State of Texas
Regional ITS Architectures and Deployment Plans

Laredo Region

Regional ITS Architecture Report

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AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society for Testing and Materials
ATIS	Advanced Travel Information System
ATMS	Advanced Traffic Management System
AVL	Automatic Vehicle Location
BCS	Bridge Control System
BRINSAP	Bridge Inventory Inspection System
CAD	Computer-Aided Dispatch
CCTV	Closed-Circuit Television
CVISN	Commercial Vehicle Information Systems and Network
CVO	Commercial Vehicle Operations
DARC	Data Radio Channel
DMS	Dynamic Message Sign
DPS	Department of Public Safety
DSRC	Dedicated Short Range Communications
EIA	Electronic Industries Association
EOC	Emergency Operations Center
ETMCC	External TMC Communication
EV	Emergency Vehicle
FHWA	Federal Highway Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HCRS	Highway Condition Reporting System
HRI	Highway-Rail Intersections
I/F	Interface
IMMS	Incident Management Message Sets
ISP	Information Service Provider

LIST OF ACRONYMS

ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
MCM	Maintenance and Construction Management
MCV	Maintenance and Construction Vehicle
MOU	Memorandum of Understanding
MS	Message Sets
NAFTA	North American Free Trade Agreement
NEMA	National Electrical Manufacturers Association
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
SAE	Society of Automotive Engineers
SDO	Standards Development Organization
STIC	Subcarrier Traffic Information Channel
STRATIS	South Texas Regional Advanced Transportation Information System
TAMIU	Texas A&M International University
TCIP	Transit Communication Interface Protocol
TEA-21	Transportation Equity Act for the 21st Century
TM	Traffic Management
TMC	Traffic Management Center
TMDD	Traffic Management Data Directory
TOC	Traffic Operations Center
TxDOT	Texas Department of Transportation
TxDPS	Texas Department of Public Safety
USDOT	United States Department of Transportation
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 Laredo Region was the third in the series of Regional ITS Architectures to be prepared as part of this initiative.

The Laredo Region is located just south of the Texas Hill Country on the north bank of the middle Rio Grande River. Interstate 35 connects the City of Laredo to the City of San Antonio to the north. For the Laredo Regional ITS Architecture and Deployment Plan, the Region was defined by stakeholders to include the four counties in the southern part of the TxDOT Laredo District, including Webb, Dimmit, La Salle, and Duval Counties.

The Architecture for the Laredo Region followed a comprehensive process focused on stakeholder outreach and education, identifying market packages and interfaces tailored to the needs of the Laredo 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 Laredo Region over the next 20 years.

Stakeholders from throughout the Region participated in the development of the Regional ITS Architecture, including representatives from TxDOT, Federal Highway Administration, Federal Motor Carrier Safety Administration, cities, counties, the Texas Department of Public Safety (TxDPS), transit agencies, police and fire, and the U.S. Border Patrol. 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. The highest priority needs focused on improving freeway and arterial control, transit operations, emergency coordination and response, and commercial vehicle operations. Coordination of traffic at the multiple international border crossings was also a priority for stakeholders.

Market packages were selected that corresponded to the desired services and functions identified for the Region, and were customized for Laredo Region agencies and equipment. These market packages included high priority 'foundation' services and functions, such as network surveillance, surface street control, and transit vehicle tracking, as well as market packages to address coordination needs, including incident management system and regional traffic control and coordination. 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 Laredo Region.

An interconnect, or "Sausage Diagram" was developed for the Laredo 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 Laredo 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 Laredo 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 Laredo Region also were identified as part of the architecture development process.

An Operational Concept for the Laredo 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 Laredo Region. This is illustrated using three operational scenarios: an emergency response due to a tornado, an incident on a freeway, and an incident on an international bridge crossing.

The Regional ITS Architecture for the Laredo 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 federal, state, and local transportation agencies, transit, police, fire, the U.S. Boarder Patrol, and private entities. A series of five meetings were held with the ITS stakeholders to discuss the development and gather input into the Laredo Regional ITS Architecture and Deployment Plan. In addition, a project web site was developed which contains all of the information on the Laredo 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 Laredo 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 Laredo Region have been identified. An operational concept has been developed that focuses on the roles and responsibilities of the various agencies involved in the Laredo Region. A separate ITS Deployment Plan was developed that identifies projects in the Laredo Region that are required to implement the architecture.

1.2 Document Overview

The Laredo 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 Laredo Region, as well as an overview of some of the key features and stakeholders in the Laredo Region.

Section 2 – Integration Strategy

This section discusses Laredo 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.

Section 3 – Regional ITS Architecture Development Process

An overview of the key steps involved in developing the ITS architecture for the Laredo 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 Laredo 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 Laredo Region also are included in this section, as are the system functional requirements. The Laredo 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 Laredo 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 Laredo Region. As part of this concept, several operational scenarios are described and roles and responsibilities of stakeholders are discussed. Potential agreements that could be required to support integration and information sharing are described.

The Laredo Regional ITS Architecture also contains three appendices:

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

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

1.3 The Laredo Region

1.3.1 Geographic Overview

The Laredo Region is located just south of the Texas Hill Country on the north bank of the middle Rio Grande River. The ITS stakeholders defined the regional boundaries to correspond with the Rio Grande River and the counties that surround or include the City of Laredo. Other counties within the TxDOT Laredo District that were not included in the Laredo Region may be included in the Del Rio Regional ITS Architecture and Deployment Plan, which will be completed at a later date. **Figure 1** presents a geographical overview of the Laredo Region.

There are four counties included in the Laredo Region:

- Webb;
- Dimmit;
- La Salle; and
- Duval.

The major cities within and immediately adjacent to the Region include the City of Laredo and Nuevo Laredo in Mexico. TxDOT partners with local governments for roadway construction, maintenance, and traffic operations support, and serves as the responsible agency for on-system roadways throughout the Region in cities with populations of less than 50,000. The City of Laredo, with a population just under 200,000 is currently the only city in the Laredo Region with a population that exceeds TxDOT's threshold.

Laredo is unique because it is the only city that maintains two border crossings, one with the Mexican State of Tamaulipas at Nuevo Laredo, and one with Nuevo Leon at Columbia. Laredo is conveniently located on the Pan American Highway (which stretches from Canada into Central and South America), and currently is the U.S. principal port of entry into Mexico. The city has been ranked as the second fastest growing city in the country, due to the passage of the North American Free Trade Agreement (NAFTA), which has brought major trade and industry to the Region. Laredo contains several major border crossings between Mexico and the United States. Commercial vehicle operations, tourism, and international trade are significant economic factors in the Region.

1.3.2 Roadway Infrastructure

As illustrated in **Figure 1**, the Laredo Region connects major cities of the United States to Mexico through Laredo and Nuevo Laredo. The roadway network is well developed. The primary facilities include I-35, US 83, US 59, State Highway 359, Loop 20, FM 1472, and Mexico's State Routes 2 and 85 (Pan American Highway).

Interstate 35 serves the heartland of the United States, connecting south Texas to northern Minnesota, and provides a direct freeway connection between Mexico and Canada. It begins at the international border with Mexico at Laredo and terminates at Duluth, Minnesota. I-35 crosses the state of Texas serving cities such as Laredo, San Antonio, Austin, Temple, Waco, and Dallas.
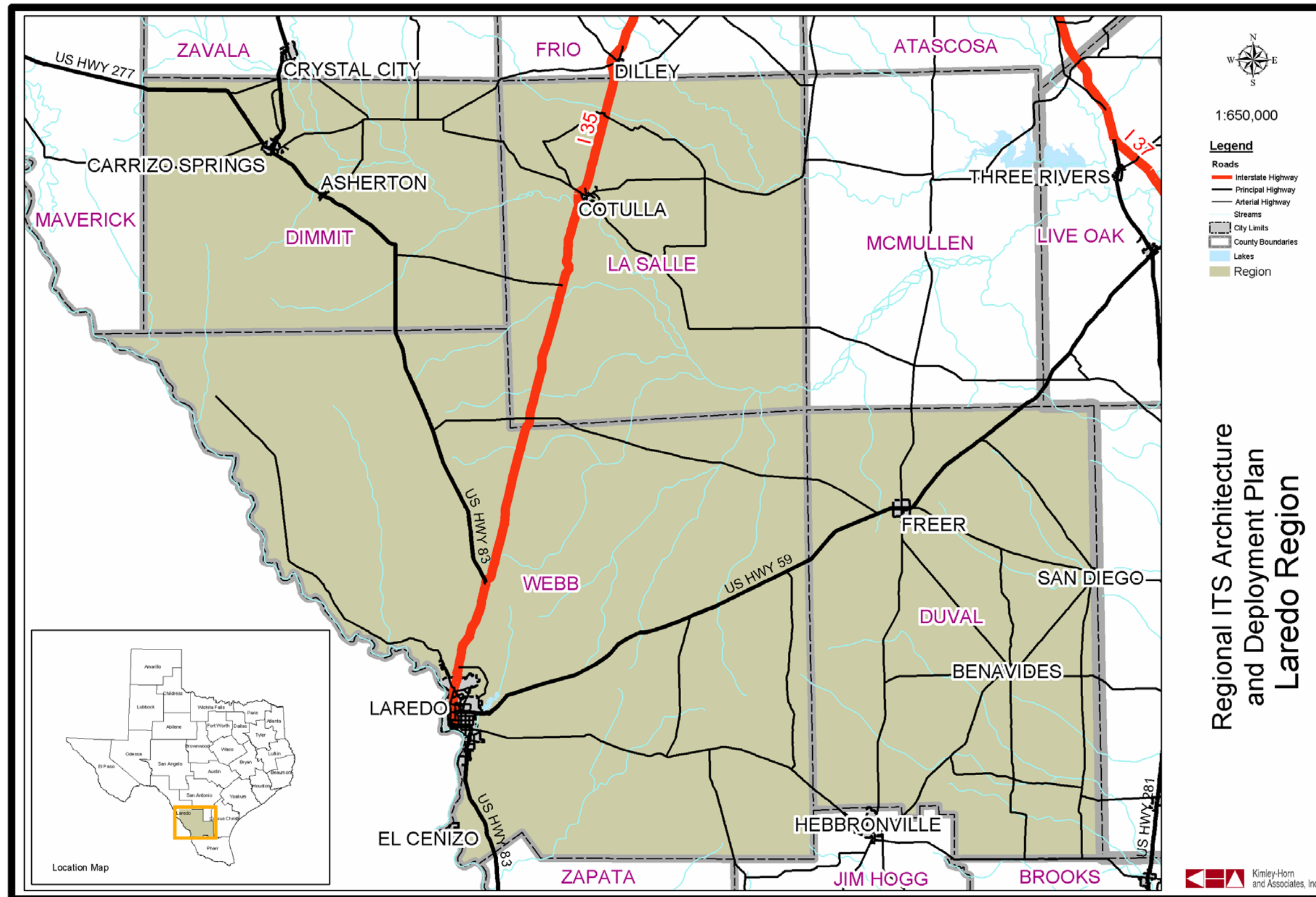
Figure 1 – Laredo Region Map

I-35 is more than a commercial vehicle route; it also is a major automobile route through Laredo, and connects to several pedestrian bridges and to International Bridge No. 1 (Puente de las Americas Bridge).

Other primary roadways in the Laredo Region include State Highway 359 and US 59. State Highway 359 crosses Webb and Duval counties, both part of the Laredo Region, and also is an alternate to US 59.

US 59 is a principal highway that travels through the entire eastern area of the state of Texas in a north-south direction between the cities of Texarkana and Laredo. US 59 carries a significant amount of truck traffic, as it is part of a major NAFTA trade corridor. In fact, this highway is the corridor alignment being considered in the state of Texas for the proposed I-69 extension between Indianapolis, Indiana, and the City of Laredo. US 59 connects Laredo to cities such as Victoria, Corpus Christi (through US 44), and Houston.

Loop 20 is a recently completed, circumferential route in the City of Laredo, which bypasses downtown and provides access to Texas A&M International University, Laredo International Airport, Casa Blanca Lake, and the TxDOT District Office. Loop 20 is considered a primary alternate route for incidents on I-35, US 83, US 59, and State Highway 359.

Numerous other state highways and farm-to-market roadways traverse the Laredo Region. For instance, a key farm-to-market route, FM 1472, connects to several toll bridge crossings leading into Mexico near Laredo.

There are two key roadways on the Mexico side that are important for the Laredo Region:

- Mexico SR 2, which follows the Rio Grande down into Matamoros; and
- Mexico SR 85, which extends I-35 into Mexico City. Also called Pan American Highway, it connects to Monterrey and South America.

1.3.3   Laredo Region ITS Plans

TxDOT and local agencies are in the process of implementing ITS throughout the Region. TxDOT has developed plans for a permanent Traffic Operations Center (TOC) in the District complex, and the City of Laredo has deployed a closed-loop traffic signal system and is operating it from an interim control center. There are plans to incorporate control system elements in the Emergency Operations Center at the City.

The City has a franchise arrangement with Time/Warner that provides fiber optic cable connections and bandwidth to many of the City's transportation and non-transportation facilities. In addition, the current transportation improvement plan contains several projects to augment the on-going infrastructure deployment at the Milo 1 interchange.

The initial phase of ITS infrastructure in the Laredo Region consists of dynamic message signs (DMS), video surveillance cameras, vehicle detectors (video image vehicle detector systems and loop detectors), highway advisory radio (HAR), and a central control software system. The primary functions of the TxDOT system are to provide congestion management, incident management, and traveler information for motorists. This system also can inform motorists of highway construction or maintenance activities as well as conditions, incidents, or congestion at the border crossings.

Dynamic Message Signs

The TxDOT Laredo District has installed several large overhead DMS on I-35 and is in the process of constructing additional signs as part of the Milo 1 interchange project.

TxDOT will use the signs to alert motorists of roadway conditions. In addition, this ITS technology will be used for coordinated bridge control to support safer and more efficient traffic management at the bridges.

Video Surveillance

The second element of the ITS plan for the TxDOT Laredo District is the deployment of video surveillance cameras. These cameras are strategically located at high accident and/or high traffic volume interchanges. The City of Laredo also will be able to utilize the signalized interchange cameras to assist with fine-tuning its traffic signal timing plans.

The City of Laredo Traffic Department has closed-circuit television (CCTV) monitoring in place at two locations and plans to add two additional locations in the short term. This system provides an interface to the City's INET. In addition, CCTV and communication links are planned for the Laredo Arena, which is scheduled to be open in Fall 2002.

Additional cameras are planned as part of several construction projects along I-35, Loop 20 and as part of the coordinated bridge control project. Interconnection with these cameras is currently planned with fiber optic cable for the TxDOT roadway projects and is yet to be determined for the coordinated bridge control project.

Highway Advisory Radio

HAR utilizes the automobile's AM band for broadcasting en-route information about weather, roadway conditions, construction, closures, detours, and other information. In the Laredo Region, HAR stations are strategically located near the airport and international border crossings.

HAR is one of the ITS technologies that is planned to be used for coordinated bridge control functions. Bridge control activities will be coordinated from the planned Traffic Operations Center.

Traffic Management System

The City of Laredo currently has an interim TOC to monitor and manage traffic flow. Incidents are detected and verified and incident information is provided to the appropriate agencies, like the Department of Public Safety (DPS), local fire and local police dispatch, and also to third party providers. Some ITS technologies currently used by this center are DMS, CCTV cameras, and traffic detectors. This center is staffed 14 hours per day with night support via pager.

A new 7000-square-foot TOC is planned for the Region. This TOC will integrate the activities of the TxDOT and City of Laredo Interim TOC into one central unit for improved coordination and efficiency. Incidents will be detected and verified (using CCTV, detectors, etc.) and incident information will be provided to the appropriate agencies, such as DPS, Border Patrol, 911 dispatch, local fire and local police dispatch, and also to third party providers. Traffic information will be disseminated using DMS and a website. The TOC also will provide maintenance work schedules and road closure information, and will

coordinate with the City of Laredo Bridge System to support traffic management functions at the bridges.

Emergency Management

The planned Emergency Management Center will be activated for major incidents and emergencies in the City of Laredo. It will be staffed only during emergencies by representatives of all allied responding agencies.

Also planned is the installation of the City of Laredo Fire Mobile Data System, which incorporates Mobile Data Terminals in fire vehicles to provide communications with the computer-aided dispatch (CAD) system.

Transit

There are plans to deploy an on-board transit security system, which will include installing on-board security cameras (linked to a recorder on the bus) to monitor the safety of transit vehicles. Additionally, the Laredo Municipal Transit System—El Metro—has plans to acquire new buses for its fleet.

An electronic fare collection system that allows transit users to use an electronic payment device on-board transit vehicles is already in place. There are proposed plans to upgrade this system.

Another system that has been proposed is a Transit Traveler Information System. With this system, transit schedules, operating hours, routes, and fare information would be available by phone. Reservations for specialized transportation services also would be available by phone.

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 several 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 Laredo Region.

The following is a list of stakeholders in the Laredo 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 Laredo Regional ITS Architecture:

- City of Laredo Bridge System;
- City of Laredo Fire Department;
- City of Laredo INET;
- City of Laredo Police Department;
- City of Laredo Traffic Safety;
- El Metro;
- Federal Motor Carrier Safety Administration, Southern Service Center;
- Federal Motor Carrier Safety Administration, Texas Division;
- FHWA Southern Resource Center;

- FHWA Texas Division;
- Laredo Independent School District;
- Texas Department of Public Safety;
- Time Warner Company;
- TxDOT Laredo District;
- TxDOT Public Transportation Division (Austin);
- TxDOT Traffic Operations Division (Austin);
- United States Border Patrol; and
- Webb County.

1.3.5   Major Industries and Employers

An increased deployment of ITS infrastructure has the potential to improve people and goods movement in the Laredo Region. Among some of the key industry stakeholders in the Region are Mercy and Doctor's Hospital, education facilities for school districts, Laredo Community College, Texas A&M International University, City of Laredo, Webb County, U.S. Border Patrol, and rail and trucking companies. There also are nearly 60 manufacturing or distribution facilities including Sony, Rheem, and Modine.

There is a surge in new services to accommodate the increase in population on both sides of the border. The air service into Laredo has expanded with Continental Express passenger jets, Azteca Airlines, and Mexicana Airlines. The new Super Wal-Mart on Loop 20 will employ more than 500 people. The Laredo Arena complex will add professional sports to the Region. Columbia and World Trade Bridge should operate more efficiently with the connection to Loop 20 and the expansion of the industrial park.

The ITS application that may have the largest impact on traffic flow is the automation of the new security policies for border crossings. There are approximately 12,000 American and Canadian long-haul trucks using the border every day. There are also about 9,000 local truck crossings to augment that number.

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 Laredo Region.

For each operating agency or stakeholder entity identified through the development of the Regional ITS Architecture, there are operations that currently exist as normal practice in order to accomplish the primary business goals and objectives for each stakeholder. The integration of each agency with any of the other stakeholders will not change the agency's primary function or disrupt its typical business practices. The integration process will require that the data that is exchanged between the two entities meet certain requirements for that particular data type. Identifying the need for this connection between agencies and the opportunities for integration and interoperability in the Region are key purposes of this section.

While there are many examples of data exchanges that will take place under the Laredo Regional ITS Architecture, they will not be discussed individually nor in totality in this section. This section will provide an overview of the major issues and stakeholders' needs within the Laredo Region and the primary areas of concern that were uncovered in the preparation of the Laredo Regional ITS Architecture. Additionally, this section will discuss the need for interregional communications with agencies external to the Laredo Region such as the Mexican states where I-35 travels.

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

2.2 Regional Needs

Needs from the Region were identified in the project kick-off meeting held on March 21, 2002. Stakeholders participating in that meeting identified the needs in the Region. The needs identified in the project kick-off meeting are categorized into functional areas and documented in **Table 2**.

Table 1 – Laredo Stakeholder Agencies and Contacts

Stakeholder Agency	Contact	Address	Phone Number	E-Mail
City of Laredo INET	Mario Ruiz	1101 Garden Street Laredo, Texas 78040	(956) 795-2385	mruiz@ci.laredo.tx.us
City of Laredo Bridge System	Berta Rivera	11601 FM 1472 Laredo, Texas 78045	(956) 791-2200	brivera0@ci.laredo.tx.us
City of Laredo Bridge System	Rubin Villarreal	11601 FM 1472 Laredo, Texas 78045	(956) 791-2200	rvillarrea@ci.laredo.tx.us
City of Laredo Fire Department	Juan Meza, Jr.	1 Guadalupe Laredo, Texas 78041	(956) 795-2150	N/A
City of Laredo Police Department	Jim Dempsey	4712 Maher Avenue Laredo, Texas 78041	(956) 795-3125	jdchuckwagon@aol.com
City of Laredo Police Department	Pete Palacios	4712 Maher Avenue Laredo, Texas 78041	(956) 795-2823	ppalacios@ci.laredo.tx.us
City of Laredo Traffic Safety	Manuel Benavides	2800 Saunders Laredo, Texas 78041	(956) 795-2550	mbenavides@ci.laredo.tx.us
City of Laredo Traffic Safety	Oscar Canales	2800 Saunders Laredo, Texas 78041	(956) 795-2550	jcanales@ci.laredo.tx.us
City of Laredo Traffic Safety	Robert Pena	2800 Saunders Laredo, Texas 78041	(956) 795-2550	rpena@ci.laredo.tx.us
City of Laredo Traffic Safety	Roberto Murillo	2800 Saunders Laredo, Texas 78041	(956) 795-2550	rmurillo@ci.laredo.tx.us
El Metro	Joe Guerra	1301 Farragut Laredo, Texas 78046	(956) 795-2288	jguerra@ci.laredo.tx.us
El Metro	Juan Gala	401 Scott Laredo, Texas 78046	(956) 795-2250	jgala@ci.laredo.tx.us
El Metro	R.J. Garza	401 Scott Laredo, Texas 78046	(956) 795-2250	rgarza0@ci.laredo.tx.us
Federal Motor Carrier Safety Administration, Southern Service Center	Joel Hiatt	61 Forsyth St., Suite 17T75 Atlanta, GA 30303	(404) 562-3610	joel.hiatt@fhwa.dot.gov
Federal Motor Carrier Safety Administration, Texas Division	Rodney Baumgartner	826 Federal Bldg. #865 300 East 8th Street Austin, Texas 78701	(512) 536-5980	rodney.baumgartner@fmcsa.dot.gov
FHWA Southern Resources Center	Daniel Grate, Jr.	61 Forsyth St., Suite 17T26 Atlanta, GA 30303-3104	(404) 562-3912	daniel.grate@fhwa.dot.gov
FHWA Texas Division	Mark Olson	300 E. 8th Street, Room 826 Austin, Texas 78701	(512) 536-5972	mark.olson@fhwa.dot.gov
Laredo Independent School District	Jose Perez	3006 Hendricks Laredo, Texas 78040	(956) 795-3675	N/A
Laredo Independent School District	Rick Gonzalez	3006 Hendricks Laredo, Texas 78040	(956) 795-3625	RKG@laredo.k12.tx.us

Table 1 – Laredo Stakeholder Agencies and Contacts (continued)

Stakeholder Agency	Contact	Address	Phone Number	E-Mail
Texas Department of Public Safety	Jesse Sharp	1901 Bob Bullock Loop Laredo, Texas 78043	(956) 728-2292	jesse.sharp@txdps.state.tx.us
Texas Department of Public Safety	Mario Salinas	1901 Bob Bullock Loop Laredo, Texas 78043	(956) 728-2210	mario.salinas@txdps.state.tx.us
Time Warner Company	Juan Botello	1313 West Carlton Road Laredo, Texas 78041	(956) 721-0612	juan.botello@twcable.com
TxDOT Laredo District	Danny Magee	1817 Bob Bullock Loop Laredo, Texas 78043	(956) 712-7443	dmagee@dot.state.tx.us
TxDOT Laredo District	Randy Aguilar	1817 Bob Bullock Loop Laredo, Texas 78043	(956) 712-7744	jaguil2@dot.state.tx.us
TxDOT Laredo District	Roberto Rodriguez	1817 Bob Bullock Loop Laredo, Texas 78043	(956) 712-7485	rrodri9@dot.state.tx.us
TxDOT Public Transportation	Loren Herr	125 East 11th Street Austin, Texas 78701-2483	(512) 416-2812	lherr@dot.state.tx.us
TxDOT Traffic Operations	Alesia Gamboa	TRF-TM 125 East 11th Street Austin, Texas 78701-2483	(512) 416-2780	agamboa@dot.state.tx.us
TxDOT Traffic Operations	Charles Brindell	TRF-TM 125 East 11th Street Austin, Texas 78701-2483	(512) 416-3268	cbrinde@dot.state.tx.us
TxDOT Traffic Operations	Janie Light	TRF-TM 125 East 11th Street Austin, Texas 78701-2483	(512) 416-3258	jlight@dot.state.tx.us
U.S. Border Patrol	Gus Cantu	207 West Del Mar Boulevard Laredo, Texas 78041	(956) 764-3269	gus.cantu@usdoj.gov
U.S. Border Patrol	Michael Knowles	207 West Del Mar Boulevard Laredo, Texas 78041	(956) 764-3214	michael.knowles@usdoj.gov
Webb County Engineering	Eliseo Valdez, Jr.	110 Victoria, Suite 207 Laredo, Texas 78040	(956) 718-8504	evaldez@webbcounty.com
Webb County Planning	Rafael Vidaurri	110 Victoria, Suite 208 Laredo, Texas 78040	(956) 721-2560	rvidaurri@webbcounty.com

Table 2 – Laredo Region: Summary of ITS Needs

Laredo Region

Summary of ITS Needs
Laredo Regional ITS Architecture and Deployment Plan Kick-Off Meeting
March 21, 2002

Institutional Issues/Needs

- Need coordination with border sites to share information (closures, restrictions, etc.)
- Need coordination with railroad
- Need coordination with Commercial Vehicle Information Systems Network
- Need security for staff at TxDOT, City of Laredo, Customs, Border Patrol, El Metro et al.

Traffic Management Needs

- Need detours for weather and emergencies
- Need road closure plans (TxDOT has a plan for I-35 only)
- Need multiple road closure/detour plans
- Need to know locations of trains when stopped
- Need flood warning systems, especially for underpasses and low water crossings

Traveler Information Needs

- Need to communicate better with travelers and to general public
- Need to identify next steps for 511
- Need to use DMS for en-route information
- Need to provide ramp closure information to travelers
- Need coordination of international bridges along the border (fiber)
- Need English and Spanish on Highway Advisory Radio
- Need English and International symbols on DMS
- Need coordination with Mexico for major events

Data Needs (Collecting, Sharing)

- Need volume information
- Need permanent count stations
- Need road information to be shared interstate and interdistrict
- Need to coordinate information on freeways and arterials
- Need off system traffic management and flow information

Public Transportation Management Needs

- Need transit operators/agencies to have access to information about closures, maintenance, weather, etc.
- Need Automatic Vehicle Location on vehicles
- Need automated fare boxes
- Need to make information available to transit passengers at stops as well as from home or office
- Need security system for drivers and passengers

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

Electronic Payment Needs

- Need electronic payment for El Metro
- Need electronic payment at border crossing
- Need Commercial Vehicle Information Systems and Network (CVISN) common transponder

Commercial Vehicle Operations Needs

- Need early notification and communication with Commercial Vehicle Operations about closures, restrictions, etc. (just-in-time delivery has made this more critical)
- Need regional study for HAZMAT shipping and routing
- Need electronic screening (CVISN is under development in Texas)

Emergency Management Needs

- Need a center to collocate Emergency Operations Center and transportation personnel
- Need Emergency Management Coordination
- Need a system like LifeLink to share video between emergency (ambulance) and trauma centers
- Need security for Traffic Management Center (TMC)/Emergency Operations Center (EOC) and places that handle emergencies

Advanced Vehicle Safety Systems Needs

- None Identified

Information Management Needs (Data Archiving)
- Need policy for shared use of video and data with media
- Need policy for shared telecommunications facility maintenance and operations

Maintenance and Construction Operations Needs

- Need speed warnings for work zones
- Need to coordinate maintenance with traffic operations during closures

Other Needs

- Need to look for opportunities to tie the Laredo Regional ITS Architecture and Deployment Plan into Homeland Defense/Security
- Need to enhance border safety and security
- Need a central, physical location for communications infrastructure sharing
- Need to update telecommunications study in light of major enhancements to the communications infrastructure over the past 2 years.
- Need to facilitate congestion management on freeways and arterials
- Need coordinated signal timing between city and state

2.3 Regional Integration and Interoperability

A vision for the Laredo Region is to integrate systems both on an intra-regional and an inter-regional basis.

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

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

In addition to the integration opportunities within the Laredo Region, integrating the Laredo Region with surrounding Regions offers great opportunity for improvements to the system.

The TxDOT Laredo District also has a need to gather information from Mexico on closures of the border or major routes in Mexico, which would require coordination with Border Patrol, U.S. Customs, as well as with transportation agencies. For example, if Mexico has closed its borders, it is crucial that the TxDOT Laredo District have this information in order to update motorists and commercial vehicles as soon as possible before they approach the border crossing.

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 service which would provide consistent traveler information throughout the state.

One of the primary purposes in developing a Regional ITS Architecture for the Laredo Region is to ensure that while various agencies are deploying ITS components, there are some commonalties 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 Laredo 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 Laredo Process

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

Prior to the first project kick-off meeting with the contractor and stakeholders, TxDOT identified relevant stakeholders in the Region to begin discussions on the development of a Regional ITS Architecture and Deployment Plan. The TxDOT District Traffic Operations Engineer led this effort. 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.
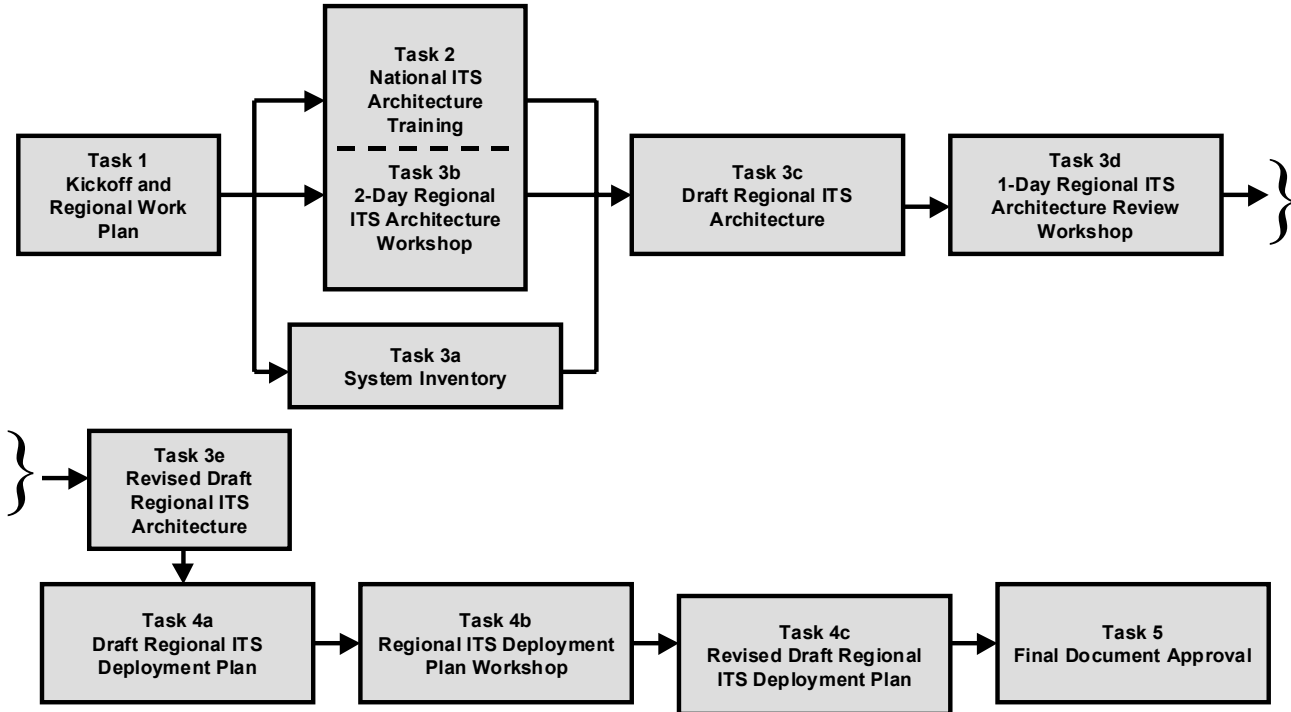
Figure 2 – Laredo Regional ITS Architecture and Deployment Plan Development Process

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

- 1-Day Kick-off and Regional Work Plan Meeting;
- 2-Day Regional ITS Architecture Workshop;
- 1-Day Regional ITS Architecture Review Workshop;
- ITS Deployment Plan Workshop; and
- Final Comment Resolution Review and Final 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 first 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 Laredo 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 Laredo 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 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 Laredo 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 selecting and customizing these elements. The result of the 2-Day Regional ITS Architecture Workshop was a Regional ITS Architecture for Laredo, which included a complete 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 project 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 Laredo Region was sent to stakeholders prior to the 1-Day Regional ITS Architecture Review Workshop.

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

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

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

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

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

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

3.2 USDOT Regional ITS Architecture Guidance

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

The process used to develop the Laredo 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 Laredo 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 Laredo 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.
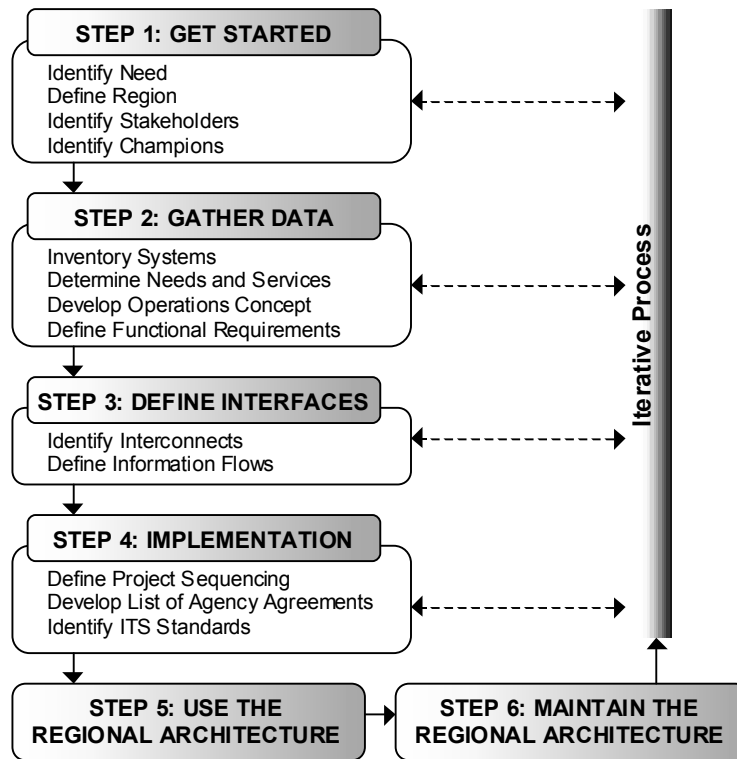
(Source: Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region, USDOT)

Figure 3 – USDOT Guidance on Regional ITS Architecture Development

4. CONCEPTUAL DESIGN

4.1 Systems Inventory

One of the key initial steps in the architecture development process is to establish an inventory of existing ITS elements. At the project kick-off meeting and through subsequent discussions with agency representatives throughout the Region, Laredo 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 Laredo Region were identified in the following categories:

- **Travel and Traffic Management** – includes state and local traffic management centers, traffic signal systems, detection systems, CCTV, fixed and portable dynamic message signs, bridge system field equipment, and other related technologies.
- **Public Transportation Management** – includes transit and dial-a-ride automated dispatch, and transit travel information systems.
- **Electronic Payment** – Laredo Trade Tag System.
- **Commercial Vehicle Operations** – includes TxDOT and U.S. Border Patrol Electronic screening systems.
- **Emergency Management** – includes dispatch for police, fire/EMS, HAZMAT, Laredo/Webb County emergency operations/management centers, and U.S. Customs/Border Patrol dispatch.
- **Information Management** – includes electronic data management and archiving systems.
- **Maintenance and Construction Operations** – includes road and bridge maintenance systems.

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 Laredo 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 Laredo Region is included in Section 4.3.1 of this report. Communication functions between the subsystems are represented in the ovals. It should be noted that "wireline" communication refers to fixed-point to fixed-point communications, which include not only twisted pair and fiber optic technologies, but also such wireless technologies as microwave and spread spectrum.

Terminators are the people, systems, other facilities, and environmental conditions outside of ITS that need to communicate or interface with ITS subsystems. They help to define the boundaries of the National ITS Architecture as well as a regional system. Examples of terminators include drivers, traffic operations personnel, information service providers, weather effects (snow, rain, fog), telecommunications systems, and government reporting systems, among others.
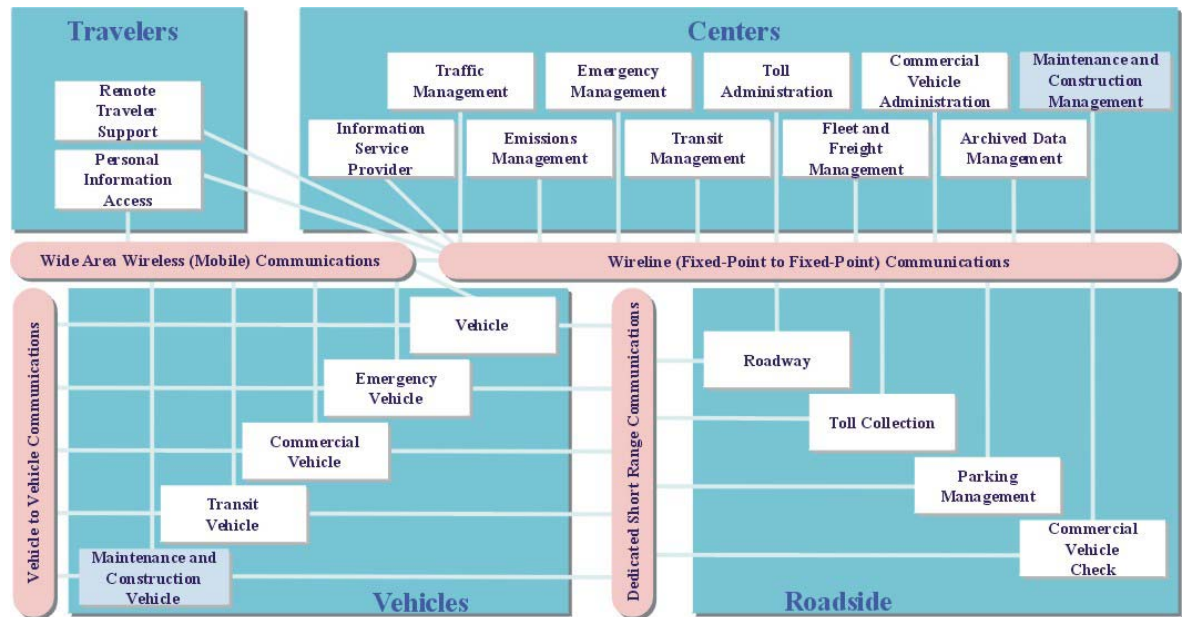
Figure 4 – Physical Subsystem Interconnect Diagram

4.1.2 Laredo 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 Laredo 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 Laredo Regional ITS Architecture.

The information in **Table 3** also is included on the Laredo Architecture web site, which is accessible by 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 Laredo Regional ITS Architecture web site was being hosted at www.consystec.com. TxDOT plans to permanently host the site in the future at www.dot.state.tx.us/trf/its.)

4.1.3 Laredo ITS Inventory by Entity

The Laredo Regional ITS Architecture inventory is made up of the transportation and communications centers, the field equipment, the vehicles, and other systems in the regional transportation system. These components have been assigned to a subsystem or terminator as defined by the National ITS Architecture. **Table 4** presents the Laredo 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 Laredo Regional ITS Architecture web site by selecting the "Inventory by Entity" button.

Table 3 – Laredo Inventory of Regional Subsystems/Terminators (sorted by Stakeholder)

Stakeholder	Element	Entity	Status
Businesses and Other Private Entities	Businesses and Other Private Entities	Archived Data User Systems	Existing
City and Community Parking System Operators	City and Community Parking Management Systems	Parking Management Subsystem	Future
City of Laredo	City of Laredo Airport PD	Emergency Management Subsystem	Existing
	City of Laredo Arena Parking Management	Event Promoters	Future
	City of Laredo Arena Parking Management	Parking Management Subsystem	Future
	City of Laredo Bridge System	Archived Data User Systems	Existing
	City of Laredo Bridge System	Toll Administration Subsystem	Existing
	City of Laredo Bridge System	Traffic Management Subsystem	Existing
	City of Laredo Bridge System Field Equipment	Roadway Subsystem	Existing
	City of Laredo Bridge System Trade Tag	Traveler Card	Future
	City of Laredo Bridge System Web Site	Information Service Provider Subsystem	Future
	City of Laredo Bridge System Web Site	Toll Administration Subsystem	Future
	City of Laredo Emergency Communications Center	Emergency Management Subsystem	Existing
	City of Laredo Equipment Repair	Equipment Repair Facility	Existing
	City of Laredo Field Equipment	Roadway Subsystem	Existing
	City of Laredo Fire/EMS/HAZMAT Vehicles	Emergency Vehicle Subsystem	Existing
	City of Laredo Police Vehicles	Emergency Vehicle Subsystem	Existing
	City of Laredo PWD	Equipment Repair Facility	Existing
	City of Laredo PWD	Maintenance and Construction Management Subsystem	Existing
	City of Laredo PWD Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
	City of Laredo TMC	Archived Data User Systems	Existing
	City of Laredo TMC	Maintenance and Construction Management Subsystem	Existing

Stakeholder	Element	Entity	Status
City of Laredo (continued)	City of Laredo TMC	Traffic Management Subsystem	Existing
	City of Laredo Trade Tag System	Toll Collection Subsystem	Existing
	City of Laredo Traffic Archived Data Management System	Archived Data Management Subsystem	Future
	City of Laredo Traffic Safety Department	Commercial Vehicle Administration Subsystem	Future
	City of Laredo Webpage	Information Service Provider Subsystem	Existing
City of Laredo/Webb County	City of Laredo/Webb County EOC	Emergency Management Subsystem	Future
City/County Public Safety	City/County Public Safety Dispatch	Emergency Management Subsystem	Existing
	City/County Public Safety Vehicles	Emergency Vehicle Subsystem	Existing
City/County/State Public Safety	Laredo Regional Incident and Mutual Aid Network	Other EM	Future
Commercial Vehicle Operators	Commercial Vehicle Operator Systems	Fleet and Freight Management Subsystem	Existing
	Commercial Vehicles	Commercial Vehicle Subsystem	Existing
	Commercial Vehicles	Vehicle Subsystem	Existing
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 Maintenance and Construction Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
Courtesy Service Patrol Provider	Courtesy Service Patrol Provider	Archived Data User Systems	Future
DPS	DPS Communications Service	Emergency Management Subsystem	Existing
	DPS Communications Service	Enforcement Agency	Existing
	DPS Electronic Screening Stations	Commercial Vehicle Check Subsystem	Future
	DPS Highway Patrol Vehicles	Emergency Vehicle Subsystem	Existing
	DPS License and Weights Division	Enforcement Agency	Existing
	DPS Regional Disaster Communications Committee	Emergency Management Subsystem	Existing

Stakeholder	Element	Entity	Status
DPS Division of Emergency Management	State EOC	Emergency Management Subsystem	Existing
El Aguila	El Aguila Transit Dispatch	Transit Management Subsystem	Existing
	El Aguila Transit Vehicle	Transit Vehicle Subsystem	Existing
El Metro	El Metro Fixed-Route Transit Dispatch	Transit Management Subsystem	Existing
	El Metro Kiosks	Remote Traveler Support Subsystem	Future
	El Metro Paratransit Dispatch	Transit Management Subsystem	Existing
	El Metro Paratransit Vehicles	Transit Vehicle Subsystem	Existing
	El Metro Transit Vehicles	Transit Vehicle Subsystem	Existing
	El Metro Transit Webpage	Information Service Provider Subsystem	Existing
	El Metro Traveler Card	Traveler Card	Future
Financial Institution	Financial Institutions	Financial Institution	Existing
Independent School Districts	Independent School District Dispatch	Transit Management Subsystem	Existing
	Independent School District Vehicles	Transit Vehicle Subsystem	Existing
Local Media	Print and Broadcast Media	Media	Existing
NOAA	National Weather Service	Weather Service	Existing
Other States DOTs	Other States Credentials Administration and Safety Information Exchange	Commercial Vehicle Administration Subsystem	Existing
Other TxDOT Regions	Other TxDOT Region TMCs	Maintenance and Construction Management Subsystem	Existing
	Other TxDOT Region TMCs	Traffic Management Subsystem	Existing
Private Ambulance Services	Private Ambulance Dispatch Center	Emergency Management Subsystem	Existing
Private ISPs	Private Sector Traveler Information Services	Information Service Provider Subsystem	Future
Private Mayday Providers	Private Vehicle Emergency Systems	Emergency Management Subsystem	Existing
Private Shippers	Private Shippers	Intermodal Freight Shipper	Existing
Private Tow/Wrecker	Private Tow/Wrecker Dispatch	Emergency Management Subsystem	Existing

Stakeholder	Element	Entity	Status
Private Travelers	Private Traveler	Traveler	Existing
	Private Traveler Personal Computing Devices	Personal Information Access Subsystem	Existing
Private Vehicle Owners	Private Vehicles	Vehicle Subsystem	Existing
Railroad Operators	Rail Cars	Commercial Vehicle Subsystem	Future
	Rail Cars	Vehicle Subsystem	Future
	Rail Operations	Fleet and Freight Management Subsystem	Existing
	Rail Operations	Rail Operations	Existing
	Railroad Wayside HRI equipment	Wayside Equipment	Existing
Regional Hospitals	Regional Hospitals	Care Facility	Existing
TAMIU	TAMIU Archive	Archived Data Management Subsystem	Existing
	TAMIU Archived Data User System	Archived Data User Systems	Future
Traveler Telecommunications System Providers	Telco 511 Call Routing	Traveler Telecommunications System	Future
TxDOT	Rest Areas/Visitor Centers/Service Plaza Kiosks	Remote Traveler Support Subsystem	Existing
	TxDOT 511 System	Traveler Info Phone System	Future
	TxDOT Area Construction Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
	TxDOT Area Office	Maintenance and Construction Management Subsystem	Existing
	TxDOT BRINSAP – Bridge Inventory Inspection System	Asset Management	Existing
	TxDOT County Maintenance Sections	Maintenance and Construction Management Subsystem	Existing
	TxDOT County Maintenance Section Storage Facility	Storage Facility	Existing
	TxDOT County Maintenance Vehicles	Maintenance and Construction Vehicle Subsystem	Existing
	TxDOT Courtesy Service Patrol Archive	Archived Data Management Subsystem	Future

Stakeholder	Element	Entity	Status
TxDOT (continued)	TxDOT Courtesy Service Patrol Dispatch	Emergency Management Subsystem	Future
	TxDOT Courtesy Service Patrol Vehicles	Emergency Vehicle Subsystem	Future
	TxDOT Crash Records Information System	Archived Data Management Subsystem	Existing
	TxDOT Credentials Administration and Safety Information Exchange	Commercial Vehicle Administration Subsystem	Future
	TxDOT District Shop	Equipment Repair Facility	Existing
	TxDOT Highway Condition Reporting System	Information Service Provider Subsystem	Existing
	TxDOT Laredo Archived Data Management System	Archived Data Management Subsystem	Future
	TxDOT Laredo CCTV	Roadway Subsystem	Existing
	TxDOT Laredo District Webpage	Information Service Provider Subsystem	Future
	TxDOT Laredo DMS	Roadway Subsystem	Existing
	TxDOT Laredo Field Sensors	Roadway Subsystem	Existing
	TxDOT Laredo HAR	Roadway Subsystem	Existing
	TxDOT Laredo TMC – STRATIS	Archived Data User Systems	Existing
	TxDOT Laredo TMC – STRATIS	Information Service Provider Subsystem	Existing
	TxDOT Laredo TMC – STRATIS	Maintenance and Construction Management Subsystem	Existing
	TxDOT Laredo TMC – STRATIS	Traffic Management Subsystem	Existing
	TxDOT Laredo Toll Tag Readers	Roadway Subsystem	Future
	TxDOT Laredo Traffic Signals	Roadway Subsystem	Existing
	TxDOT Overdimension Vehicle System	Commercial Vehicle Administration Subsystem	Existing
	TxDOT Texas Transportation Commission	Maintenance and Construction Management Subsystem	Existing
	TxDOT Tourist Bureau	Information Service Provider Subsystem	Existing
	TxDOT Work Zone Field Equipment	Roadway Subsystem	Future

Table 3 – Laredo Inventory of Regional Subsystems/Terminators (sorted by Stakeholder) (continued)

Stakeholder	Element	Entity	Status
TxDOT Motor Carrier Division	TxDOT Motor Carrier Routing Information	Information Service Provider Subsystem	Existing
US Border Patrol	US Border Patrol Air Operations	Emergency Management Subsystem	Existing
	US Border Patrol CVO Inspectors	CVO Inspector	Existing
	US Border Patrol Dispatch Center	Archived Data User Systems	Existing
	US Border Patrol Dispatch Center	CVO Information Requestor	Existing
	US Border Patrol Dispatch Center	Emergency Management Subsystem	Existing
	US Border Patrol Dispatch Center	Trade Regulatory Agencies	Existing
	US Border Patrol Stations	Emergency Management Subsystem	Future
	US Border Patrol Vehicles	Emergency Vehicle Subsystem	Existing
US Customs	US Customs Dispatch Center	Emergency Management Subsystem	Existing
	US Customs Product Manifest System	Commercial Vehicle Administration Subsystem	Future
	US Customs Product Manifest System	Trade Regulatory Agencies	Future

Table 4 – Laredo Inventory of Regional Subsystems/Terminators (sorted by Entity)

Entity	Element	Stakeholder	Status
Archived Data Management Subsystem	City of Laredo Traffic Archived Data Management System	City of Laredo	Future
	TAMIU Archive	TAMIU	Existing
	TxDOT Courtesy Service Patrol Archive	TxDOT	Future
	TxDOT Crash Records Information System	TxDOT	Existing
	TxDOT Laredo Archived Data Management System	TxDOT	Future
Archived Data User Systems	Businesses and Other Private Entities	Businesses and Other Private Entities	Existing
	City of Laredo Bridge System	City of Laredo	Existing
	City of Laredo TMC	City of Laredo	Existing
	Courtesy Service Patrol Provider	Courtesy Service Patrol Provider	Future
	TAMIU Archived Data User System	TAMIU	Future
	TxDOT Laredo TMC – STRATIS	TxDOT	Existing
	US Border Patrol Dispatch Center	US Border Patrol	Existing
Asset Management	TxDOT BRINSAP – Bridge Inventory Inspection System	TxDOT	Existing
Care Facility	Regional Hospitals	Regional Hospitals	Existing
Commercial Vehicle Administration Subsystem	City of Laredo Traffic Safety Department	City of Laredo	Future
	Other States Credentials Administration and Safety Information Exchange	Other States DOTs	Existing
	TxDOT Credentials Administration and Safety Information Exchange	TxDOT	Future
	TxDOT Overdimension Vehicle System	TxDOT	Existing
	US Customs Product Manifest System	US Customs	Future
Commercial Vehicle Check Subsystem	DPS Electronic Screening Stations	DPS	Future
Commercial Vehicle Subsystem	Commercial Vehicles	Commercial Vehicle Operators	Existing
	Rail Cars	Railroad Operators	Future
CVO Information Requestor	US Border Patrol Dispatch Center	US Border Patrol	Existing

Entity	Element	Stakeholder	Status
CVO Inspector	US Border Patrol CVO Inspectors	US Border Patrol	Existing
Emergency Management Subsystem	City of Laredo Airport PD	City of Laredo	Existing
	City of Laredo Emergency Communications Center	City of Laredo	Existing
	City of Laredo/Webb County EOC	City of Laredo/Webb County	Future
	City/County Public Safety Dispatch	City/County Public Safety	Existing
	DPS Communications Service	DPS	Existing
	DPS Regional Disaster Communications Committee	DPS	Existing
	Private Ambulance Dispatch Center	Private Ambulance Services	Existing
	Private Tow/Wrecker Dispatch	Private Tow/Wrecker	Existing
	Private Vehicle Emergency Systems	Private Mayday Providers	Existing
	State EOC	DPS Division of Emergency Management	Existing
	TxDOT Courtesy Service Patrol Dispatch	TxDOT	Future
	US Border Patrol Air Operations	US Border Patrol	Existing
	US Border Patrol Dispatch Center	US Border Patrol	Existing
	US Border Patrol Stations	US Border Patrol	Future
	US Customs Dispatch Center	US Customs	Existing
Emergency Vehicle Subsystem	City of Laredo Fire/EMS/HAZMAT Vehicles	City of Laredo	Existing
	City of Laredo Police Vehicles	City of Laredo	Existing
	City/County Public Safety Vehicles	City/County Public Safety	Existing
	DPS Highway Patrol Vehicles	DPS	Existing
	TxDOT Courtesy Service Patrol Vehicles	TxDOT	Future
	US Border Patrol Vehicles	US Border Patrol	Existing
Enforcement Agency	DPS Communications Service	DPS	Existing
	DPS License and Weights Division	DPS	Existing

Entity	Element	Stakeholder	Status
Equipment Repair Facility	City of Laredo Equipment Repair	City of Laredo	Existing
	City of Laredo PWD	City of Laredo	Existing
	County Road and Bridge Equipment Repair	County Road and Bridge	Existing
	TxDOT District Shop	TxDOT	Existing
Event Promoters	City of Laredo Arena Parking Management	City of Laredo	Future
Financial Institution	Financial Institutions	Financial Institution	Existing
Fleet and Freight Management Subsystem	Commercial Vehicle Operator Systems	Commercial Vehicle Operators	Existing
	Rail Operations	Railroad Operators	Existing
Information Service Provider Subsystem	City of Laredo Bridge System Web Site	City of Laredo	Future
	City of Laredo Webpage	City of Laredo	Existing
	El Metro Transit Webpage	El Metro	Existing
	Private Sector Traveler Information Services	Private ISPs	Future
	TxDOT Highway Condition Reporting System	TxDOT	Existing
	TxDOT Laredo District Webpage	TxDOT	Future
	TxDOT Laredo TMC – STRATIS	TxDOT	Existing
	TxDOT Motor Carrier Routing Information	TxDOT Motor Carrier Division	Existing
	TxDOT Tourist Bureau	TxDOT	Existing
Intermodal Freight Shipper	Private Shippers	Private Shippers	Existing
Maintenance and Construction Management Subsystem	City of Laredo PWD	City of Laredo	Existing
	City of Laredo TMC	City of Laredo	Existing
	County Road and Bridge	County Road and Bridge	Existing
	Other TxDOT Region TMCs	Other TxDOT Regions	Existing
	TxDOT Area Office	TxDOT	Existing
	TxDOT County Maintenance Sections	TxDOT	Existing

Entity	Element	Stakeholder	Status
Maintenance and Construction Management (continued)	TxDOT Laredo TMC – STRATIS	TxDOT	Existing
	TxDOT Texas Transportation Commission	TxDOT	Existing
Maintenance and Construction Vehicle Subsystem	City of Laredo PWD Vehicles	City of Laredo	Existing
	County Road and Bridge Maintenance and Construction Vehicles	County Road and Bridge	Existing
	TxDOT Area Construction Vehicles	TxDOT	Existing
	TxDOT County Maintenance Vehicles	TxDOT	Existing
Media	Print and Broadcast Media	Local Media	Existing
Other EM	Laredo Regional Incident and Mutual Aid Network	City/County/State Public Safety	Future
Parking Management Subsystem	City and Community Parking Management Systems	City and Community Parking System Operators	Future
	City of Laredo Arena Parking Management	City of Laredo	Future
Personal Information Access Subsystem	Private Traveler Personal Computing Devices	Private Travelers	Existing
Rail Operations	Rail Operations	Railroad Operators	Existing
Remote Traveler Support Subsystem	El Metro Kiosks	El Metro	Future
	Rest Areas/Visitor Centers/Service Plaza Kiosks	TxDOT	Existing
Roadway Subsystem	City of Laredo Bridge System Field Equipment	City of Laredo	Existing
	City of Laredo Field Equipment	City of Laredo	Existing
	TxDOT Laredo CCTV	TxDOT	Existing
	TxDOT Laredo DMS	TxDOT	Existing
	TxDOT Laredo Field Sensors	TxDOT	Existing
	TxDOT Laredo HAR	TxDOT	Existing
	TxDOT Laredo Toll Tag Readers	TxDOT	Future
	TxDOT Laredo Traffic Signals	TxDOT	Existing
	TxDOT Work Zone Field Equipment	TxDOT	Future

Entity	Element	Stakeholder	Status
Storage Facility	TxDOT County Maintenance Section Storage Facility	TxDOT	Existing
Toll Administration Subsystem	City of Laredo Bridge System	City of Laredo	Existing
	City of Laredo Bridge System Web Site	City of Laredo	Future
Toll Collection Subsystem	City of Laredo Trade Tag System	City of Laredo	Existing
Trade Regulatory Agencies	US Border Patrol Dispatch Center	US Border Patrol	Existing
	US Customs Product Manifest System	US Customs	Future
Traffic Management Subsystem	City of Laredo Bridge System	City of Laredo	Existing
	City of Laredo TMC	City of Laredo	Existing
	Other TxDOT Region TMCs	Other TxDOT Regions	Existing
	TxDOT Laredo TMC – STRATIS	TxDOT	Existing
Transit Management Subsystem	El Aguila Transit Dispatch	El Aguila	Existing
	El Metro Fixed-Route Transit Dispatch	El Metro	Existing
	El Metro Paratransit Dispatch	El Metro	Existing
	Independent School District Dispatch	Independent School Districts	Existing
Transit Vehicle Subsystem	El Aguila Transit Vehicle	El Aguila	Existing
	El Metro Paratransit Vehicles	El Metro	Existing
	El Metro Transit Vehicles	El Metro	Existing
	Independent School District Vehicles	Independent School Districts	Existing
Traveler	Private Traveler	Private Travelers	Existing
Traveler Card	City of Laredo Bridge System Trade Tag	City of Laredo	Future
	El Metro Traveler Card	El Metro	Future
Traveler Info Phone System	TxDOT 511 System	TxDOT	Future
Traveler Telecommunications System	Telco 511 Call Routing	Traveler Telecommunications System Providers	Future

Entity	Element	Stakeholder	Status
Vehicle Subsystem	Commercial Vehicles	Commercial Vehicle Operators	Existing
	Private Vehicles	Private Vehicle Owners	Existing
	Rail Cars	Railroad Operators	Future
Wayside Equipment	Railroad Wayside HRI equipment	Railroad Operators	Existing
Weather Service	National Weather Service	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 Laredo Region. In the National ITS Architecture, services are referred to as market packages. Market packages may include several stakeholders and elements that work together to provide a service in the Region. Examples of market packages from the National ITS Architecture include Network Surveillance, Traffic Information Dissemination, and Transit Vehicle Tracking. There are currently a total of 75 market packages identified in the National ITS Architecture.

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

In several cases, there are multiple elements or systems in the Region that provide the same service at different levels. For example, Surface Street Control (ATMS03) is provided on highways through the TxDOT Laredo TMC and on arterials by the City of Laredo TMC. Market packages also are identified as either existing or planned for the Region. In many cases, existing market packages might still need to be enhanced to increase the service that the market package provides. For example, the market package for Network Surveillance is listed as existing for the TxDOT Laredo TMC. Although TxDOT currently has this ability, additional cameras may be desired to increase the level of network surveillance on the highways.

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 – Laredo Region Selected Market Packages

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
ATMS01	Network Surveillance	City of Laredo Bridge System	TxDOT Laredo	Existing
		City of Laredo Bridge System Field Equipment	City of Laredo	Existing
		City of Laredo Field Equipment		
		City of Laredo TMC		
		City of Laredo Webpage		
		Private Sector Traveler Information Services		
		TxDOT Laredo CCTV		
		TxDOT Laredo District Webpage		
		TxDOT Laredo Field Sensors		
		TxDOT Laredo TMC – STRATIS		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
ATMS02	Probe Surveillance	City of Laredo Bridge System	TxDOT Laredo	Future
		City of Laredo Bridge System Field Equipment	City of Laredo	Future
		City of Laredo TMC		
		Commercial Vehicles		
		El Metro Fixed-Route Transit Dispatch		
		Private Vehicles		
		TxDOT Laredo TMC – STRATIS		
		TxDOT Laredo Toll Tag Readers		
ATMS03	Surface Street Control	City of Laredo Field Equipment	TxDOT Laredo	Existing
		City of Laredo TMC	City of Laredo	Existing
		TxDOT Laredo CCTV		
		TxDOT Laredo DMS		
		TxDOT Laredo Field Sensors		
		TxDOT Laredo HAR		
		TxDOT Laredo TMC – STRATIS		
		TxDOT Laredo Traffic Signals		
ATMS04	Freeway Control	TxDOT Laredo CCTV	TxDOT Laredo	Existing
		TxDOT Laredo Field Sensors		
		TxDOT Laredo TMC – STRATIS		
ATMS06	Traffic Information Dissemination	City of Laredo Airport PD	TxDOT Laredo	Existing
		City of Laredo Bridge System	City of Laredo	Existing
		City of Laredo Bridge System Field Equipment		
		City of Laredo Emergency Communications Center		
		City of Laredo Field Equipment		
		City of Laredo PWD		
		City of Laredo TMC		
		City of Laredo Webpage		
		City of Laredo/Webb County EOC		
		City/County Public Safety Dispatch		
		County Road and Bridge		
		DPS Communications Service		
		DPS Regional Disaster Communications Committee		
		El Aguila Transit Dispatch		
		El Metro Fixed-Route Transit Dispatch		
		El Metro Paratransit Dispatch		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
ATMS06 (continued)	Traffic Information Dissemination (continued)	Independent School District Dispatch Print and Broadcast Media Private Ambulance Dispatch Center Private Tow/Wrecker Dispatch Private Vehicle Emergency Systems State EOC TxDOT Area Office TxDOT County Maintenance Sections TxDOT Laredo District Webpage TxDOT Laredo DMS TxDOT Laredo HAR TxDOT Laredo TMC – STRATIS US Border Patrol Dispatch Center US Customs Dispatch Center		
ATMS07	Regional Traffic Control	City of Laredo Bridge System City of Laredo TMC Other TxDOT Region TMCs TxDOT Laredo TMC – STRATIS	TxDOT Laredo	Future
ATMS08	Incident Management System	City of Laredo Airport PD City of Laredo Arena Parking Management City of Laredo Bridge System City of Laredo Emergency Communications Center City of Laredo Field Equipment City of Laredo Fire/EMS/HAZMAT Vehicles City of Laredo Police Vehicles City of Laredo PWD City of Laredo TMC City of Laredo/Webb County EOC City/County Public Safety Dispatch City/County Public Safety Vehicles County Road and Bridge DPS Communications Service DPS Highway Patrol Vehicles DPS Regional Disaster Communications Committee El Metro Transit Webpage	Traffic and Emergency Management Agencies	Existing

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
ATMS08 (continued)	Incident Management System (continued)	National Weather Service Private Tow/Wrecker Dispatch Private Vehicle Emergency Systems State EOC TxDOT Area Office TxDOT County Maintenance Sections TxDOT Courtesy Service Patrol Dispatch TxDOT Courtesy Service Patrol Vehicles TxDOT Highway Condition Reporting System TxDOT Laredo CCTV TxDOT Laredo District Webpage TxDOT Laredo Field Sensors TxDOT Laredo TMC – STRATIS TxDOT Motor Carrier Routing Information TxDOT Tourist Bureau US Border Patrol Dispatch Center US Border Patrol Vehicles US Customs Dispatch Center		
ATMS10	Electronic Toll Collection	City of Laredo Bridge System City of Laredo Bridge System Trade Tag City of Laredo Bridge System Web Site City of Laredo Trade Tag System Commercial Vehicle Operator Systems Financial Institutions	City of Laredo	Existing
ATMS13	Standard Railroad Grade Crossing	City of Laredo Field Equipment	TxDOT Laredo	Existing
		City of Laredo TMC	City of Laredo	Existing
		Rail Operations Railroad Wayside HRI equipment TxDOT Laredo DMS TxDOT Laredo HAR TxDOT Laredo TMC – STRATIS TxDOT Laredo Traffic Signals		
ATMS15	Railroad Operations Coordination	City of Laredo TMC	TxDOT Laredo	Future
		Rail Operations	City of Laredo	Future
		TxDOT Laredo TMC – STRATIS		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
ATMS16	Parking Facility Management	City and Community Parking Management Systems	City of Laredo	Future
			Other Cities/Communities	Future
		City of Laredo Arena Parking Management		
		Private Sector Traveler Information Services		
		TxDOT Tourist Bureau		
ATMS17	Regional Parking Management	City and Community Parking Management Systems	City of Laredo	Future
			Other Cities/Communities	Future
		City of Laredo Arena Parking Management		
		City of Laredo Emergency Communications Center		
		City of Laredo TMC		
		El Metro Fixed-Route Transit Dispatch		
		Financial Institutions		
		TxDOT Laredo TMC – STRATIS		
EM1	Emergency Response	City of Laredo Airport PD	Emergency Management Agencies	Existing
		City of Laredo Emergency Communications Center		
		City of Laredo/Webb County EOC		
		City/County Public Safety Dispatch		
		DPS Communications Service		
		DPS Regional Disaster Communications Committee		
		Laredo Regional Incident and Mutual Aid Network		
		US Border Patrol Air Operations		
		US Border Patrol Dispatch Center		
		US Border Patrol Stations		
		US Customs Dispatch Center		
EM2	Emergency Routing	City of Laredo Emergency Communications Center	City of Laredo	Existing
		City of Laredo Field Equipment		
		City of Laredo Fire/EMS/HAZMAT Vehicles		
		City of Laredo TMC		
		Regional Hospitals		
		TxDOT Laredo TMC – STRATIS		
		TxDOT Laredo Traffic Signals		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
MC01	Maintenance and Construction Vehicle Tracking	City of Laredo PWD	TxDOT Laredo	Future
		City of Laredo PWD Vehicles	City of Laredo	Future
		TxDOT Area Construction Vehicles		
		TxDOT Area Office		
		TxDOT County Maintenance Sections		
		TxDOT County Maintenance Vehicles		
MC02	Maintenance and Construction Vehicle Maintenance	City of Laredo Equipment Repair	TxDOT Laredo	Future
		City of Laredo PWD	City of Laredo	Future
		City of Laredo PWD Vehicles	Counties	Future
		County Road and Bridge		
		County Road and Bridge Equipment Repair		
		County Road and Bridge Maintenance and Construction Vehicles		
		TxDOT Area Construction Vehicles		
		TxDOT Area Office		
		TxDOT County Maintenance Sections		
		TxDOT County Maintenance Vehicles		
		TxDOT District Shop		
MC07	Roadway Maintenance and Construction	City of Laredo TMC	TxDOT Laredo	Future
		National Weather Service		
		TxDOT Area Construction Vehicles		
		TxDOT Area Office		
		TxDOT BRINSAP – Bridge Inventory Inspection System		
		TxDOT County Maintenance Sections		
		TxDOT County Maintenance Storage Facility		
		TxDOT County Maintenance Vehicles		
		TxDOT Laredo TMC – STRATIS		
MC08	Work Zone Management	City of Laredo Emergency Communications Center	TxDOT Laredo	Future
		City of Laredo Field Equipment		
		City of Laredo PWD		
		City of Laredo TMC		
		City of Laredo/Webb County EOC		
		City/County Public Safety Dispatch		
		County Road and Bridge		
		DPS Communications Service		
		El Aguila Transit Dispatch		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
MC08 (continued)	Work Zone Management (continued)	El Metro Fixed-Route Transit Dispatch		
		El Metro Paratransit Dispatch		
		Independent School District Dispatch		
		TxDOT Area Construction Vehicles		
		TxDOT Area Office		
		TxDOT County Maintenance Sections		
		TxDOT County Maintenance Vehicles		
		TxDOT Highway Condition Reporting System		
		TxDOT Laredo District Webpage		
		TxDOT Laredo DMS		
		TxDOT Laredo HAR		
		TxDOT Laredo TMC – STRATIS		
		US Border Patrol Dispatch Center		
		US Customs Dispatch Center		
MC09	Work Zone Safety Monitoring	TxDOT Area Construction Vehicles	TxDOT Laredo	Future
		TxDOT Area Office		
		TxDOT County Maintenance Sections		
		TxDOT County Maintenance Vehicles		
		TxDOT Work Zone Field Equipment		
MC10	Maintenance and Construction Activity Coordination	City of Laredo PWD	TxDOT Laredo	Future
		City of Laredo TMC	City of Laredo	Future
		County Road and Bridge		
		El Aguila Transit Dispatch		
		El Metro Fixed-Route Transit Dispatch		
		El Metro Paratransit Dispatch		
		Independent School District Dispatch		
		Other TxDOT Region TMCs		
		Private Sector Traveler Information Services		
		Rail Operations		
		TxDOT Area Office		
		TxDOT County Maintenance Sections		
		TxDOT Highway Condition Reporting System		
		TxDOT Laredo District Webpage		
		TxDOT Laredo TMC – STRATIS		
		TxDOT Tourist Bureau		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
APTS1	Transit Vehicle Tracking	El Metro Fixed-Route Transit Dispatch	El Metro	Future
		El Metro Paratransit Dispatch		
		El Metro Paratransit Vehicles		
		El Metro Transit Vehicles		
APTS2	Transit Fixed-Route Operations	City of Laredo Bridge System	El Metro	Future
		City of Laredo PWD	El Aguila	Future
		City of Laredo TMC	Independent School Districts	Future
		El Aguila Transit Dispatch		
		El Aguila Transit Vehicles		
		El Metro Fixed-Route Transit Dispatch		
		El Metro Transit Vehicles		
		Independent School District Dispatch		
		Independent School District Vehicles		
		Private Sector Traveler Information Services		
		TxDOT Area Office		
		TxDOT Laredo TMC – STRATIS		
APTS3	Demand Response Transit Operations	City of Laredo Bridge System	El Metro	Future
		City of Laredo TMC	El Aguila	Future
		El Aguila Transit Dispatch		
		El Metro Fixed-Route Transit Dispatch		
		El Metro Paratransit Dispatch		
		El Metro Paratransit Vehicles		
		El Metro Transit Vehicles		
		Private Sector Traveler Information Services		
		TxDOT Laredo TMC – STRATIS		
APTS4	Transit Passenger and Fare Management	El Metro Fixed-Route Transit Dispatch	El Metro	Future
		El Metro Kiosks		
		El Metro Transit Vehicles		
		Financial Institutions		
APTS5	Transit Security	City of Laredo Emergency Communications Center	El Metro	Existing
		El Metro Fixed-Route Transit Dispatch		
		El Metro Kiosks		
		El Metro Transit Vehicles		
APTS8	Transit Traveler Information	El Metro Fixed-Route Transit Dispatch	El Metro	Future
		El Metro Kiosks		
		Private Traveler Personal Computing Devices		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
CVO01	Fleet Administration	Commercial Vehicle Operator Systems	Commercial Vehicle Operators	Existing
		Commercial Vehicles		
		Private Sector Traveler Information Services		
		TxDOT Motor Carrier Routing Information		
CVO02	Freight Administration	Commercial Vehicle Operator Systems	Commercial Vehicle Operators	Existing
		Commercial Vehicles		
CVO03	Electronic Clearance	Commercial Vehicle Operator Systems	DPS	Existing
		Commercial Vehicles		
		DPS Electronic Screening Stations		
		DPS License and Weights Division		
		Other States Credentials Administration and Safety Information Exchange		
		TxDOT Credentials Administration and Safety Information Exchange		
CVO04	CV Administrative Processes	City of Laredo Traffic Safety Department	TxDOT	Existing
		Commercial Vehicle Operator Systems	City of Laredo	Existing
		Financial Institutions		
		Other States Credentials Administration and Safety Information Exchange		
		TxDOT Credentials Administration and Safety Information Exchange		
		TxDOT Texas Transportation Commission		
		US Border Patrol Dispatch		
		US Customs Enforcement		
CVO05	International Border Electronic Clearance	Commercial Vehicle Operator Systems	DPS	Existing
		Commercial Vehicles		
		DPS Electronic Screening Stations		
		Other States Credentials Administration and Safety Information Exchange		
		Private Shippers		
		TxDOT Credentials Administration and Safety Information Exchange		
		US Border Patrol		
		US Border Patrol Dispatch Center		
		US Customs Product Manifest System		
CVO06	Weigh-In-Motion	Commercial Vehicles	DPS	Existing
		DPS Electronic Screening Stations		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
CVO07	Roadside CVO Safety	Commercial Vehicle Operator Systems	DPS	Existing
		Commercial Vehicles		
		DPS Communications Service		
		DPS Electronic Screening Stations		
		Other States Credentials Administration and Safety Information Exchange		
		TxDOT Credentials Administration and Safety Information Exchange		
CVO08	On-board CVO Safety	Commercial Vehicle Operator Systems	Commercial Vehicle Operators	Future
		Commercial Vehicles		
		DPS Electronic Screening Stations		
CVO09	CVO Fleet Maintenance	Commercial Vehicle Operator Systems	Commercial Vehicle Operators	Existing
		Commercial Vehicles		
CVO10	HAZMAT Management	City of Laredo Emergency Communications Center	City of Laredo	Future
		Commercial Vehicle Operator Systems	US Border Patrol	Future
		Commercial Vehicles		
		Rail Cars		
		Rail Operations		
		US Border Patrol Dispatch Center		
ATIS1	Broadcast Traveler Information	City of Laredo PWD	TxDOT Laredo	Future
		City of Laredo TMC	City of Laredo	Future
		City of Laredo Webpage		
		National Weather Service		
		Other TxDOT Region TMCs		
		Print and Broadcast Media		
		Private Traveler		
		Rest Areas/Visitor Centers/Service Plaza Kiosks		
		Telco 511 Call Routing		
		TxDOT 511 System		
		TxDOT Area Office		
		TxDOT Highway Condition Reporting System		
		TxDOT Laredo District Webpage		
		TxDOT Laredo TMC – STRATIS		
		TxDOT Tourist Bureau		

Table 5 – Laredo Region Selected Market Packages (continued)

Market Package	Market Package Name	Elements Associated with Market Package	Primary Stakeholders Responsible for Implementation	Status
ATIS5	ISP Based Route Guidance	Commercial Vehicle Operator Systems	TxDOT Motor Carrier Routing	Future
		TxDOT Area Office		
		TxDOT Laredo TMC – STRATIS		
		TxDOT Motor Carrier Routing Information		
AD1	ITS Data Mart	Businesses and Other Private Entities	TxDOT Crash Record Information System	Future
		City of Laredo Bridge System		
		City of Laredo Emergency Communications Center	TxDOT Laredo	Future
		City of Laredo TMC	City of Laredo	Future
		City of Laredo Traffic Archived Data Management System	TAMIU	Existing
		Courtesy Service Patrol Provider		
		DPS Communications Service		
		Rail Operations		
		TAMIU Archive		
		TAMIU Archived Data User System		
		TxDOT Courtesy Service Patrol Archive		
		TxDOT Courtesy Service Patrol Dispatch		
		TxDOT Crash Records Information System		
		TxDOT Laredo Archived Data Management System		
		TxDOT Laredo TMC – STRATIS		
		US Border Patrol Dispatch Center		

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 Laredo Region based on the information gathered from the stakeholders and system inventory. **Figure 5** on the following page summarizes the existing, planned, and future ITS elements for the Laredo Region in the context of a physical interconnect. Subsystems and elements specific to Laredo are called out in the boxes surrounding the main interconnect diagram, and these are color-coded to the subsystem to which they are associated. The rectangles represent the architecture subsystems, and the terminators are represented by the rounded rectangles. Elements with an asterisk (*) are planned and future system elements.

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

Figure 6 is an example of an Advanced Traffic Management System (ATMS) market package for Surface Street Control that has been customized for the Laredo Region. This market package shows the two subsystems, Traffic Management and Roadway, and the associated entities (City of Laredo Street Services TOC and City of Laredo Field Equipment) and equipment packages. The equipment packages are the rectangles inside of the subsystems, and represent the functions that deliver a particular service to support the market package. Data flows between the subsystems and the terminators (Other Roadway) indicate what information is being shared.

Market packages that were customized for the Laredo Region are shown in **Appendix A**. These market packages also are included on the Laredo 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 Laredo 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.
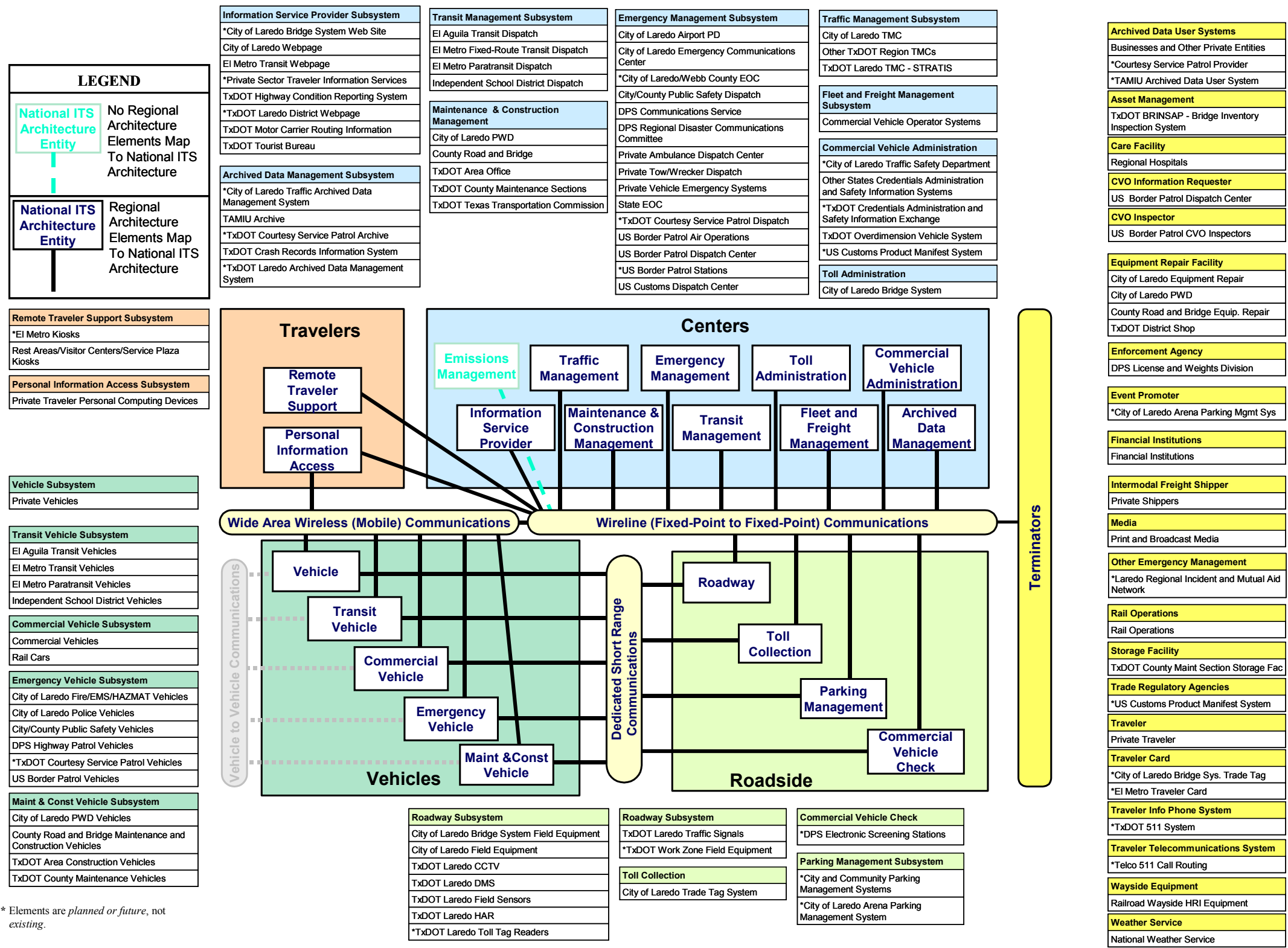
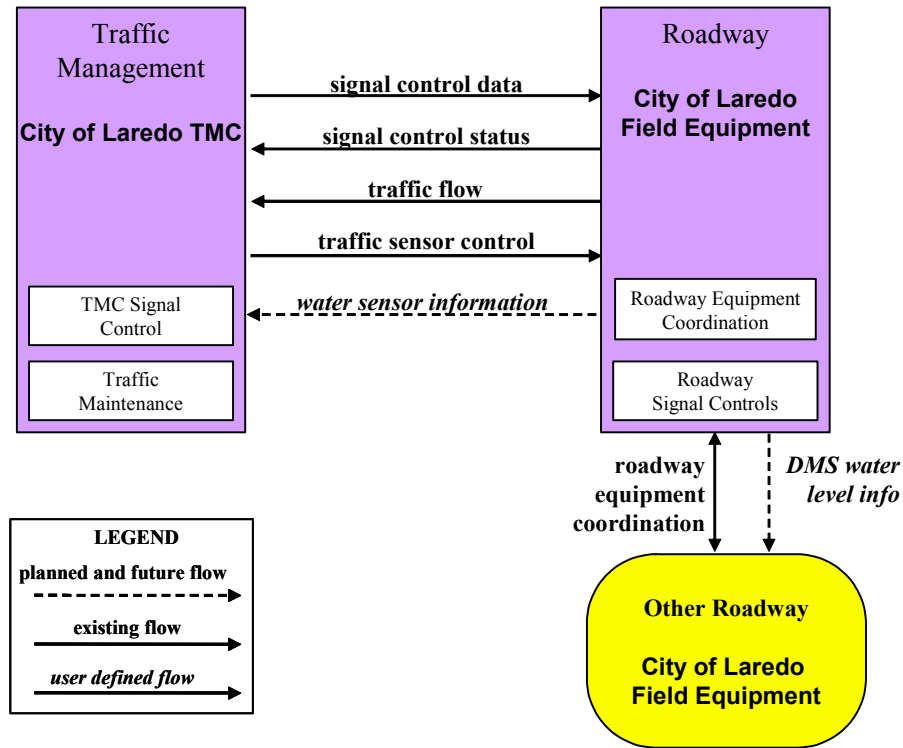## Figure 5 – Laredo Regional System Interconnect Diagram

Information Service Provider Subsystem
- *City of Laredo Bridge System Web Site
- City of Laredo Webpage
- El Metro Transit Webpage
- *Private Sector Traveler Information Services
- TxDOT Highway Condition Reporting System
- *TxDOT Laredo District Webpage
- TxDOT Motor Carrier Routing Information
- TxDOT Tourist Bureau

Archived Data Management Subsystem
- *City of Laredo Traffic Archived Data Management System
- TAMIU Archive
- *TxDOT Courtesy Service Patrol Archive
- TxDOT Crash Records Information System
- *TxDOT Laredo Archived Data Management System

Transit Management Subsystem
- El Aguila Transit Dispatch
- El Metro Fixed-Route Transit Dispatch
- El Metro Paratransit Dispatch
- Independent School District Dispatch

Maintenance & Construction Management
- City of Laredo PWD
- County Road and Bridge
- TxDOT Area Office
- TxDOT County Maintenance Sections
- TxDOT Texas Transportation Commission

Emergency Management Subsystem
- City of Laredo Airport PD
- City of Laredo Emergency Communications Center
- *City of Laredo/Webb County EOC
- City/County Public Safety Dispatch
- DPS Communications Service
- DPS Regional Disaster Communications Committee
- Private Ambulance Dispatch Center
- Private Tow/Wrecker Dispatch
- Private Vehicle Emergency Systems
- State EOC
- *TxDOT Courtesy Service Patrol Dispatch
- US Border Patrol Air Operations
- US Border Patrol Dispatch Center
- *US Border Patrol Stations
- US Customs Dispatch Center

Traffic Management Subsystem
- City of Laredo TMC
- Other TxDOT Region TMCs
- TxDOT Laredo TMC - STRATIS

Fleet and Freight Management Subsystem
- Commercial Vehicle Operator Systems

Commercial Vehicle Administration
- *City of Laredo Traffic Safety Department
- Other States Credentials Administration and Safety Information Systems
- *TxDOT Credentials Administration and Safety Information Exchange
- TxDOT Overdimension Vehicle System
- *US Customs Product Manifest System

Toll Administration
- City of Laredo Bridge System

LEGEND

National ITS Architecture Entity (green)	No Regional Architecture Elements Map To National ITS Architecture
National ITS Architecture Entity (blue)	Regional Architecture Elements Map To National ITS Architecture

Remote Traveler Support Subsystem
- *El Metro Kiosks
- Rest Areas/Visitor Centers/Service Plaza Kiosks

Personal Information Access Subsystem
- Private Traveler Personal Computing Devices

Vehicle Subsystem
- Private Vehicles

Transit Vehicle Subsystem
- El Aguila Transit Vehicles
- El Metro Transit Vehicles
- El Metro Paratransit Vehicles
- Independent School District Vehicles

Commercial Vehicle Subsystem
- Commercial Vehicles
- Rail Cars

Emergency Vehicle Subsystem
- City of Laredo Fire/EMS/HAZMAT Vehicles
- City of Laredo Police Vehicles
- City/County Public Safety Vehicles
- DPS Highway Patrol Vehicles
- *TxDOT Courtesy Service Patrol Vehicles
- US Border Patrol Vehicles

Maint & Const Vehicle Subsystem
- City of Laredo PWD Vehicles
- County Road and Bridge Maintenance and Construction Vehicles
- TxDOT Area Construction Vehicles
- TxDOT County Maintenance Vehicles

Elements are planned or future, not existing.

Roadway Subsystem
- City of Laredo Bridge System Field Equipment
- City of Laredo Field Equipment
- TxDOT Laredo CCTV
- TxDOT Laredo DMS
- TxDOT Laredo Field Sensors
- TxDOT Laredo HAR
- *TxDOT Laredo Toll Tag Readers

Roadway Subsystem
- TxDOT Laredo Traffic Signals
- *TxDOT Work Zone Field Equipment

Toll Collection
- City of Laredo Trade Tag System

Commercial Vehicle Check
- *DPS Electronic Screening Stations

Parking Management Subsystem
- *City and Community Parking Management Systems
- *City of Laredo Arena Parking Management System

Travelers
- Remote Traveler Support
- Personal Information Access

Centers
- Emissions Management
- Traffic Management
- Emergency Management
- Toll Administration
- Commercial Vehicle Administration
- Information Service Provider
- Maintenance & Construction Management
- Transit Management
- Fleet and Freight Management
- Archived Data Management

Vehicles
- Vehicle
- Transit Vehicle
- Commercial Vehicle
- Emergency Vehicle
- Maint &Const Vehicle

Roadside
- Roadway
- Toll Collection
- Parking Management
- Commercial Vehicle Check

Wide Area Wireless (Mobile) Communications

Wireline (Fixed-Point to Fixed-Point) Communications

Dedicated Short Range Communications

Vehicle to Vehicle Communications

Terminators

Archived Data User Systems
- Businesses and Other Private Entities
- *Courtesy Service Patrol Provider
- *TAMIU Archived Data User System

Asset Management
- TxDOT BRINSAP - Bridge Inventory Inspection System

Care Facility
- Regional Hospitals

CVO Information Requester
- US Border Patrol Dispatch Center

CVO Inspector
- US Border Patrol CVO Inspectors

Equipment Repair Facility
- City of Laredo Equipment Repair
- City of Laredo PWD
- County Road and Bridge Equip. Repair
- TxDOT District Shop

Enforcement Agency
- DPS License and Weights Division

Event Promoter
- *City of Laredo Arena Parking Mgmt Sys

Financial Institutions
- Financial Institutions

Intermodal Freight Shipper
- Private Shippers

Media
- Print and Broadcast Media

Other Emergency Management
- *Laredo Regional Incident and Mutual Aid Network

Rail Operations
- Rail Operations

Storage Facility
- TxDOT County Maint Section Storage Fac

Trade Regulatory Agencies
- *US Customs Product Manifest System

Traveler
- Private Traveler

Traveler Card
- *City of Laredo Bridge Sys. Trade Tag
- *El Metro Traveler Card

Traveler Info Phone System
- *TxDOT 511 System

Traveler Telecommunications System
- *Telco 511 Call Routing

Wayside Equipment
- Railroad Wayside HRI Equipment

Weather Service
- National Weather Service

Kimley-Horn and Associates, Inc.

ConSysTec Corp

Laredo

Figure 6 – Custom Market Package for Laredo Surface Street Control

4.3.3   Laredo 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 Laredo Region. The interconnect diagram shown previously in **Figure 5** showed the high-level relationships of the subsystems and terminators in the Laredo 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 103 different elements identified as part of the Laredo Regional ITS Architecture. These elements include local and state traffic operations centers, transit vehicles, dispatch systems, emergency management agencies, media outlets, and others – essentially, all of the existing and planned physical components that contribute to the regional intelligent transportation system. Interfaces have been identified for each element in the Laredo Regional ITS Architecture, and each element has been mapped to those other elements with which it must interface. For example, the City of Laredo TMC has existing or planned interfaces with 38 other elements in the Laredo Region, ranging from field equipment and dispatch centers, to transit and Border Patrol. Other interfaces are far less complex, such as the interface between the City of Laredo police vehicles and the City of Laredo Emergency Communications Center.

An example of one of the system interfaces is shown in **Figure 7** on the following page. This graphic shows the TxDOT Laredo 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 Laredo 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 Laredo Regional ITS Architecture.

An example of the architecture flows between two elements is shown in **Figure 8**. In this interface, the flows between the City of Laredo TMC and the City's Field Equipment show information that must go from the TMC to the field equipment, 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 Laredo 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 Laredo Region are discussed in more detail in Section 4.5.
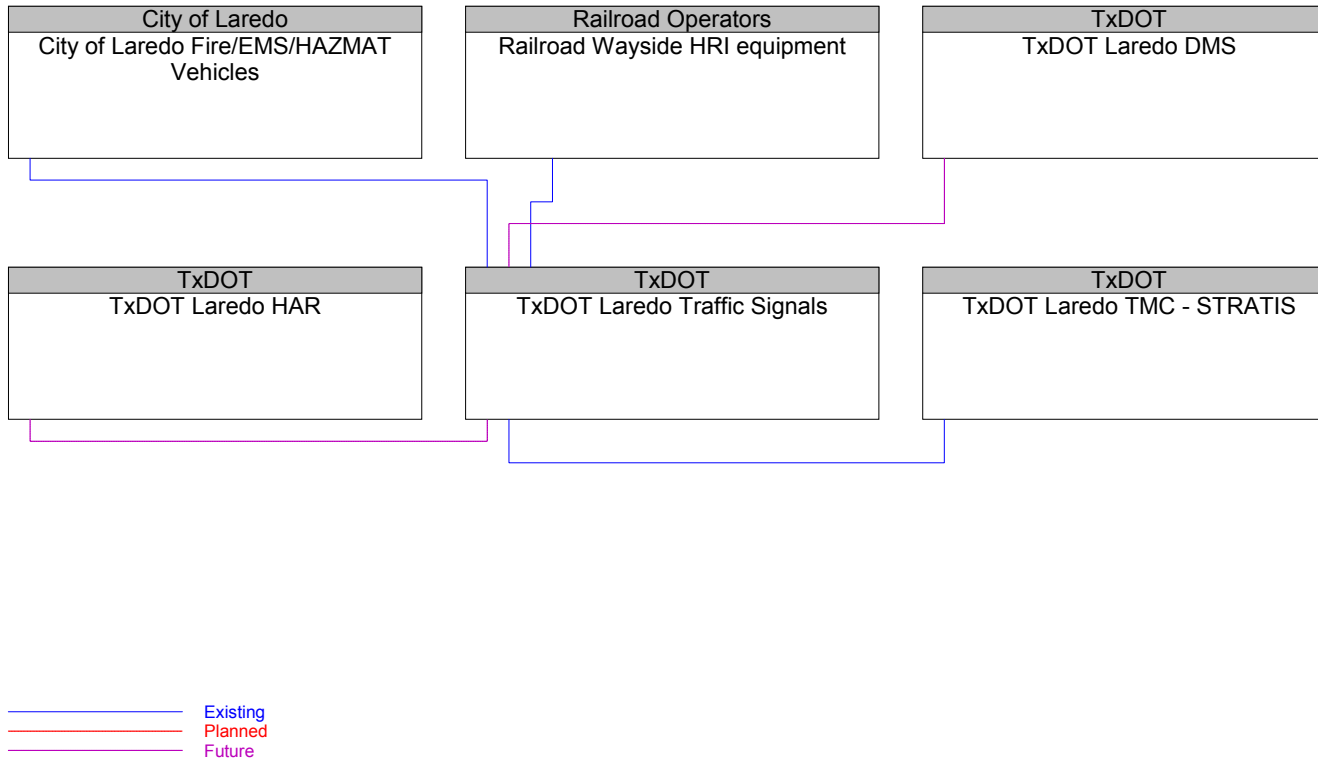
City of Laredo	Railroad Operators	TxDOT
City of Laredo Fire/EMS/HAZMAT Vehicles	Railroad Wayside HRI equipment	TxDOT Laredo DMS

TxDOT	TxDOT	TxDOT
TxDOT Laredo HAR	TxDOT Laredo Traffic Signals	TxDOT Laredo TMC - STRATIS

Existing
Planned
Future

Figure 7 – TxDOT Laredo Traffic Signals Interfaces
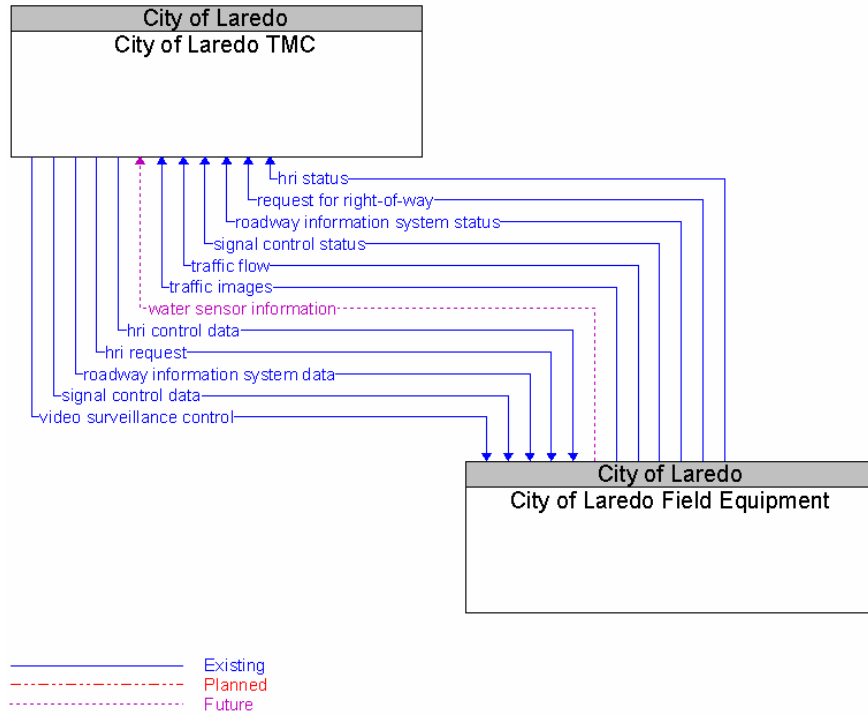
Figure 8 – Laredo TMC to Field Equipment Architecture Flows

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 Laredo 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 Laredo Regional ITS Architecture, functional requirements have been identified at two levels. The customized market packages, included 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 Laredo has to do and the data that needs to be shared among elements.

At a more detailed level, functional requirements for the Laredo Region also are described in terms of equipment packages that are associated with one or more subsystems in the Laredo Regional ITS Architecture as shown in **Table 6**. As described in Section 4.3.2, an equipment package is a functional capability that may be deployed at a specific time. Each equipment package can be linked in the National ITS Architecture to the Process Specifications that may be applicable. It is recommended that during the design concept stage of a project, the applicable

equipment package and associated Process Specifications from the National ITS Architecture be reviewed by the implementer to determine the appropriate functional requirements for the project. A link for each equipment package is available on the Laredo Regional ITS Architecture web site by clicking on the "Functions" button.

Table 6 – Laredo Region Equipment Packages

Subsystem	Equipment Package
Subsystem	Equipment Package
Archived Data Management Subsystem	Government Reporting Systems Support
	ITS Data Repository
	Traffic and Roadside Data Archival
Commercial Vehicle Administration Subsystem	Credentials and Taxes Administration
	CV Information Exchange
	CV Safety Administration
	International CV Administration
Commercial Vehicle Check Subsystem	Citation and Accident Electronic Recording
	International Border Crossing
	Roadside Electronic Screening
	Roadside Safety Inspection
	Roadside WIM
Commercial Vehicle Subsystem	On-board Cargo Monitoring
	On-board CV Electronic Data
	On-board CV Safety
	On-board Trip Monitoring
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 Incident Management Communication
Fleet and Freight Management Subsystem	Fleet Administration
	Fleet Credentials and Taxes Management and Reporting
	Fleet HAZMAT Management
	Fleet Maintenance Management
	Freight Administration and Management

Table 6 – Laredo Region Equipment Packages (continued)

Subsystem	Equipment Package
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 Data Collection
	MCM Incident Management
	MCM Maintenance Decision Support
	MCM Roadway Maintenance and Construction
	MCM Vehicle and Equipment Maintenance Management
	MCM Vehicle Tracking
	MCM Work Activity Coordination
	MCM Work Zone Management
	MCM Work Zone Safety Management
Maintenance and Construction Vehicle Subsystem	MCV Infrastructure Monitoring
	MCV Roadway Maintenance and Construction
	MCV Vehicle Location Tracking
	MCV Vehicle Safety Monitoring
	MCV Vehicle System Monitoring and Diagnostics
	MCV Work Zone Support
Parking Management Subsystem	Parking Coordination
	Parking Electronic Payment
	Parking Management
	Parking Surveillance
Personal Information Access Subsystem	Personal Interactive Information Reception
Remote Traveler Support Subsystem	Remote Basic Information Reception
	Remote Mayday I/F
	Remote Transit Fare Management
	Remote Transit Information Services
	Secure Area Monitoring
Roadway Subsystem	Roadside Signal Priority
	Roadway Basic Surveillance
	Roadway Equipment Coordination
	Roadway Freeway Control
	Roadway Incident Detection
	Roadway Probe Beacons
	Roadway Signal Controls
	Roadway Traffic Information Dissemination

Table 6 – Laredo Region Equipment Packages (continued)

Subsystem	Equipment Package
Roadway Subsystem (continued)	Roadway Work Zone Safety
	Roadway Work Zone Traffic Control
	Standard Rail Crossing
Toll Administration Subsystem	Toll Administration
	Toll Data Collection
Toll Collection Subsystem	Toll Plaza Toll Collection
Traffic Management Subsystem	Collect Traffic Surveillance
	HRI Traffic Management
	Rail Operations Coordination
	TMC Freeway Management
	TMC Incident Detection
	TMC Incident Dispatch Coordination/Communication
	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 Garage Operations
Transit Vehicle Subsystem	On-board Fixed Route Schedule Management
	On-board Paratransit Operations
	On-board Transit Fare and Load Management
	On-board Transit Security
	On-board Transit Trip Monitoring
Vehicle Subsystem	Vehicle Location Determination
	Vehicle Mayday I/F
	Vehicle Probe Support
	Vehicle Toll/Parking Interface

4.5 Standards

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

Table 7 – Applicable ITS Standards for the Laredo Region

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

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

SDO	Document ID	Title	Type
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 DD 17.54.00.2	ADMS Data Dictionary Specifications	Data
	ASTM PS 105-99	Specification for Dedicated Short Range Communication (DSRC) Data Link Layer: Medium Access and Logical Link Control	Communication
	ASTM PS 111-98	Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz	Communication
EIA/CEA	CEA/EIA-794	Data Radio Channel (DARC) System	Communication
	CEA/EIA-795	Subcarrier Traffic Information Channel (STIC) System	Communication
IEEE	IEEE P1512.1	Standard for Traffic Incident Management Message Sets for Use by EMCs	Message
	IEEE P1512.2	Standard for Public Safety Incident Management Message Sets (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
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

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

SDO	Document ID	Title	Type
SAE	SAE J1746	ISP-Vehicle Location Referencing Standard	Data
	SAE J2313	On-Board Land Vehicle Mayday Reporting Interface	Message
	SAE J2353	Data Dictionary for Advanced Travel 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 archive the final Regional ITS Architecture build out will occur over many years.

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

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

- Network Surveillance;
- Surface Street Control;
- Freeway Control;
- Transit Vehicle Tracking;
- Broadcast Traveler Information; and
- ITS Data Mart.

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

5. OPERATIONAL CONCEPT

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

In **Appendix C**, a copy of an existing agreement between agencies in the Laredo Region has been included. Additional agreements between agencies might need to be developed for operations of new systems as they are incorporated. Potential agreements that may need to be developed are identified as part of the operational concept.

5.1 Operational Scenarios

Scenario 1

In this operational scenario, it is spring and the recent stormy weather has alerted people that it is tornado season again. A tornado rips through a section of Webb completely destroying the local hospital and some neighboring residential areas. The local Webb County Sheriff Deputies alert the Duval County Sheriff's office and the neighboring La Salle County Sheriff's office that the tornado has struck and that there is considerable damage in the area. The Duval County Sheriff arrives at the location of the damage and begins to assess resources that are needed. TxDOT is notified by the Sheriff's Office to send staff and equipment to the area to help clear US 59 that runs through the damaged area. The TxDOT Laredo TMC coordinates the clean up efforts on the state routes and also updates travelers of road closures through the use of DMS and the TxDOT website.

The Duval County Sheriff Dispatcher places a call to the local EOC requesting additional help. The EOC sends an automated request to other local EOCs for additional resources, such as ambulances and medical teams to assist in moving the patients from the hospital to other facilities in the Region.

Fires begin to break out in the damaged area that are more than the local fire department can handle. The local EOC sends a request for additional fire vehicles. The Laredo Fire Department, which had been put on alert by the Laredo EOC, dispatches several fire trucks to the scene. Because all fire vehicles are equipped with automatic vehicle location (AVL), the nearest vehicles to Webb County with the appropriate equipment are quickly identified and dispatched. An automated alert is also sent from the local EOC to the Statewide EOC to notify them of the potential need for additional resources on a statewide basis. Throughout the emergency, the local incident command center that has been set up in Webb is able to coordinate with the Sheriff's Office, TxDOT, EOCs, and fire vehicles through a common radio frequency.

Scenario 2

In the second scenario, a multi-vehicle crash has occurred on I-35 northbound just as the afternoon rush hour is about to begin. Motorists call 911 from cell phones and reach the TxDPS dispatch, which is now informed of the crash. An alert is automatically sent from TxDPS to the City of Laredo TMC and the TxDOT Laredo District TMC. TxDOT activates DMS and monitors the situation with a CCTV camera that is near the accident. The City of Laredo Fire Department uses the video feed from TxDOT to determine the severity of the accident and the number and type of fire and rescue vehicles to dispatch. Using AVL on the fire vehicles, those vehicles that are closest to the scene with the appropriate equipment are dispatched. The Doctor's Hospital of Laredo is also put on alert through an automated message from TxDPS so that they are aware of the possible incoming casualties.

I-35 northbound is completely closed and the City of Laredo police begin setting up a closure and detour. The City of Laredo uses its closed loop signal system to implement a timing plan on alternate routes along the arterials to accommodate the large increases in traffic volume.

TxDOT enters the closure on the Highway Condition Reporting System, which also feeds the statewide 511 traveler information number. DMS and HAR continue to warn motorist that I-35 Northbound is closed. The CCTV camera feed, which has been turned away from the crash to focus on the traffic condition on the freeway, is shared with the media which broadcasts the live shots of I-35 on the evening news to warn motorist that I-35 northbound is still closed.

Scenario 3

The third operational scenario describes how the integrated elements of the Laredo Region's ITS program will function together in the event of a major incident caused by a turned-over truck that has spilled flammable chemicals on I-35 approaching Bridge II (Lincoln/Juarez Bridge). This commercial vehicle was on its way to Mexico and is blocking all the lanes towards the bridge. A Bridge Coordination System (BCS) has been implemented to optimize the flow of traffic at border crossings. The BCS includes CVISN, detectors, decision support system (software), DMS, and trailblazer signs. The congestion caused by this incident is identified by the BCS detector system and a flag is sent to the center that manages the BCS. The conditions are verified using a CCTV camera. Automatic notifications including incident location and a description of the nature of the incident are sent from the center to TxDPS, Laredo Fire Department, the Laredo Emergency Operations Center, City of Laredo TMC, TxDOT Laredo District TMC, and the media. In addition, HAZMAT is informed of the spill and a response plan is initiated according to the nature of the incident and the type of HAZMAT material.

Simultaneously, the BCS is used to manage traffic flow from the United States to Mexico. Messages are sent to the BCS DMS informing commercial vehicles and motorists of the closure conditions ahead. All border crossing traffic is directed towards Bridge I (Gateway to the Americas) using DMS and trailblazer signs located on access roads to the bridges.

At the scene, TxDPS has placed barricades isolating the area affected by the spill. All access roads to Bridge II have been closed by TxDPS. An emergency vehicle is taking the injured truck driver to the Mercy Health Center. An emergency routing system is in place that supports automated vehicle location and dynamic routing of emergency vehicles. Coordination between the emergency vehicle and the TMC is established in order to collect detailed road network conditions and request special priority on the selected route(s). Information is exchanged between Mercy Health Center and the emergency vehicle in order to establish the conditions of the patient and have the personnel and equipment ready to assist him/her.

Meanwhile the incident has been cleared. The truck has been removed from the road and the spill was cleaned by HAZMAT. Bridge II is open to traffic and the BCS starts the process to balance the flow of traffic to both Bridges. Data provided by the detectors at both bridges is used by the Decision Support System software to estimate the queue time at every bridge. This information is sent to DMS located at strategic locations so drivers can decide which bridge to use to cross the border. This information is updated every minute in order to maintain a balanced flow of vehicles to the bridges. After two hours, conditions are back to normal.

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 Laredo Region. During any operational scenario, a number of agencies will be required to coordinate closely to perform their operational responsibilities. The key agencies that have a lead role or responsibility during operations are listed below for each ITS area. It is recognized that a number of other agencies will also need to be involved during a scenario in addition to the ones listed below, although it is not expected that these agencies will play as critical a role in operations.

Travel and Traffic Management

- City of Laredo (TMC, Bridge, Emergency Communications Center)
- County Road and Bridge
- Other Texas Department of Transportation Districts
- Texas Department of Public Safety
- Texas Department of Transportation
- U.S. Border Patrol
- U.S. Customs

Public Transportation Management

- Independent School Districts
- El Metro
- El Aguila

Commercial Vehicle Operations

- Texas Department of Public Safety
- Texas Department of Transportation
- U.S. Border Patrol
- U.S. Customs

Emergency Management

- City of Laredo (Police, Fire, Emergency Communications Center)
- City/County EOCs
- Regional Hospitals
- Texas Department of Public Safety

- Texas Department of Transportation
- U.S. Border Patrol
- U.S. Customs

Advanced Vehicle Safety System Needs

- Not Applicable

Information Management

- City of Laredo
- Texas Department of Transportation
- Texas A&M International University

Maintenance and Construction Operations

- City of Laredo (Public Works Department)
- County Road and Bridge
- Texas Department of Transportation

5.3   Laredo Agreements

The Regional ITS Architecture for the Laredo 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 Laredo 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 several formal agreements in place in the Laredo Region. 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 existing and potential agreements for the Laredo 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. One existing agreement for sharing of ITS software and data between TxDOT and the City of Laredo has been included in **Appendix C**.

Table 8 – Potential Agreements for the Laredo Region

Agreement and Agencies	Status	Agreement Description	Considerations
Signal Agreements TxDOT and City of Laredo	Existing	TxDOT and the City of Laredo have an existing agreement whereby TxDOT reimburses the City for maintaining the traffic signals at freeway interchanges.	This agreement covers interchange signals only, and is only with the City of Laredo.
Data Sharing and Usage (Public) TxDOT Laredo and Public Agencies within the Region	Future	This agreement would define the parameters, guidelines, and policies for inter- and intra-agency ITS data sharing. This data sharing would support regional activities related to traffic management, incident management, and traveler information, and other functions. The terms of this agreement should generally address such items as: ▪ Types of data and information to be shared ▪ Repository for information (i.e., TxDOT Laredo TMC as central hub) ▪ How the information will be used (traffic incident management, displayed on web site for travel information, distributed to private media, etc.) ▪ Parameters for data format, quality, security	These agreements are typically zero-dollar agreements, in that there is no charge among agencies for the actual data, although there might be some cost incurred for infrastructure, systems or fiber to enable communications between agencies.
Data Sharing and Usage (Public-Private) TxDOT Laredo and Private Media/Information Service Providers	Future	This agreement would define the parameters, guidelines and policies for private media use of regional ITS-related information from TxDOT Laredo. 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).	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.

Table 8 – Potential Agreements for the Laredo Region (continued)

Agreement and Agencies	Status	Agreement Description	Considerations
Shared Video Monitoring (Public) TxDOT, City of Laredo	Existing	TxDOT has an agreement with the City of Laredo Traffic and City of Laredo Police to allow shared video monitoring of TxDOT CCTV cameras in the Laredo Region for incident management purposes. This agreement defines the parameters and policies for these agencies to access video images from TxDOT's CCTV cameras.	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.
Mutual Aid Agreements (Public) TxDPS, TxDOT, Laredo Police, Laredo Fire	Existing (Informal)	Mutual aid agreements currently exist as informal arrangements in the Laredo, 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.	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.).
Joint Operations/Shared Control Agreements (Public) TxDOT, City of Laredo, TxDPS (potential)	Existing/ Future	These agreements are formal arrangements to allow joint operations or control of certain systems and equipment. TxDOT currently has such an agreement with the City of Laredo for shared use of the Advanced Traffic Management Software, DMS software, and CCTV camera access and control. These types of agreements need to define the terms of this arrangement, such as hours of operation and time of day/time of week where shared control would take effect, circumstances or incidents where shared control would take effect, notification procedures between the agencies agreeing to shared control arrangements, etc. Additional agencies (such as TxDPS) could be part of a joint operations/shared control agreement for certain types of devices.	Joint operations/shared control agreements could consider some form of mutual funding for certain system elements, primarily communication links.