecture. These elements include traffic management centers, transit vehicles, dispatch systems, emergency management agencies, media outlets, and others – essentially, all of the existing and planned physical components that contribute to the regional intelligent transportation system. Interfaces have been identified for each element in the Permian Basin Regional ITS Architecture, and each element has been mapped to those other elements with which it must interface. For example, the TxDOT Odessa District TMC has existing or planned interfaces with 40 other elements in the Permian Basin Region, ranging from field equipment and dispatch centers, to other TxDOT District TMCs. Other interfaces are far less complex, such as the interface between the DPS vehicles and the DPS Communications Dispatch.

An example of one of the system interfaces is shown in **Figure 7**. This graphic shows the TxDOT Odessa District Traffic Signals and the existing and planned interfaces with other elements throughout the Region. These interfaces are shown as existing, planned, or future. Interfaces defined as planned have funding identified, while future interfaces are desired by stakeholders but funding has not yet been identified.

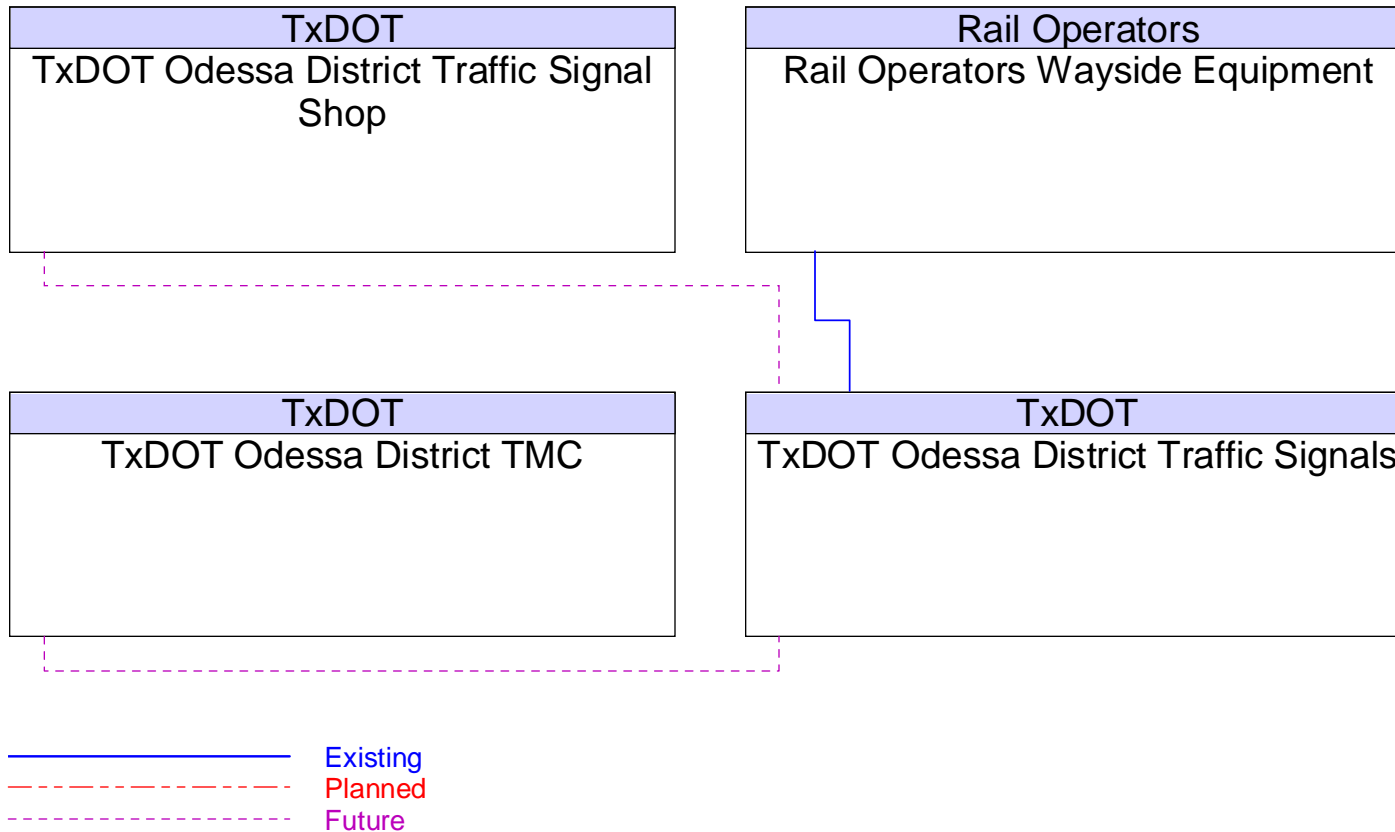
Each element and its defined interfaces are listed in **Appendix B**. Elements and their interfaces also are accessible via the Permian Basin Regional ITS Architecture web site by clicking on the “Interfaces” button. Elements are listed alphabetically in the column on the left, and each entry in the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

#### *4.3.4 Physical Subsystem Architecture Flows*

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

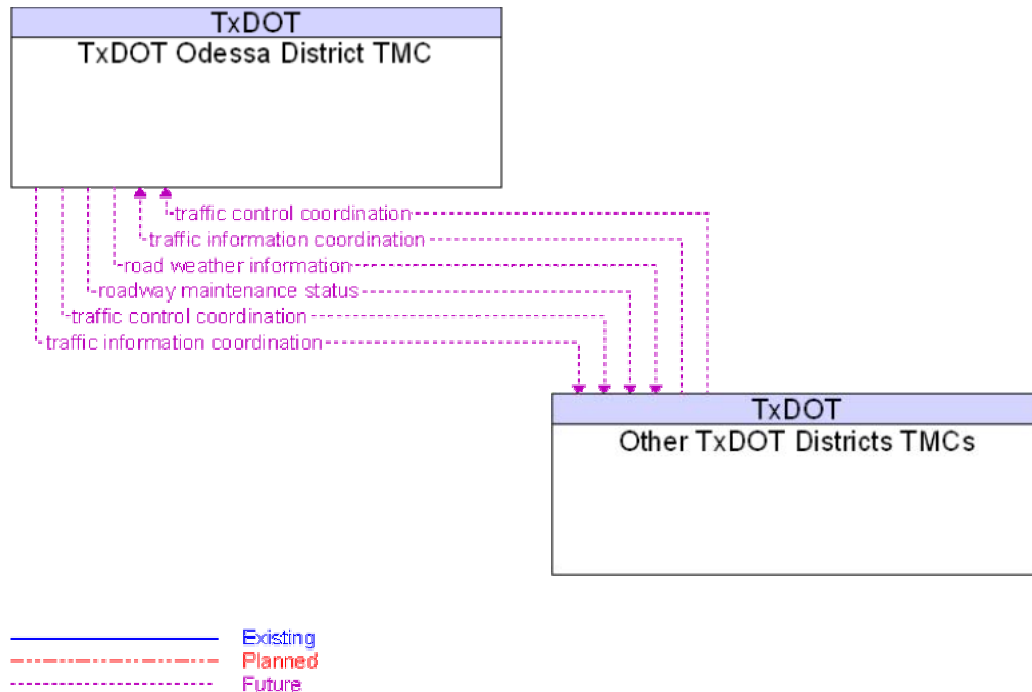
An example of the architecture flows between two elements is shown in **Figure 8**. In this interface, the flows between the TxDOT Odessa District TMC and Other Texas District TMCs show information that must go from the Odessa District TMC to other Texas TMCs, as well as information that the TMC needs from devices. Similar to the interfaces, architecture flows also are defined as existing, planned, or future.

Each of the individual element interfaces can be accessed on the Permian Basin Regional ITS Architecture web site by clicking on the “Interfaces” button. Selecting any of the interfacing elements from the column on the right will display an interface diagram and architecture flows between two specific elements, similar to the diagram shown in **Figure 8**. Each data flow is defined, and any standards associated with that data flow are noted. Standards as they apply to the Permian Basin Region are discussed in more detail in Section 4.5.



**Figure 7 – TxDOT Odessa District Traffic Signals Interfaces**





**Figure 8 – TxDOT Odessa District TMC to Other Texas District TMCs Architecture Flows**

#### 4.4 Functional Requirements

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

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

At a more detailed level, functional requirements for the Permian Basin Region also are described in terms of equipment packages that are associated with one or more subsystems in the Permian Basin Regional ITS Architecture as shown in **Table 6**. An equipment package is a functional capability that could be deployed at a specific time. Each equipment package can be linked in the National ITS Architecture to the Process Specifications that might be applicable. It is

recommended that during the design concept stage of a project, the applicable equipment package, and associated Process Specifications from the National ITS Architecture be reviewed by the implementer to determine the appropriate functional requirements for the project. A link for each equipment package is available on the Permian Basin Regional ITS Architecture web site by clicking on the “Functions” button.

**Table 6 – Permian Basin Region Equipment Packages**

<b>Subsystem</b>	<b>Equipment Package</b>
Archived Data Management Subsystem	Government Reporting Systems Support
	ITS Data Repository
	Traffic and Roadside Data Archival
Commercial Vehicle Administration Subsystem	CV Data Collection
	CV Information Exchange
	CV Safety Administration
Commercial Vehicle Check Subsystem	Citation and Accident Electronic Recording
	Roadside Electronic Screening
	Roadside WIM
Commercial Vehicle Subsystem	On-board Cargo Monitoring
	On-board CV Electronic Data
Emergency Management Subsystem	Emergency Call-Taking
	Emergency Data Collection
	Emergency Dispatch
	Emergency Environmental Monitoring
	Emergency Response Management
	Mayday Support
Emergency Vehicle Subsystem	On-board EV En Route Support
	On-board EV Environmental Monitoring
	On-board EV Incident Management Communication
Emissions Management Subsystem	Emissions Data Collection
Fleet and Freight Management Subsystem	Fleet HAZMAT Management
Information Service Provider Subsystem	Basic Information Broadcast
	Infrastructure Provided Route Selection
	Interactive Infrastructure Information
	ISP Data Collection
	ISP Probe Information Collection
Maintenance and Construction Management Subsystem	MCM Automated Treatment System Control
	MCM Data Collection
	MCM Environmental Information Collection
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Maintenance Decision Support
	MCM Roadway Maintenance and Construction

**Table 6 – Permian Basin Region Equipment Packages (continued)**

<b>Subsystem</b>	<b>Equipment Package</b>
Maintenance and Construction Management Subsystem (continued)	MCM Vehicle and Equipment Maintenance Management
	MCM Vehicle Tracking
	MCM Winter Maintenance Management
	MCM Work Activity Coordination
	MCM Work Zone Management
	MCM Work Zone Safety Management
Maintenance and Construction Vehicle Subsystem	MCV Environmental Monitoring
	MCV Infrastructure Monitoring
	MCV Roadway Maintenance and Construction
	MCV Vehicle Location Tracking
	MCV Vehicle Safety Monitoring
	MCV Vehicle System Monitoring and Diagnostics
	MCV Winter Maintenance
	MCV Work Zone Support
Parking Management Subsystem	Parking Data Collection
Personal Information Access Subsystem	Personal Basic Information Reception
	Personal Interactive Information Reception
	Personal Location Determination
	Personal Provider-Based Route Guidance
Remote Traveler Support Subsystem	Remote Basic Information Reception
	Remote Interactive Information Reception
	Remote Mayday I/F
	Remote Transit Fare Management
	Remote Transit Information Services
	Secure Area Monitoring
Roadway Subsystem	Advanced Rail Crossing
	Roadside Data Collection
	Roadside Signal Priority
	Roadway Automated Treatment
	Roadway Basic Surveillance
	Roadway Environmental Monitoring
	Roadway Equipment Coordination
	Roadway Freeway Control
	Roadway Incident Detection
	Roadway Infrastructure Monitoring
	Roadway Probe Beacons
	Roadway Signal Controls
	Roadway Traffic Information Dissemination
	Roadway Work Zone Safety

**Table 6 – Permian Basin Region Equipment Packages (continued)**

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

**Table 6 – Permian Basin Region Equipment Packages (continued)**

Subsystem	Equipment Package
Vehicle Subsystem	Basic Vehicle Reception
	Interactive Vehicle Reception
	Smart Probe
	Vehicle Location Determination
	Vehicle Mayday I/F
	Vehicle Probe Support
	Vehicle Provider-Based Route Guidance
	Vehicle Safety Monitoring System

#### 4.5 Standards

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

**Table 7 – Applicable ITS Standards for the Permian Basin Region**

SDO	Document ID	Title	Type
AASHTO/ITE/NEMA	NTCIP 1201	Global Object Definitions	Message
	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller Units	Message
	NTCIP 1203	Object Definitions for DMS	Message
	NTCIP 1204	Object Definitions for Environmental Sensor Stations and Roadside Weather Information System	Message
	NTCIP 1205	Data Dictionary for CCTV	Message
	NTCIP 1206	Data Collection and Monitoring Devices	Message
	NTCIP 1207	Ramp Meter Controller Objects	Message
	NTCIP 1208	Object Definitions for Video Switches	Message
	NTCIP 1209	Transportation System Sensor Objects	Message
	NTCIP 1210	Objects for Signal Systems Master	Message
	NTCIP 1211	Objects for Signal Control Priority	Message
	NTCIP 1301	Message Set for Weather Reports	Message

**Table 7 – Applicable ITS Standards for the Permian Basin Region (continued)**

SDO	Document ID	Title	Type
AASHTO/ITE/NEMA (continued)	NTCIP 1401	TCIP – Common Public Transportation (CPT) Business Area Standard	Message
	NTCIP 1402	TCIP – Incident Management (IM) Business Area Standard	Message
	NTCIP 1403	TCIP – Passenger Information (PI) Business Area Standard	Message
	NTCIP 1404	TCIP – Scheduling/Runcutting (SCH) Business Area Standard	Message
	NTCIP 1405	TCIP – Spatial Representation (SP) Business Area Standard	Message
	NTCIP 1406	TCIP – Onboard (OB) Business Area Standard	Message
	NTCIP 1407	TCIP – Control Center (CC) Business Area Standard	Message
	NTCIP 1408	TCIP – Fare Collection (FC) Business Area Standard	Message
	View List	NTCIP Center-to-Center Standards Group	Communication
	View List	NTCIP Center-to-Field Standards Group	Communication
ANSI	ANSI TS284	Commercial Vehicle Safety Reports	Message
	ANSI TS285	Commercial Vehicle Safety and Credentials Information Exchange	Message
	ANSI TS286	Commercial Vehicle Credentials	Message
ASTM	ASTM 5 GHz Data Link	Standard Specification for 5.9 GHz Data Link Layer	Communication
	ASTM 5 GHz Phys	Standard Specification for 5.9 GHz Physical Layer	Communication
	ASTM PS 105-99	Specification for Dedicated Short Range Communication (DSRC) Data Link Layer: Medium Access and Logical Link Control	Communication
	ASTM PS 111-98	Specification for DSRC Physical Layer using Microwave in the 902-928 MHz	Communication
EIA/CEA	CEA/EIA-794	Data Radio Channel (DARC) System	Communication
	CEA/EIA-795	Subcarrier Traffic Information Channel (STIC) System	Communication
IEEE	IEEE P1512.1	Standard for Traffic Incident Management Message Sets (IMMS) for Use by Emergency Management Centers (EMCs)	Message
	IEEE P1512.2	Standard for Public Safety IMMS for use by EMCs	Message
	IEEE P1512.3	Standard for Hazardous Material IMMS for use by EMCs	Message
	IEEE P1512.a	Standard for Emergency Management Data Dictionary	Data
	IEEE P1512-2000	Standard for Common IMMS for use by EMCs	Message
	IEEE P1556	Security/Privacy of Vehicle/RS Communications including Smart Card Communications	Communication
	IEEE P1570	Standard for Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection	Message
	IEEE Std 1455-1999	Standard for Message Sets for Vehicle/Roadside Communications	Message

**Table 7 – Applicable ITS Standards for the Permian Basin Region (continued)**

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

#### 4.6 Phases of Implementation

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

A sequence of projects and their respective time frames have been identified in the Permian Basin Regional ITS Deployment Plan. These projects have been sequenced over a 20-year period, with projects identified for deployment in 5-, 10-, and 20-year timeframes.

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

- Network Surveillance;
- Surface Street Control;
- Traffic Information Dissemination;
- Transit Vehicle Tracking; and
- Broadcast Traveler Information.

## 5. OPERATIONAL CONCEPT

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

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

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

### 5.1 Operational Scenarios

#### *Scenario 1*

The first operational scenario describes how ITS technologies may be used during a multi-vehicle crash on I-20 between Midland and Odessa. Motorists call 911 from cellular telephones and the Department of Public Safety Dispatch is quickly informed of the crash. An alert is automatically sent from the Department of Public Safety Dispatch to the TxDOT Odessa TMC. TxDOT activates DMS and monitors the situation with a CCTV camera that is near the crash.

Westbound I-20 is completely closed and the Department of Public Safety, in coordination with the TxDOT Odessa District, begins setting up a closure and detour. The TxDOT Odessa TMC also contacts the TxDOT Abilene TMC so that motorists leaving the Abilene area westbound on I-20 can be forewarned of the impending delay.

TxDOT enters the closure on the Highway Condition Reporting System, which also feeds the statewide 511 traveler information number. DMS and highway advisory radio (HAR) continue to warn motorists that westbound I-20 is closed. The CCTV camera feed, which has been turned away from the crash to focus on the traffic condition on the Interstate, is shared with the media which broadcasts the live shots of I-20 on the evening news to warn motorists that I-20 remains closed.



### *Scenario 2*

High wind conditions are developing in the Permian Basin Region. As winds increase, the roadside weather data collection centers monitor the roadway visibility conditions and send reports to the Odessa TMC. Warnings are placed on DMS signs in the area informing motorists of the potential for poor visibility conditions.

The high winds continue and visibility is further reduced in many areas. Video images captured along the interstates using TxDOT's CCTV cameras are fed to the TMC where officials monitor the situation as well as to emergency personnel watching for incidents along the roadways. As the storm continues, several multiple vehicle accidents occur. This information is passed along to the local emergency dispatch centers and HCRS by the TxDOT Odessa TMC.

Notice is given to the media to alert the public of the dangers of trying to travel during dust storms. Even after winds begin to subside, emergency crews continue to work clearing accidents from the roadways. The DMS messages are changed to disseminate information about the remaining roadway blockages. Once roadways are cleared, the messages are removed from the DMS signs and any detour routes implemented are also removed.

## **5.2 Roles and Responsibilities**

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

### **Travel and Traffic Management**

- City of Midland
- City of Odessa
- County Road and Bridge
- Texas Department of Transportation Odessa District
- Other Texas Department of Transportation Districts
- Texas Department of Public Safety

### **Public Transportation Management**

- EZ Rider
- Independent School Districts
- Permian Basin Rural Public Transportation

### **Electronic Payment**

- EZ Rider
- Permian Basin Rural Public Transportation
- Service Providers

### **Commercial Vehicle Operations**

- Texas Department of Public Safety
- Texas Department of Transportation

### **Emergency Management**

- City of Midland Public Safety Communications
- City of Odessa Public Safety Communications
- County Public Safety (Sheriff's Office, Emergency Operations Center)
- Texas Department of Public Safety
- Texas Department of Transportation

### **Advanced Vehicle Safety System Needs**

- Not Applicable

### **Information Management**

- City of Midland
- City of Odessa
- Department of Public Safety
- Permian Basin Regional Planning Commission
- Texas Department of Transportation

### **Maintenance and Construction Management**

- City of Midland
- City of Odessa
- County Road and Bridge
- Texas Department of Transportation

## **5.3 Permian Basin Agreements**

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

Currently, there are no formal agreements in place in the Permian Basin Region with regards to ITS. Stakeholders indicated that while there is a high degree of cooperation among agencies, there hasn't been a need for formal agreements to facilitate multi-jurisdictional resource sharing and cooperation. With the implementation of ITS technologies, integrating systems from one or more agencies, the anticipated level of information exchange identified in the architecture, it is likely that more formal agreements will be needed. These agreements, while perhaps not

requiring a financial commitment from agencies in the Region, should outline specific roles, responsibilities, data exchanges, levels of authority, and other facets of regional operations. Some agreements also will outline specific funding responsibilities, where appropriate and applicable.

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

**Table 8 – Potential Agreements for the Permian Basin Region**

Agreement and Agencies	Status	Agreement Description	Considerations
<p><b>Data Sharing and Usage (Public)</b>            TxDOT Odessa District and Public Agencies within the Region</p>	<p>Future</p>	<p>This agreement would define the parameters, guidelines, and policies for inter- and intra-agency ITS data sharing. This data sharing would support regional activities related to traffic management, incident management, traveler information, and other functions. The terms of this agreement should generally address such items as:</p> <ul style="list-style-type: none"> <li>▪ Types of data and information to be shared</li> <li>▪ Repository for information (i.e., TxDOT Odessa TMC as central hub)</li> <li>▪ How the information will be used (traffic incident management, displayed on web site for travel information, distributed to private media, etc.)</li> <li>▪ Parameters for data format, quality, security</li> </ul>	<p>These agreements are typically zero-dollar agreements, in that there is no charge among agencies for the actual data, although there might be some cost incurred for infrastructure, systems or fiber to enable communications between agencies.</p>
<p><b>Data Sharing and Usage (Public-Private)</b>            TxDOT Odessa District and Private Media/Information Service Providers</p>	<p>Future</p>	<p>This agreement would define the parameters, guidelines, and policies for private media use of regional ITS-related information from TxDOT Odessa. This type of agreement is recommended between TxDOT (data provider) and the media (data user) to define terms of use for broadcasting public-agency information regarding traffic conditions, closures, restrictions, as well as video images. Agreements can also include requirements for the media to 'source' the information (i.e., using the TxDOT logo on all video images broadcast).</p>	<p>These agreements can be zero-dollar agreements, although some agencies have stipulated identifying the information, public service announcements by the media, or other requirements as a term of use. The private media entity is typically responsible for paying any necessary costs for access (i.e., communications infrastructure to link to the TxDOT database or video switch). These agreements also typically include a sunset clause to allow the agency to periodically review the agreement and make any modifications prior to renewal.</p>

**Table 8 – Potential Agreements for the Permian Basin Region (continued)**

Agreement and Agencies	Status	Agreement Description	Considerations
<p><b>Shared Video Monitoring (Public)</b>            TxDOT Odessa District, City of Midland, City of Odessa, State EOC, DPS</p>	<p>Future</p>	<p>This agreement would enable shared video monitoring of TxDOT CCTV cameras by public safety and emergency services agencies in the Permian Basin Region for incident management purposes. This agreement would define the parameters and policies for public safety agencies to access video images via the TxDOT video switch. It is recommended that the agreement include any TxDOT policies relating to video images (including archiving, privacy, disclaimers, use of video and redistribution) as well as processes for agency requests for specific views. Shared video monitoring does not address shared use or shared control of video equipment functions.</p>	<p>These agreements are typically zero-dollar agreements, in that there is no charge among agencies for the actual data, although there might be some cost incurred for infrastructure, systems or fiber to enable communications between agencies, particularly with the high bandwidth required for transmitting live video images.</p>
<p><b>Mutual Aid Agreements (Public)</b>            DPS, TxDOT Odessa District, Odessa Police and Fire, Midland Police and Fire, County Sheriffs, Rural Volunteer Fire</p>	<p>Existing (Informal)</p>	<p>Mutual aid agreements currently exist as informal arrangements in the Permian Basin Region, although they are a routine practice among public safety and emergency services agencies. Formal mutual aid agreements will become more important as agencies integrate systems and capabilities, particularly automated dispatch and notification.</p>	<p>These agreements are typically zero-dollar agreements, although there might be some funding required to support regional incident management activities. The agreement also would outline resource commitments that would be part of any mutual aid arrangement (personnel, equipment, facilities, etc.).</p>
<p><b>Joint Operations/Shared Control Agreements (Public)</b>            TxDOT Odessa District, City of Midland, City of Odessa, DPS (potential)</p>	<p>Future</p>	<p>These agreements are formal arrangements to allow joint operations or control of certain systems and equipment. The agreement would need to define the terms of this arrangement, such as hours of operation and time of day/time of week where shared control would take effect, circumstances or incidents where shared control would take effect, notification procedures between the agencies agreeing to shared control arrangements, etc. Additional agencies (such as DPS) could be part of a joint operations/shared control agreement for certain types of devices.</p>	<p>Joint operations/shared control agreements could consider some form of mutual funding for certain system elements, primarily communication links.</p>