



El Paso Regional ITS Architecture Report

Prepared for the El Paso Region through TxDOT's
Transportation Systems Management and
Operations (TSMO) Contract

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Part I: Executive Summary: The El Paso Regional Intelligent Transportation Systems (ITS) Architecture

1. Introduction

The El Paso Regional Intelligent Transportation Systems (ITS) Architecture is a roadmap for the deployment and integration of ITS technologies in the Texas Department of Transportation (TxDOT) El Paso District and within the El Paso Metropolitan Planning Organization (MPO) boundaries for the next twenty years.

The El Paso region, defined as the region in this Architecture, geographically covers the six Texas counties in the TxDOT El Paso District (El Paso, Hudspeth, Culberson, Jeff Davis, Presidio, and Brewster), and the El Paso MPO boundary that covers portions of neighboring counties in New Mexico (Doña Ana and Otero counties).

The El Paso Regional ITS Architecture provides a framework for institutional agreements and technical integration of ITS implementation projects in the region. It describes the “big picture” for ITS deployment in terms of individual ITS components that will perform the functions necessary to deliver the desired needs. It supports effective and efficient deployment of transportation and ITS projects that address the transportation problems and needs in the region.

2. Purpose

The purpose of the El Paso Regional ITS Architecture is to illustrate and document the integration of regional ITS systems to allow planning and deployment to occur in an organized and coordinated process. The Architecture helps guide the planning, implementation, and integration of ITS devices deployed and managed by multiple types of agencies that provide transportation services within the region.

The Architecture helps to accomplish the following objectives for ITS deployment in the region:

- Facilitate stakeholder coordination in ITS planning, deployment and operations;
- Reflect the current state of ITS planning and deployment within a region;
- Provide high-level planning for enhancing regional transportation systems using current and future ITS technologies; and
- Conform with the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) and Federal Highway Administration (FHWA) Final Rule 940 and Federal Transit Administration (FTA) Final Policy on ITS Architecture and Standards.

3. El Paso Regional ITS Architecture

The El Paso Regional ITS Architecture describes coordination of overall system operations by defining interfaces between equipment and systems which have been or will be deployed by different organizational or operating agencies in the region. The Architecture identifies the current ITS deployment and how these systems interact and integrate with each other. It also builds on the existing systems and addresses the additional components deemed necessary to grow the ITS systems in the region over the next 20 years to accommodate specific needs and issues of participating stakeholders.

A high-level interconnect diagram for the El Paso Regional ITS Architectures, also referred to as a subsystem diagram as shown below, illustrates the architecture subsystems and primary types of interconnections (or communications) between these subsystems. The diagram was customized to reflect the systems of the El Paso Regional ITS Architecture. The areas with clear text indicate the functions and services that currently exist as well as are desired in the region. Areas without clear text indicate other possible functions and services that do not exist and are not planned for the region.

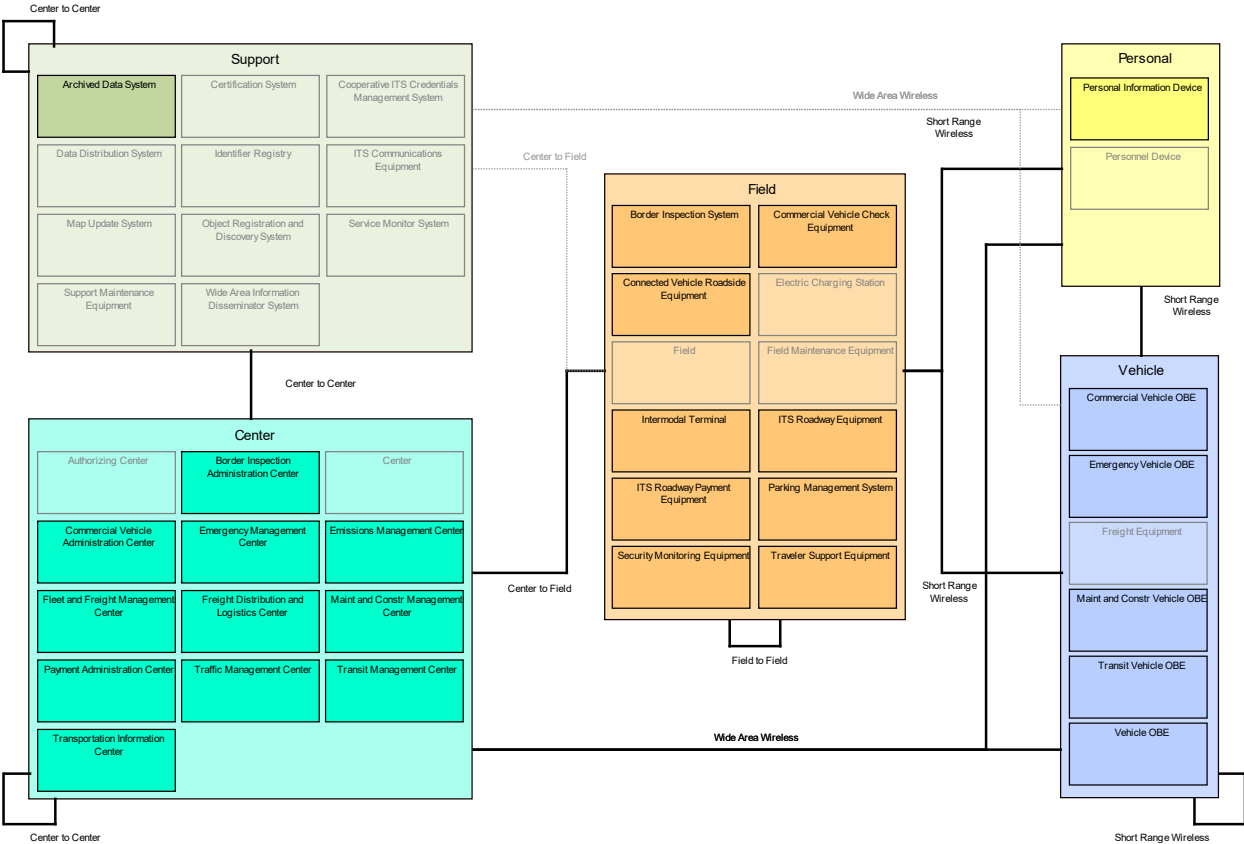


Figure 1. High-Level Interconnect or Subsystem Diagram

4. Applicable ITS Standards

ITS Standards are fundamental to the establishment of an open ITS environment that achieves the goals originally envisioned by the United States Department of Transportation (USDOT). Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances and new approaches evolve. Standards can be thought of as the glue that holds the various pieces of architecture together. They define how the communications within an ITS environment take place.

While the El Paso Regional ITS Architecture includes various ITS applications, it does not cover every conceivable ITS technology. As such, not all ITS standards will be applicable to the existing ITS component and future deployment. Forty-nine (49) ITS standards were identified as standards supporting the ITS projects in the region.

It is important that stakeholders are aware of the importance of ITS standards, especially with respect to cost, risk, and interoperability issues both within the region and when connecting with other ITS architecture regions. These standards can save money in the long run, and make sure that various devices and systems “play well together”.

5. Recommended ITS Projects and Implementation Sequencing

The El Paso Regional ITS Architecture identifies a list of ITS projects for considering and recommends a sequence in which those projects may be implemented. The project implementation sequence is based on a combination of two factors:

- Prioritization of projects based on existing conditions and stakeholder needs. ITS projects were prioritized to reflect a deployment path (sequence) of stakeholder needs. As technology, funding opportunities and requirements continue to evolve, it is expected that stakeholders will reevaluate and reprioritize projects periodically.
- Project dependencies based on how successive ITS projects can build upon one another. Project dependencies influence the project sequencing. It is beneficial to identify the information and functional dependencies between projects.

6. Documentation of ITS Architecture

The El Paso Regional ITS Architecture is documented in three forms. The first is this report which provides more detailed, technical-oriented information regarding various aspects of the Architecture. The second form is an Architecture website that provides detailed architecture outputs in an organized web environment. The third form is the Architecture database that is prepared using the Regional Architecture Development for Intelligent Transportation (RAD-IT) software, which is developed by FHWA for developing ITS architectures. The details of the El Paso Regional ITS Architecture, including definitions of stakeholders, ITS inventory, projects, stakeholder roles and responsibilities, ITS services, interfaces among ITS systems, functional requirements, standards and agreements, are captured in the RAD-IT database and the Architecture website.

7. Architecture Maintenance

By its nature, an ITS architecture is not a static set of outputs. The El Paso Regional ITS Architecture is a living document and should be modified as plans and priorities change, ITS projects are implemented, and ITS needs and services evolve in the region. An architecture maintenance plan is developed to address the needs for maintenance and updates.

The El Paso MPO, in collaboration with the TXDOT El Paso District, will be responsible for housing and maintaining the ITS Architecture. The general steps for architecture maintenance are:

- Stakeholders identify changes, notify the El Paso MPO of changes and submit it to the El Paso MPO.
- The El Paso MPO reviews the proposed changes, offers comments, and/or asks for additional information.
- The El Paso MPO, in coordination with the appropriate stakeholders affected by the proposed changes, evaluates the changes and determines what impact they may have on the Architecture and/or associated documentation.
- Upon its evaluation, the El Paso MPO makes a decision to accept the change, reject it, or ask for additional information.

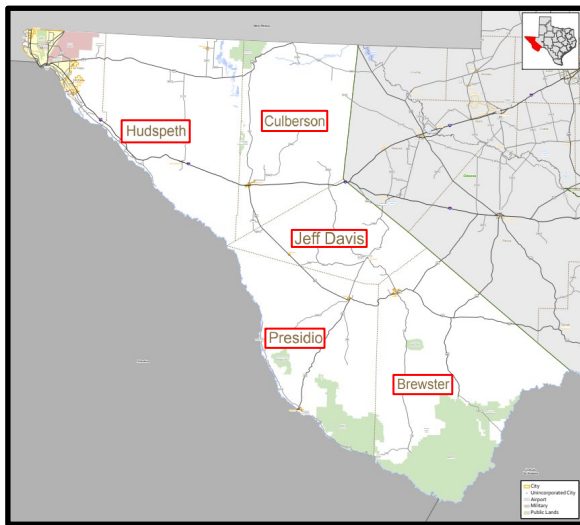
- If the decision is to accept the change, then the appropriate portions of the architecture baseline are updated by a designated member of the El Paso MPO.
- Once the ITS Architecture has been modified, the El Paso MPO publishes the updated architecture documentation, database and website.
- The El Paso MPO also notifies all stakeholders of architecture updates and provides information on how to obtain the latest version of the Architecture.

Part II: Technical Report

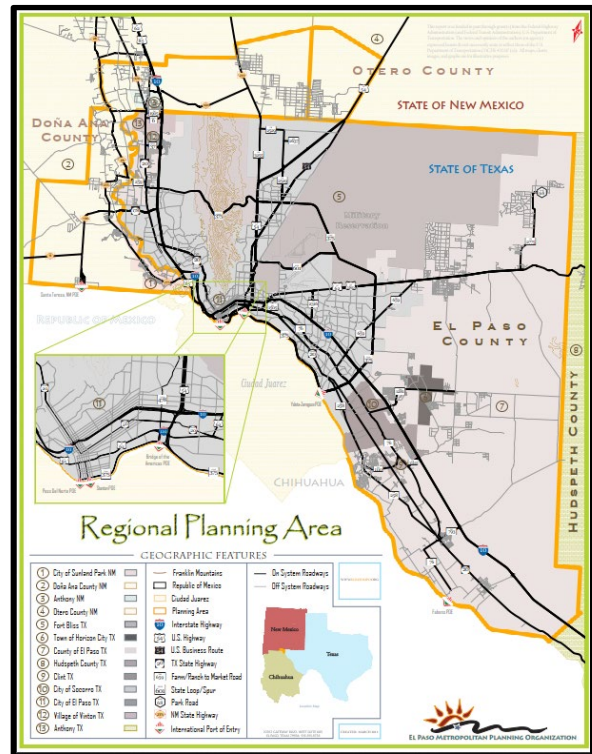
1. Regional ITS Architecture Overview

An Intelligent Transportation System (ITS) architecture describes the “big picture” for ITS deployment in terms of individual components (i.e. subsystems) that will perform the functions necessary to deliver the desired needs. It describes what is to be deployed but not how those systems are to be deployed. An ITS architecture defines the components and subsystems that must interface with each other, the functions to be performed by those subsystems and the data flows among these subsystems.

The region covered by the El Paso Regional ITS Architecture is illustrated in **Figure 2**. The region covers the six Texas counties in the TxDOT El Paso District (El Paso, Hudspeth, Culberson, Jeff Davis, Presidio, and Brewster) and the El Paso MPO Regional Planning Area that covers El Paso County and portions of neighboring counties in New Mexico (Doña Ana and Otero counties), encompassing local, regional and state transportation agencies and transportation stakeholders.



TxDOT El Paso District



El Paso MPO Regional Planning Area (Source: El Paso MPO)

Figure 2. El Paso Regional ITS Architecture Boundary

The Architecture is a roadmap for the deployment and integration of transportation systems in the region over the next 20 years. It was developed based on ARC-IT Version 8.3 and using the Regional Architecture Development for Intelligent Transportation (RAD-IT) software Version 8.3. The architecture has been developed through a cooperative effort by the transportation, transit, law enforcement, emergency management, commercial vehicle and freight management agencies. It represents a shared vision of how each agency’s systems work together by sharing information and resources to enhance transportation safety,

efficiency, capacity, mobility, reliability, and security. The collaboration and information sharing among transportation stakeholders in the region helps illustrate integration options and gain consensus on systematic and cost-effective implementation of ITS technologies and systems in the region. It should also be noted that the El Paso Regional ITS Architecture is a living document and will evolve as needs, technology, stakeholders, and funding streams change.

1.1 Purpose of a Regional ITS Architecture

The purpose of the El Paso Regional ITS Architecture is to illustrate and document the integration of regional ITS systems to allow planning and deployment to occur in an organized and coordinated process. The Architecture helps guide the planning, implementation, and integration of ITS devices deployed and managed by multiple types of agencies that provide transportation services within the region. More specifically, the Architecture helps to accomplish the following objectives for ITS deployment in the region:

- Facilitate stakeholder coordination in ITS planning, deployment and operations;
- Reflect the current state of ITS planning and deployment within a region;
- Provide high-level planning for enhancing regional transportation systems using current and future ITS technologies; and
- Conform with ARC-IT and the Federal Highway Administration (FHWA) Final Rule 940 and Federal Transit Administration (FTA) Final Policy on ITS Architecture and Standards.

The Final Rule and the Final Policy provide policies and procedures for implementing Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21), pertaining to conformance with ARC-IT and Standards. The Final Rule and the Final Policy ensure that ITS projects carried out using funds from the Highway Trust Fund including the Mass Transit Account conform to ARC-IT and applicable ITS standards.

The ARC-IT is a tool to guide the development of regional ITS architectures. It is a common framework that guides agencies in establishing ITS interoperability and helps them choose the most appropriate strategies for processing transportation information, implementing and integrating ITS components and systems, and improving operations. The El Paso Regional ITS Architecture is a specific application of the framework specified in the ARC-IT, tailored to the needs of the transportation stakeholders in the El Paso region.

1.2 Architecture Development Process

The process used to develop the El Paso Regional ITS Architecture is illustrated in **Figure 3**. This figure shows six general steps in the “life-cycle” of an ITS architecture. In the first four steps, the ITS architecture components are developed and then these components are used and maintained in steps 5 and 6. The development process begins with basic scope definition and team building and moves through increasingly detailed steps, culminating in specific architecture outputs and documents that will guide the “implementation” of the ITS architecture.

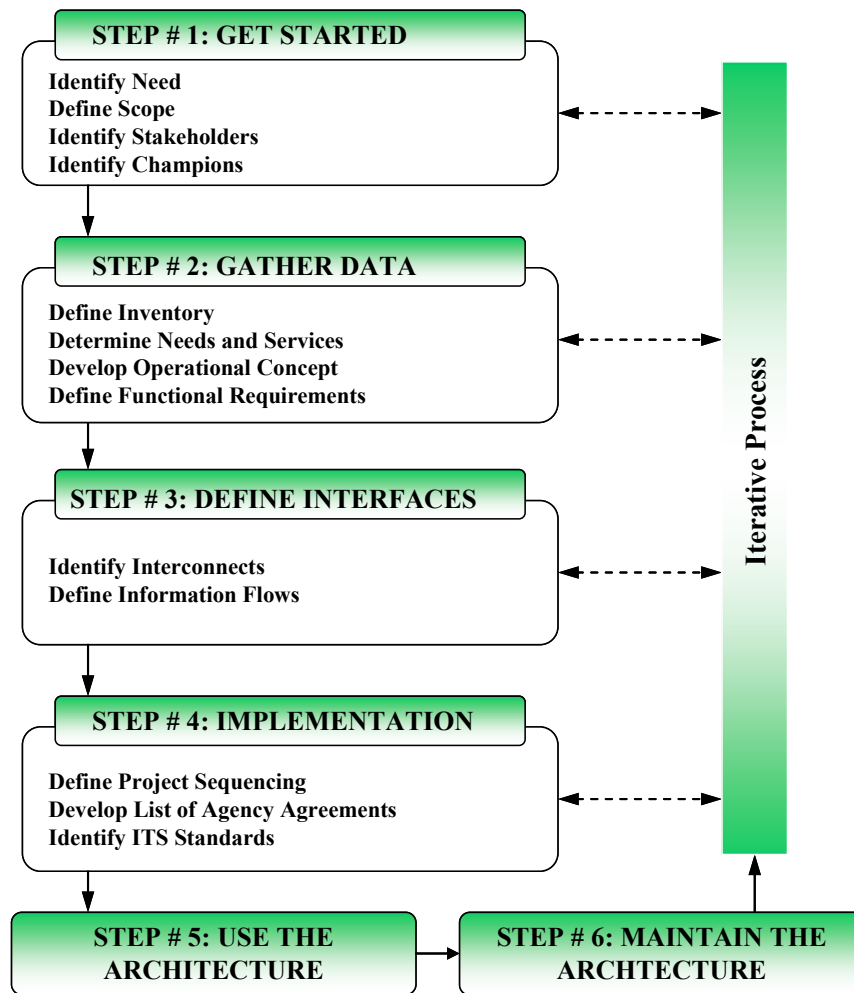


Figure 3. ITS Architecture Development Process (Source: FHWA)

The key to the ITS architecture development process is to identify stakeholder needs, identify ITS projects to address those needs, and define project sequencing. The project definition outlines the project concepts and the associated details including project title, stakeholder, project scope, costs, benefits and the service packages defined in the El Paso Regional ITS Architecture. The project sequencing provides an approximate timeframe in which an ITS project may be implemented based on the understanding of the projects, project dependencies of the project, as well as other existing or planned ITS systems.

1.3 Systems Engineering

Systems Engineering is a phrase used to describe a cyclical process of planning, designing, implementing, testing, operating, and maintaining an ITS system. Essentially, this process covers the entire useful life of the system. Systems Engineering is a multi-step process that requires agencies to ask critical questions about how the technical aspects of the system will work together. This is often overlooked in complex systems. **Figure 4** graphically illustrates the Systems Engineering process in what is often referred to as the “Vee” diagram. The purpose of a “V” in the diagram is to show how the final deliverables relate back to the early decisions (The right side relates directly back to the left side). That way there are no surprises when the system is finally delivered. For example, while a system is being designed the various functions are documented as

requirements, and then when the system is being built, these same functional requirements are compared to what was actually delivered.

The Systems Engineering process shows how each step of the process builds on the previous one and is reliant on a system of back checking to ensure that the project is being designed and constructed based on its originally intended purpose. Systems Engineering is a risk management tool that sets expectations and then verifies that those expectations are met. It also enables a change management system so that unexpected issues can be incorporated into the process.

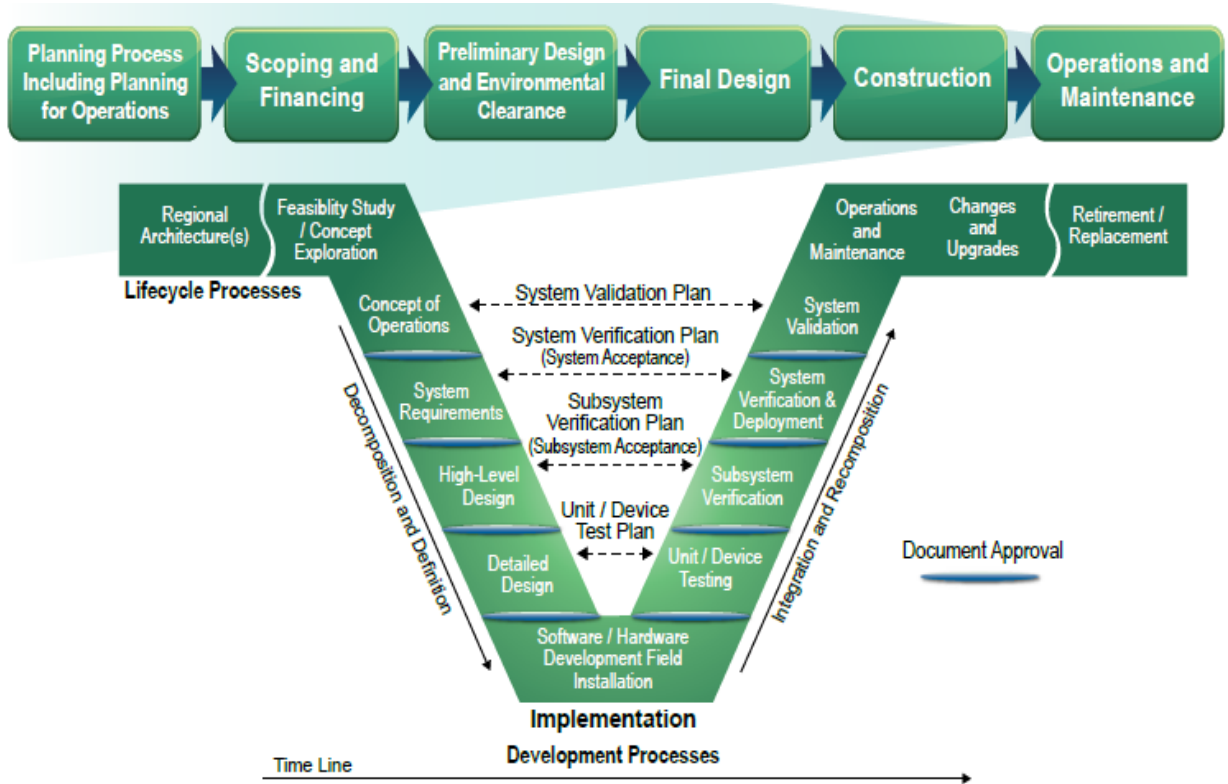


Figure 4. Systems Engineering V-Diagram (Source: FHWA)

1.4 FHWA and FTA Requirements on ITS Architectures

FHWA Rule 940 (http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf) provides policies and procedures for implementing Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21), Public Law 105-178, 112 Stat. 457, pertaining to conformance with ARC-IT and Standards. The rule states, in part, that the final design of all ITS projects funded with Highway Trust Funds must accommodate the interface requirements and information exchanges as specified in the regional ITS architecture.

For federally funded ITS projects, several steps need to be followed as part of the systems engineering analysis and Rule 940 requirements. Rule 940 states that the systems engineering analysis shall include, at a minimum:

- Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of ARC-IT)
- Identification of participating agencies roles and responsibilities
- Requirements definitions
- Analysis of alternative system configurations and technology options to meet requirements
- Procurement options
- Identification of applicable ITS standards and testing procedures
- Procedures and resources necessary for operations and management of the system

The rule requirements are applicable for all ITS projects funded through the Highway Trust Fund account. Conformity with the Rule 940 requirements is required for both routine and non-routine projects. However, with routine projects, the effort and the scope of systems engineering analysis should be minimal. For non-routine projects, the scale of the systems engineering analysis depends on the scope of the project.

While the use of the architecture and the systems engineering approach is mandatory for federally funded projects, project developers are encouraged to use this approach for any ITS project using state or local funds, especially for projects that integrate with other systems in the region.

The El Paso Regional ITS Architecture is a specific application of the framework specified in ARC-IT, tailored to the needs of the transportation stakeholders in the region. The Architecture was developed following the systems engineering approach and the requirements set forth in FHWA Final Rule 940.

2. Stakeholder Involvement

Stakeholders are commonly considered to be those who own or operate ITS systems in the region as well as those who have an interest in regional transportation issues. Stakeholders provide crucial input regarding the region's transportation investment and ITS deployments; therefore, stakeholder participation and coordination is critical to the success of the ITS architecture development.

The El Paso Regional ITS Architecture includes a wide range of stakeholders, and key stakeholders were identified early in the architecture development process. Information on current and potential ITS deployment was gathered at a stakeholder meeting in April 2020. At the stakeholder meeting, facilitators guided stakeholders through a listing of ITS projects identified in various prior studies to discuss the current status of those projects, identified additional projects, and discussed implementation timeline and strategies.

A survey was distributed to stakeholders via email after the stakeholder meeting. The survey presented stakeholders with a list of common transportation issues/needs that can be addressed through the use of ITS technologies, and asked stakeholders to rank the severity of the issue as High, Medium, Low, or Not Applicable in the region. The survey also asked stakeholders to list the top 5 needs and challenges that would like to see addressed by the update to the El Paso Regional ITS Architecture. A total of 30 surveys were completed by stakeholders. Follow-up discussion with key stakeholders were also conducted to gather and verify their state of ITS implementation as well as to gain better understanding on ITS gaps and needs.

In August 2020, stakeholders were again invited to a second stakeholder meeting where they were presented with the draft architecture and encouraged to review, provide comments and add missing information. Facilitators guided stakeholders through updates made to the El Paso Regional ITS Architecture through review of the updated web pages that were made available for review prior to the second stakeholder meeting.

3. ITS Needs

Upon reviewing the total of 30 survey responses, high priority needs for the region were identified and are summarized in **Table 1**. A total of 29 high priority needs were identified and categorized into eight areas: traffic management, safety and security, traveler information, communications, interagency data sharing and coordination, data collection and management, asset management and incident management.

Table 1. High Priority ITS Needs for the El Paso Region

Category	Needs
Traffic Management	Reduce congestion, delays and crashes due to work zones
	Mitigate congestion and delay on freeways
	Monitor traffic conditions in real time
	Mitigate congestion and delay on arterials
	Enhance traffic signal controller capabilities to support advanced and future technology
	Improve traffic signal timing and coordination, including across-jurisdictional coordination
Safety and Security	Improve worker safety in and around work zones
	Reduce vehicle crashes at intersections
	Reduce crashes between vehicles and pedestrians/cyclists
	Reduce incidents on curves and ramps
	Reduce traffic queues and rear-end collisions
	Reduce wrong way driving incidents
Traveler Information	Provide real-time traffic, incident, closure, road conditions and other traveler information to the public
	Improve alternate route planning, traffic management and information sharing with partner agencies and the public
	Provide border crossing information (wait time, lane closure, etc.) at Ports of Entry (POEs)
Communications	Improve communications network reliability and availability
	Improve communications network redundancy and self-healing capability
	Expand fiber optical communications network
	Expand wireless communications
Interagency Data Sharing and Coordination	Improve information sharing and coordination of events, incidents and road construction with transit providers
	Share real-time traffic incident information with agencies in the region
Data Collection and Management	Improve traffic data collection capabilities
	Establish consistence performance measures across agencies
	Improve accuracy of border crossing wait time estimation
Asset Management	Modernize ITS technology and equipment
	Train agency staff on technology and its maintenance
Incident Management	Identify alternate/quickest routes for emergency vehicles
	Improve incident detection capabilities
	Improve incident notification, response, management and coordination

4. Regional ITS Architecture Components

This section describes the processes that were followed in developing the El Paso Regional ITS Architecture through the use of the ARC-IT framework and the RAD-IT software.

4.1 Inventory

The inventory of the El Paso Regional ITS Architecture contains all of the existing and future elements of ITS technology within the region. An inventory of elements was previously defined for the El Paso region in 2003 was used as a starting point in developing this inventory. These elements were updated and modified based on information gathered through survey responses provided at the first stakeholder meeting and received via email, as well as open discussion held at the first meeting.

ITS elements within the Inventory represent the range of ITS devices and systems in the region. **Figure 5** displays the five types of inventory elements that can exist within an ITS Architecture (represented by the five colored boxes). ITS elements can exist:

- On vehicles (i.e. police cars, snow plows, etc.)
- In the field (i.e. traffic signals)
- At a center (i.e. Traffic Management Center)
- Personally in the hands of travelers (i.e. computers, smartphones, etc.)
- As support systems (i.e. back-office map systems, etc.)

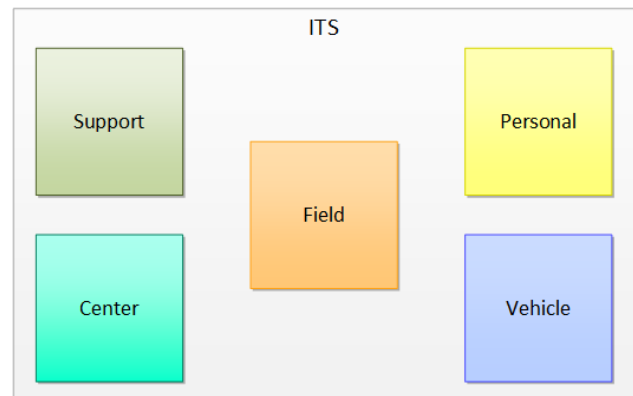


Figure 5. Five Classes of Physical ITS Objects (Source: FHWA)

The technical functions that each of these elements perform are defined by ARC-IT as Subsystems and illustrated in **Figure 6**.

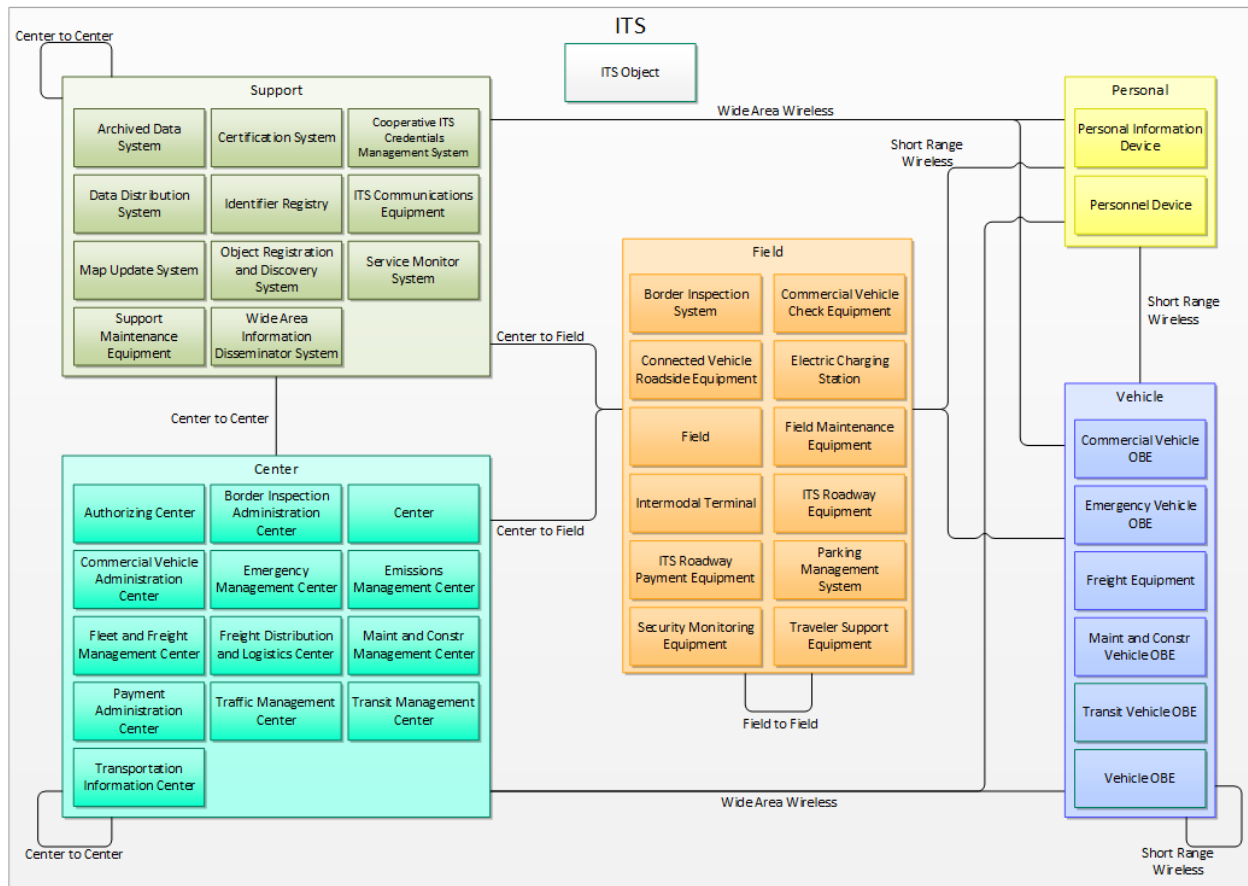


Figure 6. ARC-IT Subsystems and Interconnections (Source: FHWA)

In addition to Subsystem elements, there are additional elements added to the Inventory defined by ARC-IT as Terminators. These represent the people, systems, and general environment that interface with the Subsystem elements. Terminators typically represent the beginning or end of a flow of information in the ITS Architecture. No technical or functional requirements are assigned to terminators because they are the points outside the system boundaries where the architecture “plugs in” to the outside world.

A detailed listing of all the ITS elements in the El Paso region can be found on the El Paso Regional ITS Architecture Website. Each ITS element is documented, at a high level, by the associated stakeholder(s), its status (e.g. existing or planned), and a brief description for each element in the ITS inventory. Each element is also mapped to the various types of subsystems and terminators defined by ARC-IT.

4.2 Service Packages

The service packages of an ITS Architecture define a “service-oriented” perspective of how an ITS Architecture can be structured. Service packages are a convenient way to assemble ITS components to address frequently needed services without having to itemize the components. This can be compared to buying a car. In one purchase you acquire a complex set of systems such as engine, drive train, suspension, cargo handling, etc.) In the same way, service packages present how the ITS elements (and their assigned subsystems and terminators) work together to deliver a given ITS service, as well as the flows of information that connect those ITS elements with other important external systems. They are tailored to fit real world transportation problems

and needs. Service packages enable transportation planners and decision makers to select appropriate ITS services that satisfy local and statewide needs.

All 141 service packages in ARC-IT (Version 8.3) were considered for their applicability to the El Paso region. **Table 2** summarizes the status of ITS deployment with respect to service packages in the region. A detailed list of applicable service packages is available on the El Paso Regional ITS Architecture Website.

Table 2. Service Packages for the El Paso Regional ITS Architecture

Service Package	Service Package Name	Service Package Status
CV001	Carrier Operations and Fleet Management	Existing
CV002	Freight Administration	Future
CV003	Electronic Clearance	Future
CV005	International Border Electronic Clearance	Existing
CV008	Smart Roadside and Virtual WIM	Future
CV011	Freight Drayage Optimization	Existing
CV012	HAZMAT Management	Future
DM01	ITS Data Warehouse	Future
DM02	Performance Monitoring	Future
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Existing
MC02	Maintenance and Construction Vehicle Maintenance	Existing
MC04	Winter Maintenance	Existing
MC05	Roadway Maintenance and Construction	Future
MC06	Work Zone Management	Future
MC07	Work Zone Safety Monitoring	Future
MC08	Maintenance and Construction Activity Coordination	Existing
MC09	Infrastructure Monitoring	Future
PM01	Parking Space Management	Existing
PM02	Smart Park and Ride System	Future
PM03	Parking Electronic Payment	Existing
PM04	Regional Parking Management	Future
PS01	Emergency Call-Taking and Dispatch	Existing
PS02	Emergency Response	Existing
PS03	Emergency Vehicle Preemption	Existing
PS08	Roadway Service Patrols	Existing
PS09	Transportation Infrastructure Protection	Future
PS10	Wide-Area Alert	Existing
PS11	Early Warning System	Existing
PS12	Disaster Response and Recovery	Existing
PS13	Evacuation and Reentry Management	Existing
PS14	Disaster Traveler Information	Existing
PT01	Transit Vehicle Tracking	Existing
PT02	Transit Fixed-Route Operations	Existing
PT03	Dynamic Transit Operations	Existing
PT04	Transit Fare Collection Management	Existing
PT05	Transit Security	Existing
PT06	Transit Fleet Management	Future
PT07	Transit Passenger Counting	Existing
PT08	Transit Traveler Information	Existing
PT09	Transit Signal Priority	Existing
PT14	Multi-modal Coordination	Future
PT18	Integrated Multi-Modal Electronic Payment	Future
ST01	Emissions Monitoring	Existing
TI01	Broadcast Traveler Information	Existing
TI02	Personalized Traveler Information	Future
TI03	Dynamic Route Guidance	Existing
TI06	Dynamic Ridesharing and Shared Use Transportation	Existing

Table 2. Service Packages for the El Paso Regional ITS Architecture (Continued)

Service Package	Service Package Name	Service Package Status
TM01	Infrastructure-Based Traffic Surveillance	Existing
TM02	Vehicle-Based Traffic Surveillance	Existing
TM03	Traffic Signal Control	Existing
TM04	Connected Vehicle Traffic Signal System	Future
TM05	Traffic Metering	Future
TM06	Traffic Information Dissemination	Existing
TM07	Regional Traffic Management	Existing
TM08	Traffic Incident Management System	Existing
TM09	Integrated Decision Support and Demand Management	Future
TM10	Electronic Toll Collection	Existing
TM12	Dynamic Roadway Warning	Future
TM13	Standard Railroad Grade Crossing	Existing
TM15	Railroad Operations Coordination	Future
TM17	Speed Warning and Enforcement	Future
TM20	Variable Speed Limits	Future
TM21	Speed Harmonization	Future
TM22	Dynamic Lane Management and Shoulder Use	Existing
TM23	Border Management Systems	Existing
VS05	Curve Speed Warning	Future
VS08	Queue Warning	Future
VS11	Oversize Vehicle Warning	Future
VS12	Pedestrian and Cyclist Safety	Future
VS13	Intersection Safety Warning and Collision Avoidance	Future
VS16	Automated Vehicle Operations	Future
WX01	Weather Data Collection	Future
WX02	Weather Information Processing and Distribution	Future
WX03	Spot Weather Impact Warning	Future

4.3 Stakeholders' Operational Roles and Responsibilities

An operational concept defines each stakeholder's current and future roles and responsibilities within the El Paso region's ITS systems. Defining the roles and responsibilities of the participating stakeholders in the region is an important step in realizing the common goal of an interoperable ITS system throughout the region.

A detailed list of the stakeholders' operational roles and responsibilities is contained in the El Paso Regional ITS Architecture Website. These roles and responsibilities have been defined based on existing documents (for existing ITS systems), as well as responses contained within the surveys (for proposed systems). Together, these roles and responsibilities define the Operational Concept for the ITS Architecture and provide an overview how ITS services operate within the region.

4.4 Functional Requirements

A functional requirement is a task or activity that is currently performed or is planned to be performed by each system in the region to provide the required regional ITS services. The ARC-IT has pre-defined all possible functional requirements (i.e. equipment packages) that are associated with respective subsystems in each service package. The regional architecture is created through selecting those functional requirements that apply from this master list of functional requirements.

The process of selecting the functional requirements for the El Paso Regional ITS Architecture began with the mapping of functional areas (equipment packages) to service packages and associated ITS elements. The functional requirements of each equipment package were then tailored to represent the specific local agency functions performed. RAD-IT software is then used to produce lists and graphics that can be easily interpreted by the end users.

A detailed listing of the Functional Requirements of all ITS Inventory elements in the El Paso region is on the El Paso Regional ITS Architecture Website.

4.5 Interfaces

While it is important to identify the various ITS systems and stakeholders as part of the Architecture, a primary purpose of the El Paso Regional ITS Architecture is to identify the connectivity between systems. The two ways to describe this connectivity are:

- Architecture Interconnects define the connections between equipment and systems which may be deployed by the agencies throughout the region. In other words, what entities interact with each other.
- Architecture (Information) Flows define a high-level information exchange associated with each interconnect between equipment and systems. In other words, what information is passed along the interconnect paths.

An example of an interconnect diagram is illustrated in **Figure 7**.

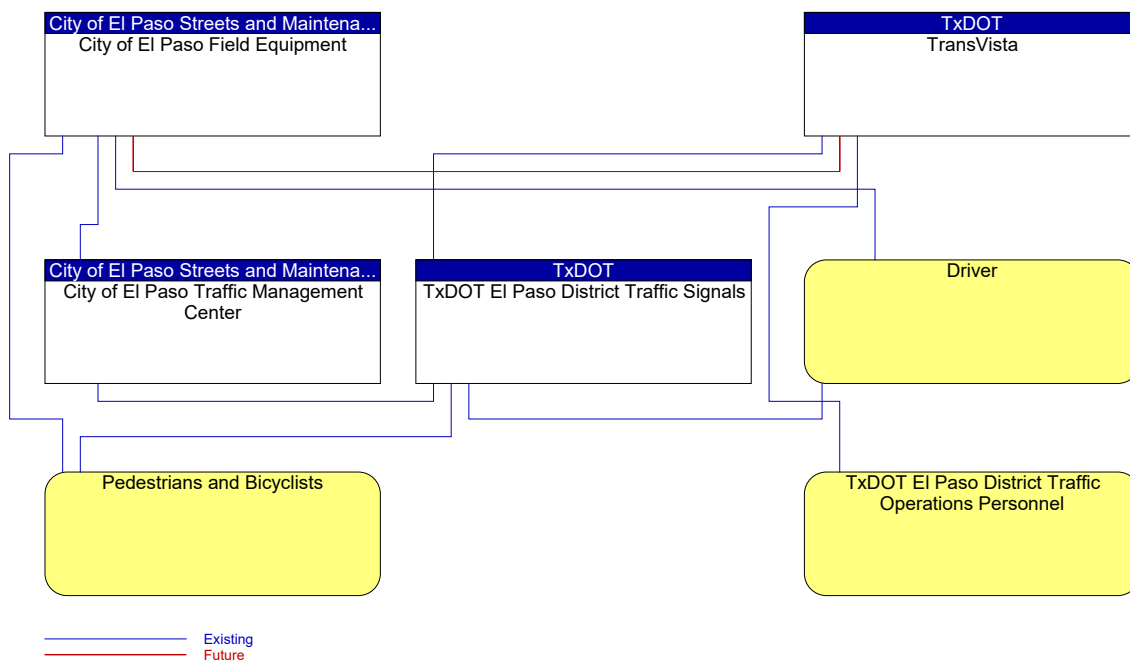


Figure 7. Interconnect Diagram Example: El Paso TMC Traffic Signal Control

Figure 8 illustrates the information flow diagram for the City of El Paso Traffic Management Center for the Traffic Signal Control function. Information flows provide a high-level description of information exchanges associated with each interconnect path between equipment and systems. From these diagrams the

stakeholders can easily identify the existing or potential information exchange between agencies and systems. This provides a framework for analyzing how elements are related and thus identifies the areas for potential coordination and cooperation among agencies. Quite often, from these diagrams agencies can identify missing communication flows that should occur, leading to refinements during the lifecycle of the system.

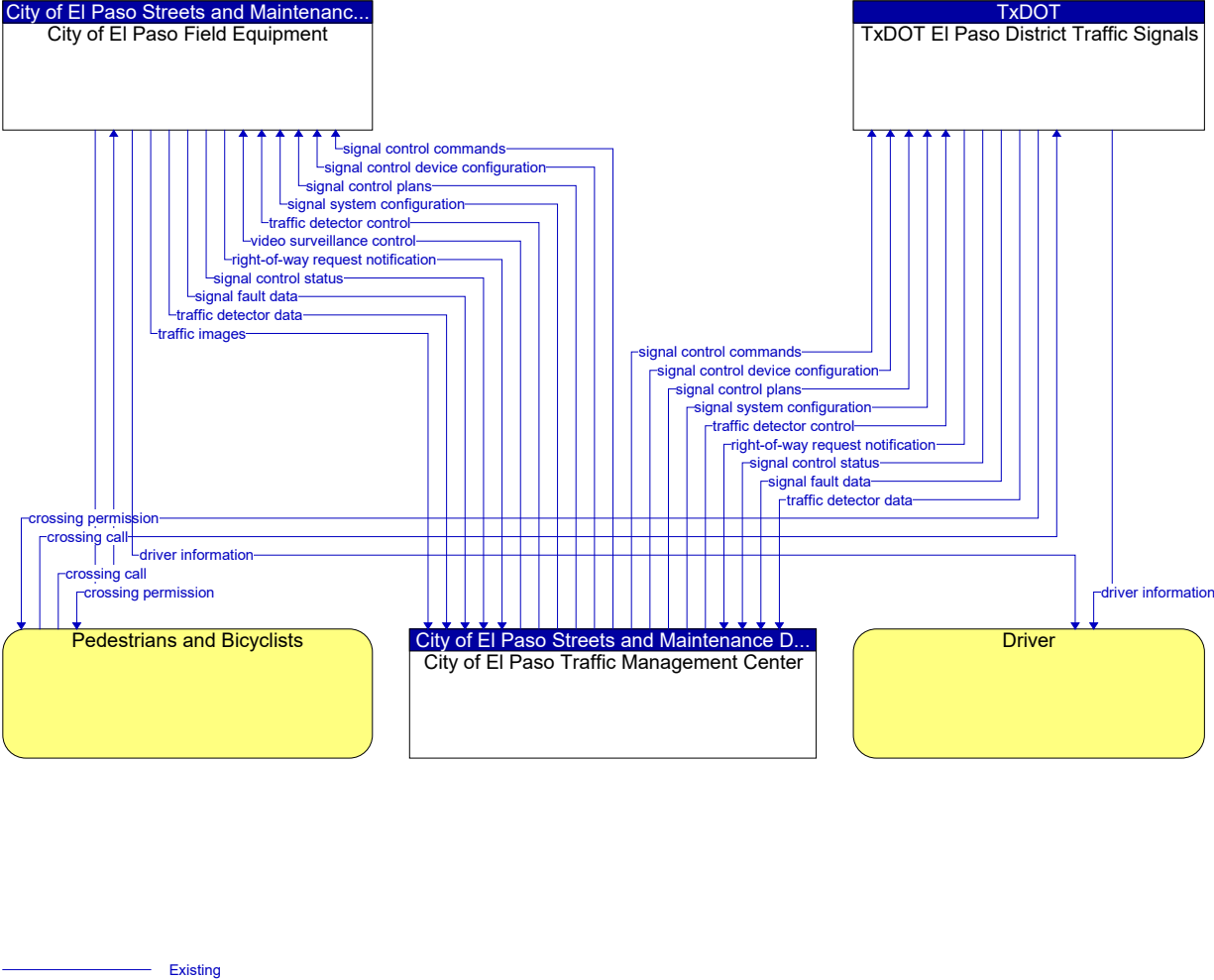


Figure 8. Information Flow Diagram: El Paso TMC Traffic Signal Control

The ARC-IT provides guidance in identifying potential information to be exchanged between commonly used ITS elements in the Inventory, and the RAD-IT software is used to generate the information flow diagrams between ITS elements in the Inventory.

A detailed listing of the interconnects and information flows of all ITS Inventory elements in the El Paso region is included on the El Paso Regional ITS Architecture Website.

4.6 Standards

Identification of ITS technical standards to support interfaces in the regional ITS architecture is often not understood by stakeholders, so ARC-IT was created to provide the stakeholders with easy access to

appropriate ITS standards that can be specifically applied to an ITS project. A summary of this task process is as follows:

- Using information flows identified in Step 3, identify relevant ITS standards for the region.
- Assess the ITS standard maturity and develop agreements for use of interim standards when determined necessary.
- Identify other regional and/or statewide standards that might apply.

As previously noted, it is important that stakeholders are aware of the importance of ITS standards, especially with respect to cost, risk, and interoperability issues both within the region and when connecting with other ITS architecture regions. These standards can save money in the long run, and make sure that various devices and systems “play well together”.

A list of ITS Standards identified by the RAD-IT as applicable to the El Paso region can be found on the El Paso Regional ITS Architecture Website.

4.7 Agreements

The El Paso Regional ITS Architecture also provides an institutional framework for the deployment of ITS in the region. Institutional interoperability involves cooperation and coordination between various agencies and jurisdictions to achieve seamless functionality, regardless of agency boundaries or differences in neighboring agency systems.

Because the regional architecture identifies systems that require agencies to contribute resources and manpower to operate, inter-agency agreements are often needed to define the roles and responsibilities of each party.

There are several types of arrangements associated with the interfaces identified in the El Paso Regional ITS Architecture:

- Information sharing and exchanges between systems require knowledge of the transmission protocol and data formats to ensure compatibility.
- Coordinating field device operations owned by different agencies requires defined procedures for submitting message requests and rules governing when such requests can be honored. Such coordination may be done with informal arrangements such as a Memoranda of Understanding (MOU).
- Sharing control of field devices operated by different agencies sometimes involves liability issues, which leads to more formal agreements.
- Coordinated incident response may also require formal agreements, but also requires group training of personnel from various agencies.

In general, agreements may be obtained for data sharing, establishing common procedures, supporting regional operations, cost effective maintenance arrangements, and personnel training.

Some common types of agreements are listed in **Table 3**. The agreement process may begin with something as simple as a handshake agreement. However, once interconnections and integration of systems begin, agencies may want to have more formalized agreements in place. A documented agreement will aid agencies in planning their operational costs, understanding their respective roles and responsibilities, and build trust for future projects. Formal agreements may be necessary where funding or financial arrangements are defined or

participation in large regionally significant projects is required. Formal agreements also provide a means for sustaining the stakeholders' expectations when personnel and administration changes occur.

Table 3. Common Types of Agreements for ITS

Type of Agreement	Description
Handshake Agreement	<ul style="list-style-type: none"> ▪ Early agreement between one or more partners ▪ Not recommended for long term operations.
Memorandum of Understanding (MOU)	<ul style="list-style-type: none"> ▪ Initial agreement used to provide minimal detail and usually demonstrating a general consensus. ▪ Used to expand a more detailed agreement like an Interagency Agreement that may be broad in scope but contains all of the standard contract clauses required by a specific agency. ▪ May serve as a means to modify a much broader Master Funding Agreement, allowing the master agreement to cover various ITS projects throughout the region and the MOUs to specify the scope and differences between the projects.
Interagency Agreement	<ul style="list-style-type: none"> ▪ Between public agencies (i.e., transit authorities, cities, counties, etc.) for operations, services or funding ▪ Documents responsibility, functions and liability at a minimum.
Intergovernmental Agreement	<ul style="list-style-type: none"> ▪ Between governmental agencies (i.e., Agreements between universities and State DOT, MPOs and State DOT, etc.)
Operational Agreement	<ul style="list-style-type: none"> ▪ Between any agency involved in funding, operating, maintaining or using the right of way of another public or private agency. ▪ Identifies respective responsibilities for all activities associated with shared systems being operated and / or maintained.
Funding Agreement	<ul style="list-style-type: none"> ▪ Documents the funding arrangements for ITS projects (and other projects) ▪ Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements	<ul style="list-style-type: none"> ▪ Standard contract and / or legal verbiage for a specific agency and serving as a master agreement by which all business is done. These agreements can be found in the legal department of many public agencies. ▪ Allows states, cities, transit agencies and other public agencies that do business with the same agencies over and over (i.e., cities and counties) to have one Master Agreement that uses smaller agreements (i.e., MOUs, Scope of Work and Budget Modifications, Funding Agreements, Project Agreements, etc.) to modify or expand the boundaries of the larger agreement to include more specific language.

A list of ITS Agreements to support interagency data sharing and operation has been documented in the RAD-IT database and can be found on the El Paso Regional ITS Architecture Website. The Appendix includes example agreements, including regional transportation operations; live video sharing; CCTV control, operations and maintenance sharing; and fiber optic sharing. These examples can be used as references for developing potential agreements.

5. Recommended ITS Projects and Implementation Sequencing

The ITS projects included in the El Paso Regional ITS Architecture were identified based on the following sources:

- Stakeholder surveys, inputs and feedback
- TxDOT ITS Master Implementation Plan
- El Paso MPO 2045 Metropolitan Transportation Plan (MTP)
- El Paso MPO Transportation Improvement Program
- El Paso Regional Mobility Strategy (RMS)
- Interstate Highway 10 (IH-10) Integrated Corridor Management (ICM) Concept of Operations
- US 67 Corridor Master Plan
- Mesa Street (SH 20) Corridor Master Plan

A total of 62 projects were recommended for consideration over the next 20 years. Each of the recommended project addresses specific ITS needs and provides services in one or more ITS service areas. Implementation of these projects and ITS services provides support to achieve the goals defined in the El Paso MPO 2045 MTP (Destino 2045), as illustrated in **Table 4**.

Table 4. ITS Architecture Supports MTP 2045 Goals

ITS Service Areas	Destino 2045 Goals						
	Safety	Operations & Maintenance	Mobility	Accessibility & Travel Choice	Sustainability	Economic Vitality	Quality of Life
Traffic Management	🎯	🎯	🎯	🎯	🎯	🎯	🎯
Traveler Information	🎯		🎯	🎯	🎯	🎯	🎯
Public Transportation	🎯	🎯	🎯	🎯	🎯		🎯
Incident and Emergency Management	🎯		🎯			🎯	🎯
Traveler Safety & Security	🎯	🎯					🎯
Communications Infrastructure		🎯	🎯				🎯
Asset Management		🎯	🎯		🎯		🎯
Interagency Coordination & Data Sharing	🎯		🎯			🎯	🎯
Parking Management				🎯		🎯	🎯
Freight Management						🎯	🎯
Data Management		🎯	🎯				🎯

A project sequence defines the order in which ITS projects may be implemented. A good sequence is based on a combination of two factors:

- Prioritization of projects based on existing conditions and stakeholder needs. The ITS projects were prioritized to reflect a deployment path (sequence). Although the information collected through stakeholder surveys and meetings was the basis of the ITS Architecture, real world conditions of changing technology, funding opportunities and public demand continue to evolve. It is expected that the stakeholders will reevaluate and reprioritize projects frequently to keep up with these imposed changes.
- Projects often depend on prior projects being completed. For example, a fiber optic network would need to be in place before a set of detectors are constructed to provide a means to communicate with the detection system. These project dependencies influence the project sequencing. Therefore, it is important to identify these dependencies between projects during the planning stages.

In most cases, the sequence of currently planned projects has already been programmed and can simply be extracted from existing transportation plans. Successive projects will then be added to the sequence based on the project dependencies and other planning factors.

The project timeframes provide a means to position each project along the architecture’s lifetime. This enables the scheduling of funds and resources to deliver the projects in an appropriate sequence. Three timeframe categories are used, and their definitions are described below:

Table 5. Project Implementation Timeframes

Category	Time Frame	Year of Deployment
Short Term	0 – 5 years	2020 - 2025
Medium Term	6 – 10 years	2026 - 2030
Long Term	11 years and beyond	2031 and beyond

The El Paso Regional ITS Architecture represents a roadmap for transportation systems deployment and integration in the region over the next 20 years. A list of ITS projects recommended for consideration over the next 20 years is identified in **Table 6**. Through the above process, the recommended ITS project sequencing was determined. The list was further refined to establish which projects were allocated to the short term (within 5 years), medium term (6 to 10 years), and long term (over 11 years). This provided a priority for the list of projects denoting a general order for project implementation.

Table 6. List of Recommended ITS Projects / Initiatives for Consideration

Project	Timeframe	Description	Lead Stakeholder(s)
City of El Paso ITS Field Equipment Expansion	Short to Long Term	This project will expand the deployment of CCTV cameras and Dynamic Message Signs (DMS) to increase the number of roadway miles with ITS devices managed and monitored by the City of El Paso TMC. Increased CCTV coverage can assist TMC operators with monitoring traffic congestion, as well as incident and emergency response personnel that respond to traffic incidents. Increased DMS coverage can assist TMC operators in communicating messages to drivers regarding incidents downstream of the DMS location, which can allow drivers to seek alternate routes around the incident location.	City of El Paso
Active Transportation and Demand Management (ATDM) Implementation	Short to Long Term	This project will implement Active Transportation and Demand Management (ATDM) strategies to dynamically manage, control and influence travel demand and traffic flows through key regional corridors. ATDM strategies can include ramp metering, hard shoulder running, dynamic lane use control, and variable speed limits. Use of these strategies would be done to achieve operational objectives, such as improving safety, reducing emissions, and maximizing system efficiency. TMC operators continuously monitor traffic conditions through CCTV and other ITS field equipment to detect when systems should be implemented. Using archived data and or/predictive methods, actions can also be performed in real-time to achieve or maintain system performance.	TxDOT
Regional Traffic Signal Timing Optimization and Coordination	Short to Long Term	The purpose of this project is to establish a program for planning, managing and implementing signal timing optimization efforts on arterial corridors in the El Paso region. TxDOT and City of El Paso will work together to identify arterial signalized corridors and schedule to perform signal timing optimization over time. This project may also include a review of signal phasing and recommendation of updates to reflect changes in travel patterns, and in turn, increase the efficiency of traffic signal operations.	TxDOT and City of El Paso
City of El Paso Traffic Management Center Upgrade	Short to Medium Term	This project will modernize the City of El Paso's existing, aging ITS field equipment through replacements or upgrades. This includes replacing or upgrading traffic signals, controllers, vehicle detection, pedestrian signals/countdown timers, cameras, DMS, communications, etc. Equipment upgrades can include Advanced Traffic Controllers (ATCs) that can provide advanced features, and support Automated Traffic Signal Performance Measures (ATSPM) and future connected vehicle applications. Citywide traffic signal controller upgrade is programmed in the MPO TIP, titled "Traffic Management Center Upgrade – Phase 1," for FY2022. Phase 1 is the design of the traffic signal upgrades. Phases 2–5 is for construction and implementation.	City of El Paso

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
Fiber Optic Communications Expansion	Short to Medium Term	This project will expand the backbone and connecting segments of the fiber-optic cable infrastructure system deployed by TxDOT. The backbone expansion will also include increasing the capacity of the fiber optic communications, connecting to additional ITS devices/traffic signals, as well as implementing redundant rings within the fiber communications network to maintain communications in the event of fiber cable damage to one area of the network. This project also includes potential for fiber sharing with El Paso County as well as connecting to New Mexico DOT fiber along the IH-10 corridor. ITS Master Plan has defined corridors for new fiber cable segments in the region.	TxDOT
TxDOT Coastcom (T1) Ring Replacement	Short to Medium Term	<p>This project will replace the existing TxDOT TransVista T1 Rings B, C, D and E with Ethernet network solutions. The scope of the project may include:</p> <ul style="list-style-type: none"> • Replacing all T1 nodes (Coastcom multiplexors) with 10 G Ethernet switches that comply with the IEEE 802.3-2008 Standard. • Adding an additional 1 G Standard-compliant Ethernet switch in cabinets that house/support the City of El Paso's Traffic Signal system. • Replacing terminal servers and patch panels. • Adding video encoders to cabinets that currently house Video Optical Transceivers. • Replacing CCTV field equipment that uses Coastcom for PTZ with Ethernet-based equipment. • Replacing SONET nodes with similar Ethernet solutions. 	TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
TxDOT CCTV Modernization and Expansion	Short to Medium Term	<p>This project will upgrade existing as well as expand the deployment of CCTV cameras to increase the number of roadway miles with ITS devices managed and monitored by the TxDOT TransVista TMC. Device modernization includes upgrading the aging analog cameras to digital. Increased CCTV coverage can assist TMC operators with monitoring traffic congestion, as well as incident and emergency response personnel that respond to traffic incidents. Specific priority locations have been identified in ITS Master Plan along Loop 375 and along IH-10.</p> <p>CCTV cameras will be connected to TransVista either via fiber or wireless communications. They will be installed and interconnected at the following locations:</p> <ul style="list-style-type: none"> • IH-10 from FM 1281 (Horizon Blvd.) to O T Smith Rd.: 17 cameras connected via fiber or wireless communications. • Loop 375 (Purple Heart Highway) from Spur 601 to US 54 (Dyer St.): 8 cameras connected via fiber. • Loop 375 (Transmountain Rd.) from IH-10 to US 54: 18 cameras connected wirelessly. • IH-10 at Sierra Blanca: 5 cameras connected wirelessly. • IH-10 at Van Horn: 8 cameras connected wirelessly. • IH-10 at Border Patrol Station: 3 cameras connected wirelessly. • US 62/180 from FM 659 (Zaragoza Blvd.) to FM 2775 (Hueco Tanks Rd.): 11 cameras connected wirelessly. • US 54 from 2529 (McCombs St.) to TX-NM Stateline (Stateline Rd.): 5 cameras connected wirelessly. 	TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
TxDOT DMS Modernization and Expansion	Short to Medium Term	<p>This project will upgrade existing as well as expand the deployment of Dynamic Message Signs (DMS) to increase the number of roadway miles with ITS devices managed by the TxDOT TransVista TMC. Device modernization includes replacing the older DMS with color DMS. Increased DMS coverage can assist TMC operators in communicating traffic/travel conditions to drivers such as incidents or construction downstream of the DMS location. Specific priority locations have been identified in ITS Master Plan along Loop 375 and along IH-10.</p> <p>DMS will be connected to TransVista either via fiber or wireless communications. DMS at the following locations are planned to be connected to TransVista via fiber communications:</p> <ul style="list-style-type: none"> • IH-10 at Anthony: 2 DMS; one for EB at 1,500 ft south of Antonio St. and one for WB at Travel Information Center. • Loop 375 from BUS 54 (Dyer St.) to Spur 601: 2 DMS at the locations on the opposite direction of travel of the existing DMS. • Spur 601 from US 54 to Loop 375: 5 DMS along the corridor. <p>DMS at the following locations are planned to be connected wirelessly:</p> <ul style="list-style-type: none"> • IH-10 at Sierra Blanca: 2 DMS. • IH-10 at Van Horn: 2 DMS. • US 54 from Mesquite Hills Drive to TX-NM Stateline (Stateline Rd.): 2 DMS. • US 62/180 from FM 659 (Zaragoza Blvd.) to FM 2775 (Hueco Tanks Rd.): 2 DMS. 	TxDOT
TxDOT C2C Protocols for Interagency Data Sharing	Short to Medium Term	<p>This project will implement the TxDOT Center-to-Center (C2C) Protocol to share information between TxDOT El Paso, City of El Paso, Sun Metro and other agencies including law enforcement and 911 centers. Data streams can include real time traffic and incident data, traffic signal status and state, DMS message, CCTV snapshots or streaming videos, CCTV command and control, and other ITS hardware status and data.</p>	TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
TxDOT ITS Asset Management Program and Maintenance Plan	Short to Medium Term	The purpose of this project is to plan for and procure an asset management system to document and store ITS asset information, including ITS devices and communications infrastructure deployed by TxDOT. This project could start with an investigation of available systems and desired functions and features which may determine the availability of asset management systems. Based on the investigation, TxDOT could develop an asset management system in-house or procure an asset management system from vendors. A second component of the project is to develop a robust ITS asset maintenance plan to guide maintenance, troubleshooting, repair and replacement of TxDOT ITS assets. Coordination with City of El Paso is possible if study is conducted concurrently.	TxDOT
IH-10 Integrated Corridor Management System	Short to Medium Term	This project will deploy an Integrated Corridor Management (ICM) system in the El Paso region, near the IH-10 corridor. The ICM concept involves the operational coordination of multiple transportation networks and cross-network connections comprising a corridor, and the coordination of the different agencies and stakeholders responsible for corridor mobility. The underlying principle behind the ICM concept is that these independent, individual transportation networks, and their cross-network connections, can be operated in a more coordinated and integrated manner, resulting in increased overall corridor throughput and enhanced mobility of the corridor users. The IH-10 ICM system will enable all individual transportation networks within the corridor to be managed as a multimodal system.	TxDOT and City of El Paso
Connected Vehicle Pilot Program	Short to Medium Term	This project will utilize Connected Vehicle (CV) technology to improve the safety and efficiency of passenger vehicle and public agency vehicle travel. Roadside units (RSUs) will be installed along IH-10, at signalized intersections and other strategic locations (curves, locations with weather issues) to communicate with on-board units (OBUs) on passenger vehicles and public agency fleet vehicles using DSRC or other real-time message protocols. CV applications could be considered in this project include Signal Phase and Timing (SPaT), Queue Warning, Speed Harmonization, Work Zone Traveler Information, Weather Data Collection, and Red Light Violation Warning, and other applications.	TxDOT and City of El Paso

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
Emergency Vehicle Preemption Expansion	Short to Medium Term	This project will expand the installation of Emergency Vehicle Pre-emption (EVP) technology to improve emergency response times along arterial signalized corridors to the scene of an incident. Systems require the installation of hardware on emergency vehicles and at signalized intersections to facilitate the request from vehicle to intersection in the field. Opportunities exist for potential cost sharing with public transit agencies, who could leverage field-based hardware to communicate transit signal priority requests, which are less disruptive to traffic operations than traffic signal pre-emption requests from emergency vehicles.	TxDOT and City of El Paso
Regional Traveler Information System	Short to Medium Term	This project will enhance and integrate current traveler information delivery systems in the El Paso Region. The Regional Traveler Information System will deliver traveler information for both freeway and arterial systems as well as transit services in the region. Information that could be delivered by the system includes travel times, roadway congestion, closures, incidents, work zones, border wait times, weather events, special events, parking, upcoming constructions, transit services, etc. Information could be disseminated through webpages and mobile applications. Information could also be made available to major employers in the region. This project could also integrate data from third party provider systems to increase amount of data provided to travelers.	TxDOT, City of El Paso, Sun Metro and MPO
El Paso County Transit Fare Payment System Enhancement	Short to Medium Term	This project will implement fare payment technology for use by passengers on transit vehicles. This could include electronic fare payment cards, mobile smartphone ticketing applications, and Smart Card technology that would allow passengers to tap their card to an electronic reader on transit vehicles or at transit stations for fare payment.	El Paso County
El Paso County Transit Traveler Information System	Short to Medium Term	This project will upgrade the current El Paso County Transit website to provide both real-time and static transit information to the public, such as bus schedules, bus fares, bus arrival/departure times, and bus location updates. Transit information could also be provided to travelers via mobile application that could allow for general transit information as well as personalized information to be provided to transit riders based on their preferences.	El Paso County
TMC and Public Safety CAD Integration	Short to Medium Term	This project will utilize center-to-center (C2C) protocols to enable integration of Traffic Management Centers (TMCs) with public safety Computer Aided Dispatch (CAD) systems to improve incident notification and response, interagency coordination, and information and resource sharing throughout the El Paso region.	TxDOT and City of El Paso

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
Wireless Communications Expansion	Short to Medium Term	This project will expand the current wireless communications networks for traffic operations and public safety communications. Expansion of the wireless communications network will allow for TMC operators to control and configure additional ITS devices in areas without fiber optic infrastructure, as well as increase data sharing with agencies in the region. This project also provides enhanced capabilities to public safety agencies in communications and coordination during incident and emergency situations. Wireless communications could serve as a bridge between two segments of fiber-optic cable that are not connected.	TxDOT and City of El Paso
ITS at BOTA and Zaragoza Ports of Entry	Short Term	This project will deploy multiple ITS solutions on the Bridge of the Americas (BOTA) and Zaragoza Ports of Entry in El Paso. ITS deployments will include 28 Dynamic Message Signs (DMS), 49 Closed-Circuit Television (CCTV) cameras, 28 Radar Vehicle Sensing Devices (RVSDs), 28 Bluetooth Readers, 34 Automatic Vehicle Identification devices, 13 lane management signs, and toll and traffic management systems upgrades.	TxDOT and City of El Paso
Automated Traffic Signal Performance Measures	Short Term	Automated Traffic Signal Performance Measures (ATSPM) is defined as a suite of performance measures, data collection and data analysis tools to support objectives and performance based approaches to traffic signal operations, maintenance, management and design of the signal system. The purpose of the application is to improve the overall safety, mobility and efficiency of signalized intersections for all system users. The technology allows for agencies responsible for traffic signal timing updates to use the data provided through ATSPM to determine how best to optimize traffic signal timings based on the collected data.	TxDOT and City of El Paso
Pedestrian/Cyclist Detection and Warning System	Short Term	This project will deploy intersection based equipment to detect the presence of pedestrians and bicyclists and potential conflicts with vehicles in crosswalk areas at signalized intersections. Upon detection, systems could provide warnings to passenger vehicles through a Connected Vehicle application, or to pedestrians and bicyclists through roadside warning devices or smartphone applications.	TxDOT and City of El Paso
El Paso County Transit Automatic Passenger Counters	Short Term	This project will install automated passenger counters (APCs) on El Paso County Rural Transit vehicles to obtain more detailed ridership per stop information for reporting and analysis purposes.	El Paso County
Sun Metro Real-time Transit Arrival/Departure Sign Expansion	Short Term	This project will expand the installation of displays or dynamic message signs at key transit stations and locations to present real-time bus arrival / departure information.	Sun Metro

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
Sun Metro Security Cameras on Transit Centers, Stations and Vehicles	Short Term	This project will expand the installation of security cameras by Sun Metro to improve the overall safety of passengers on transit vehicles and at key transit centers and stations. Videos could be stored temporarily on the vehicle for upload at the transit garage or relay events in real-time to transit dispatchers who can dispatch emergency services as needed.	Sun Metro
Sun Metro Automated Passenger Counters Expansion	Short Term	This project will expand the installation of automated passenger counters (APCs) to 100% of Sun Metro fleet of fixed route vehicles to obtain more detailed ridership per stop information for reporting and analysis purposes. The data can also help analyze the possibility of the First and Last Mile rideshare.	Sun Metro
Alternate Route Traffic Management Study and Implementation	Short Term	The purpose of this project is to develop and update alternate route traffic diversion plans for traffic operations and incident management staff to use in identifying and implementing alternate routes based on incidents or events occurring on the roadway network that disrupt traffic. Current alternate route plans are updated through the Regional Incident Management Plan for the El Paso region. This project will review and study the use and effectiveness of alternate routes and recommend updates where needed, which may include the implementation of alternate route signage that could be activated by TMC operators.	TxDOT
Automated Traffic Incident Detection System	Short Term	This project will implement an automated traffic incident detection system. This could include using video and/or data analytics to detect crashes, stopped vehicles or other abnormal traffic patterns. The system will send alerts to TMC operators for incident verification and taking appropriate actions such as posting incident information on DMS and notifying incident responders.	TxDOT
TxDOT Curve Speed Warning System	Short Term	Curve speed warning systems utilize roadside speed detection equipment to detect the speed of vehicles approaching a roadway curve to automate a warning to the vehicles about the need to reduce their speed. Warning messages could be provided through flashing beacons that are activated when vehicle speeds exceed a speed threshold. Flashing beacons would be installed on static signage with messages about the roadway curve ahead. Other messages could be provided through dynamic message signs that present messages to reduce vehicle speed in advance of the roadway curve.	TxDOT
TxDOT Smart Work Zones	Short Term	This project will implement smart work zone technology as work zone management practice into future construction projects. The purpose of the technology is to optimize safety and mobility in and around work zones, and provide real time data (speeds, volumes, delay/travel times, etc.) that could be viewed TMC operators and maintenance staff. Real time data can be shared with the public through DMS, a web interface and social media.	TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
TxDOT Speed Feedback and Warning System	Short Term	This project will implement speed feedback signs that can detect the speed of approaching vehicles and present those speeds in real time on small dynamic message signs inserted underneath posted regulatory speed limit signs. Signs will warn drivers traveling above the speed limits, prompting them to slow down in high crash-potential areas. This project is defined in the ITS Master Plan as along IH-10 from SH 20 to the Culberson County Line. Additional implementation of the system is also recommended for Mesa Street in the SH 20 Corridor Master Plan.	TxDOT
Traffic Incident Management Program Refinement	Short Term	This project will examine and further refine and optimize the Traffic Incident Management (TIM) program for the TxDOT El Paso District. This project will update the TIM Plan and utilize performance metrics strategy to monitor performance of TIM program and adjust as needed. Potential training opportunities could also be identified for emergency response personnel.	TxDOT
TxDOT Traffic Signal Controller Upgrades	Short Term	This project will focus on upgrades to traffic signal controllers at TxDOT-operated signalized intersections. This project includes upgrades traffic signal controllers to Advanced Traffic Controllers (ATCs) that can support advanced features, Automated Traffic Signal Performance Measures (ATSPM), adaptive traffic signal control, and future connected vehicle applications.	TxDOT
TxDOT TMC Upgrades	Short Term	This project will upgrade TransVista, the TxDOT El Paso District TMC with building, new equipment and software. This project will upgrade TransVista with new equipment, including the video wall, work stations, center communications equipment, hardware, and video analytics equipment. The upgrades will improve real-time situational awareness and management of ITS from the TMC. This project will also upgrade TMC software with additional programming to: (1) integrate incident data from third party applications (e.g., Waze and Google Maps) into TxDOT's LoneStar System and (2) integrate TMC incident data into third party applications. In addition, the software upgrade will allow for displaying performance metrics on upgraded TMC video wall. Performance metrics may also include ATSPM information from traffic signals, and performance metrics from other ITS devices.	TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
US 67 ITS Projects – Short-Term	Short Term	This is a list of ITS projects identified and recommended for short term implementation in the US 67 Corridor Master Plan. These projects are generally focused on specific locations, with costs being low to medium and also providing the most benefit in terms of safety and operations of the proposed US 67 corridor projects. Recommended short term ITS deployments include automated visibility warning systems (AVWS), pedestrian and bicycle safety/warning systems, and curve speed warning systems, speed warning systems, work zone safety systems, rock slide warning systems, DMS, and incident management support trucks. In addition, it is recommended to include traffic incident management training and establish corridor coordination groups as short term initiatives.	TxDOT
Wrong Way Driver Detection System	Short Term	This project will install wrong way detection system for exit ramp locations along corridors. The system could include detection on exit ramps with video verification of the wrong way drivers by TMC operators. Automated notification system to TMC staff of wrong way vehicles will be done for verification of events. There is also the potential to automate the posting advisory messages on upstream DMS to alert for the wrong way vehicles. This project locations have been defined in the ITS Master Plan as the following: IH-10 from New Mexico State Line to US 54; IH-10 from US 54 to SL 375; US 54 from Cesar Chavez Border Highway to New Mexico State Line.	TxDOT
IH-10 Queue Detection System	Short Term	This project will deploy a queue detection system on Interstate Highway 10 at the Sierra Blanca Border Patrol station. This system will provide advanced notification of vehicle queueing to drivers using CCTV cameras and DMS. Additional systems may be deployed at other locations or corridors.	TxDOT
TxDOT Static Travel Time Displays	Short Term	This project will install static signs with small DMS panels to display estimated travel times to destinations or comparable travel times via different routes. Those signs will be installed at locations approaching major interchanges. In addition, confirmation signs will be installed throughout the corridors. The ITS Master Implementation Plan identifies eight project segments totaling 28 travel time displays along IH-10, SL 375, Spur 601, and US 54.	TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
IH-10 Truck Parking Space Availability System (TPAS)	Short Term	The I-10 Corridor Coalition consists of Texas, New Mexico, Arizona and California Departments of Transportation. The Coalition was awarded a \$6.85 million USDOT grant to implement an IH-10 Truck Parking Availability System (TPAS) along the corridor. 18 safety rest areas (SRAs) have been identified in Texas along IH-10 for TPAS deployment. 6 of the Texas SRA sites are located in the El Paso District: 2 at the Travel Information Center at TX/NM border; 2 in El Paso County; and 2 in Culberson County. The SRA site configurations will help determine which parking detection approach will be used, either entrance/exit counting or space occupancy counting. Dynamic Parking Availability Signs (DPAS) will be placed upstream from the parking areas. These signs will provide drivers with real-time advanced warning ahead of the parking site to allow drivers to consider alternate plans if a location is full. Smartphone and web-based services may also be used to provide data to drivers and dispatchers.	TxDOT
Doniphan Drive (SH 20) ITS and Fiber Expansion	Short Term	This project will expand the center-to-center support structure, ITS device deployments and Incident Management Plan to include SH 20 (Doniphan Drive). The proposed ICM communication network for the Doniphan Drive Corridor will be integral to the existing alignment for approximately 15 miles from the state line to Racetrack Dr, which then connects to the Border West Expressway. The initial stage of the ICM will be to install a conduit duct bank with fiber optic cable between the southbound travel lanes and the right of way adjacent to the BNSF railroad. This fiber communication network will provide the potential to connect to each of the traffic signal controllers, school zones flasher systems, and the proposed Sun Metro and El Paso County transit bus shelters along the Doniphan Drive corridor. At strategic locations, Dynamic Message Signs (DMS) will be installed to provide real time information to the public, Bluetooth readers for travel time data collection, and CCTV cameras to provide incident verification and corridor monitoring. In addition to real-time traffic monitoring and support, this initial ICM project sets the stage for Connected and Autonomous vehicles to be used within the Doniphan Drive Corridor in the future.	TxDOT and City of El Paso
Mesa Street (SH 20) Short Term ITS Improvements	Short Term	This project includes signal timing optimization, bus queue-jump lanes, Bluetooth readers, CCTV cameras, and Video Imaging Vehicle Detection System (VIVDS) at multiple signalized locations along Mesa Street (SH 20). This project also includes Speed Feedback Signs approaching Executive Center Boulevard.	TxDOT and Sun Metro

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
City of El Paso ITS Asset Management Program and Maintenance Plan	Medium Term	The purpose of this project is to plan for and procure an asset management system to document and store ITS asset information, including ITS devices and communications infrastructure deployed by the City of El Paso. This project could start with an investigation of available systems and desired functions and features which may determine the availability of asset management systems. Based on the investigation, the City of El Paso could develop an asset management system in-house or procure an asset management system from vendors. Coordination with TxDOT is possible if study is conducted concurrently. A second component of the project is to develop a maintenance plan for the City to guide maintenance, troubleshooting, repair and replacement of ITS assets.	City of El Paso
Transit Signal Priority Expansion	Medium Term	This project will expand the installation of Transit Signal Priority (TSP) system technology to additional locations along the Brio routes. Technology is currently deployed along main Brio rapid transit corridors. This project may also include upgrades and enhancements to the existing TSP system.	Sun Metro
Regional Transit Data Hub	Medium Term	The purpose of this project will be to establish a regional transit data hub that would collect and store transit related data for the El Paso region. The data hub could serve as a central data storage and clearinghouse for access and distribution of transit data to other agencies in the El Paso region. This data hub could be a subset of a regional transportation data hub.	Sun Metro
Sun Metro Fare Payment System Enhancement	Medium Term	This project will implement advanced fare payment technology for Sun Metro passengers on vehicles. This could include mobile smartphone ticketing applications used by passengers, as well as Smart Card technology that would allow passengers to tap their card to an electronic reader on transit vehicles or at transit stations for fare payment.	Sun Metro
El Paso County Transit Real-Time Bus Arrival / Departure Signs	Medium Term	This project will implement electronic displays/signs at stations and bus stops/shelters along El Paso County Transit routes to present real-time bus arrival and departure information to riders. Bus schedule times will be estimated based on information from Automated Vehicle Locator (AVL) equipment located on transit buses.	El Paso County
Regional Transportation Data Hub with Analytic Tools	Medium Term	This project will establish a central data hub that will collect and store transportation data related to the El Paso Region. Data could be from both public agencies and third parties. Regional data hub would serve as a central data storage and a data clearinghouse for data access and distribution to all regional stakeholder agencies. In addition, the data hub will have data management and analytic tools to allow agencies and researchers to mine, aggregate, extrapolate and analyze data from multiple sources.	MPO and TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
TxDOT Flood Warning System	Medium Term	Flood detection and warning systems use field sensors for high water detection and activate advanced warning signs to alert drivers approaching the high water roadway segments. Flood warning functions may be completed locally by field detection and warning signs or in conjunction with a communications connection to the TMC if desired.	TxDOT
TxDOT High Wind Warning System	Medium Term	This project will deploy systems that detect high wind speeds at locations where high winds have been a factor in traffic incidents. Upon detection, warnings could be provided to drivers to slow their vehicle speeds, as well as to TMC operators that can post messages about high wind speeds detected along the roadway network.	TxDOT
TxDOT RWIS at Strategic Locations	Medium Term	The purpose of project is to install Road Weather Information System (RWIS) stations at key locations in the El Paso region to gather real-time weather conditions that could impact travel along the roadway network. An RWIS station would measure multiple types of weather information, such as air / pavement temperatures, precipitation types / amounts, surface conditions, wind velocity, and air pressure, among other types of information. Data would be reported to a central office location for processing and review by agency staff responsible for maintenance and / or traffic operations. Primary locations for these stations have been identified in ITS Master Plan along Interstate 10 between 375 and FM 3380, and between SH 20 and the Culberson County line.	TxDOT
TxDOT Slippery Pavement Warning System	Medium Term	This project will deploy a system that could detect slippery conditions on pavement surfaces due to rain, snow or ice, and provide warnings to motorists as well as TMC operators. Roadside sensors will monitor pavement friction or surface conditions and send a warning alert through flashing beacons upstream of the slippery pavement location to warn drivers. Alerts could also be sent to TransVista for use in activating dynamic message signs for warnings to motorists in advance of the slippery roadway.	TxDOT
TxDOT Visibility Warning System	Medium Term	This project will implement field equipment to detect low levels of visibility and activate warning messages either on Dynamic Message Signs or through means to alert drivers about low visibility on the corridor. System could be integrated with TxDOT TransVista for central monitoring of weather conditions on the corridor.	TxDOT

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
US 67 ITS Projects – Mid-Term	Medium Term	This is a list of ITS projects identified and recommended for mid-term implementation in the US 67 Corridor Master Plan. These are projects that could potentially be addressed in other ways and/or where the benefits from implementation are less substantial than for short term projects. Recommended mid-term ITS deployments include variable speed limit (VSL), animal warning systems, and traffic detection sensors, planned special event management systems, smartphone applications for first responders, integrated weather monitoring/prediction systems, integrated traveler information systems, traffic surveillance cameras, and Port of Entry smart parking system.	TxDOT
Doniphan Drive (SH 20) / Horizon Boulevard (FM 1281) HAWK Signal Deployment	Medium Term	This project includes the design and construction of High-intensity Activated crosswalk (HAWK) beacons at various locations along the Doniphan Drive (SH 20) and Horizon Boulevard (FM 1281) corridors. The existing mid-block crosswalk south of La Union Avenue within the Canutillo community is one of these areas where a HAWK beacon could be implemented to increase pedestrian safety. These projects could be done independently of roadway improvements, or in conjunction with other improvements along Doniphan Drive (SH 20) and Horizon Boulevard (FM 1281). HAWK beacons provide drivers multiple cues to emphasize the potential presence of pedestrians. These cues include HAWK beacons with two red lenses over a single yellow lens, high-visibility crosswalk markings, a 24-inch stop bar approximately 50-feet from the crosswalk, 8-inch solid lane lines between through travel lanes, and signs that illuminate and read "CROSSWALK." When activated, the HAWK uses a red indication to inform drivers to stop, thereby creating a time period for pedestrians to cross the roadway.	TxDOT and City of El Paso
Doniphan Drive (SH 20) Railroad Crossing Improvements	Medium Term	This project will install crossing signals and barricade arms, dedicated pedestrian paths with the latest ADA improvements, and warning devices and signage to improve safety and mobility concerns around railroad tracks along Doniphan Drive (SH 20) at a total of 18 crossings within the County of El Paso. This project sponsors include TxDOT, El Paso County, Village of Vinton, Town of Anthony, and BNSF.	TxDOT and City of El Paso
Mesa Street (SH 20) Mid Term ITS Improvements	Medium Term	This project includes bus queue-jump lanes and Dynamic Message Signs (DMS) at multiple locations along Mesa Street (SH 20). This project also includes cellular / wireless communications connection to TxDOT TransVista for control and configuration of DMS.	TxDOT and Sun Metro

Table 6. List of Recommended ITS Projects / Initiatives for Consideration (Continued)

Project	Timeframe	Description	Lead Stakeholder(s)
Critical Infrastructure Monitoring Systems	Medium Term	This project will deploy systems that monitor the security and conditions of critical infrastructure systems, such as bridges, tunnels, and other critical assets. Based upon detection of abnormal activity, alerts can be sent to TMC operators, public safety agencies or maintenance personnel for response actions.	TxDOT and City of El Paso
TxDOT Smart Street Lighting	Medium to Long Term	TxDOT will deploy a smart street lighting system that includes installation of photocell sensors and lighting controllers on street lights. The system will monitor and automatically turn street lights on and off based on sensed local conditions.	TxDOT
Weigh-in-Motion Scales and Virtual Weigh Stations	Medium to Long Term	This project will deploy weigh-in-motion scales and virtual weigh station systems that can assist TxDOT and Texas Highway Patrol with more efficient sorting and screening of commercial vehicles.	TxDOT and DPS
Portable Weigh-in-Motion Scales	Medium to Long Term	This project will procure portable weigh-in-motion scales for city and county law enforcement agencies to provide them the ability to bring commercial vehicle screening and/or direct enforcement capabilities to areas not served by permanent weigh stations. This allows for more efficient and effective target enforcement on commercial vehicle weigh compliance.	Cities and Counties
IH-10 Adaptive Lanes	Long Term	Adaptive lanes are proposed along the IH-10 Corridor between Redd Road and Loop 375. The adaptive lanes concept allows TxDOT for better management and response to on-demand traffic need for the corridor. The adaptive lanes project will include the following technology features: (1) Data Collection such as travel times, incidents, traffic volumes and speeds; (2) Active Traffic Management; (3) Drone Pathway – using drones to aid with incident management and provide live streaming video to TMC and incident responders; (4) Internet of Things to facilitate exchange of useful information; and (5) Truck Platooning – using vehicle to infrastructure (V2I) connectivity to improve the safety and efficiency of truck travel.	TxDOT
Mesa Street (SH 20) Long Term ITS Improvements	Long Term	This project includes fiber cable deployment along SH 20 / Mesa Street from Doniphan Drive (SH 20) to Loop 375 which can enable a connection of City of El Paso Cameras to TxDOT Lonestar system and also transform the SH 20 / Mesa Street corridor to a Smart Corridor for Connected Vehicle / Automated Vehicle (CV/AV) technology deployments in long term.	TxDOT and City of El Paso
US 67 ITS Projects – Long-Term	Long Term	This is a list of ITS projects identified and recommended for long term implementation in the US 67 Corridor Master Plan. ITS Deployments include Highway-Rail Crossing Safety Systems, Next Generation 911, and enhancing power and communications availability.	TxDOT

Part III: User Reference Guide

1. Glossary of Terms

Adaptive Traffic Signal System: A system that automatically adjusts traffic signal green times to improve the flow of vehicles as conditions change. The system monitors current traffic conditions, demand and capacity.

Architecture Flow: Architecture Flows (also referred to as “information flows”) refer to information that moves between the components of the physical architecture view of ARC-IT. Architecture flows are the primary tool that is used to define the Regional ITS Architecture interfaces. These architecture flows define what types of information is transferred and how that transfer should occur. For example, one architecture flow would be a dispatcher communicating information to an emergency vehicle responding to an incident.

Architecture Interconnect: Interconnects are communications paths that carry information between components of the physical architecture view of ARC-IT. Several different types of interconnects are defined in ARC-IT to reflect the range of interface requirements in ITS. Some common examples are vehicle to vehicle, point to point, and roadside to vehicle links.

Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT): ARC-IT is a reference architecture that reflects the contributions of a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.). It provides common basis for planners and engineers with differing concerns to conceive, design and implement systems using a common language as a basis for delivering ITS, but does not mandate any particular implementation.

Arterial (Non-Freeway) Traffic Management: Systems that monitor traffic conditions on roads other than freeways (ex. arterial streets and rural roads). The data collected is used to adjust traffic signal timing in order to improve traffic flow. The information is also used for incident management purposes and is distributed to the public in a variety of ways.

Automated Vehicle Maintenance: This technology performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on agency fleet and construction equipment. It includes on-board sensors capable of automatically performing diagnostics and using it to schedule and manage vehicle maintenance.

Automatic Vehicle Location (AVL): AVL systems track the approximate location of vehicles moving within a transportation network. The most common applications of AVL technology are for dispatching emergency vehicles, tracking transit vehicles and providing passengers with arrival time estimations through information displays.

Computer-Aided Dispatch (CAD): "Intelligent" interactive mapping and data entry systems that assist in the process of dispatching, monitoring, and managing emergency services. Emergency-dispatching hubs use computers to store, use, and report on information such as incident histories, manpower activities, and other tasks in ways that are logical and simplify the dispatchers' tasks.

Commercial Vehicle Operations (CVO): Automated and semi-automated systems that support administrative functions for processing many of the functions required of commercial vehicle operators. This includes

acquiring credentials, paying taxes, complying with enforcement and safety regulations as well as oversize/overweight permits.

Dedicated Short Range Communications (DSRC): A wireless communications channel used for close-proximity communications between vehicles and the roadway devices. It enables communications to occur between devices that are very near each other, usually within just a few feet. Examples include automated toll collection, transit vehicle electronic fare payments and equipment maintenance reporting. These systems can also deliver information to drivers and provide electronic transactions for automated vehicle operations.

Dynamic Message Sign (DMS): Electronic signs that display traffic conditions, alerts or other useful information to motorists or pedestrians. The term is used interchangeably with previous terminology such as variable message signs (VMS) and changeable message signs (CMS).

Element: This is the basic building block of Regional and Project ITS Architectures. It is the name used by stakeholders to describe a system or piece of a system.

Emergency Vehicle Preemption (EVP): This technology allows emergency vehicles (police, fire trucks, ambulances, etc.) to get priority treatment as they approach traffic signals. These systems can sense the location of the emergency vehicles and adjust the green times so they arrive at the incident sites faster and safer.

Environmental Sensor Stations (ESS): Technology that monitors, weather, roadway surface, vehicle emissions, and air/water quality conditions. The primary users of the information from these devices are roadway maintenance, driver information and traffic operations.

Fixed-Point to Fixed-Point Communications: A communication link serving stationary devices. It may operate using a variety of public or private communication networks and technologies. Examples include twisted pair, coaxial cable, fiber optic, microwave relay networks, and spread spectrum radio.

Freeway Management Systems: Freeway Management Systems provide real-time control, guidance, warning, and management of traffic in order to improve the flow of people and goods safely and efficiently.

Functional Object: Functional objects are the building blocks of the physical objects of the physical view. Functional objects group similar processes of a particular physical object together into an "implementable" package. The grouping also takes into account the need to accommodate various levels of functionality. Since functional objects are both the most detailed components of the physical view and tied to specific service packages, they provide the common link between the interface-oriented architecture definition and the deployment-oriented service packages.

Incident Detection: Incident Detection provides the capability for traffic managers to detect and verify that incidents have occurred. This includes analyzing data from traffic surveillance equipment, monitoring alerts from external reporting systems, collecting special event information, and responding to reports from their agency personnel in the field.

Incident/Emergency Management: Incident/Emergency Management enables communities to quickly identify any conditions that interrupt normal traffic flow such as crashes, vehicle breakdowns and debris in the roadway. The system also supports agency coordination to minimize clean-up and medical response time.

Intelligent Transportation Systems (ITS): ITS applies state-of-the-art and emerging technologies to provide more efficient and effective solutions to current multimodal transportation problems. Some examples of ITS are dynamic message signs, closed-circuit television monitoring systems, and traffic signal systems.

ITS Architecture: A common framework for planning, defining, and integrating intelligent transportation systems. An architecture functionally defines what the pieces of the system are and the information that is exchanged between those pieces. Architecture is defined functionally and does not prescribe particular technologies. This allows the architecture to remain effective over time as technologies evolve. It defines "what must be done," not "how it will be done."

On Board Security Monitoring System: On board security system for transit vehicles. This includes surveillance and sensors to monitor the on-board environment, silent alarms that can be activated by transit user or operator, and a remote vehicle disable function. The surveillance equipment includes video (e.g. CCTV cameras), audio systems and/or event recorder systems.

Ops Concept or Operational Concept: An Operational Concept describes the roles and responsibilities of stakeholders in providing the ITS services included in the ITS Architecture. For example, one of the roles and responsibilities of the City of El Paso Streets & Maintenance is to operate and maintain the traffic signal system within the city limits.

Physical Object: Physical objects are systems or device that provide ITS functionality that makes up the ITS and the surrounding environment. They are defined in terms of the services they support, the processing they include, and their interfaces with other physical objects. They are grouped into six classes: Centers, Field, ITS, Support, Travelers, and Vehicles. Example physical objects are the Traffic Management Center, the Vehicle Onboard Equipment, and the ITS Roadway Equipment. These correspond to the physical world: respectively traffic operations centers, equipped connected automobiles, and roadside signal controllers. Due to this close correspondence between the physical world and the physical objects, the interfaces between them are prime candidates for standardization.

Public Transportation (PT): A variety of technology applications that make public transportation more efficient and convenient. Some examples include automated fare payment systems, enunciators to inform people inside and outside the transit vehicles, smart phone APP's to track bus arrival times, and many other applications.

RAD-IT Software: The Regional Architecture Development for Intelligent Transportation (RAD-IT) is an automated software tool used to build and maintain an ITS Architecture. It provides a means to input and manage system inventory, service packages, architecture flows and interconnects with regard to a Regional ITS Architecture and/or multiple Project ITS Architectures.

Regional ITS Architecture: A local version of the ITS National Architecture that is tailored for a specific region. It can be used to produce project architecture reports for specific federally funded projects.

Road Weather Information System (RWIS): A system consisting of roadside meteorological components strategically located to provide information about weather issues affecting transportation. The principal components of RWIS include pavement sensors, atmospheric sensors, remote processing units (RPU), and central processing units (CPU).

Security Sensors and Surveillance Equipment: This technology includes cameras and sensors to monitor transportation infrastructure (e.g., bridges, tunnels and management centers) to detect potential threats. Such equipment includes acoustic, environmental threat (nuclear, explosive, chemical), motion and object sensors, and video and audio surveillance devices.

Service Package: Service packages are a combination of ITS architecture components tailored to provide a specific ITS service. For example, the Traffic Incident Management System Service Package combines incident detection systems, roadside surveillance devices, and coordination of traffic management centers to fulfill a number of useful needs related to the rapid clearing of incidents.

Standards: Documented technical specifications sponsored by a Standards Development Organization (SDO) to be used consistently as rules, guidelines, or definitions of characteristics for data transactions.

Subsystem: The principle elements of the physical architecture view of ARC-IT. Subsystems are individual pieces of the Intelligent Transportation System defined by ARC-IT. Subsystems are grouped into five classes: Center, Field, Vehicle, Support, and Personal.

Terminator: Terminators define the boundary of an architecture. The ARC-IT terminators represent the people, systems, and general environment that connect to Intelligent Transportation Systems.

Traffic Management (TM): A broad category of systems that collect and process information from sensors and CCTV cameras along major roadways. Once processed, the information is then used to manage traffic control devices such as ramp meters, traffic signals and other control devices. These systems are also the source of much of the data used to inform motorists through the Traveler Information systems listed below.

Transit Signal Priority (TSP): Transit signal priority refers to systems that usher transit vehicles through traffic-signal controlled intersections. Transit signal priority modifies the normal signal operation to better accommodate transit vehicles. Transit Signal Priority is similar to Emergency Vehicle Preemption; but it is less invasive to the signal operation.

Traveler Information (TI): A system, which distributes information to the traveling public over a variety of methods such as dynamic message sign, kiosks, Internet, cable television, social media, smartphones, etc.

Wi-Fi: Wi-Fi is a short-hand generic term referring to the wireless interface of mobile computing devices, such as laptops in local area networks (LANs) and Internet access. Standards are in development that will allow Wi-Fi to be used by cars on highways in support of an ITS to increase safety, gather statistics, and enable mobile commerce.

2. How to Navigate the Website

The purpose of the El Paso Regional ITS Architecture Website is to organize the details of the architecture into a form that is more readily accessible to stakeholders. It provides a method for stakeholders to access the architecture information in order to encourage use of the architecture in both transportation planning and project implementation. The El Paso Regional ITS Architecture Website can be accessed via the El Paso MPO website at: www.elpasompo.org.

The menu bar at the left provides access to different pages of the architecture. The pages to which each of these buttons lead are described below.

Home: This button takes the user to the homepage for the El Paso Regional ITS Architectures. The homepage describes the purpose of the architecture.

Scope: This page provides the geographic scope and service scope of the architecture. It also provides the planning time frame for the architecture.

Stakeholders: This page presents the full list of regional stakeholders, along with descriptions for each.

Inventory: This page presents the inventory of ITS elements along with a brief description of each. The inventory of ITS elements is arranged in an alphabetic order. The list of inventory can also be viewed by entity (subsystems and terminators as defined by ARC-IT) or by stakeholder.

Inventory by Entity: This page presents the inventory of ITS elements arranged by entity (subsystems and terminators). This allows all elements with related functions to be viewed simultaneously. Clicking on an element name opens a detail page that provides more information about the element, including a listing of all interfacing elements.

Inventory by Stakeholder: This page presents the inventory of ITS elements arranged by stakeholder. This allows all the elements owned by a single stakeholder to be viewed simultaneously. Clicking on an element name leads to a detail page that provides more information about the element, including a listing of all interfacing elements.

Services: This page presents a list of relevant service packages for the region and their deployment status. Clicking on the service package name links to the definition of the service package, its deployment status in the region, and a list of ITS elements associated with the service package.

Ops Concept: This page presents a table of relevant ITS service areas for the region. Clicking on a service area links to a detailed page with a list of stakeholders providing the service and their roles and responsibilities in the operations of the relevant ITS systems in the region.

Requirements: The page presents a list of ITS functional areas for the region. Clicking on a functional area leads to a detailed page that provides a description of the functional area, a list of regional ITS elements supporting the functions, and a list of functional requirements.

Interfaces: This page presents a table that identifies interfaces among ITS elements for the region. Clicking on an element in the "Element" column leads to a context diagram that shows how the element interfaces with other elements in the region. Clicking on an element in the "Interfacing Element" column brings up a detailed page that shows an interface diagram between the two elements, along with the definitions of the architecture/information flows.

Standards: This page provides a list of ITS standards that are applicable to the region. Clicking on the title of a standard opens a page that identifies how the standard can be applied to facilitate communications and electronic information exchanges in the region.

Agreements: This page presents a list of agreements that support ITS in the region.

Projects: This page presents a list of potential ITS projects for the region, along with recommended implementation time frame and brief project descriptions. Clicking on a project title opens a detailed page that provides additional information on the project.

3. Uses for the Architecture

3.1 Project Planning

The El Paso MPO, in collaboration with the TxDOT El Paso District, will be responsible for housing and maintaining the ITS Architecture. Being responsible for the architecture requires the MPO to be able to deliver a subset of the regional architecture that relates to specific projects. In other words, they must be able to produce a project architecture when a local agency is pursuing an ITS project. Typically a Project Architecture can be created as an extract from the Regional Architecture if the elements were included in the Regional Architecture. The flow diagram in **Figure 9** provides guidance on that process.

In order to produce a project architecture, the first step is to identify the type of service package(s) (e.g. transit, traveler information, emergency management, etc.) that are related to the project. Depending on the scope of the project, multiple types of service packages could be relevant and they should all be identified. For example, for a project involving the installation of dynamic message signs, the relevant service package types would be traveler information and emergency management. After service package types are identified, the specific service package(s) that describe the project must be identified. In continuing the example, the specific service packages that relate to dynamic message sign installation would be TM06 Traffic Information Dissemination, PS10 Wide-Area Alert, and MC06 Work Zone Management.

Once specific service packages have been identified, the service package diagrams must be reviewed to make sure they are correct and not duplicating functionality with another service package. For each project, the following items should be considered and inputted into RAD-IT:

- Make sure all specific service packages that relate to the project are identified (i.e. TM06, PS10, MC06, etc.);
- A specific service package may be relevant to multiple agencies, In this case, create multiple instances of that service package (i.e. an TM06 for City of El Paso, and TM06 for TxDOT El Paso District, etc.);
- Select the appropriate inventory items that are related to each specific service package;
- Select the appropriate stakeholder that owns the inventory item; and
- Check whether the data flow is planned or existing.

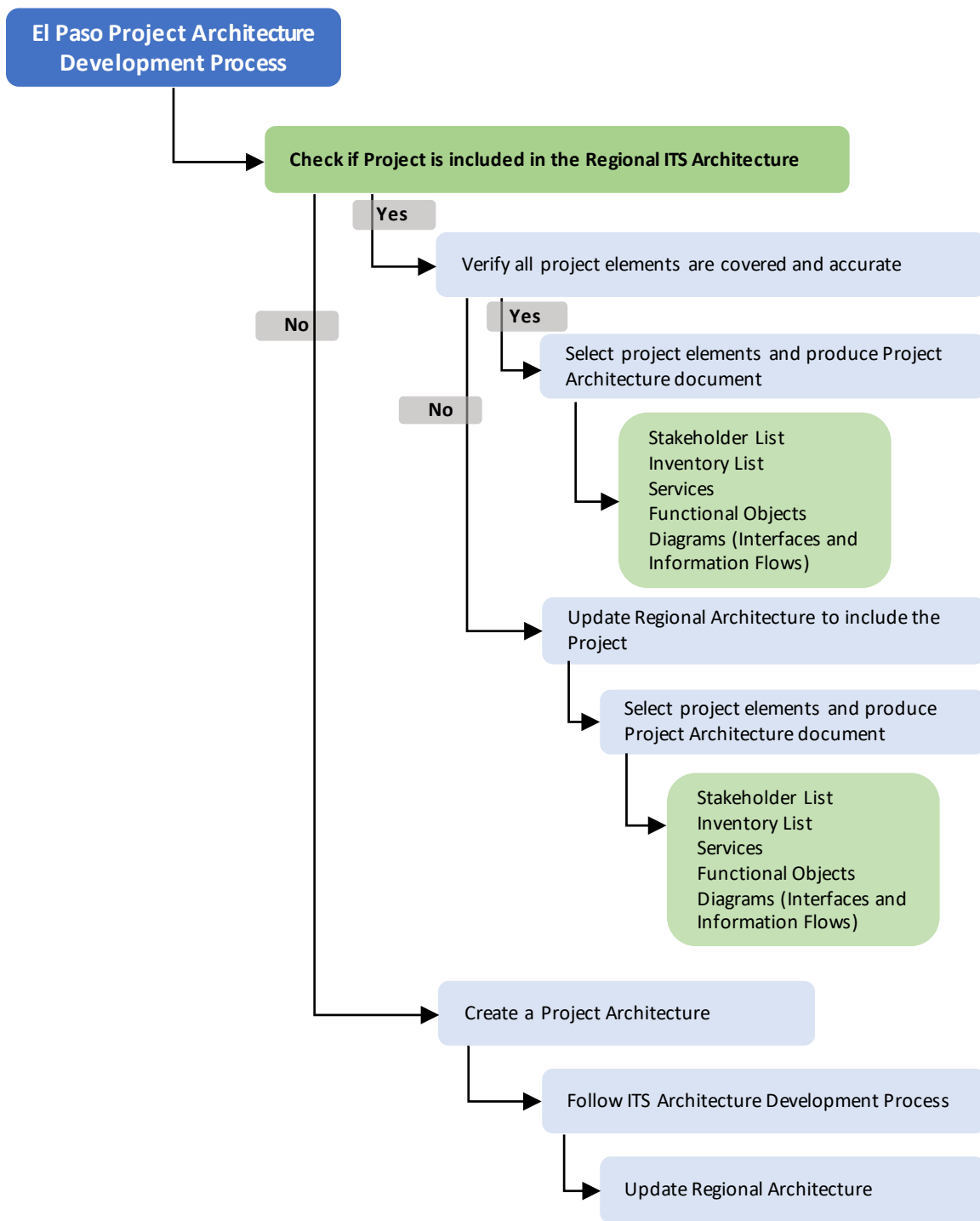


Figure 9. Project Architecture Development Process

Following review of the service package diagrams, the updated diagrams should be passed along to the agencies who are implementing the project to ensure all stakeholders are involved and they have the proper information to determine if it will impact other projects.

3.2 Project Programming

An up-to-date regional ITS architecture is important because projects must be aligned with the area's regional ITS architecture to receive federal funds. This section discusses how stakeholders can determine if a project is consistent with the architecture.

In order to use the El Paso Regional ITS Architecture to support project development, the agency must identify how the project contributes to or aligns with a portion of the architecture. This is a key step when using the architecture because it requires the agency to view the ITS project in the broader context of the entire architecture. Having an agency consider the wider architecture while the project's scope is being defined, enables them to consider the services, functionality, and integration opportunities that are envisioned by the region as a whole. This step is also required to meet the FHWA Architecture Rule/FTA Architecture Policy.

The ITS Architecture should be used as early in the project development lifecycle as possible so that integration opportunities are considered. The architecture should be reviewed before firm project cost estimates are established so there is still opportunity to adjust the scope in order to accommodate the regional functionality and interfaces identified. This opportunity may occur before or after programming/budgeting, depending on how specifically the ITS project is defined in the programming/budget documents.

3.3 Funding for ITS Projects

ITS projects proposed for the El Paso region would qualify for several categories of federal highway and transit funding. Each of these categories is discussed below with additional information on the location of these sources. Highway-related ITS initiatives would likely be funded with Surface Transportation Program (STP) funding dedicated to the El Paso region or with Congestion Mitigation and Air Quality (CMAQ) funds. Transit-related ITS initiatives would be funded with 5307 and CMAQ funds.

Increasingly, ITS elements are included as a component of broader-purposed TxDOT sponsored highway improvement projects. In these cases the ITS elements would be included with the National Highway Performance Program (NHPP), STP, or Highway Safety Improvement Program (HSIP) funded project, and such projects would be added to the Transportation Improvement Program (TIP) by Update, Amendment, or Modification procedures, as appropriate.

ITS projects and components may also be funded with, or included with projects funded with, state or local funds. State and locally funded projects are not required to be listed in the TIP unless they are deemed to be "regionally significant" (refer to the TIP for more discussion). It should also be noted that a re-authorization of federal transportation funding beyond the year 2020 will be required to support many of the grant programs described in this section.

FAST ACT (2015)

Most recently, the Fixing America's Surface Transportation (FAST) Act was signed into law in December 2015 for fiscal years 2016 through 2020. The previous federal transportation authorization program (Moving Ahead for Progress in the 21st Century (MAP-21)) included provisions to help make the delivery of transportation projects more streamlined and timelier while still meeting the requirements for planning, public outreach and engagement, and environmental review processes. The FAST Act builds on the efforts of MAP-21 and FHWA's Every Day Counts program to continue the acceleration of the delivery of complex but vital transportation projects.

The FAST Act authorizes a significant amount of funding for programs related to research, development, technology, and education. It also builds on MAP-21's transformation of the national transportation program to a performance and outcome-based program. The emphasis on performance management is intended to provide a means to more efficient investment of Federal transportation funds by focusing on national transportation goals, increasing the accountability and transparency of the Federal highway programs, and improving transportation investment decision making through performance-based planning and programming as DOTs incorporate performance goals, measures, and targets into the process of identifying needed transportation improvements and project selection. States will invest resources in projects to achieve individual targets that collectively will make progress toward national goals.

Federal and State Transportation Programs

A combination of federal and state funds is a likely scenario to pay for the implementation and operation of projects. Federal transportation authorization bills, including the FAST Act, continued or established a number of programs which are applicable to the deployment or operation of ITS technologies. Programs such as the National Highway System (NHS) and STP can be used to support ITS solutions. In addition to those broader programs, there are several specific programs with potential to fund ITS projects:

- Intelligent Transportation Systems (ITS) Program – The ITS Program provides \$100 million annually (FY2016-2020) for the research, development, and operational testing of ITS aimed at solving congestion and safety problems, improving operating efficiencies in transit and commercial vehicles, and reducing the environmental impact of growing travel demand (80% federal share).
- Advanced Transportation and Congestion Management Technologies Deployment Program (ATCMTD) – This program provides competitive grants for the development of model deployment sites for large scale installation and operation of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment (50% federal share).
- Congestion Mitigation and Air Quality (CMAQ) – The FAST Act continues the CMAQ program from MAP-21. The program funds projects that help reduce emissions and traffic congestion in areas designated as nonattainment or maintenance areas for carbon monoxide, ozone or particulate matter. Eligible projects include projects to improve mobility such as through real-time traffic, transit and multimodal traveler information, or otherwise reduce demand for roads through means such as telecommuting, ridesharing, carsharing, and pricing. The FAST Act also specifically makes eligible the installation of vehicle-to-infrastructure communications equipment. The FAST Act also continues eligibility for electric vehicle and natural gas vehicle infrastructure and adds priority for infrastructure located on the corridors designated under 23 U.S.C. 151.
- Surface Transportation Block Grant Program (STBG) – Program provides flexible funding that may be used by States and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals.
- National Highway Performance Program (NHPP) - NHPP funds may be obligated for a project on an eligible facility that supports progress toward the achievement of national performance goals for improving infrastructure condition, safety, congestion reduction, system reliability, or freight movement on the NHS5. Eligible projects include highway safety improvements on the NHS, which may also include truck parking per 23 U.S.C. 148.
- National Highway Freight Program (NHFP) – The NHFP provides formula funds to States to improve the condition and performance of the National Highway Freight Network under 23 U.S.C. 167(i)(5)(C). Eligible

activities include truck parking facilities and real-time traffic, truck parking, roadway condition, and multimodal transportation information systems. The NHFP funds are eligible for use on the National Highway Freight Network, as appropriate.

- Highway Research and Development (HRD) program – The HRD Program funds strategic investment in research activities that address current and emerging highway transportation needs, including activities to improve highway safety; activities to reduce congestion, improve highway operations, and enhance freight productivity; and exploratory advanced research (80% federal share).
- Technology and Innovation Deployment Program (TIDP) – The TIDP is focused on funding efforts to accelerate the implementation and delivery of new innovations and technologies that result from highway research and development to benefit all aspects of highway transportation (80% federal share).
- FASTLANE (Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies) grants – The FAST Act establishes a discretionary competitive grant program of \$4.5 billion over five years to provide financial assistance to nationally and regionally significant highway, rail, port, and intermodal freight and highway projects (maximum 60% federal share through this program).
- Nationally Significant Freight and Highway Projects (NSFHP) program – The NSFHP provides competitive grants, known as Infrastructure for Rebuilding America (INFRA) grants, or credit assistance to nationally and regionally significant freight and highway projects (maximum 60% federal share through this program).
- Highway Safety Improvement Program (HSIP) – The HSIP promotes reduced traffic fatalities and serious injuries on urban and rural public roads including work zones.
- Railway/Highway Crossings – The FAST Act authorized \$1.3 billion over five years for this program, which promotes reductions in the number and severity of injuries at public highway-railroad crossings (90% federal share).
- Training and Education Program – Funding for training, education, and workforce development activities that promote and support national transportation programs and activities.

Federal Grants

The principal purpose of an award of financial assistance is to transfer a thing of value from a federal agency to a recipient to carry out a public purpose of support or stimulation authorized by a law of the United States. A grant differs from a contract, which is used to acquire property or services for the Federal government's direct benefit or use. Federal grant information is available electronically at www.grants.gov.

- BUILD Grant Program – The Better Utilizing Investments to Leverage Development, or BUILD Transportation Discretionary Grant program, provides a unique opportunity for the DOT to invest in road, rail, transit and port projects that promise to achieve national objectives. Previously known as Transportation Investment Generating Economic Recovery, or TIGER Discretionary Grants, the BUILD program enables DOTs to examine projects on their merits to help ensure that taxpayers are getting the highest value for every dollar invested. The eligibility requirements of BUILD allow project sponsors at the State and local levels to obtain funding for multi-modal, multi-jurisdictional projects that are more difficult to support through traditional DOT programs. BUILD can provide capital funding directly to any public entity, including municipalities, counties, port authorities, tribal governments, MPOs, or others in contrast to traditional Federal programs which provide funding to very specific groups of applicants (mostly State DOTs and transit agencies).
- Innovative Technology Deployment (ITD) Grant Program – The Federal Motor Carrier Safety Administration (FMCSA) offers additional funding opportunities through its Innovative Technology Deployment (ITD) Grant

program. The program supports the deployment, operation, and maintenance aspects of the ITD program across the US.

- Motor Carrier Safety Assistance Program (MCSAP) Grants – The goal of the program is to improve motor carrier, commercial motor vehicle, and driver safety to support a safe and efficient surface transportation system. The program funds are eligible for deployment activities and activities to develop new and innovative advanced technology solutions that support commercial motor vehicle information systems and networks and for the operation and maintenance costs associated with innovative technology.

Public/Private Partnerships (P3)

A public-private partnership (commonly called a P3) is a contractual agreement between a public agency and a private entity that allows for greater private sector participation in the delivery and financing of a project. P3 arrangements provide the public sector with a proven tool to accelerate infrastructure delivery and contain costs. P3s provide a role for the private sector in solving public challenges, provide a variety of contract structures and financing, and are performance-based and outcome-focused. P3 delivery methods commonly fall into the following categories: design-build (DB), operate-maintain (OM), design-build-operate-maintain (DBOM), design-build-finance (DBF), and design-build-finance-operate-maintain (DBFOM). Each method can offer advantages or disadvantages, depending on the specific project and parties involved. Every transportation project is different and may or may not benefit from innovative delivery methods such as P3s.

Transit Funding

Federal transit funding is appropriated annually. Programs include: Urbanized Area Formula Program (5307), Rural Area Formula Program (5311, includes rural, small urban, and intercity bus), Enhanced Mobility of Seniors and Individuals with Disabilities Formula Program (5310), Metropolitan and Statewide Non-metropolitan Transportation Planning Formula Program (5303, 5304, 5305), State of Good Repair Grants (5337), and Bus and Bus Facilities Formula Grants (5339(a)).

The FAST Act continues several important goals established in MAP-21, including safety, state of good repair, and performance. It adds funding eligibility for the deployment of low or no emission vehicles, zero emission vehicles, or associated advanced technology. It continues to fund BRT projects in defined corridors that demonstrate substantial investment in fixed transit facilities including transit stations, ITS technology, traffic signal priority, and off-board fare collection.

Transportation Security Funds

Transportation security funds are another opportunity for funding projects with security applications, such as surveillance cameras or communications devices. Transportation enhancements and ITS projects can address security concerns by detecting threats, maximizing the movement of people, goods, and services, and supporting response activities. Security funds could be available through the Department of Homeland Security, Department of Agriculture, or the Department of Energy, as well as other agencies.

One example of these sources through the Department of Homeland Security is through preparedness grants to improve the nation's readiness in preventing, protecting against, responding to, recovering from and mitigating terrorist attacks, major disasters and other emergencies. ITS technologies can be used for monitoring and surveillance of transportation infrastructure (e.g., bridges, tunnels and management centers) and help to mitigate the impact of an incident if it occurs. CCTV cameras are a common technology used by

transportation agencies for this purpose, and thus preparedness grants through the department of homeland security are a potential funding source for this activity.

3.4 Project Design Concerns

When designing a project, functionality and ITS standards provide guidance and criteria to identify how the project will relate to the region’s overall operations. As projects grow in size, the functions and standards become complex and sometimes require agreements between agencies. It is beneficial to identify the agencies involved and the type(s) of agreement(s) needed early on in the project design.

How ITS components are shown in the architecture

The ARC-IT uses service packages to depict the current and future functions of ITS systems. Entities that represent sources of information are called “subsystems”, which are grouped into four classes: centers, fields, vehicles, and travelers as shown in **Table 7**, which also provides descriptions from ARC-IT for each subsystem and identifies examples of those subsystems.

Table 7. Subsystem Definitions

Subsystem	Definition	Examples
Center	Provides management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions.	Traffic Management Centers Emergency Operations Centers 911 Communications Centers
Field	Intelligent infrastructure distributed along the transportation network which perform surveillance, information gathering, and information dissemination and whose operation is governed by the center subsystem.	Traffic Signals CCTV Cameras Dynamic Message Signs Vehicle Detection
Vehicle	Covers ITS related elements on vehicle platforms such as automatic vehicle location equipment and operations capabilities for portable field equipment.	Maintenance and Construction Vehicles Public Safety Vehicles Incident Response Vehicles
Traveler	Equipment used by travelers to access ITS services prior to a trip, including information service providers.	Transit Bus Arrival/Departure Signs Smartphones Personal Computers

How to find general functional requirements related to a proposed project

Functional requirements explain how an inventory item provides the services described in their equipment packages. Equipment packages group inventory items together based on what overall function they serve and are listed in deployment-sized pieces (for example: emergency dispatch, roadway basic surveillance, traffic data collection, and transit center fixed-route operations).

The functional requirements can be found on the ARC-IT website (<https://local.iteris.com/arc-it/index.html>). The following process should be followed to access requirements for specific inventory items:

- Under the “Architecture” drop-down arrow in the top left corner of the Home Page of the ARC-IT website, select “Physical” that appears under “Views”

- Then click on the “Physical Objects” hyperlink that appears in the text on the Physical architecture web page
- Click on the “Subsystems” tab that will present all of the subsystems in ARC-IT, and then select the subsystem for which you are seeking functional requirements
- Click on the “Functionality” tab that will present the equipment packages associated with the subsystem
- Click on the “Requirements” tab, which will present a list of functionalities for each relevant equipment package.

How to obtain specific functional requirements from the El Paso Regional ITS Architecture

The need to obtain specific functional requirements from the El Paso Regional ITS Architecture related to a specific project can be found on the ITS Architecture website hosted by the El Paso MPO, following the instructions in Part C, Section 2 of this report.

A complete listing of functional requirements for the El Paso Regional ITS Architecture can be found on the El Paso Regional ITS Architecture Website.

How to select communication standards that apply to the project

ITS standards define how system components interact within the overall framework of ARC-IT. The use of standards ensures interoperability amongst various functions of an ITS project so that components or technologies from various vendors and at different scales (local, regional, and national) are still compatible. Standards also facilitate innovation in technology development without necessitating replacement of hardware or software systems that are needed to operate the new technology. Other purposes for ITS standards include:

- ITS standards used in a deployment can greatly reduce component development costs;
- ITS standards are open and non-proprietary, helping state and local transportation managers avoid costly single-source procurements and locked-in maintenance relationships with vendors;
- ITS standards support the deployment of interoperable ITS systems, helping agencies link together different types of ITS technologies and making system expansions easier to plan and implement; and
- ITS standards are being developed for many different types of ITS technologies and their use in project deployment is a key aspect of conformity with the FHWA Final Rule 940.

New standards that are developed go through an approval process before they are included in documents as formalized standards. Existing standards are amended and modified as needed based on new standards development or new technology development. Several national and international standards organizations are working toward developing ITS standards for communications, field infrastructure, messages and data dictionaries, and other areas. The organizations participating in ITS standards activities include:

- AASHTO (American Association of State Highway and Transportation Officials)
- ANSI (American National Standards Institute)
- APTA (American Public Transportation Association)
- ASTM (American Society for Testing and Materials)
- IEEE (Institute of Electrical and Electronics Engineers)
- ITE (Institute of Transportation Engineers)
- NEMA (National Electrical Manufacturers Association)
- SAE (Society of Automotive Engineers)

A listing of ITS standards that are pertinent to the El Paso Regional ITS Architecture is contained in Section 9 of the RAD-IT Report.

Why agreements may be needed to support a proposed project

Institutional agreements can support ITS functionality and project development in the region. Agreements allow agencies to document the roles and responsibilities of the particular service or function that is being agreed to, as well as any obligations each agency has for maintenance, operations, or financial support.

A listing of agreements based on the types of interfaces identified in the El Paso Regional ITS Architecture is contained on the Architecture Website. It is important to note that as ITS services and systems are implemented or expanded 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. These additional agreements are not listed in the ITS Architecture for specific projects because the possibility of coordination/sharing/joint operations is unique and should be evaluated for every project.

4. Architecture Maintenance Plan

The El Paso Regional ITS Architecture has been created as a consensus view of what ITS systems the stakeholders within the architecture boundary already have in place and what systems they plan to implement in the future. By its nature, the architecture is not a static set of outputs. The Architecture should be modified as plans and priorities change, ITS projects are implemented, and the ITS needs and services evolve in the region. There are many actions that may cause a need to update the architecture, including:

- Changes in Project Definition. When actually defined, a project may add, subtract or modify elements, interfaces, or information flows of the ITS Architecture. Because the architecture is meant to describe not only ITS planned, but also the current ITS implementations, it should be updated to correctly reflect the deployed projects.
- Changes due to Project Addition/Deletion. Occasionally a project will be added, deleted or modified during the planning process. When this occurs, the aspects of the ITS Architecture associated with the project should be added, deleted or modified.
- Changes in Project Status. As projects are deployed, the status of the architecture elements, services and flows that are part of the projects will have to be changed from planned to existing. Elements, services and flows should be considered to exist when they are substantially complete.
- Changes in Project Priority. Due to funding constraints, technological changes or other considerations, a project planned may be delayed or accelerated. Such changes should be reflected in the ITS Architecture.
- Changes in Regional Needs. Transportation planning is done to address regional transportation needs. Over time these needs change and the corresponding aspects of the ITS Architecture that addresses these needs should be updated.
- Changes in Participating Stakeholders. Stakeholder involvement can also change over time. The ITS Architecture should be updated to reflect the participating stakeholder roles in the statewide view of ITS elements, interfaces, and information flows.
- Changes in Other Architectures. The ITS Architecture includes not only elements and interfaces within the architecture boundary, but also interfaces to elements in adjacent and other areas. Changes in the Statewide ITS Architecture and ITS Architectures in adjacent areas may necessitate changes in the El Paso Regional ITS Architecture to maintain consistency. A Regional ITS Architecture may overlap with the Statewide ITS Architecture, and a change in one architecture may necessitate a change in the other.

- Changes in ARC-IT. The ARC-IT will be expanded and evolved from time to time to include new user services or refine existing services. These changes should be considered as the ITS Architecture is updated. Updates to ARC-IT and RAD-IT will be publicized on the ITS Joint Program Office (JPO) Architecture website: <https://www.its.dot.gov/index.htm>.

4.1 Who Is Responsible for Architecture Maintenance?

Responsibility for maintaining the ITS Architecture will lie with the El Paso MPO and the TxDOT El Paso District. The MPO and TxDOT should coordinate the maintenance activities and be the points of contact, including collecting, reviewing and evaluating change requests, tracking change requests, requesting additional information from stakeholders, distributing documentation, as well as calling meetings, making meeting arrangements, assembling an agenda, leading the meetings, and approving minutes. The El Paso MPO will make changes to the ITS Architecture and notify stakeholders of the changes.

4.2 What Will Be Maintained?

The following should be reviewed and updated at regular intervals:

- Description of the region
- Participating agencies and other stakeholders, including key contact information
- Inventory of existing and planned ITS systems in the region
- Operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems
- Agreements for operations and interoperability
- System functional requirements
- Interface requirements and information exchanges with planned and existing systems and subsystems
- Applicable ITS standards supporting regional and national interoperability
- Sequence of projects for implementation

There are several different components that make up the ITS Architecture. Some may require more frequent updates than others, but the entire architecture will need periodic review to ensure that it is consistent with the regional goals. The most current version of the El Paso Regional ITS Architecture shall be the baseline architecture upon which future revisions are conducted as necessary.

The El Paso Regional ITS Architecture was created based on ARC-IT Version 8.3 using RAD-IT Software Version 8.3.89. The Architecture was documented and stored in the following forms:

- El Paso Regional ITS Architecture Report
- El Paso Regional ITS Architecture Website
- Electronic RAD-IT database

The RAD-IT database can generate a set of outputs including various reports, tables, diagrams, and the architecture webpages. Such outputs include interconnect and information flow diagrams, inventory lists, stakeholder lists, service package lists, functional requirements, and other diagrams and reports. A generic ITS architecture report can also be generated directly from RAD-IT. At a minimum, the architecture should be maintained through updates in the database using the RAD-IT software.

4.3 How Changes Are Identified

Changes to the ITS Architecture may be identified by two channels. One is that stakeholders submit a request, and the second channel is actively soliciting changes from each stakeholder on an annual basis.

Stakeholders can contact the El Paso MPO or the TxDOT El Paso District to propose changes to the ITS Architecture. The MPO and TxDOT will perform an initial assessment of the proposed change for the impact to the ITS Architecture and/or the affected documentation. If the proposed change has an impact on other stakeholders, the MPO should contact those stakeholders to confirm their agreement with the proposed modification.

The second channel is for the MPO to distribute an annual survey to stakeholders to actively solicit the need for updating the architecture. This survey will contain a few basic questions for stakeholders to answer. A sample survey can be found in **Table 8**. If additional information is needed, the MPO will contact the stakeholder/s to identify the need for updating the architecture.

Table 8. Sample Architecture Maintenance Survey Questionnaire

<p>El Paso Regional ITS Architecture Maintenance Survey Questionnaire</p> <p>1. Did your agency implement (including upgrade) any technology and communications related systems or projects for transportation systems or emergency management in the past 12 months?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If YES, please describe the project(s) and/or provide project name(s) and available documentation source(s).</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>2. Does your agency plan to implement any technology or communications related projects in the next 5 years?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If YES, please describe the project(s) and/or provide project name(s) and available documentation source(s).</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>3. Please provide your contact information:</p> <p>Name: _____</p> <p>Agency: _____</p> <p>Phone: _____</p> <p>Email: _____</p> <p>Please submit this form to: XXXXXXXX, Email: XXXX, Phone: XXXX, Fax: XXXX. Thank you!</p>
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4.4 How Often Changes Are Made

A comprehensive, formal update of the ITS Architecture Baseline should be performed concurrently with the MPO's MTP updates to ensure the architecture continues to accurately represent the regional goals. The transportation goals set forth in the 2045 MTP include:

- **Safety:** improve the safety for all who travel in the region
- **Operations & Maintenance:** maintain the current transportation system in a state of good repair and maximize functionality
- **Mobility:** improve the ability for travelers to reach destinations quickly and efficiently
- **Accessibility & Travel Choice:** provide a variety of reliable transportation options that are equitable and context sensitive
- **Sustainability:** enhance the performance of the transportation system while protecting and enhancing the natural environment
- **Economic Vitality:** expand economic opportunities and strengthen the regional freight network
- **Quality of Life:** implement plans, programs, and projects that contribute to the overall goals and objectives designed in *Destino 2045* to ensure an enhanced quality of life in the El Paso Region.

It is recommended that a comprehensive update of the architecture baseline is performed within 6 months prior to or in conjunction with the MTP update.

Between major updates of the architecture, minor or informal modifications may be made at the discretion of the El Paso MPO and the TxDOT El Paso District. The MPO will solicit changes from stakeholders of needed updates. The MPO will contact stakeholders, via e-mail, written correspondence, and/or by telephone, and inquire if the stakeholder has any changes to the ITS Architecture. The change requests will be collected and reviewed by the MPO and the TxDOT El Paso District for consideration in the next minor update.

In addition, this Maintenance Plan should also be reviewed and evaluated periodically for required changes to the maintenance process. The actual maintenance process and procedures may differ from those anticipated during the initial development of this Maintenance Plan. Revising the Maintenance Plan will ensure both an effective architecture maintenance process and a change management process.

4.5 Change Review, Implementation and Release

The general steps in the change management process are described below:

- Stakeholders identify changes, notify the El Paso MPO or TxDOT of changes, (or complete the annual survey), and submit it to the MPO or TxDOT. If the initial information is gathered via the annual survey, the MPO/TxDOT contacts the stakeholder for more information.
- The MPO and TxDOT reviews the proposed changes, offers comments, and/or asks for additional information.
- The MPO and TxDOT, in coordination with the appropriate stakeholders affected by the proposed changes, evaluates the changes and determine what impact they may have on the Architecture and/or associated documentation.
- Upon its evaluation, the MPO and TxDOT make a decision to accept the change, reject it, or ask for additional information.
- If the decision is to accept the change, then the appropriate portions of the architecture baseline are updated by a designated member of the MPO.

- Once the ITS Architecture has been modified, the MPO publishes the updated architecture documentation, database and website.
- The MPO also notifies all stakeholders of architecture updates and provides information on how to obtain the latest version of the Architecture.

Appendix: Examples of Interagency Agreements

1. Regional Transportation Operations Consortium

MEMORANDUM OF UNDERSTANDING

For

CENTRAL FLORIDA'S

REGIONAL TRANSPORTATION OPERATIONS CONSORTIUM

PURPOSE

This **MEMORANDUM OF UNDERSTANDING (MOU)** provides the framework and guidelines to promote coordinated decision-making and information sharing in planning, design, development and evaluation of Intelligent Transportation Systems (ITS) via a **REGIONAL TRANSPORTATION OPERATIONS CONSORTIUM (CONSORTIUM)**. This MOU is made by and among the Central Florida ITS Working Group members, collectively referred to as the **Parties**, and includes the following operating agencies:

FLORIDA DEPARTMENT OF TRANSPORTATION - DISTRICT 5
ORLANDO-ORANGE COUNTY EXPRESSWAY AUTHORITY
FLORIDA DEPARTMENT OF TRANSPORTATION -TURNPIKE
ORANGE COUNTY
SEMINOLE COUNTY
VOLUSIA COUNTY
CITY OF ORLANDO
CITY OF DAYTONA BEACH
CENTRAL FLORIDA REGIONAL TRANSPORTATION AUTHORITY d/b/a LYNX
UNIVERSITY OF CENTRAL FLORIDA - CENTER FOR ADVANCED
TRANSPORTATION SYSTEMS SIMULATION
FLORIDA HIGHWAY PATROL, TROOP D
OSCEOLA COUNTY
BREVARD COUNTY

CONCEPT

The **Parties** to this **MOU** recognize the importance of rapid dissemination of reliable, credible, real-time Regional Traveler Information, improved vehicular mobility, increased energy conservation and improved air quality and each will work in coordination and cooperation to establish a regional approach to Intelligent Transportation Systems (ITS), which includes a coordinated implementation of various transportation management technologies to facilitate regional mobility across jurisdictional lines.

The regional cooperative approach to ITS will be accomplished through a Regional Transportation Operations Consortium whose primary goal is to establish ITS performance standards that will provide interoperability among the regional partners.

OBJECTIVE

The objective of this **MOU** is to establish the organizational structure to promote coordinated decision-making and information sharing in planning, developing, and funding a Regional Transportation Operations Consortium of operating agencies within the Central Florida region for the deployment, operation and maintenance of ITS initiatives.

The primary Goals of all **Parties** are described below:

- Goal 1:** Safe and efficient transportation for residents, visitors and commerce
- Goal 2:** Protection of the public's investment in transportation
- Goal 3:** A region-wide interconnected transportation system that enhances Central Florida's economic competitiveness
- Goal 4:** Travel choices to ensure mobility, sustain the quality of the environment, preserve community values and reduce energy consumption
- Goal 5:** Safe and efficient evacuation efforts
- Goal 6:** Create a positive environment that allows for the development and deployment of ITS initiatives and leverage individual agency initiatives for regional benefit

It is desirable that all **Parties** enter into this **MOU**, which describes the working relationship and responsibilities in the operating and communication of all parties' respective Intelligent Transportation Systems and will maximize the involvement of all Parties in creating a Regional Transportation Operations Consortium in Central Florida.

All **Parties** executing this **MOU** agree to be responsible for their own acts and shall not be held responsible for the acts of any other agency executing this **MOU**.

ORGANIZATIONAL STRUCTURE

This **MOU** establishes an organizational structure for Central Florida's Regional Transportation Operations Consortium. This organizational structure will consist of three (3) tiers of "Coordination Teams" as described below:

1. **Agency Managers – Handle Day to Day Operations**
The Agency Managers shall be comprised of managers that are involved in the design, construction, operation and maintenance of Central Florida's various transportation management programs.
2. **Leadership Teams – Various ITS Public Partners that are involved in ITS.**
The Leadership Team shall be comprised of managers from public entities that administer or are involved in transportation management.

3. Executive Committee – Provides Overall Program direction. The Executive Committee shall consist of two committees:

- Florida Intrastate Highway System (FIHS) Executive Committee for operators of FIHS facilities
- Arterial Executive Committee for operators of arterials and other facilities

The FIHS and Arterial Executive Committees shall be comprised of a senior level executive or equivalent thereof.

Each Agency agrees to:

- Share all available data and information gathered from its traffic management or traveler information systems with other **Parties**
- Promptly share all available tourist, incident congestion or emergency information gathered from its traffic management or traveler information systems with other **Parties**
- Coordinate the implementation of ITS initiatives
- Pursue joint funding opportunities for collective implementation of ITS initiatives where participation of a **Party** in collective initiatives is subject to the agreement of that **Party**
- Coordinate to reduce vehicular delay from incidents and minimize response time
- Coordinate to improve emergency management communications for evacuations and major route closings, re-routings or restrictions

Notwithstanding the above, the parties should not be required to share information that is not subject to the Florida Public Records Act or is otherwise exempt therefrom.

All **Parties** executing this **MOU** commit to developing a Business Model for the **MOU** that will be reviewed and approved on an annual basis by the Executive Committee. The Business Model will include, but is not limited to, the following key areas:

- Roles of the three (3) Coordination Teams
- Decision Making Model for the **MOU**
- Definition of the Region
- Future Expansion of the Region
- Exchange of Information
- Identify Funding Opportunities
- Branding and Promotion

SOVEREIGN IMMUNITY

Each Party hereto agrees that it shall be solely responsible for the wrongful acts of its employees, officers and authorized agents to the extent provided under Section 768.28 Statutes. Nothing contained herein shall constitute a waiver by any party of its sovereign immunity under Section 768.28, Florida Statutes.

GENERAL PROVISIONS

All Parties executing this **MOU** recognize the following general provisions:

1. This **MOU** is not a binding contract, and each of the participants recognizes and acknowledges the individual constraints which may be imposed upon individual Consortium members because of such things as local regulations, specific state statutes, bonds, or other contractual covenants, agency policies and etc.
2. Each participating member of the Consortium has a specific constituency to which it has a primary duty and obligation, as well as, statutory or constitutional obligations generally described in the member's enabling legislation or charter.
3. Notwithstanding the provisions herein contained regarding the sharing of information, such sharing may be limited by individual agency policies or statutes or may be the subject of contractual non-disclosure, licenses or confidentiality agreements.
4. Consortium participants will exercise efforts in good faith, but no other Consortium member is entitled to contractually or otherwise rely upon such efforts, nor shall any member be subject to claims from another member because of failures or omissions.
5. Coordination in the implementation of Consortium initiatives does not impose an obligation upon any member to adopt or follow policies, equipment specifications, protocols or criteria in furtherance of a desire for uniformity.
6. Except as may be required by applicable law no Consortium member shall be required to comply with emergency management directives or plans where such compliance is inconsistent with or adverse to the practices and procedures of such member. No Consortium member shall be required to lift tolls unless so directed by the Governor in compliance with Florida Statutes

AGREEMENT EXECUTION: USE OF COUNTERPART SIGNATURE PAGES

This **MOU**, and any amendments hereto may be simultaneously executed in multiple counterparts, each of which so executed shall be deemed to be an original, and such counterparts together shall constitute one and the same instrument. Notwithstanding any other provision herein to the contrary, this **MOU** shall constitute an agreement amongst the parties that have executed a counterpart and parties listed but not executing shall not be deemed to be parties to the **MOU**.

Any party to this **MOU** may terminate its involvement with the Regional Transportation Operations Consortium provided that the party gives written notice of intent to terminate to all parties adhered to.

2. CCTV Live Video Sharing Agreement

Tennessee Department of Transportation And Private Entity USERS

ACCESS AGREEMENT FOR LIVE VIDEO AND INFORMATION SHARING

This Access Agreement for Live Video and Information Sharing is an Agreement between the Tennessee Department of Transportation (TDOT) and _____ hereafter referred to as the "USER."

The effective date of this Agreement is _____.

The "Access to Live Video" is that video provided by a Closed Circuit Television (CCTV) system developed for traffic management and provided by the Tennessee Department of Transportation Regional Transportation Management Centers (RTMC) operated by TDOT. The CCTV feeds will show live traffic conditions including crashes, stalled vehicles, road hazards, weather conditions, traffic congestion, maintenance work, and repair work locations.

The purpose of providing the USER with Access to Live Video is to detect and disseminate real-time traffic information to motorists and improve incident response and recovery. The following provisions of this Agreement are intended to ensure that the CCTV system is accessed and its information is used for this purpose and this purpose alone.

Information Sharing, as defined in this agreement, is that information provided or discovered by the USER which has an adverse traffic impact on any Tennessee Interstate, State Route, and that which adversely affects travelers. Any information that falls within this definition will be shared with the TDOT RTMC within 10 minutes of receiving such information.

The USER hereby acknowledges and agrees that other matters not specifically addressed in this Agreement may arise and that TDOT shall have the right to make changes in this Agreement, by adding provisions, deleting provisions, and/or changing existing provisions when in TDOT's opinion circumstances require such changes. TDOT shall provide prior written notice of any such changes to this Agreement to the USER at which time the USER may or may not accept the revisions. Not accepting future revisions may result in the USER being denied access to the live video feeds.

USER shall also retain the right to terminate this Agreement as provided herein.

1. GENERAL INFORMATION:

- A. TDOT will operate and maintain the CCTV system as a traffic management tool and, consistent with this purpose, TDOT agrees to provide the USER with Access to Live Video and Information Sharing. TDOT does not guarantee the continuity of this access, and TDOT does not warrant the quality of any video feeds or the accuracy of any image or information provided. Any reliance on such images or information is at the risk of the USER.
- B. TDOT will not record video feeds except for staff training purposes, and no recordings will be made available to the USER under this Agreement.
- C. TDOT will maintain exclusive control of the information and images released from the CCTV system to the USER, including but not limited to determining whether and when to provide a CCTV system feed, from what location, and for what duration. No feed will deploy the cameras' zoom capabilities, and no image will focus on vehicle license plates, drivers, or other personal identification of individuals involved in any traffic-related incident. No image will focus on any property or person outside the TDOT right-of-way. Access via feed will not be provided for events that are not, in the opinion of TDOT personnel, traffic-related. The decision whether to activate, and upon activation to terminate the access, is exclusively at the discretion of TDOT personnel.
- D. TDOT RTMC personnel will not accept requests that specific CCTV cameras are operated or repositioned.
- E. TDOT will provide each USER the same video feed from the CCTV system as any other USER participating in this Agreement. This Agreement in no way limits or restricts TDOT from providing video information to any other potential USER.
- F. TDOT reserves the right to terminate this video access program or to change the areas, times, or levels of access within the RTMC at any time.
- G. TDOT will provide Training Opportunities to all entities named in this Agreement and encourage participation in said training.

2. USER'S RESPONSIBILITIES:

- A. USER is exclusively responsible for any costs related to the purchase and installation of the equipment necessary to receive the live video feed. User will be required to remove previously installed equipment from the

RTMC (if any). USER is exclusively responsible for any costs related to the removal of this equipment. USER must give RTMC personnel reasonable advance notice to schedule an appointment to remove equipment and RTMC personnel reserve the right to schedule such at a time and in such a manner so as to not interrupt or otherwise obstruct RTMC operations. USER staff at the RTMC shall be under the general direction of the RTMC Manager for routine conduct, privileges, and protocols within the RTMC.

- B. USER shall maintain the security and integrity of the CCTV system by limiting use of the system to trained and authorized individuals within their organization, and by insuring the system is used for the specific purpose stated in this Agreement. No feed shall be purposely broadcast live or rebroadcast that is zoomed in on an incident where individuals or license numbers are recognizable.
- C. USER accepts all risks inherent with the live video feeds, including, but not limited to, interruptions in the video feed, downtime for maintenance, or unannounced adjustments to the camera displays. TDOT is providing the video feeds as a convenience to the USER and agrees to provide a good faith effort to maintain the video feed from TDOT equipment. The USER agrees to hold TDOT harmless, including TDOT employees and TDOT designated agents, from any damages caused to USER by loss of a video signal due to equipment failure or any act or omission on their part.
- D. USER agrees to provide TDOT with a technical contact person and with a list of all USER personnel trained to operate the TDOT SmartView system. USER shall limit technical calls to the RTMC for monitoring, diagnosing problems or otherwise performing any minor service on the SmartView system.
- E. USER agrees to acknowledge that the video feeds are provided by the Tennessee Department of Transportation.
- F. USER agrees to display the SMARTWAY logo in the upper left hand corner of any view provided outside of the agency.
- G. USER agrees to provide timely, accurate information and assistance to TDOT or other agencies, responders and roadway users about roadway conditions, major and minor incidents and alternate routes through the use of any media and USER resources.
 - i. USER agrees to notify the RTMC of their surrounding TDOT Region of any unexpected incidents that are expected to have an adverse impact on traffic operations of Interstate or State Routes, within 10 minutes of first notification to the USER. This applies to

any incident where TDOT or the Tennessee Highway Patrol is not already on-scene. Unexpected incidents may include, but are not limited to: traffic crashes, disabled vehicles, roadway debris, hazardous weather conditions, traffic queues, or traffic signal failures.

- ii. USER agrees to collaborate with TDOT with respect to traffic management of planned events that are expected to have an adverse impact on traffic operations of Interstate or State Routes. Planned events include temporary traffic generating events (such as concerts or fairs) and roadway work zone activities (such as construction or maintenance activities). Collaboration and information sharing between USER and TDOT should occur as early as possible.

H. USER is invited to participate in quarterly Regional Traffic Incident Management meetings and may attend any traffic incident management training provided by participating agencies.

3. LIABILITY AND INDEMNITY PROVISIONS:

- A. USER agrees to defend, indemnify, and hold TDOT harmless from and against any and all liability and expense, including defense costs and legal fees, caused by any negligent or wrongful act or omission of the USER, or its agents, officers, and employees, in the use, possession, or dissemination of information made available from the CCTV system to the extent that such expenses or liability may be incurred by TDOT, including but not limited to, personal injury, bodily injury, death, property damage, and/or injury to privacy or reputation.
- B. The liability obligations assumed by the USER pursuant to this Agreement shall survive the termination of the Agreement, as to any and all claims including without limitation liability for any damages to TDOT property or for injury, death, property damage, or injury to personal reputation or privacy occurring as a proximate result of information made available from the CCTV system.

4. TERMINATION:

- A. TDOT or USER may terminate this Agreement at any time for any reason by providing written notice of termination.

**State of Tennessee
Department of Transportation**

Approved as to Form:

By: _____
John Schroer
Commissioner

John Reinbold
General Counsel

Date: _____

USER AGENCY _____

By _____

(Print Name) _____

(Title) _____

Date: _____

Approved by Legal Counsel for USER AGENCY

By _____

(Print Name) _____

(Title) _____

Date: _____

3. Multiagency CCTV Sharing, Control, Operations and Maintenance

MEMORANDUM OF UNDERSTANDING

between

City of Syracuse, New York State Department of Transportation, Onondaga County Department of Transportation and Onondaga County 911 Emergency Communications

The City of Syracuse and New York State Department of Transportation, Region 3, each operate and maintain video surveillance equipment for monitoring traffic flow and to detect traffic incidents within the Syracuse metropolitan area. It has been recognized through the ITS Regional Architecture and other efforts that traffic and incident management in the area could be enhanced through the sharing of traffic monitoring video images among the agencies responsible for traffic and incident management as well as providing this information to the public. The intent of this Memorandum of Understanding is to outline the terms of understanding regarding the sharing, control, operations and maintenance of the video surveillance equipment. This memorandum also addresses the maintenance responsibilities for the traffic signal equipment that is part of both the existing City of Syracuse Interconnected Signal System and the planned expansion of that system.

Proper mediation of video control is critical. For the Syracuse region, Table 1 provides the basis for control hierarchy relating to video images by stakeholder. The intent of this table is provide operational guidelines for **direct video feeds and control**, and is not intended to limit other means of video distribution to the general public or other agencies via Internet web sites, local media, or other public traveler information systems.

Table 1: Video Access and Control Mediation by Owning Agency & Stakeholder

CCTV Camera Owning Agency	Stakeholder	Primary Control	Secondary Control	View Only	No Direct Connection
City of Syracuse	City of Syracuse Dept. of Public Works (Traffic Engineering & Maintenance)	X			
	New York State Department of Transportation		X		
	Local Media			X	
	Onondaga County Department of Transportation			X	
	Onondaga County 911 Emergency Communications (ECD)		X		
New York State Department of Transportation	City of Syracuse Dept. of Public Works (Traffic Engineering & Maintenance)			X	
	New York State Department of Transportation	X			
	Local Media			X	
	Onondaga County Department of Transportation			X	
	Onondaga County 911 Emergency Communications (ECD)			X	

Based on NYSDOT’s plans for enhancing its video server and providing video to the Onondaga County 911 Emergency Communications and possibly to the media and general public, it is recommended that this video server act as the single point for video distribution throughout the region. Therefore video images from the City of Syracuse would be shared with NYSDOT and then be available to any other stakeholders that end up with a connection to the NYSDOT video server.

Physical System Maintenance

The Syracuse regional traffic signal and communication system will consist of an integrated system of hardware, technologies, and processes for performing an array of functions, including data acquisition, command and control, computing, and communications. Disruptions or failures in the performance of these functions can impact traffic safety, reduce system capacity, and ultimately lead the traveling public to lose faith in the transportation network. The problem is further complicated by the fact that today’s systems, subsystems, and components often are highly interdependent, meaning that a single malfunction can critically impact the ability of the overall systems to perform their intended functions.

Physical maintenance of the system will follow the guidelines as highlighted in Table 2.

Table 2: Physical System Maintenance Responsibilities

Item	Maintenance Responsibility
City of Syracuse Traffic Signal Infrastructure	City of Syracuse
NYSDOT Traffic Signal Infrastructure	NYSDOT
City of Syracuse Communication System Infrastructure	City of Syracuse
NYSDOT Communication System Infrastructure	City of Syracuse
CCTV Cameras - City of Syracuse ROW	City of Syracuse
CCTV Cameras – NYSDOT ROW	NYSDOT
System Data Archiving / Data Repository	City of Syracuse
Facility Computer & Network Equipment – City of Syracuse	City of Syracuse
Facility Computer & Network Equipment – NYSDOT	NYSDOT
Other Agency ROW / Facility Infrastructure (IF APPLICABLE)	Other Agency

Regarding the NYSDOT Communication System Infrastructure referenced in Table 2 above, this only refers to communication infrastructure directly connecting NYSDOT traffic signals to the City of Syracuse traffic signal system. All other communication infrastructure of NYSDOT is separate from the Syracuse Interconnect Expansion Project and shall remain the responsibility of NYSDOT. The practice that has been in place since the signal system was implemented is the City of Syracuse owns and maintains the communication infrastructure serving the NYSDOT traffic signals connected to the

system. The demarcation line for maintenance responsibility is the fiber optic transceiver within the NYSDOT control cabinets. The City of Syracuse maintains all communication infrastructure up to and including the transceiver, while NYSDOT maintains everything else within and including the traffic signal cabinet. It is agreed that this maintenance practice and the areas of responsibility presented above will continue until further modified by the parties included in this memorandum of understanding.

NYSDOT is in the process of implementing solutions that will allow for the sharing of video images among various stakeholders throughout the region. As part of the Syracuse Interconnect Expansion Project, existing video and new cameras that will be added to the signal system by the City of Syracuse will be linked to the NYSDOT Region 3 TMC through the information exchange network. The majority of the communications infrastructure to facilitate this sharing of video will be implemented by the City of Syracuse through use of the signal system fiber optic interconnect and other fiber and communications equipment resources that have been installed by the City of Syracuse. Regarding the maintenance of this equipment, all equipment that has been purchased and installed by the City of Syracuse will be maintained by the City of Syracuse. Any communication equipment installed in NYSDOT facilities to allow for this exchange will be the property of and will be maintained by NYSDOT. Through the Technical Advisory Committee meetings, the issue of supporting the video distribution throughout the region has been discussed and NYSDOT has agreed that it will provide and maintain the equipment at its facilities necessary to support the video sharing. Communication infrastructure connections or equipment necessary for other agencies to gain access to the video distribution network will be the responsibility of each agency as will the maintenance of any required equipment or connections.

This Memorandum of Understanding shall become effective when signed by all parties, and shall remain in force until thirty (30) days after written notice of a desire to terminate by any party.

AGREED:

City of Syracuse:

Matthew J. Driscoll Date
Mayor, City of Syracuse

New York State Department of Transportation

Carl F. Ford Date
Director, Region 3

Onondaga County

Nicholas J. Pirro Date
Onondaga County Executive

SAMPLE

4. Fiber Optic Cable Sharing Agreement

MULTIPLE USE AGREEMENT
for
SHARING FIBER OPTIC CABLE RELATED INFRASTRUCTURE

with
City of El Paso
and the
Texas Department of Transportation

This agreement is made by and between the State of Texas, acting by and through the Texas Department of Transportation, hereinafter called the "Department," and City of El Paso, hereinafter called the "Local Government", and collectively known as the "parties."

The parties desire to connect to and/or use existing Fiber Optic Cable Related Infrastructure for the purpose of transmitting traffic safety and transportation-related data only. Related Infrastructure includes but is not limited to fiber optic facilities such as conduit, ducts, control cabinets, poles, structures, etc. along TxDOT roadways and right-of-way, as well as offices, operations and control centers, substations, etc. within the TxDOT operations network. The desired connection and use must not cause damage to or adversely effect data, interconnections, systems, facilities, infrastructure or operations as determined by the Department.

The governing body of the Local Government has authorized entering into this agreement by resolution or ordinance dated March 23, 2010, which is attached to and incorporated by reference in this agreement as Attachment A.

This contract incorporates the provisions of **Attachment A**, Local Government's Resolution or Ordinance; **Attachment B**, Descriptions and Specifications of Rights Granted in Article 2; **Attachment C**, Request for Authorization of Fiber Optic Cable Connection; **Attachment D**, Request for Authorization of [Fiber Optic Cable-Related] Infrastructure Connection; **Attachment E**, Map of Mutually Agreed-Upon Fiber Optic Cable and/or Related Infrastructure.

In consideration of the mutual promises contained in this agreement, the Department and the Local Government now agree as follows:

A G R E E M E N T

ARTICLE 1. CONTRACT PERIOD

This agreement becomes effective when signed by the last party whose signing makes the agreement fully executed, and shall terminate five (5) years from that date, or when otherwise modified or terminated, as hereinafter provided.

ARTICLE 2. RIGHTS GRANTED

- A. The Department agrees to allow the connection to the Department's Fiber Optic Cable Related Infrastructure by the Local Government.
- B. The Local Government shall be allowed to use only the mutually agreed upon Department Fiber Optic Cable Related Infrastructure as listed in Attachments B, C, D, and further illustrated in Attachment E.
- C. The unit of capacity exchange by either shared method shall be mutually agreed upon on a

- case-by-case basis. Capacity exchanges need not be on an equal basis.
- D. The Department permits the Local Government to enter upon its right-of-way and to attach, install, operate, maintain, remove, reattach, reinstall, relocate, and replace such connections of the Local Government's Fiber Optic Related Infrastructure to the Department's Fiber Optic Cable Related Infrastructure.
 - E. Any and all rights expressly granted to Local Government to use the Fiber Optic Cable Related Infrastructure of the Department shall be subject to the prior and continuing right of the Department to use its Fiber Optic Cable Related Infrastructure for its own purposes under applicable laws. The rights granted shall be further subject to all deeds, easements, dedications, conditions, covenants, restrictions, encumbrances, and claims of title of record which may affect the rights to use the Fiber Optic Cable Related Infrastructure.
 - F. Nothing in this agreement shall be deemed to grant, convey, create, or vest in either party a real property interest in land, including any fee, leasehold interest, or easement.

ARTICLE 3. OPERATION AND MAINTENANCE RESPONSIBILITIES

- A. Each party will be responsible for the design, engineering, installation, operation and maintenance of their respective Fiber Optic Cable Related Infrastructure system and components, to include the connections, within their respective right-of-ways.
- B. Each party is responsible for providing and maintaining any hardware, software, and additional infrastructure that are necessary to obtain the rights in Article 2. The Department may provide unused Intelligent Transportation Systems infrastructure and Department facilities to support the additional infrastructure when possible and when deemed to be in the best interest of the Department.
- C. Because of unforeseen circumstances that may arise from the operation of the Department hardware or software, or other difficulties in telecommunications transmission over which the Department has no control, no guarantee is made that use of facilities will be available to the Local Government at all times during the term of this agreement. The Department is not responsible for any loss of revenue to the Local Government due to any interruption in the facilities. The Department does not guarantee a minimum response time to re-establish the facilities due to Department network or system failures or any other circumstance.
- D. The Local Government will pay its predetermined share (based on fibers in use) of any routine maintenance required for the applicable Fiber Optic Cable Related Infrastructure, and fully 50% of any emergency repair of shared Fiber Optic Cable Related Infrastructure, including excavation costs.

ARTICLE 4. INSTALLATION STANDARDS

- A. Any installation, repairs, or removal of equipment shall be performed in accordance with industry standards.
- B. At the Local Government's sole cost and expense, all such work shall be done in compliance with all applicable building codes, ordinances, and other laws, rules, or regulations of governmental authorities having jurisdiction over such work, including, but not limited to, the Americans with Disabilities Act and the Texas Architectural Barriers Act.
- C. The Local Government must obtain all required governmental agreements, permits, and authorizations prior to beginning any such work and shall provide copies of the same to the Department upon request.
- D. After commencement of the installation of the equipment, the Local Government shall perform such work with due diligence to its completion.
- E. The Local Government is solely responsible for meeting and adhering to the above listed standards notwithstanding the Department's approval of plans and specifications.

ARTICLE 5. INSTALLATION OF EQUIPMENT

- A. The Local Government shall install any necessary hardware, software, or other infrastructure at its sole cost and risk.
- B. Any equipment installation, engineering design, or operations and maintenance plan provided by the Local Government shall be subject to the Department's review and approval to ensure compatibility with existing equipment and software.

- C. All equipment shall be clearly labeled to identify it as equipment installed by the Local Government.
- D. The Local Government shall provide all interface items required to maintain the equipment.
- E. Access by the Local Government's employees or contractors to the equipment located at the Department's facility will be by appointment only and must have designated Department personnel present.

ARTICLE 6. NOTICE TO PROCEED

A properly completed Request for Authorization of Fiber Optic Cable Related Infrastructure Connection form, attached to this agreement as Attachments C and D, shall be submitted to the Department for approval prior to any work being done. The Department shall review and approve or disapprove the connection, in writing, within sixty (60) days. During the course of the work, any substantial changes or alterations must also be submitted to the Department for prior written approval. All work shall be done in conformity with the approved Attachment B and/or C. Upon completion of the work, the Local Government shall promptly furnish suitable documentation showing the exact nature of the connection.

ARTICLE 7. FEES

The Department may require consideration for the agreement in the form of a payment; shared use of a telecommunication facility; or equipment, facilities, or services. The Department requires a tape of any stories related to the Department or those that involve any input from Department employees that are aired by the Local Government.

ARTICLE 8. INSPECTION

Ingress and egress shall be allowed at all times to the Local Government's facility for Federal Highway Administration and Department personnel and equipment when highway maintenance operations are necessary, and for inspection purposes; and upon request, all Local Government activities shall be prohibited until further notice from the Department.

ARTICLE 9. INSURANCE

To the extent that this agreement authorizes the Local Government or its contractor to perform any work on State right-of-way, before beginning work the entity performing the work shall provide the Department with a fully executed copy of the Department's Form 1560 Certificate of Insurance verifying the existence of coverage in the amounts and types specified on the Certificate of Insurance for all persons and entities working on State right-of-way. This coverage shall be maintained until all work on the State right-of-way is complete. If coverage is not maintained, all work on State right-of-way shall cease immediately, and the Department may recover damages and all costs of completing the work.

ARTICLE 10. AMENDMENTS

Amendments to this agreement must be in writing and executed by both parties. Any amendments must be executed during the contract period established in Article 1, Contract Period.

ARTICLE 11. TERMINATION

- A. Including the provisions established herein, this agreement may be terminated by either of the following conditions:
 - (1) By mutual written agreement, or 30 days after either party gives notice to the other party, whichever occurs first; or
 - (2) By the Department at any time if it is found that traffic conditions have so changed that the existence or use of the respective Fiber Optic Cable Related Infrastructure is impeding maintenance, damaging the highway facility, impairing safety or that the facility is not being properly operated or maintained or that it is not in the public interest; or
 - (3) By the Department, upon written notice to the Local Government as consequence of the Local Government's failure to comply with the requirements of this agreement,

unless the Local Government's failure to comply with the agreement is due to no fault of its own.

- B. If the termination is due to the failure of the Local Government to fulfill its contractual obligations, the Department will notify the Local Government that a possible breach of contract has occurred. The Local Government must remedy the breach as outlined by the Department to the Department's satisfaction within thirty (30) days from receipt of the Department's notification. The Department will declare this agreement terminated upon the Local Government's failure to remedy the breach within the 30-day period.
- C. Termination of the agreement shall extinguish all rights, duties, obligations and liabilities of the Department and the Local Government under this agreement.
- D. Termination or expiration of this agreement shall not extinguish any of the Local Government's or the Department's obligations under this agreement that by their terms continue after the date of termination or expiration.

ARTICLE 12. REMEDIES

Violation or breach of contract by the Local Government shall be grounds for termination of the agreement and any increased costs arising from the Local Government's default, breach of contract or violation of agreement terms shall be paid by the Local Government. This agreement shall not be considered as specifying the exclusive remedy for any default, but either party may avail itself of any remedy existing at law or in equity, and all remedies shall be cumulative.

ARTICLE 13. RELATIONSHIP BETWEEN THE PARTIES

Each party acknowledges that it is not an agent, servant, or employee of the other party. Each party is responsible for its own acts and deeds and for those of its agents, servants, or employees.

ARTICLE 14. ASSIGNMENT PROHIBITION

The Local Government is prohibited from assigning any of the rights conferred by this agreement, to any third party without the advance written approval of the Department. Any attempted transfer of the rights or obligations of this agreement without the Department's consent shall be void and shall be grounds for termination of this agreement.

ARTICLE 15. HOLD HARMLESS

The Local Government shall indemnify and save harmless the Department and its officers and employees from all claims and liability due to its materials or activities of itself, its agents, or employees, performed under this agreement and that are caused by or result from error, omission, or negligent act of the Local Government or of any person employed by the Local Government. The Local Government shall also indemnify and save harmless the Department from any and all expense, including but not limited to attorney fees that may be incurred by the Department in litigation or otherwise resisting the claim or liabilities that may be imposed on the Department as a result of such activities by the Local Government, its agents, or employees. The Local Government agrees to indemnify and save harmless the Department and its officers, agents, and employees from any and all claims, damages, and attorneys' fees arising from the use of outdated data or information. The Local Government's indemnification of the Department shall extend for a period of three (3) years beyond the date of termination of this agreement.

ARTICLE 16. GRATUITIES

Any person who is doing business with or who reasonably speaking may do business with the Department under this agreement may not make any offer of benefits, gifts, or favors to employees of the Department. The only exceptions allowed are ordinary business lunches and items that have received the advanced written approval of the Department's executive director.

ARTICLE 17. CONFLICT OF INTEREST

The Local Government shall not assign an employee to activities relating to this agreement if the employee:

- a. owns an interest in or is an officer or employee of a business entity that has or may have

- a contract with the Department relating to this agreement;
- b. has a direct or indirect financial interest in the outcome of this agreement;
- c. has performed services regarding the subject matter of the agreement for an entity that has a direct or indirect financial interest in the outcome of this agreement or that has or may have a contract with the Department; or
- d. is a current part-time or full-time employee of the Department.

ARTICLE 18. COMPLIANCE WITH LAWS

The Local Government shall comply with all applicable federal, state, and local laws, statutes, ordinances, rules and regulations, and with the orders and decrees of any court or administrative bodies or tribunals in any manner affecting the performance of this agreement. When requested, the Local Government shall furnish the Department with satisfactory proof of this compliance. The Local Government shall provide or obtain all applicable permits, plans, or other documentation required by a federal or state entity.

ARTICLE 19. INFORMATION EXCHANGE

- A. Each party agrees to meet on, at a minimum, an annual basis for the purpose of reviewing future plans and current status of their respective Fiber Optic Cable Related Infrastructure.
- B. The Local Government shall provide quarterly evaluation reports during the first calendar year of the agreement and annually thereafter detailing how and when the rights and infrastructure granted have been used.
- C. The Local Government shall not disclose information obtained from the Department under this agreement without the express written consent of the Department.

ARTICLE 20. STATE AUDITOR'S PROVISION

The State Auditor may conduct an audit or investigation of any entity receiving funds from the Department directly under the contract or indirectly through a subcontract under the contract. Acceptance of funds directly under the contract or indirectly through a subcontract under this contract acts as acceptance of the authority of the State Auditor, under the direction of the legislative audit committee, to conduct an audit or investigation in connection with those funds. An entity that is the subject of an audit or investigation must provide the State Auditor with access to any information the State Auditor considers relevant to the investigation or audit.

ARTICLE 21. NOTICES

All notices to either party by the other party required under this agreement shall be delivered personally or sent by U.S. Mail, postage prepaid, addressed to such party at the following respective addresses:

Local Government:	Department:
City of El Paso 2 Civic Center Plaza El Paso, Texas 79901	Texas Department of Transportation ATTN: Director, Maintenance Division 125 East 11 th Street Austin, Texas 78701

All notices shall be deemed to be received by the addressee on the date so delivered or so deposited in the mail, unless otherwise provided herein. Either party hereto may change the above address by sending written notice of such change to the other in the manner provided herein.

ARTICLE 22. SIGNATORY AUTHORITY

Each signatory warrants that the signatory has the necessary authority to execute this agreement on behalf of the entity represented.

IN TESTIMONY WHEREOF, the Department and the Local Government have executed duplicate counterparts of this agreement.

CITY OF EL PASO

By: Joyce Wilson
Joyce Wilson, City Manager

Date: 3/23/2010

THE STATE OF TEXAS

Executed for the Executive Director and approved for the Texas Transportation Commission for the purpose and effect of activating and/or carrying out the orders, established policies or work programs heretofore approved and authorized by the Texas Transportation Commission.

By: Toribio Garza Jr.
Toribio Garza Jr., P.E., Director, Maintenance Division

Date: 4/8/10

SAMPLE