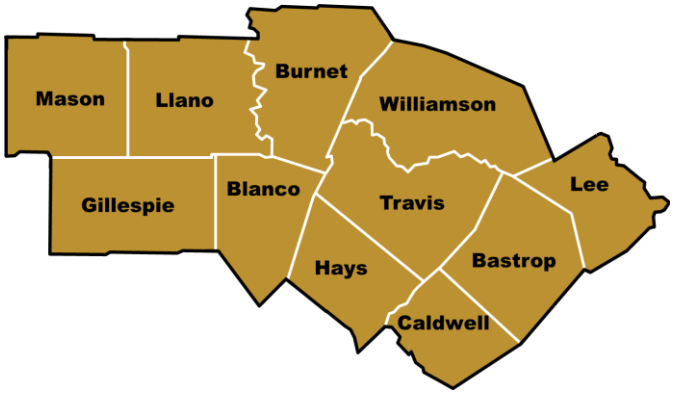
Austin Regional ITS Architecture Update

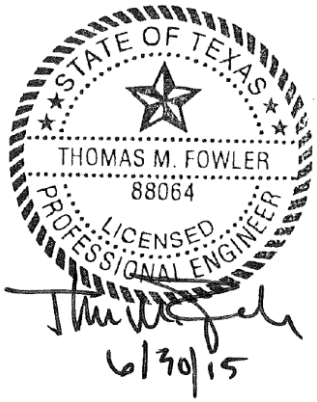
Regional ITS Deployment Plan

June 2015

Austin
REGIONAL ITS ARCHITECTURE
2015 UPDATE



Regional ITS Deployment Plan



Prepared by the **Texas Department of Transportation** in coordination with stakeholder agencies throughout the TxDOT Austin District

June 2015

Kimley»Horn

TABLE OF CONTENTS

AUSTIN REGIONAL ITS DEPLOYMENT PLAN

TABLE OF CONTENTS

AUSTIN REGIONAL ITS DEPLOYMENT PLAN

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AUSTIN REGIONAL ITS ARCHITECTURE

AASHTO	American Association of State Highway and Transportation Officials
ABIA	Austin Bergstrom International Airport
AIMHigh	Austin-area Incident Management for Highways
AMBER	America's Missing: Broadcast Emergency Response
APCO	Association of Public Safety Communications Officials
ASTM	American Society for Testing and Materials
ATIS	Advanced Travel Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
CAD	Computer Aided Dispatch
CAMPO	Capital Area Metropolitan Planning Organization
CARTS	Capital Area Rural Transportation System
CCTV	Closed-Circuit Television
CTECC	Combined Transportation and Emergency Communications Center
CTRMA	Central Texas Regional Mobility Authority
CVISN	Commercial Vehicle Information Systems and Networks
CVRIA	Connected Vehicle Reference Implementation Architecture
DEM	Department of Emergency Management
DMS	Dynamic Message Sign
DOT	Department of Transportation
DPS	Department of Public Safety
DSRC	Dedicated Short Range Communication
EMC	Emergency Management Center
EMS	Emergency Medical Services
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FTP	File Transfer Protocol
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HCRS	Highway Conditions Reporting System

LIST OF ACRONYMS

AUSTIN REGIONAL ITS ARCHITECTURE

HRI	Highway Rail Intersection
IEEE	Institute of Electrical and Electronics Engineers
IMMS	Incident Management Message Sets
ITE	Institute of Transportation Engineers
ITIS	International Traveler Information Systems
ITS	Intelligent Transportation System
ISD	Independent School District
ISO	International Standards Organization
LCRA	Lower Colorado River Authority
LED	Light Emitting Diode
LRMS	Location Referencing Message Specification
LRTP	Long Range Transportation Plan
MAC	Medium Access Control
MDT	Mobile Data Terminal
MPO	Metropolitan Planning Organization
NEMA	National Electrical Manufacturers Association
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
OER	Octet Encoding Rules
PIO	Public Information Office
PSAP	Public Safety Answering Point
PTMS	Public Transportation Management System
PWD	Public Works Department
RDMT	Radio, Dispatch, Mobile Data, Transportation
RDS	Radio Data Systems
RTP	Regional Transportation Plan
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible and Efficient Transportation Equity Act – A Legacy for Users
SDO	Standards Development Organization
STMF	Simple Transportation Management Framework
STS	Special Transit Service

LIST OF ACRONYMS

AUSTIN REGIONAL ITS ARCHITECTURE

TCEQ	Texas Commission on Environmental Quality
TEA-21	Transportation Equity Act for the 21st Century
TIP	Transportation Involvement Plan
TMC	Traffic Management Center
TMDD	Traffic Management Data Directory
TOC	Traffic Operations Center
TOD	Toll Operations Division
TxDOT	Texas Department of Transportation
USDOT	United States Department of Transportation
USGS	United States Geological Survey
UT	University of Texas
VIVDS	Video Imaging Vehicle Detection System

1. INTRODUCTION

1.1 Project Overview

The Austin Regional ITS Deployment Plan was developed as a companion document to the Austin Regional ITS Architecture. The Regional ITS Architecture was updated in May 2015 and provides a long-range plan for the deployment, integration, and operation of ITS in the Austin Region. It offers a high-level view of the existing and planned ITS systems in the Region, with particular focus on how these systems can be integrated together. The Regional ITS Deployment Plan supports the Regional ITS Architecture by identifying specific projects and initiatives that stakeholders would like to implement. These projects support the vision of ITS integration and operations developed in the Regional ITS Architecture.

The Regional ITS Architecture, in addition to being a useful planning tool, is also a requirement from the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) for any region deploying ITS projects using federal transportation funding. An FHWA Final Rule and an FTA Final Policy issued in 2001 require that regions develop an ITS architecture and show how ITS projects conform to their Regional ITS Architecture in order to receive federal funding. Although not required by FHWA and FTA, a Regional ITS Deployment Plan supports the Regional ITS Architecture by identifying ITS projects that are either planned or necessary to successfully implement the ITS architecture. The Regional ITS Deployment Plan also links each project to the Regional ITS Architecture by identifying the ITS service packages that correspond to those projects.

The Austin Regional ITS Architecture and Regional ITS Deployment Plan were updated in May 2015. The update was led by the Texas Department of Transportation, working in close coordination with stakeholders throughout the Austin Region. Significant input was gathered from local, state, and federal officials representing a variety of agencies including traffic, transit, public safety, emergency management, toll, and rail in the Austin Region. Four workshops, as well as individual interviews with many of the regional stakeholders, were held to gather input and ensure that the plans reflected the unique needs of the Region. The draft report was made available to all stakeholders on the project website for their review, which is located at www.AustinITSArchitecture.com.

During the development of the Regional ITS Deployment Plan, stakeholders expressed a desire for the plan to focus primarily on regional ITS deployments rather than local deployments. Many of the stakeholder agencies have been deploying ITS projects for several years, and they believe that they have a strong understanding of their agency's needs and have developed a plan for how ITS will be deployed within their agency. However, they felt that more focus should be given on identifying larger multi-agency regional deployments and initiatives that could not be implemented by a single agency. They types of regional projects, such as improved regional traveler information, improved incident management, and deployment of integrated corridor management strategies became the primary focus of this Regional ITS Deployment Plan.

The Regional ITS Architecture and Deployment Plan were both developed with significant input from stakeholders agencies across the Austin Region. While the plan strives to present an accurate snapshot of existing ITS deployments and future ITS plans in the Region, it will inevitably become outdated over the long term. Needs and priorities of the Region will change in the future, and in order to remain effective, the plan should be periodically reviewed and updated.

1.2 Austin Region

The Austin Region is comprised of Bastrop, Blanco, Burnet, Caldwell, Gillespie, Hays, Lee, Llano, Mason, Travis, and Williamson Counties. These boundaries correspond with the boundaries of the TxDOT Austin District, which is shown in **Figure 1.** The Region encompasses approximately 9,489 square miles in central Texas and has a population of approximately 2.06 million according to the 2014 U.S. Census population estimates.

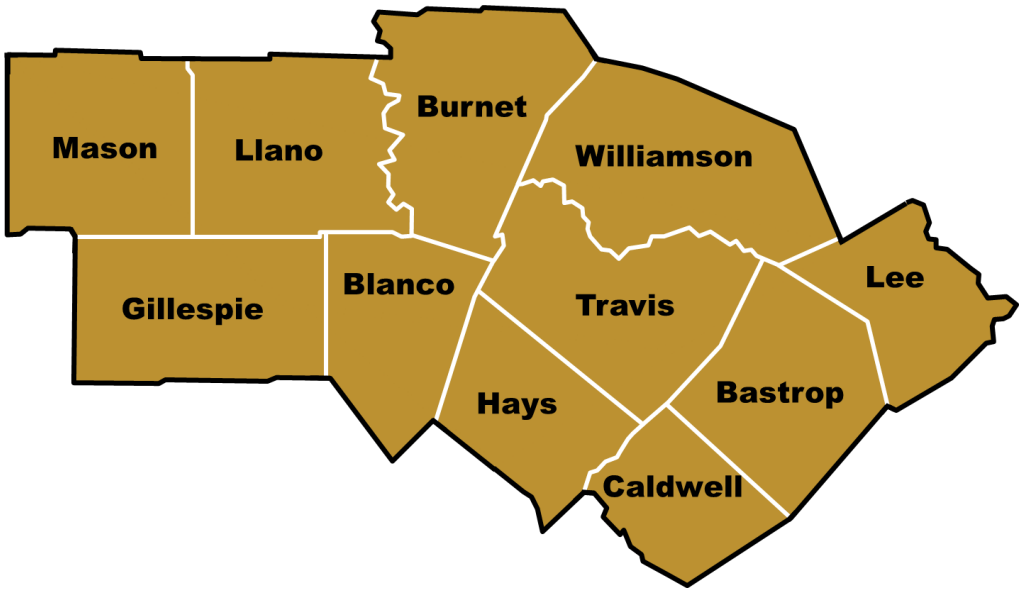


Figure 1 – Austin Regional Boundaries

When developing the stakeholder group, the project team coordinated with the TxDOT Austin District in order to include the appropriate agencies. Stakeholders included representatives from traffic, transit, public safety, emergency management, toll, and rail agencies in the Austin Region.

The following stakeholder agencies participated in the Austin Region project workshops or provided input during individual interviews:

- Capital Area Metropolitan Planning Organization
- Capital Area Rural Transportation System
- Capital Metropolitan Transportation Authority
- Central Texas Regional Mobility Authority
- City of Austin
- City of Cedar Park
- City of Georgetown
- City of Pflugerville
- City of Round Rock
- City of San Marcos
- Lone Star Rail District
- Federal Highway Administration Texas Division
- Texas Department of Public Safety
- Texas State University
- Travis County
- TxDOT Austin District
- TxDOT Public Transportation Division
- TxDOT Rail Division
- TxDOT Toll Operations Division
- TxDOT Traffic Operations Division
- TxDOT Transportation Planning and Programming Division
- University of Texas
- Williamson County

A more detailed list of stakeholders, including the individuals representing each agency, is provided in Table 1 and Appendix D of the Austin Regional ITS Architecture Final Report.

1.3 Document Overview

The Austin Regional ITS Deployment Plan is organized into the following five sections:

Section 1 – Introduction

This section provides an overview of the Austin Regional ITS Deployment Plan, including a description of the Austin Region and participating stakeholders.

Section 2 – Regional ITS Architecture Service Package Implementation

This section provides a summary of the ITS service packages that were selected and prioritized by the stakeholders in the Austin Region, including a review of the existing and planned ITS deployments related to each service package.

Section 3 – Recommended ITS Deployments – Local Deployments

This section describes the existing and planned ITS deployments by individual stakeholder agencies in the Region. Stakeholders indicated that the ITS Deployment Plan should focus primarily on regional deployments; therefore, the local deployments section provides a high-level overview of local deployments rather than an exhaustive review of all existing and planned deployment projects.

Section 4 – Recommended ITS Deployments – Regional Deployments

This section describes the recommended regional ITS deployments for the Austin Region. Eight deployment areas are identified:

- Regional Traveler Information Improvements
- Traffic Incident Management Improvements
- Freeway Service Patrol Expansion
- Integrated Corridor Management
- Center-to-Center Communications
- Regional or Statewide Transit Payment System
- Bus Rapid Transit Expansion
- Archived Data Warehouse Implementation

For each deployment area, a description of the following is provided: basis of need, stakeholders involved, deployment components, best practices and current trends, and regional ITS architecture conformance.

Section 4 – Use and Maintenance of the Regional ITS Architecture

This section contains a description of the maintenance procedure for the Regional ITS Deployment Plan.

2. REGIONAL ITS ARCHITECTURE SERVICE PACKAGE IMPLEMENTATION

In Section 2, the ITS service packages from the National ITS Architecture that were selected by the stakeholders for implementation in the Austin Region are presented. Stakeholders selected and prioritized these services for the Austin region based on the need for the service and the current and planned level of deployment. The prioritization of the ITS service packages is included in Section 2.1. In Section 2.2 through 2.8, each of the selected ITS service packages is discussed in more detail, and the current and planned ITS deployments in the Austin Region that relate to each ITS service package are identified.

2.1 Regional ITS Architecture Service Package Priority

In the Austin Region, the National ITS Architecture service packages were reviewed by the stakeholders and selected based on the relevance of the functionality that the ITS service package could provide to the Region. ITS service packages describe the services that ITS can provide, and are grouped together in service areas such as traffic management, public transit management, and traveler information. ITS service packages provide a visual representation of the services stakeholders in a Region can perform utilizing ITS and identify the information or data that is transferred between various elements or agencies in a region.

Stakeholders selected 59 ITS service packages for implementation in the Austin Region out of a total of 97 ITS service packages that have been identified in the National ITS Architecture. The selected service packages are shown in **Table 1,** and they are grouped together by the ITS Service Area from the National ITS Architecture and the priority that was assigned by the regional stakeholders.

Stakeholders prioritized the selected ITS service packages as high, medium, or low during the workshops and agency interviews. Priority of the ITS service packages was based on several factors.

High Priority ITS service packages include services that are currently deployed on a widespread basis, are actively being deployed, or stakeholders identified a critical need to begin deploying the service in the short-term (typically within 5 years).

Medium Priority ITS service packages include service packages that have been deployed on a limited basis, are actively being deployed on a limited basis, or stakeholder agencies identified a moderate need to begin deploying the service in the short to mid-term (typically within 10 years.) In some cases, the ITS service package may be deployed on a widespread bases but there may only be limited use of the service.

Low Priority ITS service packages include those in which there was typically little deployment or agencies do not plan to actively implement the service within the next 10 years. In some cases, the ITS service package may be considered fully deployed and there is no need to expand the deployment or functionality of the service.

After selecting the service packages that were applicable for the Region, stakeholders reviewed each service package and the elements that could be included to customize it for the Region. This customization is discussed further in Section 5.1.3 of the Regional ITS Architecture document.

Table 1 – Austin ITS Service Packages Prioritization by Functional Area

High Priority Service Packages	Medium Priority Service Packages	Low Priority Service Packages
Traffic Management		
ATMS01 Network Surveillance ATMS03 Traffic Signal Control ATMS05 HOV Lane Management ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management ATMS08 Traffic Incident Management System ATMS10 Electronic Toll Collection ATMS23 Dynamic Lane Management and Shoulder Use	ATMS02 Probe Surveillance ATMS13 Standard Railroad Grade Crossing ATMS16 Parking Facility Management ATMS17 Regional Parking Management ATMS19 Speed Warning and Enforcement ATMS21 Roadway Closure Management ATMS22 Variable Speed Limits ATMS24 Dynamic Roadway Warning ATMS26 Mixed Use Warning System	ATMS04 Traffic Metering ATMS11 Emissions Monitoring and Management ATMS12 Roadside Lighting System Control ATMS15 Railroad Operations Coordination ATMS18 Reversible Lane Management
Emergency Management		
EM01 Emergency Call Taking and Dispatch EM02 Emergency Routing EM04 Roadway Service Patrols EM06 Wide-Area Alert EM07 Early Warning System	EM03 Mayday and Alarms Support EM08 Disaster Response and Recovery EM09 Evacuation and Reentry Management EM10 Disaster Traveler Information	EM05 Transportation Infrastructure Protection
Maintenance and Construction Management		
MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution MC08 Work Zone Management MC10 Maintenance and Construction Activity Coordination	MC01 Maintenance and Construction Vehicle and Equipment Tracking MC07 Roadway Maintenance and Construction	MC02 Maintenance and Construction Vehicle Maintenance MC09 Work Zone Safety Monitoring
Public Transportation Management (All Service Packages Selected as High Priority)		
APTS01 Transit Vehicle Tracking APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations APTS04 Transit Fare Collection Management APTS05 Transit Security APTS06 Transit Fleet Management APTS07 Multi-modal Coordination	APTS08 Transit Traveler Information APTS09 Transit Signal Priority APTS10 Transit Passenger Counting APTS11 Multimodal Connection Protection	
Commercial Vehicle Operations		
	CVO10 HAZMAT Management	CVO04 CV Administrative Processes
Traveler Information		
ATIS01 Broadcast Traveler Information ATIS02 Interactive Traveler Information		ATIS05 ISP Based Route Coordination
Archived Data Management		
AD1 ITS Data Mart AD2 ITS Data Warehouse AD3 Virtual ITS Data Warehouse		

2.2 Traffic Management Implementation

The following traffic management ITS service packages from the National ITS Architecture were selected and customized for stakeholders in the Austin Region. These ITS service packages represent how agencies are currently implementing, or planning to implement, traffic management services. For each ITS service package selected by stakeholders, a general description as well as the current and planned ITS deployment activities in the Region are identified.

ATMS01 Network Surveillance (High Priority) – Includes the collection of volume and speed data using video image vehicle detection systems, remote traffic microwave sensors, or traditional loops in addition to live-video feeds from CCTV cameras to monitor roadways. These ITS elements can assist in the detection of incidents and provide data for transportation planning.

Various agencies in the Austin Region have deployed network surveillance equipment. TxDOT has installed CCTV cameras primarily along I-35, MoPac, US 290 and US 183. Many of the municipalities have installed CCTV cameras at certain signalized intersections including the City of Austin, City of Cedar Park, City of Georgetown, City of Round Rock, and City of San Marcos. CTRMA is currently deploying CCTV cameras in connection with the construction of tolled express lanes along MoPac. Additionally, TxDOT and the municipalities utilize video image and traditional loops for vehicle detection at signalized intersections. The Cities of Cedar Park, Round Rock and San Marcos use pneumatic tubes for counts and vehicle classification data. TxDOT, CTRMA, and the municipalities would like to install additional cameras and detection equipment in the future.

ATMS02 Probe Surveillance (Medium Priority) – Includes the collection of vehicle volumes, speed data, or location information using either vehicle to center or vehicle to field (roadside equipment) communications. Vehicle communications can occur either with on-board vehicle equipment or through personal devices in the possession of vehicle occupants. Agencies can collect this information through the use of field equipment such as Bluetooth sensors or through private information service providers such as cell phone companies.

Both TxDOT and CTRMA utilize field equipment to manage the payment of tolls. Motorists attach a TxTag sticker to the windshield of their vehicles and electronic readers located along tolled facilities identify the tags and apply the charge of using the facility to the appropriate account. For vehicles without TxTags, cameras capture images of the vehicle's tag for payment by mail. The Cities of Austin and Cedar Park have deployed Bluetooth readers along certain corridors to obtain travel time information with additional deployments likely. The City of San Marcos has explored the possibility of installing Bluetooth sensors in the future.

ATMS03 Traffic Signal Control (High Priority) – Provides centralized monitoring and control of traffic signals in addition to sending traffic signal data back to a traffic management or operations center. Elements of this service package not only include the signal itself, but vehicle detectors and pedestrian indications as well. From the centralized locations, traffic management personnel can control signal timing, phasing, and offsets, and receive fault, traffic flow, and right-of-way request information.

Traffic signals on the state highway system within cities that have populations less than 50,000 are typically controlled by TxDOT. Once a city reaches 50,000, they must maintain and operate their own signals; however, TxDOT may elect to maintain control of certain traffic signals along state highway frontage roads. Of the key municipalities specifically identified in the architecture, the City of Georgetown is the only city that does not maintain or operate traffic signals on the state highway system. However, all cities have made extensive investments in traffic signal infrastructure, communications, and software. Austin and Georgetown communicate with their signals though fiber optic cable. Round Rock, San Marcos and Cedar Park currently connect to many of their traffic signals through dual band wireless Ethernet radios.

Pilot adaptive signal projects are being implemented in the City of Austin along South Lamar Avenue and at certain interchanges along I-35. Additional locations for adaptive signal projects include Burnet

Road in the City of Austin and along Palm Valley Boulevard (US 79) near the Dell Diamond Baseball Stadium in the City of Round Rock. Both San Marcos and Round Rock have programmable school flashers that are controlled remotely with plans to expand locations.

To supplement the existing vehicle detection system, the City of Austin is exploring the development of a mobile phone application for cyclists. The application uses GPS to determine the location of a cyclist, and communicates with the traffic signal system to alert the system when a cyclist approaches. This application would not provide any priority for cyclists, but would supplement the existing detection system by providing a secondary method for bicycle detection at traffic signals.

ATMS04 Traffic Metering (Low Priority) – Allows for the control of traffic on the mainline of roadways in addition to the flow of traffic from entrance ramps. Traffic signals permit traffic operations personnel to control traffic flow on the mainline in advance of tunnels, bridges, or long and steep slopes. Ramp meters control the flow of traffic onto the mainline to help reduce congestion that often occurs due to the merging of multiple vehicles at one time.

Although there are no specific plans for implementation, the City of Austin has expressed interest in utilizing ramp metering along I-35 as various ramps are reconstructed to accommodate ramp metering.

ATMS05 HOV Lane Management (High Priority) – Provides for the control and management of preferential lanes including High Occupancy Vehicle (HOV) and High Occupancy Toll (HOT) lanes. Information received from field sensors regarding the flow of high occupancy lanes versus the general purpose lanes allows for dynamic pricing and active traffic management utilizing ramp meters, dynamic message signs (DMS), and lane control signals.

Express lanes are currently being constructed along an 11 mile section of MoPac by CTRMA, and are expected to be complete in late 2015. Although these lanes are not HOV lanes, they will allow certain vehicles such as registered van pools, transit buses, and emergency vehicles to use the lanes for free. All other vehicles will be charged a variable toll that increases with congestion. Access to these lanes will occur only at certain points and dynamic message signs will display the current price to utilize the lanes.

ATMS06 Traffic Information Dissemination (High Priority) – Provides current or planned road network information to motorists through a variety of outlets including radio and television stations, DMS, highway advisory radios (HAR), websites, and mobile phone applications. Additionally, information is supplied to other agencies including transit and emergency to improve their operations as well as to private information service providers.

TxDOT has deployed HAR and DMS throughout the Austin Region along I-35 and other state highways. Additionally, TxDOT's Drive Texas website displays incident information along with congestion levels. The Drive Texas website also provides access to a TxDOT website that includes CCTV camera images, DMS messages, road closures, and incident information. The City of Austin operates permanent DMS along several major corridors and maintains several DMS that are portable for use during incidents or construction projects. CTRMA is adding DMS to support the operation of the express lanes being constructed along MoPac.

Most cities have portable DMS, but Round Rock and Cedar Park would like to install permanent signs at strategic locations. The City of Austin would also like to display travel times on existing DMS or through the installation of Graphic Route Information Panels (GRIP) that can display several colors and route choice information. Multiple stakeholders have individual websites or issue press releases that provide varying degrees of information to the public and media, but the creation of a single website that compiles and displays transportation related information from various agencies around the Austin Region is needed.

ATMS07 Regional Traffic Management (High Priority) – Includes the collection of traffic information and sharing that information with other traffic management agencies. Also included in this service package is the control of another agency's traffic management center or field devices. Real-time traffic signal system coordination and integrated corridor management are also supported by this service package.

CTECC provides a location in which many agencies share physical space in an effort to improve coordination, including TxDOT, Capital Metro, City of Austin 911 dispatch, and Travis County Sheriff. The City of Austin TMC and TxDOT Austin District TMC share traffic images and road network conditions with each another through a center-to-center connection. In coordination with the addition of express lanes on MoPac, CTRMA will have an operations center to manage their facilities. With the exception of Georgetown, all municipalities have a centralized traffic management center or traffic operations center (TOC) in which they control their traffic signals along with other ITS equipment.

Interest in a fiber optic connection to obtain access to the resources at CTECC was expressed by multiple stakeholders, in addition to the colocation of additional agencies within CTECC in the future. Georgetown plans to develop a more comprehensive TOC in the future. Stakeholders also expressed interest in the ability to control another agency's ITS equipment either as a backup system or during incidents as a way to help support integrated corridor management.

ATMS08 Traffic Incident Management System (High Priority) – Provides for the coordination of various agencies during planned and unplanned events. Several roadway elements including CCTV cameras and DMS (both static and portable) play a key role in the detection and monitoring of incidents and the dissemination of information to motorist. The inclusion of private tow and other emergency response companies is critical.

CTECC was designed in part to support the management of incidents in the Austin Region and includes departments or divisions from the City of Austin, TxDOT, Travis County, and CapMetro. The TxDOT Austin District TMC currently shares video images with the Austin/Travis County EOC. Additionally, the City of Austin TMC and TxDOT Austin District currently share incident information, road network conditions and traffic images through a center-to-center connection.

There is a regional need for continual training regarding incident management in addition to maintaining an updated list with key contacts for various agencies. Interest in a fiber optic connection to obtain access to the resources at CTECC was expressed by multiple stakeholders, in addition to the colocation of additional agencies within CTECC in the future. A regional incident and mutual aid network where all emergency management providers can share or gather information regarding an incident has been cited by stakeholder as a need.

ATMS10 Electronic Toll Collection (High Priority) – Allows toll agencies to manage tolled facilities electronically, which includes toll collection and processing toll violations. In-vehicle equipment in addition to field elements can be utilized by toll operators for payment. This service package also supports the administration of an electronic funds transfer system and a regional smart card that could be used in conjunction with payment for parking and transit.

TxDOT Toll Operations Division (TOD) and CTRMA operate toll facilities in the Region which include Toll Road 183A, Toll Road 290 (Manor Expressway), MoPac Express Lanes, SH 130, and SH 45. Each of these tolled facilities is operated electronically through field detection equipment. Although other regions in Texas have different toll tags, all tolled facilities in the State of Texas are interoperable with one another.

Toll interoperability with adjacent states with tolled facilities such as Oklahoma and Louisiana is a potential project. CTRMA and TxDOT TOD may implement additional tolled facilities in the future as a means to address congestion and provide motorist with alternative routes.

ATMS11 Emissions Monitoring and Management (Low Priority) – Allows for the collection of emissions data from both mobile and static sources in a region for air quality analysis. General, area-wide air quality monitoring in addition to individual vehicle specific information is included in this service package. Air quality information can be used for long-range planning efforts required by the Environmental Protection Agency (EPA) in addition to local enforcement for violations.

The Texas Commission on Environmental Quality (TCEQ) monitors the air quality throughout the state and shares that information with local agencies such as the City of Austin Air Quality Division. TCEQ provides air quality information including ozone and particulate matter on their website in addition to the existing and forecasted air quality index.

ATMS12 Roadside Lighting System Control (Low Priority) – Includes the remote or automatic control of lighting systems to provide optimal lighting for roadway conditions or time of day. Street lights can be dimmed, brightened, or turned off when necessary, which can aid in the conservation of energy.

No specific projects or plans for roadside lighting control are currently being considered for the Austin Region; however, a need has been expressed for its potential benefit in the future.

ATMS13 Standard Railroad Grade Crossing (Medium Priority) – Manages railroad and highway at-grade crossings in which train speeds are less than 80 miles per hour. Although this service package includes passive warning systems that only include static signs, it is primarily focused on active warning systems that include gates, flashing lights, bells, and dynamic signs. Railroad wayside equipment works in coordination with active warning systems to warn motorists, pedestrians, and cyclists of an approaching train. Additionally, the wayside equipment and active warning equipment can operate in coordination with nearby traffic signals to control vehicular movements across a highway rail crossing.

There are multiple at-grade rail crossings throughout the region with tracks owned and operated by CapMetro and two other railroad companies. All railroad operators maintain their own equipment at highway crossings; however, TxDOT maintains the interconnect between their traffic signals and the operator's equipment on state maintained roads. Cities that have traffic signals that are adjacent to railroad crossings receive track status information from the rail operators. Additionally, the Cities of Austin and Cedar Park have electronic rail notification signs at certain crossings to warn that the tracks are currently blocked and turns are prohibited. The City of Round Rock recently completed a railroad traffic signal coordination improvement project, which also included notification to the City TMC of the occurrence of railroad preemption at various signals. CapMetro is currently implementing positive train control, which monitors the location of trains and can stop them if necessary, for the railroad tracks that it owns and operates

TxDOT would like to implement positive train control for all trains in the Region in addition to a system in which emergency medical responders are notified if a crossing is blocked. TxDOT has also explored the possibility of adding CCTV cameras at railroad crossings deemed critical to detect vehicles that are stopped on the tracks. The City of San Marcos is looking to develop a mobile phone application that notifies motorists of blocked crossings as motorist within the City frequently encounter stopped trains at multiple highway crossings. The City of Round Rock would like to implement electronic rail notification signs at certain crossings.

ATMS15 Railroad Operations Coordination (Low Priority) – Provides for the advanced coordination between rail operators and traffic management personnel concerning maintenance or construction and train schedule information that may adversely affect highway rail crossings.

TxDOT would like to create a data sharing agreement with rail operators in the Region for improved coordination. This agreement could include the sharing of real-time and planned train schedule information in addition to maintenance and construction activities. San Marcos would particularly benefit from information regarding track siding or passing as trains frequently block highway crossings.

ATMS16 Parking Facility Management (Medium Priority) – Supports the operation of parking structures, on-street spaces, and surface lots specifically related to the electronic payment of parking fees. The administration of a regional smart card that could be used in conjunction with payment for tolls and transit is supported by this service package. Additionally, field equipment can be used to monitor parking demand for the implementation of variable pricing.

The City of Austin Parking Enterprise employs technology that allows motorists to electronically pay for parking. In-vehicle parking meters work in conjunction with on-street parking meters to monitor the available parking. The City of Austin displays the availability of on-street parking and rates on their website.

Other municipalities in the Austin Region have expressed interest in installing metered parking in the future. The development of a regional smart card may also be used in the future for the payment of parking.

ATMS17 Regional Parking Management (Medium Priority) – Includes the coordination between parking management agencies in addition to traffic management and transit agencies and private information service providers. Parking facility operators can disseminate information on the availability and current price of parking in addition to allowing motorists to reserve parking in advance.

There are currently no plans for regional parking management in the Austin Region, but key stakeholders that could benefit from its implementation include the City of Austin, CARTS, and CapMetro.

ATMS18 Reversible Lane Management (Low Priority) – Allows for certain travel lanes to serve either direction of travel depending on the time of day or road network conditions. Static and dynamic signs, field sensors, CCTV cameras, and lane control signals are elements typically used in the operation of reversible lanes.

Reversible lanes are currently used within Travis County during racing events at the Circuit of the Americas Formula 1 Racing venue. Although these lanes are managed by law enforcement utilizing static signs and portable DMS during events, there is the possibility that the installation of ITS equipment with centralized control could be implemented in the future. The City of Austin has expressed interest in reversible lanes on certain corridors in the future.

ATMS19 Speed Warning and Enforcement (Medium Priority) – Provides for the monitoring of vehicle speeds which is used to warn drivers that they are traveling too fast for conditions. Monitoring and warning of speeds can occur along road segments with sharp curves that require a reduction of speed (typically below the speed limit) to safely traverse the curve. Additionally, speed feedback signs can display the current travel speed of vehicles and are often used in school zones. This service package also includes the use of speed monitoring equipment by law enforcement to issue citations.

Some municipalities in the Region have deployed mobile speed limit feedback signs that display a vehicle's current speed versus a static speed limit signs. The Cities of Austin and Cedar Park currently use Bluetooth devices to monitor vehicle speeds; however these speeds are not used for law enforcement and do not provide driver warnings.

ATMS21 Roadway Closure Management (Medium Priority) – Provides for the closure of roadway segments when conditions warrant. Closures primarily related to weather or maintenance are included in this service package, and interagency coordination as well as field to field equipment coordination are a key components. Field elements related to roadway closure management may include DMS to warn motorists, CCTV cameras to monitor low water crossings, barrier gates, and warning lights.

The City of Austin Watershed Protection Department maintains several automated barricades at 15 low water crossings within the City. Other cities in the Region have expressed interest in installing automated flood closure gates at their low water crossings.

ATMS22 Variable Speed Limits (Medium Priority) – Allows for the regulation of the posted speed limits based on road network conditions. When adverse weather conditions such as fog, snow, ice, or traffic incidents occur, speed limits can be reduced to encourage safer driving and uniform speeds. The displayed speeds can be remotely controlled from a central location or changed automatically through field equipment coordination. This service package also allows for speed limits to be set by lane.

TxDOT has used variable speed limits at certain locations around the state and is evaluating their effectiveness for future deployments that could include the Austin Region.

ATMS23 Dynamic Lane Management and Shoulder Use (High Priority) – Allows for the control of travel lanes or shoulders along a roadway or at an intersection. Overhead lane control signals or dynamic signs can allow traffic operations personnel to shift traffic to the appropriate lane(s) in advance of an incident or in response to traffic demand. Other uses include managing lanes or shoulders for vehicles that meet certain provisions such as HOV and buses or the prohibition of certain vehicles such as commercial trucks.

TxDOT employs active traffic management signals over traffic lanes on various controlled access facilities in the region. These signals help to inform motorists if a particular lane is closed ahead. The City of Austin has implemented dynamic lane control at several intersections to allow turning movements only when the dynamic lane assignment signs indicate they are permitted.

ATMS24 Dynamic Roadway Warning (Medium Priority) – Allows for the monitoring of the roadway at certain locations and actively alerting motorists when potentially hazardous conditions are detected. Notifications to the driver can include warning lights and dynamic signs. Hazards can include low water crossings, ice on bridges, wild animals, fallen rocks, wrong-way drivers, and stopped traffic ahead.

Dynamic roadway warning is primarily used in the region to warn motorists that they are approaching a low water crossing that may be covered by water. The City of Austin and Hays County employ these systems that coordinate with field sensors to activate warning lights that supplement static signs. Additionally, the City of Austin has also installed CCTV cameras at several low water crossings to assist in monitoring conditions.

The City of Round Rock plans to implement warning beacons at low water crossings by the end of 2015. Additionally, Round Rock would like to install automatic gates and CCTV cameras at low water crossings. The City of San Marcos has expressed interest in dynamic roadway warning systems for low water crossings.

ATMS26 Mixed Use Warning System (Medium Priority) – Provides notification to motorist of the presence of vulnerable road users. Motorists are warned that pedestrians or cyclists may either be in the roadway or crossing the roadway at a certain point. This service package supports automated detection of vulnerable road users in addition to traffic signals or beacons specifically installed for pedestrians and cyclists. Pedestrians signals located at signalized intersections are covered under ATMS03 – Traffic Signal Control.

The City of Austin has installed pedestrian hybrid beacons at several locations and around downtown. The Cities of Round Rock and San Marcos have installed pedestrian activated rectangular rapid flash beacons that alert motorist of the presence pedestrians or cyclists at certain locations.

2.3 Emergency Management ITS Service Packages

The following emergency management ITS service packages from the National ITS Architecture were selected and customized for stakeholders in the Austin Region. These ITS service packages represent how agencies are currently implementing, or planning to implement, emergency management services. For each ITS service package selected by stakeholders, a general description as well as the current and planned ITS deployment activities in the Region are identified.

EM01 Emergency Call Taking and Dispatch (High Priority) – Includes public safety personnel receiving emergency calls from the public and other emergency agencies and dispatching the appropriate response. Effective coordination among the public safety answering point (PSAP) and fire and police departments and emergency medical personal is essential. Additional elements of this service package include emergency vehicle tracking and emergency telecommunications systems for caller location information.

The majority of emergency call-taking in the Austin Region is performed by either a county or a combined county/city agency. The City of Round Rock is the one exception as they maintain their own public safety answering point for emergencies within city limits. Most 911 systems include the important function of displaying the number and location of the caller to the dispatcher, which aids in reduced response times.

EM02 Emergency Routing (High Priority) – Allows for the routing of emergency response vehicles once they have been dispatched to an incident. Coordination with health care facilities, rail operators, and maintenance and construction agencies is critical to reduce any delay. This package also includes coordination with traffic management agencies for traffic signal preemption.

The Cities of Austin and San Marcos have emergency vehicle traffic preemption at certain traffic signals, but the City of Round Rock has preemption at all traffic signals.

Improved communication between emergency management agencies and regional medical centers has been discussed as a need for the Region. The City of Austin may expand emergency vehicle preemption to include police vehicles. Additionally, Austin may modify how their preemption system operates by utilizing GPS to locate the vehicles and allowing the vehicles to communicate directly with the City's ATMS servers instead of with individual traffic signal controllers.

EM03 Mayday and Alarms Support (Medium Priority) – Allows for the manual or automatic notification of emergency management personal in the event that an incident occurs along the roadway, rest stops, or parking facilities. In-vehicle systems that provide location and incident information are included in this service package along with emergency call boxes, panic buttons, and security cameras.

Although no agency within the region specifically covers this service package, many private vehicles include systems that detect if a crash has occurred, and can alert emergency personnel to the vehicle's location. Additionally, most drivers carry cell phones which they can use to notify emergency management agencies of emergencies.

EM04 Roadway Service Patrols (High Priority) – Includes service patrol vehicles that cover designated freeway routes, monitor roadways, assist motorists that are broken down, move vehicles out of travel lanes, assist with incident clearance, and provide assistance with traffic control during major incidents. Motorist assistance can include changing flat tires, supplying gas, and jumpstarting batteries. Service patrol vehicle location information and incident data is often shared with traffic and emergency management agencies.

CTRMA's highway emergency response operator (HERO) vehicles serve I-35 from the City of Kyle north to the City of Georgetown and SH 183 from I-35 north to Lakeline Boulevard. The HERO units provide gas, change tires, move disabled vehicles, and assist with incident management. Many stakeholders in the region would like to have the HERO coverage area expanded to additional highways. TxDOT also provides freeway service patrols on the SH 45 and SH 130 toll roads.

EM05 Transportation Infrastructure Protection (Low Priority) – Allows for the monitoring and protection of various structures including bridges and tunnels or other critical infrastructure components. Specific examples of threats, incidents, or natural causes that would require monitoring or protection include earthquakes, floods, terrorist attacks, tornados, or unintentional damage caused by a vehicle or any other means. Agencies can actively mitigate the impact on the infrastructure from future or existing threats or incidents using CCTV cameras, blast shields, barriers, field sensors, and exhaust systems.

The Austin Region has a number of bridges that are essential for the transport of people and goods, and additional security measures to ensure the safety of those structures may be implemented in the future.

EM06 Wide-Area Alert (High Priority) – Provides for public notification of life-threatening emergency situations through multiple outlets including DMS, HAR, broadcast media, agency websites, telecommunication companies, and private information service providers. Alert notifications are also sent to toll, transit, maintenance and construction agencies.

AMBER alerts are currently posted on TxDOT DMS signs along with other alerts received from the Texas Department of Public Safety.

EM07 Early Warning System (High Priority) – Includes the detection of imminent or potential natural or man-made disasters though sensors and surveillance cameras and notification of threat information to the appropriate agencies.

Flash flooding at low water crossings is a dangerous threat along many roadways in the Region. The City of Austin and Hays County have implemented field sensors that measure the water levels and automatically flash warning lights at low water crossings to notify motorists that they are approaching an area where water may be overtopping the roadway. . The City of Austin also employs CCTV cameras

and automatic gates at certain low water crossings. A website operated by the City of Austin Watershed Protection Department displays the crossing status in multiple cities and counties in the region. The public can also view CCTV camera images at certain crossings.

The Cities of Round Rock and San Marcos would like to implement flood monitoring systems at various locations that include flood detectors, warning beacons and automatic gates.

EM08 Disaster Response and Recovery (Medium Priority) – Includes the coordination of agencies within the region in addition to adjacent regions in the event that a large scale man-made or natural disaster overwhelms agencies within the devastated region. A detailed plan outlining resource deployments, incident command, and other critical information must be completed well in advance of a disaster to minimize the recovery time.

City and county emergency management agencies plan and prepare for disasters on a continual basis. Many of them operate physical or virtual emergency operations centers (EOC) that connect officials from various agencies and allow them to communicate more effectively during disasters. These local agencies coordinate efforts with agencies in adjacent regions, with state agencies, and federal officials. CTECC was designed in part to manage incidents in the Austin Region and includes departments or divisions from the City of Austin, TxDOT, Travis County, and CapMetro.

EM09 Evacuation and Reentry Management (Medium Priority) – Allows for a well-organized evacuation and reentry plan for communities affected by or in imminent danger of a man-made or natural threat. Key stakeholders outside the region include state and federal officials in addition to local agencies that may receive evacuees or provide support. Traffic control strategies are a key component to an orderly evacuation and may include suspending tolls, using roadway shoulders, reversing the direction of traffic (contra-flow), and implementing emergency traffic signal plans. Additionally, transit management agencies play a pivotal role in the evacuation and reentry process by providing transportation to individuals that are unable to travel on their own.

As noted in the EM08 description, city and county emergency management agencies plan and prepare for disasters on a continual basis and many operate physical or virtual emergency operations centers (EOC) that connect officials from various agencies and allow them to communicate more effectively during disasters.

EM10 Disaster Traveler Information (Medium Priority) – Provides real-time essential information to the public through the coordination of multiple agencies during a natural or man-made disaster. All possible outlets are used to disseminate information to the public. Information includes temporary shelter sites, roadway closures, food and gas locations, medical care facilities, weather, and transit services.

Disaster traveler information within the Austin Region can be disseminated through a variety of methods including TxDOT and City of Austin DMS, agency websites, local broadcast media, TxDOT HAR, and private information service providers. TxDOT and all the key municipalities provide information the public through their public information offices.

2.4 Maintenance and Construction Management ITS Service Packages

The following maintenance and construction management ITS service packages from the National ITS Architecture were selected and customized for stakeholders in the Austin Region. These ITS service packages represent how agencies are currently implementing, or planning to implement, maintenance and construction management services. For each ITS service package selected by stakeholders, a general description as well as the current and planned ITS deployment activities in the Region are identified.

MC01 Maintenance and Construction Vehicle and Equipment Tracking (Medium Priority) – Allows for maintenance and construction personnel to determine the locations of vehicles and equipment to ensure that they are being utilized in an efficient manner.

Most agencies have expressed interest in tracking the location of maintenance and construction vehicles to effectively dispatch resources.

MC02 Maintenance and Construction Vehicle Maintenance (Low Priority) – Allows for the automatic or remote monitoring of maintenance and construction vehicles and equipment. Vehicles can alert maintenance and construction personnel of required routine maintenance or if a problem is detected that needs addressing immediately.

There are no specific plans to implement the management of vehicle maintenance systems, but stakeholders do agree it would be a beneficial resource.

MC03 Road Weather Data Collection (High Priority) – Includes the collection of weather information through weather services; infrastructure sensors that may be deployed on or near roadways, bridges, or rail lines; and sensors located on vehicles used by maintenance and construction and traffic management agencies. Collected data may include rainfall amounts, snow/ice accumulation, wind speeds, air temperatures, and fog visibility.

TxDOT would like to install road weather information system (RWIS) stations primarily to monitor roadways during winter weather conditions.

MC04 Weather Information Processing and Distribution (High Priority) – Includes the analysis and dissemination of road weather information among various agencies to help make decisions related to operations. Dissemination of road weather information to the public is also supported through local media and information service providers.

The implementation of this service package would assist in the allocation of maintenance and emergency management resources depending on weather data. School systems and transit agencies could make the appropriate decisions regarding routes and schedules, and traffic agencies could disseminate information to the motoring public.

MC07 Roadway Maintenance and Construction (Medium Priority) – Provides for the scheduling and execution of planned and unplanned maintenance or construction work to reduce delays or interruptions to the transportation network.

Within the Austin Region there was limited use identified of systems that automate planning for maintenance and construction work. Stakeholders showed interest in considering these types of systems provided an adequate benefit-cost ratio exists.

MC08 Work Zone Management (High Priority) – Allows for the oversight, monitoring, and control of static or mobile work zones and the surrounding areas. Elements of this service package include portable, fixed, or vehicle mounted maintenance and construction equipment including CCTV cameras, DMS, traffic signals, field sensor, and HAR in addition to gates and barriers. Work zone information is also disseminated to various other agencies and various media outlets.

Various agencies in the Region utilize portable DMS during maintenance and construction activities and these have been proven to be a high priority implementation in the Austin Region. Other work zone technologies, such as portable CCTV cameras experience much more limited usage and generally only during major construction projects.

MC09 Work Zone Safety Monitoring (Low Priority) – Includes measures that directly affect the safety of work zone crews and motorists traveling within work zones. Monitoring of the physical location of individual crew members to warn of movement into hazardous zones in addition to audible and visual alerts concerning vehicles encroaching into restricted areas is supported by this service package.

There was limited interest among the stakeholders in the Austin Region in pursuing these types of technologies and there were no specific plans identified to implement this ITS service package at the current time. However, given the high priority on safety the Austin Region stakeholders did want to continue considering use of technology to make work zones safer in the future.

MC10 Maintenance and Construction Activity Coordination (High Priority) – Includes the dissemination of maintenance and construction information to various agencies including transit, emergency, traffic, and other maintenance and construction management; commercial vehicle administration; the media; and other information service providers.

Although most agencies provide updates regarding construction and maintenance closures to the media and other stakeholders through email, fax, or website information, there is a strong need to implement center-to-center connections between agencies to automatically provide this information. This is particularly helpful for emergency management dispatchers so they know of closures and can route emergency vehicles around such closures. Traffic management agencies would also benefit from this information so they can avoid any planned closures during incidents if alternate routing is needed.

2.5 Public Transportation Management ITS Service Packages

The following public transportation management ITS service packages from the National ITS Architecture were selected and customized for stakeholders in the Austin Region. These ITS service packages represent how agencies are currently implementing, or planning to implement, public transportation management services. For each ITS service package selected by stakeholders, a general description as well as the current and planned ITS deployment activities in the Region are identified.

APTS01 Transit Vehicle Tracking (High Priority) – Allows transit management agencies to track the location of transit vehicles in real-time and determine if those vehicles are ahead or behind schedule. This service package includes distributing schedule adherence information to transit riders and traffic management agencies.

CapMetro and CARTS personnel can track the location of all their vehicles including the CapMetro MetroRail Passenger Rail Vehicles. CapMetro currently tracks the movement of trains from freight rail operators that use their tracks, and they are currently implementing positive train control that assists in the location of trains and can also stop them if necessary. Transit riders can track the real-time location of CapMetro trains and buses by going to the CapMetro website, dialing the CapMetro customer service number, scanning the QR codes at bus stops, or texting the bust stop ID number. The Bobcat Shuttle for Texas State University also allows riders to track the location of buses.

APTS02 Transit Fixed-Route Operations (High Priority) – Allows for the dispatching of transit vehicles on a fixed-route or deviated fixed-route, monitoring of system performance, and altering scheduling when necessary.

CapMetro operates four distinct fixed-route lines, MetroBus, MetroFlyer, MetroRapid, and MetroExpress. CARTS also operates several fixed-routes in the Region including intercity buses, municipal buses in San Marcos and Bastrop, commuter routes. Texas State also operates a fixed-route service on their campus.

APTS03 Demand Response Transit Operations (High Priority) – Allows for the dispatching of demand responsive, paratransit, or deviated fixed-route transit vehicles, monitoring of system performance, and altering scheduling when necessary. This service package also includes the ability for transit riders to make requests for customized transit service.

Within a three-quarter mile distance of all CapMetro regular fixed routes, demand response service is provided by the CapMetro MetroAccess paratransit vehicles. Transit riders can request service from MetroAccess vehicles through the CapMetro website. CARTS provides demand response services outside of CapMetro service area, and riders can also request service through the CARTS website. The City of Round Rock also operates its own demand response service.

APTS04 Transit Fare Collection Management (High Priority) – Includes the automatic collection of transit fares on transit vehicles and the ability to purchase fares remotely. This service package also supports the administration of an electronic funds transfer system and regional smart card that could be used in conjunction with payment for parking and tolls.

CapMetro Riders can purchase passes several ways including online and at ticket vending machines located at MetroRail stations. Additionally, the CapMetro Mobile App allows riders to purchase tickets on their mobile phones and use their phones as their pass. Operators or fare inspectors validate the purchase of passes via the mobile app on fixed-route, MetroAccess, and MetroRail vehicles; however, MetroRapid vehicles have scanners installed that validate mobile passes. CARTS riders can purchase rechargeable cards online, and passes can be purchased at kiosks located at certain CARTS transit centers.

It is envisioned that in the future, a regional smartcard will allow riders to use a single payment method that is accepted not only by CARTS and CapMetro, but other transportation systems in the state including in Dallas, Houston, Fort Worth, San Antonio, and Corpus Christi. CARTS would like to expand the acceptance of its rechargeable fare cards throughout its routes.

APTS05 Transit Security (High Priority) – Provides transit and emergency management personnel the ability to monitor transit facilities and vehicles to help ensure safe and secure operations for both transit personnel and transit riders. Elements of this service package include panic buttons, video and audio recorders, motion sensors and metal detectors. In addition to transit facilities, the monitoring of structures such as tunnels and bridges is included.

Both CARTS and CapMetro have installed security cameras and alarms on their vehicles to help ensure the safety of personnel and transit riders. Additionally, they both operate CCTV cameras at certain transit stations and other transit facilities. Although live video from transit vehicles is not sent back to any of the CapMetro operations centers, CapMetro security personnel can follow certain buses and view live video from their vehicles.

APTS06 Transit Fleet Management (High Priority) – Allows for the automatic or remote monitoring of transit vehicles. Vehicles can alert transit personnel of required routine maintenance or if a problem is detected that needs addressing immediately.

CapMetro MetroRapid BRT and fixed-route vehicles automatically provide diagnostic information when they arrive at their maintenance garages; however, CapMetro can monitor the operating conditions of all its vehicles.

APTS07 Multi-modal Coordination (High Priority) – Incudes coordination among various transit agencies and other modes of travel such as air, rail, and ferry in the location of transit stops and schedules. Additional coordination between transit agencies and special event organizers and parking and traffic management agencies is included in this service package.

Both CARTS and CapMetro acknowledge the need for better coordination between the agencies regarding schedules and fares. CapMetro would also like to improve coordination among its fixed-route, MetroRail, MetroAccess, and MetroRapid services. It is envisioned that in the future, a regional smartcard will allow riders to use a single payment method that is accepted not only by CARTS and CapMetro, but other transportation systems in the state including in Dallas, Houston, Fort Worth, San Antonio, and Corpus Christi. Additionally, coordination with other agencies including Amtrak and Greyhound could also be improved.

APTS08 Transit Traveler Information (High Priority) – Provides transit riders with transit related information including fares, schedules, and vehicle location via transit agency websites, transit vehicles, mobile phone applications, kiosks, or through private information service providers. Individualized transit trip plans are also included in this service package.

CARTS provides riders with transit information on their website which includes fares and schedules, and schedule information on DMS signs at transit centers. CapMetro maintains a website that provides schedule and transit information, but also includes real-time bus location information on maps. Riders can also text bus stops IDs or scan QR codes at bus stops to obtain real-time information. MetroRapid BRT bus stops and MetroRail passenger rail stations have DMS that display next bus or train arrival information.

APTS09 Transit Signal Priority (High Priority) – Allows transit vehicles to either communicate directly with the traffic signals or through both the transit and traffic management agencies to request priority when approaching certain signals. Priority can be limited based on vehicle type, traffic conditions, time of day, and schedule adherence.

The City of Austin in coordination with CapMetro provides transit signal priority along the two MetroRapid BRT routes. The transit vehicle location is continually tracked by the transit operations center. If a priority is needed at a traffic signal, a request is communicated to the City of Austin based on the location of the bus, and the City of Austin TMC software can request priority at the appropriate traffic signal.

APTS10 Transit Passenger Counting (High Priority) – Allows transit vehicles to automatically detect and count passengers as they board and alight buses. Sensors on transit vehicles may be able to distinguish a transit rider from inanimate object. The boarding and alighting information can be used by transit management personnel to alter stops and routes.

All CapMetro fixed-route buses, trains, and BRT, as well as CARTS fixed-route buses, contain equipment that automatically counts passengers during boarding. CapMetro also utilizes transit personnel to check boarding and alighting information periodically.

APTS11 Multimodal Connection Protection (High Priority) – Incudes the coordination within a single transit agency or among various transit agencies and other modes of travel such as air, rail, and ferry to optimize the travel times of travelers. This service package helps to ensure that travelers can make necessary connections to reach their destination in addition to essential communication between the agencies if they are ahead or behind schedule.

The need for improved schedule coordination within individual agencies and between agencies in the Region was expressed by several stakeholders. This can be an automated process that can include the computer aided dispatch, AVL systems, and schedule adherence information of various agencies in addition to transit trip plans submitted by travelers.

2.6 Commercial Vehicle Operations ITS Service Packages

The following commercial vehicle operations ITS service packages from the National ITS Architecture were selected and customized for stakeholders in the Austin Region. These ITS service packages represent how agencies are currently implementing, or planning to implement, commercial vehicle operations services. For each ITS service package selected by stakeholders, a general description as well as the current and planned ITS deployment activities in the Region are identified.

CVO04 CV Administrative Processes (Low Priority) – Allows for the electronic management and documentation of commercial vehicles and drivers. A database is created to streamline the process of commercial vehicle checks along highways. This package includes the coordination of commercial vehicle administration (CVA) and enforcement agencies, financial institutions, and private fleet management.

Although many of the CVO ITS service packages are implemented on a statewide level and not included in a regional ITS architecture, stakeholders wanted to include this ITS service package to recognize the need at the local level for automating permitting on local roads. The need for automated permitting and connecting permitting to local road maintenance and construction activities was identified by TxDOT and the Cities of Austin and Round Rock.

CVO10 HAZMAT Management (Medium Priority) – Provides information to emergency management agencies regarding vehicles carrying hazardous materials along with the location of the vehicles in the event that an incident occurs. This service package includes the ability of private fleet management to track the real-time location of commercial vehicles and monitor on-board sensors.

As noted in CVO04 description, many of the CVO ITS service packages are implemented on a statewide level and not included in a regional ITS architecture. Stakeholders wanted to include this ITS

service package to recognize the need to coordinate with local emergency management agencies during the status of HAZMAT materials traveling through the region, including both commercial vehicles and freight trains.

2.7 Traveler Information ITS Service Packages

The following traveler information ITS service packages from the National ITS Architecture were selected and customized for stakeholders in the Austin Region. These ITS service packages represent how agencies are currently implementing, or planning to implement, traveler information services. For each ITS service package selected by stakeholders, a general description as well as the current and planned ITS deployment activities in the Region are identified.

ATIS01 Broadcast Traveler Information (High Priority) – Allows for the collection and dissemination of traveler information concerning parking, transit services, incidents, road network conditions, multimodal, work zone, and weather conditions through wide area broadcasts. The collection of information requires the coordination of emergency, transit, maintenance and construction, traffic, and parking management agencies with information service providers. Dissemination of information through television stations, FM or AM radio stations, satellite radio, internet web casts, and directly to vehicles is included in this service package.

All the key municipalities, TxDOT, and other agencies have public information offices that provide the media with transportation or emergency related information.

ATIS02 Interactive Traveler Information (High Priority) – Allows for the collection and dissemination of traveler information concerning parking, transit services, incidents, road network conditions, multimodal, work zone, and weather conditions through media in which information can be personalized for each traveler based on their requests. The collection of information requires the coordination of emergency, transit, maintenance and construction, traffic, and parking management agencies with information service providers. Dissemination of information through 511 phone systems, personal computers/cell phones, kiosks, and in-vehicle systems is included in this service package.

TxDOT hosts two websites that provide travelers with roadway information. The Drive Texas TxDOT Highway Conditions website provides an interactive map that displays road closures, constriction information, weather, and traffic. Travelers can also specify roadways or counties to obtain specific information. The TxDOT ITS website contains much of the same information as the Drive Texas site, but allows users to view CCTV camera images and the current display of DMS.

The City of Austin is exploring the possibility of adding real-time traffic information to their website in the future that would include CCTV camera images, incidents, DMS, and travel times.

ATIS05 ISP Based Trip Planning and Route Guidance (High Priority) – Provides travelers with the ability to intricately preplan for trips and receive turn-by-turn guidance en-route to their destination. Reservations and prepayment for transit fares, multimodal fees, and parking spaces is supported by this service package.

TxDOT's Motor Carrier Routing Information provides an on-line system that allows motor carriers to view routing and roadway information, including load restricted bridges, low vertical clearance locations, roadway closures, and permit restrictions. Bridge restriction information includes TxDOT as well as bridges owned and maintained by local agencies. Low vertical clearance, permit restriction, and roadway closure information is also available by TxDOT District.

2.8 Archived Data Management ITS Service Packages

The following archived data management ITS service packages from the National ITS Architecture were selected and customized for stakeholders in the Austin Region. These ITS service packages represent how agencies are currently implementing, or planning to implement, archived data management services. For each ITS service package selected by stakeholders, a general description as well as the current and planned ITS deployment activities in the Region are identified.

AD1 ITS Data Mart (High Priority) – Includes the collection of archived data for a particular entity, agency, or jurisdiction related to transportation and the dissemination of that data upon request.

Several agencies in the region maintain their own archives. The data kept in these archives varies by agencies. TxDOT has several databases that contain information including transit, pavement, and traffic counts. The City of Austin maintains data related to transit signal priority, pavement, and traffic counts. The Cities of San Marcos and Cedar Park collect traffic counts and post that data on their websites. Most emergency management agencies within cities maintain their own incident and crash data. The TxDOT Toll Operations Division also posts toll data on their website.

The City of Austin has identified a need to improve their data collection and management to better analyze travel times and traffic patterns.

AD2 ITS Data Warehouse (High Priority) – Includes the collection and management of archived data from various transportation related agencies, entities, or jurisdictions in a centralized location. Data sources may include transit management, emissions management, information service providers, commercial vehicle administration, parking management, emergency management and maintenance and construction management. Collected data is formatted for consistency and disseminated upon request.

Stakeholders in the region would like to establish a repository where agencies will deposit information and make it available for everyone. Various stakeholders were particularly interested in incident, detour, real-time traffic, weather, and transit ridership information.

AD3 Virtual ITS Data Warehouse (High Priority) – Provides archived data users the ability to request archived data from a single repository in which information is obtained remotely from each locally managed ITS data mart.

A centralized location does not currently exist in the region, but a virtual data warehouse could be established as an alternative to a physical data warehouse that links to the archived data that is requested by users as needed

3. RECOMMENDED ITS DEPLOYMENTS – LOCAL DEPLOYMENTS

Within the Austin Region, stakeholder agencies have been actively deploying ITS projects for more than 20 years. Primary deployments have included a freeway management system implemented by TxDOT, advanced traffic management systems including CCTV cameras and TMCs implemented by municipalities, and transit management systems including transit operations center, advanced vehicle location, and transit traveler information technologies.

The stakeholders in the Austin Region noted a continued need for deploying ITS and improving operations. Most agencies had a set of priority deployments for their agency, which often included an expansion of existing systems and programs as well as the implementation of new ITS systems and programs to meet existing and future needs. Agency plans were generally local in nature and focused primarily on needs within the geographic area that the agency served.

In Section 3, a summary is provided of the existing ITS deployments in the Austin Region as well as the plans for expansion of existing systems and deployment of new systems. Stakeholders generally noted that the Austin Regional ITS Deployment Plan should focus on regional, rather than local ITS deployments and initiatives. Therefore, a majority of the Austin Regional ITS Deployment Plan is focused on regional projects and initiatives rather than local plans. Regional ITS deployments are presented in Section 4 – Recommended ITS Deployments – Regional Deployments.

3.1 Existing Local ITS Deployments

The Austin Region has made significant investments in the deployment of ITS throughout the Region. In **Table 2**, a summary of ITS deployments by state, regional, municipal, and transit agencies is provided.

State and regional agencies focuses primarily on investments made by TxDOT and CTRMA. Both agencies have dedicated TMCs to manage and operate ITS within the Region. Fields sensors, CCTV cameras, and DMS have also been deployed by both, with TxDOT also deploying Bluetooth devices to detect travel times as well. TxDOT has deployed lane control signals on some freeway segments to provide more active traffic management and is in the process of adding a graphic route information panels (GRIP) on I-35 to provide traveler information for the I-35 and SR 130 routes through the Austin Region. CTRMA is currently operating freeway service patrols on both CTRMA and TxDOT managed facilities to assist with clearance of incidents and traffic management. TxDOT and CTRMA share camera feeds and other data, with TxDOT also implementing center-to-center capabilities with the City of Austin. Finally, TxDOT does provide real-time traveler information through two TxDOT maintained websites.

A majority of municipalities in the Austin Region have deployed TOCs, centralized traffic signal systems, field sensors, and CCTV cameras. The City of Austin and Cedar Park are also deploying Bluetooth devices to determine travel times on corridors. The City of Austin has a limited number of DMS on arterial streets. Only Austin, Georgetown, and Round Rock have flood monitoring stations.

Transit agencies, including Capital Metro and CARTS, have deployed ITS to assist with vehicle tracking, security, fare payment, and passenger counting. Capital Metro has implemented systems to allow them to provide real-time information through websites and mobile applications as well as at transit centers and stops. Both are also archiving much of the data they collect on system performance and ridership as part of the FTA's reporting requirements. Capital Metro has also deployed a bus rapid transit system on two routes in the City of Austin, which include traffic signal priority in coordination with the City of Austin's traffic signal system.

Table 2 – Austin Regional Existing ITS Deployments

	Freeway and Arterial Applications																Transit Applications									
AGENCY	Traffic Management/Operations Center	Centralized Traffic Signal Control System	Field Sensors – Freeway	Field Sensors – Arterial Intersection	Bluetooth Detection	CCTV Cameras	Dynamic Message Signs	Highway Advisory Radio	Lane Control Signals	Variable Speed Limits	Flood Monitoring	Freeway Service Patrol	Emergency Vehicle Signal Preemption	Electronic Toll Collection	Center-to-Center Comm. for Traffic Info.	Real-Time Traveler Info. Website/Mobile Data	Archived Data	Transit Operations Center	Transit Vehicle Tracking	Transit Security Systems	Automated Fare Payment	Automated Passenger Counters	Bus Rapid Transit	Center-to-Center Comm. for Traffic Info.	Real-Time Traveler Info. Website/Mobile Data	Real-Time Trav. Info. at Transit Centers/Stops	Archived Data
State and Regional																										
TxDOT	✓		✓	✓	✓	✓	✓	✓	✓			✓			✓	✓											
CTRMA	✓		✓			✓	✓					✓		✓	✓												
Municipalities																										
City of Austin	✓	✓		✓	✓	✓	✓		✓		✓		✓		✓												
City of Cedar Park	✓	✓		✓	✓	✓																					
City Georgetown		✓		✓							✓																
City of Round Rock	✓	✓		✓		✓					✓		✓														
City of San Marcos	✓	✓		✓		✓							✓														
Transit																										
Capital Metro																		✓	✓	✓	✓	✓	✓		✓	✓	✓
CARTS																		✓	✓	✓	✓	✓				✓	✓

3.2 Expansion of Existing Local ITS Deployments

All of the stakeholders that participated in the update of the Austin Regional ITS Architecture expressed a desire to expand a majority of their existing ITS deployments. This included expansion of geographical coverage as well as expansion of a number of devices covering a given area.

TxDOT noted the need to expand coverage of their freeway management system in the Austin area, specifically on I-35 through the downtown area. There was also a desire to cover more freeway sections in the Austin Region, although the need to budget for operations and maintenance of these sections was noted as a strong need. CTRMA also noted a need to provide additional coverage and traveler information on their facilities. With the implementation of the CTRMA TMC they have the capability to monitor and control their devices from a central facility. Expanded coverage, both geographically and in the frequency of patrols, for the freeway service patrol was also noted by TxDOT and CTRMA.

Many municipalities consistently recognized the need to expand their advanced traffic management systems, including adding communication to more traffic signals as well as the implementation of technologies such as adaptive traffic signal control. Additional deployments of arterial CCTV cameras and Bluetooth devices are needed to improve monitoring capabilities and provide more travel time information on corridors. Austin would like to expand the deployment of DMS to provide additional traveler information, and many cities would like to expand the number of signals with emergency vehicle preemption.

Capital Metro noted the need to expand their bus rapid transit service to additional routes. Capital Metro is also continuing to add passenger counters to fixed-route vehicles and planning to expand their mobile ticketing application to allow purchase of tickets for transit services in other parts of Texas. Both Capital Metro and CARTS will continue deploying AVL on buses and expand the capabilities of the transit systems to provide this information at transit centers and stops.

Most of the agencies participating in the Regional ITS Architecture Update have developed, or were in the process of developing, plans for the implementation and expansion of their ITS systems.

3.3 Implementation of New Local ITS Deployments

At the individual agency level, focus on new ITS deployments included increased capabilities for monitoring and controlling systems, increased capabilities for providing traveler information, and increased coordination and information sharing between agencies.

Detection capabilities such as Bluetooth was noted by several cities that did not currently have Bluetooth implemented. Deployment of DMS on arterial streets to provide local traveler information, as well as provide information on freeway conditions prior to motorists entering the freeway, was noted as a need. Variable speed limits have recently been studied by TxDOT and are being considered by TxDOT and local agencies.

The City of Austin is deploying adaptive signal control in the downtown area as well as at interchanges along I-35. Several other cities noted an interest in deploying adaptive signal control in the future, including signals in Round Rock near the Dell Diamond. The City of Austin is in the process of developing a mobile phone application that will allow bicyclists to communicate with the City of Austin ATMS and allow the City to detect when a bicyclist is approaching a traffic signal rather than rely on loops or video to detect bikes, which is sometimes unreliable. The City of Austin has considered a mobile TMC that can be used during special events or major incidents, and they are also implementing systems to determine the availability of parking and provide real-time information to travelers on parking availability. Preliminary discussions are on-going between the City of Austin and CTECC regarding the City of Austin TMC potentially relocating to CTECC.

The City of Round Rock is implementing flood detection with advanced warning flashers at low water crossings. In the City of San Marcos, they are developing a mobile application that will alert users when rail crossings may be blocked for extended periods.

TxDOT and several cities noted the need to implement center-to-center capabilities to allow sharing of incident information, traffic conditions, and CCTV camera feeds between agencies. TxDOT was in the process of implementing center-to-center communications with Austin during the development of the Austin Regional ITS Deployment Plan.

Capital Metro would like to link their computer aided dispatch (CAD) system to other transit agency's CAD systems in the Region to improve intermodal connections.

A majority of the new ITS deployments that stakeholders noted were needed in the Region are considered regional deployments that involve at least two or more regional partners. The highest priority deployment areas are identified below:

- Regional Traveler Information Improvements
- Traffic Incident Management Improvements
- Freeway Service Patrol Expansion
- Integrated Corridor Management
- Center-to-Center Communications
- Regional or Statewide Transit Payment System
- Bus Rapid Transit Expansion
- Archived Data Warehouse Implementation

These regional deployments are described in detail in Section 4 – Recommended ITS Deployments – Regional Deployments, of this document.

3.4 Recommended Local ITS Deployments by Agency

A list of all recommended local ITS deployments by individual agency is presented in **Table 3**. These projects were considered high priority by each agency and meet individual agency goals for improving the transportation network. Each project that has been identified also includes the corresponding ITS service package(s) from the Austin Regional ITS Architecture. The ITS service packages have been provided to demonstrate how each recommended deployment fits within the overall Regional ITS Architecture. The ITS service packages are important to be able to demonstrate Regional ITS Architecture conformity if a project is using federal transportation funds for implementation.

The projects identified in **Table 3** are primarily projects that will be implemented by individual agencies to meet individual goals of the state, regional, or municipal agency. Regional projects that have been identified as priority deployments by the Region are presented in Section 4 of this document.

Projects in **Table 3** that directly link to the regional ITS deployments recommended in Section 4 are shown with an asterisk (*). Additional detail on these regional projects is provided in Section 4.

Table 3 – Recommended Local ITS Deployments

ITS Project	Primary Corresponding ITS Service Packages
TxDOT Austin District	
Expand freeway management system coverage including detection, CCTV cameras, DMS, and lane control signals	ATMS01 Network Surveillance ATMS06 Traffic Information Dissemination ATMS23 Dynamic Lane Management and Should Use
Expand freeway service patrol in the Region (in coordination with CTRMA and CAMPO)*	EM04 Roadway Service Patrols
Implement Integrated Corridor Management on I-35*	ATMS01 Network Surveillance ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management
Implement road weather information stations	MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution
Implement center-to-center connection with cities*	ATMS07 Regional Traffic Management
Implement center-to-center connection with CTRMA*	ATMS07 Regional Traffic Management
Implement data sharing agreement with rail operators to share real-time and planned train schedules (TxDOT Rail Division Project)	ATMS15 Railroad Operations Coordination
Develop a concept of operations for the ITS program. The concept of operations should include operating and maintenance costs as well as strategies for how new technologies can be used to support TxDOT goals and objectives.	This project would correspond to all TxDOT ITS Service Packages for ATMS and ATIS
CTRMA	
Expand express lane coverage in the Region	ATMS05 HOV Lane Management
Implement CCTV cameras	ATMS01 Network Surveillance
Implement DMS	ATMS06 Traffic Information Dissemination
Expand freeway service patrol in the Region (in coordination with TxDOT and CAMPO)*	ATMS08 Traffic Incident Management System EM04 Roadway Service Patrols
City of Austin	
Relocate the TMC, possibly co-locate with other agencies at CTECC	ATMS01 Network Surveillance ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management
Expand adaptive signal control	ATMS03 Traffic Signal Control
Expand CCTV camera coverage	ATMS01 Network Surveillance
Expand DMS on arterial street deployment, including DMS prior to freeway entrances	ATMS06 Traffic Information Dissemination
Implement DMS at selected low water crossings to supplement detection and beacons	ATMS06 Traffic Information Dissemination MC04 Weather Information Processing and Distribution
Implement dynamic lane assignment signs at intersections as needed	ATMS23 – Dynamic Lane Management and Shoulder Use
Implement crowd sourcing mobile application to track users and improve traffic signal timing	ATMS03 Traffic Signal Control

Table 3 – Recommended Local ITS Deployments (Continued)

ITS Project	Primary Corresponding ITS Service Packages
City of Austin (continued)	
Implement Graphic Route Information Panels (GRIP)	ATMS06 Traffic Information Dissemination
Implement a data dashboard for arterial traffic information	ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination
Implement a real-time traveler information website which would include CCTV camera images and arterial travel times	ATMS06 Traffic Information Dissemination
Implement a mobile app for bicycle detection	ATMS03 Traffic Signal Control
Complete center-to-center connection with the TxDOT Austin TMC*	ATMS07 Regional Traffic Management
Implement center-to-center connection with Round Rock and CTRMA*	ATMS07 Regional Traffic Management
Expand emergency vehicle signal preemption using a GPS based system	ATMS03 Traffic Signal Control EM02 Emergency Routing
Implement a back-up TMC	ATMS01 Network Surveillance ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management
Implement ICM along the I-35 corridor in coordination with TxDOT and Round Rock	ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management
Consider the implementation of ramp metering along I-35	ATMS04 Traffic Metering
City of Cedar Park	
Upgrade the TMC to include ATMS upgrades and traveler information capabilities	ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination
Complete the upgrade of traffic signal system controllers and cabinets	ATMS03 Traffic Signal Control
Expand CCTV camera coverage	ATMS01 Network Surveillance
Expand Bluetooth coverage and make information available to the public	ATMS02 Traffic Probe Surveillance ATMS06 Traffic Information Dissemination
Implement DMS	ATMS06 Traffic Information Dissemination
Implement Cedar Park TMC workstation at City Hall for use during City emergencies	ATMS01 Network Surveillance ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination ATMS08 Traffic Incident Management System
Implement real-time traveler information website which would include CCTV camera images and arterial travel times	ATMS06 Traffic Information Dissemination
Implement center-to-center connection with the TxDOT Austin TMC, Round Rock, and CTRMA*	ATMS07 Regional Traffic Management

Table 3 – Recommended Local ITS Deployments (Continued)

ITS Project	Primary Corresponding ITS Service Packages
City of Georgetown	
Implement a TOC	ATMS01 Network Surveillance ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management
Implement center-to-center connection with the TxDOT Austin TMC*	ATMS07 Regional Traffic Management
City of Round Rock	
Expand adaptive signal control	ATMS03 Traffic Signal Control
Expand CCTV camera coverage	ATMS01 Network Surveillance
Implement DMS on arterial streets prior to freeway entrances	ATMS06 Traveler Information Dissemination
Implement railroad crossing blank-out signs to notify motorists when crossings are blocked	ATMS13 Standard Railroad Grade Crossing
Implement center-to-center connection with the TxDOT Austin TMC*	ATMS07 Regional Traffic Management
Implement flood detection, warning beacons, and CCTV cameras at low water crossings	ATMS01 Network Surveillance EM07 Early Warning System MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution
City of San Marcos	
Expand CCTV camera coverage	ATMS01 Network Surveillance
Implement center-to-center connection with the TxDOT Austin TMC*	ATMS07 Regional Traffic Management
Implement Bluetooth detection on arterial streets	ATMS02 Traffic Probe Surveillance
Implement flood detection and warning beacons at low water crossings	MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution
Capital Metro	
Continue implementation of AVL	APTS01 Transit Vehicle Tracking
Continue deployment of bus rapid transit routes*	APTS09 Transit Signal Priority
Implement regional or statewide smart fare payment system*	APTS04 Transit Fare Collection Management
Expand Capital Metro Mobile App functionality including the ability to buy tickets to events and purchase fares for other transit systems	APTS04 Transit Fare Collection Management
Continue deployment of transit traveler information technologies including next bus arrival and QR code scanning at transit stops	APTS08 Transit Traveler Information
Implement center-to-center connections with TxDOT and municipal TOCs where Capital Metro operates to provide Capital Metro with real-time information on road conditions*	APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations
Implement connections with municipal public safety CAD systems to provide Capital Metro with real-time information on incidents	APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations

Table 3 – Recommended Local ITS Deployments (Continued)

ITS Project	Primary Corresponding ITS Service Packages
CARTS	
Continue implementation of AVL	APTS01 Transit Vehicle Tracking
Continue deployment of transit traveler information technologies including next bus arrival and QR code scanning at transit stops	APTS08 Transit Traveler Information
Implement regional or statewide smart fare payment system*	APTS04 Transit Fare Collection Management
Implement center-to-center connections with municipal TOCs where CARTS operates to provide CARTS with real-time information on road conditions	APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations
Implement connections with municipal public safety CAD systems to provide CARTS with real-time information on incidents	APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations

*Regional ITS deployment with additional detail provided in Section 4.

4. RECOMMENDED ITS DEPLOYMENTS – REGIONAL DEPLOYMENTS

Although most agencies are actively deploying ITS within the Austin Region, stakeholders noted a strong need for the implementation of regional systems and programs to meet regional needs. Regional needs generally focused on traveler information, incident management, improved communications, and improved transit service.

Stakeholder identified eight regional deployment areas for ITS in the Region. These eight areas do not encompass all of the regional ITS needs within the Austin Region, however stakeholders recommended that emphasis be placed on implementation related to these eight areas in order to provide the greatest benefit to travelers. The eight areas include:

- Regional Traveler Information Improvements
- Traffic Incident Management Improvements
- Freeway Service Patrol Expansion
- Integrated Corridor Management
- Center-to-Center Communications (TxDOT-to-Local and Local-to-Local)
- Regional or Statewide Transit Payment System
- Bus Rapid Transit Expansion
- Archived Data Warehouse Implementation

A summary of each of the eight regional deployment areas is provided in Section 4. For each, the following information is provided:

Basis of Need – Describes how the regional deployment project or program meets one of more of the regional ITS needs that were identified in the Regional ITS Architecture.

Stakeholders – Identifies the stakeholder agencies that would be involved in the implementation of projects related to each deployment area. If possible a lead agency is identified.

Deployment Components – Describes the projects, programs, initiatives, or training that is required to fully implement each of the eight regional deployments.

Best Practices and Current Trends – Describes a summary of best practices and current trends related to each regional deployment area.

Regional ITS Architecture Conformance – Identifies the ITS service packages from the Austin Regional ITS Architecture that are related to each of the regional deployment areas. Conformance of ITS projects with the Regional ITS Architecture is important in order for any ITS project or program to be eligible for federal ITS funding.

4.1 Regional Traveler Information Improvements

Regional traveler information improvements for the Austin Region include the ability to monitor travel conditions throughout the Region and provide a single consolidated location that can be used for providing information on travel conditions for freeways, arterials, and transit.

Basis of Need

The need for accurate, real-time, and relevant traveler information was identified by all stakeholder agencies as a high priority. Many of the agencies are implementing key aspects of a traveler information system, such as system detection, transit vehicle tracking, and websites with real-time information. Stakeholders noted three needs:

- Continued expansion of coverage;
- Continued expansion of systems to provide information to travelers; and
- Method to consolidate all regional traveler information available from within the Region into a single location that is accessible to the public and private partners.

Regional traveler information improvements also address the following needs that were identified in the Regional ITS Architecture:

- Improve the accuracy, timeliness, and availability of regional travel information; and
- Collect and make available additional travel time information along controlled access facilities and arterials.

Stakeholders

Regional traveler information is available, or could be available, from all of regional stakeholders. TxDOT, CTRMA, Capital Metro, CARTS, CAMPO, and the larger municipalities in the Austin Region have been identified as the primary stakeholders; however, any agency that can provide traveler information such as road conditions, incidents, construction and maintenance information, or other relevant information should be considered a stakeholders. A lead agency for this effort has not yet been identified, although a regional or statewide agency such as TxDOT, CTRMA, or CAMPO would be the most likely agency to lead such an effort.

Deployment Components

Traveler information needs to be accurate, reliable, and timely and can include congestion information, incident information, weather conditions, construction closure information, and transit vehicle arrival times. In order to provide real-time information that travelers need, the infrastructure and coordination efforts necessary to collect road network conditions data, locate transit vehicles, detect incidents, and broadcast the information to the public utilizing various outlets must be in place and continuously enhanced. Agencies must be able to collect travel time information, road weather conditions and view live video from CCTV cameras along major route to understand how the network is performing. CCTV cameras, travel time information,

Regional Traveler Information Improvements Summary

Regional traveler information improvements include the deployment of additional detection and traveler information devices in the field, the consolidation of traveler information from throughout the Region, and the implementation or support of methods to make that information available to stakeholder agencies and the traveling public.

Primary stakeholders include TxDOT, CTRMA, Capital Metro, CARTS, CAMPO, and the larger municipalities in the Austin Region. A lead agency for this deployment has not been identified.

Regional traveler information improvements meet the need identified in the Austin Regional ITS Architecture to improve accuracy, timeliness, and availability of regional traveler information.

and coordination with emergency management agencies can aid in the detection of incidents. Automatic vehicle location equipment allows transit agencies to monitor the schedule adherence of transit vehicles. Websites, television, and dynamic signs are all outlets by which information can be communicated to drivers and transit riders so that they can adjust their route if necessary. Dissemination of the information at the roadside will generally be the responsibility of public sector agencies, however dissemination of information through other means, such as mobile applications, may be from either public or private agencies.

Regional Traveler Information Improvements in the Austin Area include the following components:

Increased Coverage of Detection Systems – Additional detection systems, including Bluetooth or other technologies to determine travel times and individual detection sites to determine speed, volume, and occupancy are needed on freeways and arterials. I-35 in the downtown area, which does not currently have detection systems implemented, as well as major corridors that proved mobility throughout the region are the highest priority for increased coverage.

Improved Access to Private Data – Several privatized providers are able to provide traveler information data, such as INRIX and WAZE. This data has become increasing accurate but can be costly to obtain for a single agency. The Region should consider cost sharing models to obtain this type of regional privatized data at a reduced cost.

Arterial DMS – DMS located along arterial roadways to provide traveler information prior to vehicles entering freeways would be very beneficial to motorists by allowing them select and alternate route. This could also help reduce the queuing or congestion that these additional vehicles would have added if they entered the freeway. TxDOT and local municipalities should consider cost sharing efforts to deploy these arterial DMS. Austin and Round Rock both noted a need to provide traveler information to motorists on arterial streets prior to them entering the freeway.

Regional Information Consolidation – Traveler information is currently available from many different sources within the Austin Region, such as TxDOT, City of Austin, and Capital Metro. A consolidated centralized traveler information system is needed that will pull in traveler information, including travel times, crash locations, and weather information into a single system that can be accessed by public agencies, media, and web and application developers. This system could serve as the catalyst to encourage more privatized development of traveler information website and other systems.

Stakeholder agreed that a single point of access for all regional traveler information would benefit travelers in the Austin Region. This single point does not have to be a public agency maintained system, and generally stakeholders recommended that a privatized system may be more effective.

Timeframe

The need for real-time regional traveler information was identified as a high priority for the Region and should be implemented in the short-term. A number of agencies are currently investing to expand their detection systems and TxDOT currently has access to private data sources such as INRIX. Arterial DMS have been deployed by the City of Austin but no other agencies have implemented them. However, several other municipalities noted the need to invest in arterial DMS in the short-term provided they can use the arterial DMS to provide information on freeway conditions prior to motorist entering. The greatest challenge is consolidating regional information and developing a regional traveler information network. A lead agency needs to be designated for this effort and it should begin within the next three to five years.

Regional ITS Architecture Conformance

Traveler information is identified in almost all of the ITS service areas in the Regional ITS Architecture, including the Traffic Management, Emergency Management, Maintenance and Construction Management, Public Transportation Management, and Traveler Information service areas. The primary ITS service packages that were identified in the Regional ITS Architecture related to Regional Traveler Information Improvements are identified below.

- ATMS01 Network Surveillance
- ATMS02 Probe Surveillance

- ATMS06 Traffic Information Dissemination
- EM10 Disaster Traveler Information
- MC04 Weather Information Processing and Distribution
- APTS08 Transit Traveler Information
- ATIS01 Broadcast Traveler Information
- ATIS02 Interactive Traveler Information

The ITS service packages related to traveler information are also supported by many of the other ITS service packages that have been identified in the Austin Region. For example, the ATMS01 Network Surveillance service package and the APTS01 Transit Vehicle Tracking service package provide traffic and transit agencies with important information about road conditions and bus performance, which can then be passed on to travelers through a variety of methods. The primary supporting ITS service package are identified below.

- ATMS01 Network Surveillance
- ATMS02 Probe Surveillance
- ATMS07 Regional Traffic Management
- ATMS17 Regional Parking Management
- MC03 Road Weather Data Collection
- MC08 Work Zone Management
- APTS01 Transit Vehicle Tracking

4.2 Regional Traffic Incident Management Improvements

Regional traffic incident management improvements in the Austin Region include the ability to identify incidents, provide appropriate emergency response, clear the incidents in a quick and safe manner, manage traffic during the incident, and provide accurate and timely traveler information about the incident to stakeholder agencies and the traveling public.

Basis of Need

Incidents have a major impact on congestion, particularly in Austin where much of the network is operating at or beyond capacity throughout the day. Stakeholders identified a strong need to improve the Region's ability to manage and clear incidents as quickly as possible to reduce congestion and the chance of secondary crashes during incidents. A need also exists to improve coordination between freeway and arterial operations during incidents that require the partial or of full closure of freeways and the diversion of vehicles onto arterials.

Regional traffic incident management improvements also address the following needs that were identified in the Regional ITS Architecture:

- Improve communication and coordination between agencies for traffic operations and incident management; and
- Improve the accuracy, timeliness, and availability of regional travel information.

Stakeholders

Incident management was primarily focused on freeways in the region, which are operated by TxDOT and CTRMA. Close coordination is required with municipal stakeholders during times when vehicles may be diverted onto roadways. Coordination with Capital Metro and CARTS is also necessary during major incidents that close roadways so they can reroute transit vehicles appropriately.

Deployment Components

Regional traffic incident management improvements will consist of enhancing the ability to share incident information, improving coordination between agencies to respond to incidents, providing continual training to ensure agencies work together as efficiently as possible in both the field and dispatching centers, and deploying of real-time information regarding incidents and closures.

Regional Traveler Information Improvements in the Austin Area include the following components:

Computer Aided Dispatch Data Sharing – Public safety agencies throughout the Austin Region use computer aided dispatching (CAD) systems to log incidents and dispatch public safety responders. TxDOT and municipal TMCs would like to have real-time access to this information through integration with CAD systems used by public safety dispatchers. As this coordination is further established it will

Regional Traffic Incident Management Improvements

Regional traffic incident management improvements include improved incident information sharing between agencies, improved coordination, and increased incident management training. Incident management improvements also include improvements in the accuracy, timeliness, and availability of traffic incident information throughout the Region.

Stakeholders include TxDOT, CTRMA, CAMPO and cities in the Austin Region. A lead agency for this deployment has not been identified, although TxDOT or CAMPO were identified as the most likely leads.

Regional traveler information improvements meet the regional need to improve communication and coordination between agencies for incident management as well as the need to improve accuracy, timeliness, and availability of regional traveler information.

allow TxDOT, CTRMA, and municipal TMCs to determine incident locations and severity quicker. The highest priority identified was to integrate the TxDOT Austin District TMC with CAD systems operated by municipal and county public safety agencies, to improve incident management on freeways and major state routes throughout the Region.

Center-to-Center Coordination – TxDOT and several municipalities noted the need for center-to-center coordination to share CCTV camera feeds, incident data, travel conditions, and other information. Implementation of center-to-center communications between TxDOT and municipalities will allow improved coordination during incidents.

Arterial Traffic Signal Timing Plan Implementation – Stakeholders noted the need to coordinate freeway and arterial operations during major incidents. The ability to implement timing plans on frontage roads and arterials can reduce the impact of multiple lane and full freeway closures on congestion by improving the ability of frontage roads and arterials to handle unusually high capacity demands.

Freeway Service Patrol – The need for expansion of the freeway service patrols will assist with incident management by helping to move disabled vehicles out of lanes or shoulders, and providing traffic control assistance at incidents. Freeway service patrol expansion is called out as a separate project in Section 4.3.

Traffic Incident Management (TIM) Training – In the 2014 FHWA TIM Program Self-Assessment, Austin incident management stakeholders rated the Region as "Good" for most types of TIM training and only as "Fair" when it comes to multi-agency post-incident debriefings. Stakeholders noted the need to continue providing training in the Austin Region to train as many first responders as possible.

Regional Traveler Information Improvements – A key component of incident management is to provide advanced information to travelers regarding lane closures and other incidents. Advanced information can reduce driver frustration, reduce the number of vehicles moving through an incident scene, and improve safety for travelers and first responders by alerting drivers that lanes may be blocked or closed ahead. Regional traveler information improvements are discussed in more detail in Section 4.1.

Timeframe

Each of the deployment components identified for traffic incident management improvements is currently being implemented in some capacity. CAD data sharing with the TxDOT Austin District TMC needs to be expanded, and several agencies such as Capital Metro also noted the need to implement CAD data sharing. Center-to-center coordination is being established between the TxDOT Austin District and City of Austin, but also needs to be expanded to connect TxDOT to other cities as well as connect the cities of Austin, Cedar Park, and Round Rock. Freeway service patrols are implemented but need to be expanded. All of these efforts should be implemented in the short-term as they were high priorities for the Austin Region stakeholders. Ideally they should be completed within the next five years. TIM training is on-going but stakeholders still noted the need to train as many first responders as possible. Regional traveler information improvements, which support the traffic incident management improvements, is discussed in Section 4.1 but should also be completed within the next five years.

Regional ITS Architecture Conformance

Regional traffic incident management is identified with a specific ITS service package in the Regional ITS Architecture: ATMS08 Regional Traffic Management. However, several other ITS service packages also provide key components of a complete traffic incident management program. These ITS services are related to the detection of incidents, dispatch of first responders, management of traffic at the incident, and providing en-route and pre-trip traveler information about incidents. The ITS service packages related to regional traffic incident management are identified below.

- ATMS01 Network Surveillance
- ATMS06 Traveler Information Dissemination
- ATMS08 Regional Traffic Management
- ATMS21 Roadway Closure Management

- ATMS22 Variable Speed Limits
- ATMS24 Dynamic Roadway Warning
- EM01 Emergency Call Taking and Dispatch
- EM02 Emergency Routing
- EM04 Roadway Service Patrols
- ATIS Broadcast Traveler Information
- ATIS02 Interactive Traveler Information

4.3 Freeway Service Patrol Expansion

Freeway service patrol expansion in the Austin Region includes expansion of existing coverage area and frequency, as well as an enhancement of the capabilities of the service patrols. Freeway service patrols have been recognized as a way to improve safety, reduce non-recurring congestion, and improve travel time reliability. Expansion of the existing service was noted as priority by the Austin Region stakeholders.

Basis of Need

Freeway service patrols are an important component of incident management in the Austin Region. There are currently service patrols on several major freeways within the Austin Region, however stakeholders identified a need to expand the freeways covered as well as the hours of service and number of patrol vehicles. An expansion of the services that are provided by the freeway service patrol, such as the use of larger trucks that can push vehicles off of roadways if necessary, was also noted. Although freeway service patrol expansion is identified as part of the Regional Traffic Incident Management Improvements project identified in Section 4.2, stakeholders wanted to list the need for expansion of freeway service patrol as a separate deployments to highlight its importance.

Freeway service patrol expansion also address the following need that was identified in the Regional ITS Architecture: Improve communication and coordination between agencies for traffic operations and incident management.

Stakeholders

TxDOT and CTRMA, as the two agencies that operate freeways, were identified as the primary stakeholders for the freeway service patrol expansion. CAMPO may also take a role in coordinating regional services such as the freeway service patrol expansion.

Deployment Components

The CTRMA is administering the HERO program, which provides freeway service patrol on a 55-mile section of I-35 from the City of Georgetown to the City of Kyle and a 12-mile section of US 183 between I-35 and Lakeline Boulevard. The service is operational Monday through Friday from 6:00 AM until 8:00 PM. The TxDOT Toll Operations Division also contracts to provide freeway service patrol on SH 45 and SH 130 toll roads.

Stakeholders in the Austin Region recognized the value of the HERO program to assist with incident management and improve travel time reliability. The program was previously administered by TxDOT but was discontinued for several years due to funding issues. The positive impact of the program on travel is very great and stakeholders expressed a desire to see the program be expanded in several ways.

Freeway service patrol expansion will consist of three parts:

- Expanded geographical coverage of routes by the freeway service patrol;

Freeway Service Patrol Expansion

Freeway service patrols provide the Region with the ability to preserve capacity on freeways by expediting lane or shoulder clearance, improve safety by reducing the potential for crashes, and assist with traffic control during incidents. Stakeholders noted the need to expand the coverage and frequency of existing freeway service patrols as well as enhance their capabilities related to lane clearance and traffic control.

Primary stakeholders include TxDOT, CTRMA, and CAMPO. CTRMA is currently managing the HERO program in Austin, but the lead agency for an expanded version of the freeway service patrol program could be TxDOT, CTRMA, or CAMPO.

Freeway service patrol expansion meets the regional need to improve incident management capabilities.

- Expanded frequency of coverage with more freeway service patrol vehicles covering the same routes; and
- Expanded capability of the freeway service patrol vehicles, which may include larger service patrol vehicles to push larger vehicles and objects out of the road and to carry more equipment for traffic management at traffic incidents and road closures.

Timeframe

Freeway service patrols are an important component of incident management and expansion of the service should occur as soon as possible. CAMPO has indicated a commitment to freeway service patrols and is planning to study expansion. TxDOT, CTRMA, and CAMPO will continue to look for funding to expand this service.

Regional ITS Architecture Conformance

Freeway service patrols are specifically called out in the ITS service package for EM04 Roadway Service Patrols. In the Austin Regional ITS Architecture, the EM04 Roadway Service Patrols service package has been customized for the CTRMA, which is providing freeway service patrols on both CTRMA toll facilities as well as Interstates and state freeways in the Austin Region.

In addition to the EM04 Roadway Service Patrols service package, freeway service patrols also play an important role in the ATMS08 Traffic Incident Management System ITS service package. The coordination between the CTRMA Operation Center and CTRMA HERO vehicles is included in this service package to demonstrate the dispatching and coordination between the CTRMA Operations Center and the CTRMA HERO vehicles that will occur during incidents.

4.4 Integrated Corridor Management

Integrated Corridor Management (ICM) consists of a number of strategies that seek to reduce congestion and improve travel time reliability along a defined corridor. ICM strategies generally include at least two or more modes of transportation, including freeway, arterial, bus, and rail, and provide real-time information on each mode to travelers using the corridor. If a mode experiences unusual delay on a particular day, other modes can be adjusted. For example, if a freeway along an ICM corridor is closed due to an incident, arterial signal timing can be adjusted to accommodate additional demand and transit bus service may add additional buses to accommodate increased ridership. ICM relies on close monitoring of each mode, communication between agencies that operate each mode, and accurate, timely, and reliable real-time information to travelers on the condition of each mode.

The Austin Region received a grant from the FHWA in 2015 to fund the development of a concept of operations for an ICM along the I-35 corridor through the City of Austin. FHWA funding for the implementation of the I-35 ICM will be based on a competition among the 13 sites throughout the United States that received the initial FHWA grant, however the Austin Region has indicated a desire to fund the implementation of ICM even if the Region is not awarded additional FHWA ICM funds. Austin Region stakeholders would also like to consider additional corridors for implementation of ICM in the future. These corridors will likely include other cities in addition to Austin, as well as TxDOT, CTRMA, and Capital Metro.

Basis of Need

Congestion and travel time reliability are both challenges in the Austin Region. Stakeholders identified a number of needs that relate to both of these that can be addressed to some extent through the implementation of ICM. ICM strategies address the following needs that were identified in the Regional ITS Architecture by stakeholders:

- Improve communication and coordination between agencies (State-Local, Local-Local) for traffic operations and incident management;
- Collect and make available additional travel time information along controlled access facilities and arterials;
- Implement Integrated Corridor Management (ICM) strategies; and
- Improve data sharing among agencies for both operational and planning initiatives.

Stakeholders

ICM stakeholders for the existing I-35 ICM include the TxDOT Austin District, CTRMA, City of Austin, and Capital Metro. Additional stakeholders for future phases may include the same stakeholders as well as other municipalities located on major corridors in urban areas, including Round Rock and Cedar Park.

Integrated Corridor Management

ICM provides real-time travel information to travelers for multiple modes along a corridor, including freeway, arterials, and transit. Improvements to modes can also be made to accommodate unusual demands, such as implementing new signal timing plans on an arterial to accommodate additional traffic due to a freeway closure. In Austin the first ICM effort is focused on the I-35 corridor through the City of Austin.

Primary stakeholders in the I-35 ICM effort includes TxDOT, CTRMA, Capital Metro, and the City of Austin. TxDOT is the lead agency. Future ICM efforts may include other cities in the Region.

ICM efforts meet several needs identified by stakeholders, including a need identified specifically for ICM implementation.

Deployment Components

The I-35 ICM effort was in the process of developing a concept of operations at the time the Austin Regional ITS Deployment Plan was being developed. It is envisioned that the ICM will include the following strategies:

- Integration of operational decisions for all modes along the corridor. Modes on the I-35 corridor could include I-35, MoPac, SH 130, major arterials in the City of Austin, and Capital Metro services including MetroBus, MetroRapid (bus rapid transit) and MetroRail.
- Increased use of alternate routes and modes especially during peak travel times or times.
- Increased use of active transportation and demand management to maximize existing facilities, including dynamic lane assignment, dynamic speed limits, queue warning, congestion pricing, and adaptive signal control.
- Establishment of data-sharing capabilities between all participating transportation agencies.
- Encourage changes in travel behavior such as alternating work hours or telecommuting.
- Use of private sector technology for information sharing.

The initial phase of the I-35 ICM will focus on development of the concept of operations. Should the concept of operations show that the I-35 ICM is feasible and will provide the intended benefits, Austin stakeholders have indicated that the project will be funded for implementation even if the region does not received additional FHWA ICM funding.

Additional corridors in the Austin Region should also be considered for ICM implementation to build off the momentum, partnerships, and strategies developed for the I-35 ICM.

Timeframe

The Austin Region was awarded an ICM grant from the FHWA in 2015. The grant provides initial funding for the development of a concept of operations. Funding for additional phases will be on a competitive basis between the other sites that received the same initial grant from FHWA. Should the concept of operations show that the ICM is feasible but Austin not be awarded a grant to continue moving forward, the Region should consider funding ICM using other means to move the project forward and implement ICM on in the I-35 corridor within the next three years.

Regional ITS Architecture Conformance

Integrated corridor management relies on a combination of capabilities including the ability to monitor real-time conditions on a number of modes of transportation, the ability to share information between stakeholders, and the ability to provide real-time information to travelers regarding a particular corridor both pre-trip and while en-route.

ITS service packages in the Austin Regional ITS Architecture that provide the monitoring capabilities that ICM relies upon include:

- ATMS01 Network Surveillance
- ATMS02 Probe Surveillance
- MC03 Road Weather Data Collection
- APTS01 Transit Vehicle Tracking

ITS service packages that provide the ability to share information between stakeholders include:

- ATMS07 Regional Traffic Management
- APTS07 Multi-modal Coordination

ITS service packages that provide the ability to provide pre-trip and en-route traveler information include:

- ATMS06 Traffic Information Dissemination

- MC04 Weather Information Processing and Distribution
- MC10 Maintenance and Construction Activity Coordination
- APTS08 Transit Traveler Information
- ATIS01 Broadcast Traveler Information
- ATIS02 Interactive Traveler Information

ICM could also include strategies to improve corridor operations during periods of unusual traffic, such as an incident that causes freeway traffic to divert onto arterials. ITS service packages that provide the ability to control and improve corridor operations, and could possibly be incorporated into future ICM strategies include:

- ATMS03 Traffic Signal Control
- ATMS04 Traffic Metering
- ATMS22 Variable Speed Limits
- ATMS23 Dynamic Lane Management and Shoulder Use
- EM04 Roadway Service Patrols
- APTS09 Transit Signal Priority

4.5 Center-to-Center Communications

Center-to-center communications provides agencies with the ability to share data, improve coordination, and provide more seamless operations across jurisdictional borders. In the Austin Region the TxDOT Austin District TMC currently has center-to-center capabilities with other TxDOT TMCs throughout the state. The TxDOT Austin District TMC was also implementing a center-to-center connection with the City of Austin at the time the Austin Regional ITS Deployment Plan was being updated. TxDOT and several other agencies including CTRMA, Capital Metro, and several cities indicated the need to implement center-to-center connections.

Basis of Need

Center-to-center communication directly supports two needs that were identified by Austin Region stakeholders in the Austin Regional ITS Architecture:

- Improve communication and coordination between agencies (State-Local, Local-Local) for traffic operations and incident management; and
- Improve data sharing among agencies for both operational and planning initiatives.

Improved center-to-center communications will also support many other needs identified, such as the need to improve accuracy, timeliness, and availability of regional travel information and the need to implement ICM strategies, which rely heavily on interagency coordination.

Stakeholders

TxDOT and the City of Austin were implementing center-to-center at the time the Austin Regional ITS Deployment was being developed. Other stakeholders indicated a desire to implement center-to-center in the future, including CTRMA, Capital Metro, City of Cedar Park, City of Round Rock, and the City of San Marcos.

Deployment Components

Center-to-center communications involves more than just connecting two agencies through a fiber or wireless network. A key component is determining which information will be shared, what format it will use, and what (if any) control will be shared through center-to-center. Typical types of information that may be shared include video images, travel times, traffic incident locations, construction closures, weather closures, signal timing plans, and DMS messages. Some types of information may be for sharing only, while other types may include a level of control. For example, CCTV camera images may be shared with the non-owning agency only having the ability to view cameras, or the non-owning agency may be given the ability to control cameras as well.

Typically, center-to-center communications will need to have a concept of operations developed to determine the type of information that is shared and the level of control

Center-to-Center Communications

Center-to-center communication was identified as a high priority project by many of the stakeholders in the Austin Region to share real-time information on travel conditions, construction, incidents, and video feeds. TxDOT and the City of Austin are currently in the process of implementing a center-to-center connection, and several other cities as well as Capital Metro indicated a need for center-to-center communications.

Primary stakeholders include TxDOT, CTRMA, Capital Metro, and the larger municipalities in the Austin Region. Lead agencies will be dependent on the center-to-center connection being established.

Regional traveler information improvements meet the regional need to improve communication, coordination, and data sharing among agencies for operational and planning initiatives.

The following agencies indicated a need for center-to-center communications in the Austin Region:

- TxDOT center-to-center connection with the City of Austin, Cedar Park, Georgetown, Round Rock, and San Marcos
- TxDOT center-to-center connection with Capital Metro
- City of Austin center-to-center connection with the City of Cedar Park
- City of Austin center-to-center connection with the City of Round Rock
- Capital Metro center-to-center connection with the City of Austin
- Capital Metro center-to-center connection with the City of Cedar Park
- Capital Metro center-to-center connection with the City of Round Rock

Timeframe

TxDOT and the City of Austin are currently implementing a center-to-center communications project. This effort will serve as a basis for TxDOT center-to-center communications with other cities. Once the TxDOT and City of Austin center-to-center project is completed TxDOT should consider implementing center-to-center communications with other cities. Priority should be with Round Rock, Cedar Park, and San Marcos. The City of Austin and City of Round Rock noted a need for center-to-center communication, as well as the City of Austin and City of Cedar Park. These should be implemented within the next five years. Capital Metro also noted a need to implement a center-to-center connection with TxDOT as well as with the cities where their buses operate, including the Cities of Austin, Round Rock, and Cedar Park (Capital Metro does not provide service in Cedar Park but their buses drive through Cedar Park).

Regional ITS Architecture Conformance

Center-to-center coordination primarily provides the services noted in the ATMS07 Regional Traffic Management ITS service packages. Center-to-center communications also support many of the other ITS service packages from the Austin Regional ITS Architecture that require strong communication ties, including the following:

- ATMS03 Traffic Signal Control
- ATMS06 Traffic Information Dissemination
- ATMS07 Regional Traffic Management
- ATMS08 Traffic Incident Management System
- EM01 Emergency Call Taking and Dispatch
- MC04 Weather Information Processing and Distribution
- MC10 Maintenance and Construction Activity Coordination
- APTS02 Transit Fixed-Route Operations
- APTS03 Demand Response Transit Operations
- APTS07 Multi-modal Coordination
- AD2 ITS Data Warehouse
- AD3 ITS Virtual Data Warehouse

4.6 Regional or Statewide Transit Payment System

Both Capital Metro and CARTS noted the need to develop a combined fare payment system for transit users that use both systems. Currently, there are routes which require both Capital Metro and CARTS services, and riders need to pay separately for utilizing the two systems. Capital Metro also noted the need to develop a system that can be utilized statewide for transit services throughout Texas.

Basis of Need

The Regional or Statewide Transit Payment System meets the need identified during the development of the Austin Regional ITS Architecture for a combined fare payment system. This need stated: Implement a regional or statewide transit fare payment system that could accommodate the transfer of passengers between modes and agencies.

Stakeholders

The primary stakeholders in the Austin Region are Capital Metro and CARTS. Other transit providers, such as the City of Round Rock, may also participate. If the system were expanded statewide then transit providers across Texas should be included.

Deployment Components

Capital Metro and CARTS currently have separate payment systems that are not compatible.

Capital Metro payment systems include transit passes that can be purchases for a set number of days or a stored value card that stores a prepaid amount. Capital Metro also has a mobile ticketing application that allows users to purchase a ticket from their Smart phone. Capital Metro would like to expand this application to allow the purchase of tickets in different regions of the state, allowing a person in Austin to purchase a ticket for the transit service in Houston or Dallas before they arrive. This would require that participating transit agencies have an inter-local agreement to share costs.

CARTS allows users to purchase fare cards through their website with a stored value. The fare cards can be used for Curb-to-Curb service (also known as Country Bus), but eventually CARTS would like to implement fare cards for all services.

The system architecture of the combined payment system has not been determined at this time, but Capital Metro and CARTS should continue working together to develop such a system. There are some existing routes that combine both Capital Metro and CARTS services on a single bus, but riders have to pay twice while on the route using separate fare boxes. CARTS noted the need to implement a shared payment system on this route, where riders could pay with either a Capital Metro or CARTS card and then Capital Metro and CARTS could reconcile payment. This would make transit use easier for riders by not requiring separate payment systems.

Regional or Statewide Transit Payment System

Regional payment systems would allow transit users that use both Capital Metro and CARTS to pay with a single fare card or other system. A statewide payment system would allow transit users to access transit throughout Texas using a single payment system. This type of system is needed to simplify transit ridership and encourage more use of transit throughout the Austin Region.

Primary stakeholders for a regional transit payment system include Capital Metro and CARTS. A statewide system would also need to include all other participating transit providers throughout Texas.

A combined transit payment system meets the need identified by the Austin Region stakeholders to develop a regional or statewide transit fare payment system.

Timeframe

Capital Metro and CARTS both indicated an immediate need for a combined transit payment system. This development and deployment should begin as soon as possible.

Regional ITS Architecture Conformance

The implementation of a Regional or Statewide Payment System conforms to the Austin Regional ITS Architecture through two ITS service packages that were identified in the plan:

- APTS04 Transit Fare Collection Management
- APTS07 Multi-modal Coordination

The APTS04 Transit Fare Collection Management ITS service package identified a need for a regional fare card payment system that could be used for Capital Metro's MetroBus, Metro Access, MetroRapid, and MetroRail service as well as for CARTS. The APTS07 Multi-modal Coordination ITS service package identifies the general coordination between Capital Metro and CARTS that both agencies would like to improve.

4.7 Bus Rapid Transit Expansion

Capital Metro has implemented MetroRapid, a bus rapid transit system with two routes running north and south in the City of Austin. MetroRapid provides users with advantages over personal vehicles by utilizing transit signal priority, dedicated bus lanes in the central business district of Austin, and providing next bus arrival information at bus stops. The system has proven successful and Capital Metro would like to expand the system to additional routes.

Basis of Need

As the Austin Region grows, congestion and mobility continue to be major challenges. Capital Metro MetroRapid provides an efficient alternative to convention vehicles. By taking advantage of transit signal priority and dedicated bus lanes, MetroRapid users experience a higher level of service then users of traditional buses. In the Austin Regional ITS Architecture, two needs were identified that are supported by bus rapid transit deployment:

- Expand traffic signal priority for transit vehicles; and
- Optimize transit passenger travel times.

Stakeholders

The primary stakeholders in the bus rapid transit expansion are Capital Metro and the City of Austin. Capital Metro implements the MetroRapid service and the City of Austin provides transit signal priority. If MetroRapid services were to expand to other cities, then those cities would become stakeholders to implement transit signal priority.

Deployment Components

Capital Metro and the City of Austin have deployed bus rapid transit on two routes in the City of Austin. Additional implementations will include:

- Procurement of new buses;
- Transit signal priority along routes;
- Addition of dedicated bus lanes in the most congested corridors if possible; and
- Implementation of real-time traveler information at stops.

Capital Metro and the City of Austin have successfully implemented transit signal priority. Additional routes will continue to encourage use of transit and ease congestion within the Austin Region by removing single occupancy vehicles from arterial streets.

Timeframe

Expansion of bus rapid transit is an immediate need for Capital Metro and should be implemented as soon as possible.

Bus Rapid Transit Expansion

Capital Metro and the City of Austin have successfully implemented a bus rapid transit system call MetroRail. This system improves transit service with the use of traffic signal priority, dedicated bus lanes in congested areas, and real-time traveler information at bus stops.

Primary stakeholders include Capital Metro and the City of Austin. If the system is expanded to other cities in the Region, those cities should be included as stakeholders.

Bus rapid transit expansion meets the need identified in the development of the Regional ITS Architecture to expand traffic signal priority for transit vehicles.

Regional ITS Architecture Conformance

Implementation of bus rapid transit in the Austin Region conforms to the Austin Regional ITS Architecture ITS service package for APTS09 Transit Signal Priority. This ITS service package included Capital Metro and the City of Austin. If the bus rapid transit system is expanded to other cities in the Austin Region then the ITS service package should be modified to include those cities as needed.

4.8 Archived Data Warehouse Implementation

As stakeholders throughout the Austin Region implement various components of ITS, a need for archiving the data collected by ITS has been recognized. Archived data can included volumes, speeds, congestion levels, reliability, incidents, weather information, arterial performance, etc. The Austin Region has not determined if the archived data should be keep in a single location or virtually, but implementation of an archived data warehouse was identified as a priority for the Region.

Basis of Need

During the development of the Austin Regional ITS Architecture, stakeholders noted the need to access data from other agencies, both for real-time operations as well as for planning purposes. Archived data can be utilized for research, transportation studies, and to predict future conditions. There were two needs identified in the Austin Regional ITS Architecture that are supported by the implementation of an archived data warehouse:

- Improve data sharing among agencies for both operational and planning initiatives; and
- Improve communication and coordination between agencies (State-Local, Local-Local) for traffic operations and incident management.

Stakeholders

Stakeholders include all agencies within the Austin Region that currently, or plan to have in the future, ITS components. The lead agency for the implementation of the archived data warehouse should most likely be CAMPO as they serve as the regional planning agency for the Austin Region. TxDOT, with its jurisdiction including all of the Austin Region, could also serve as the lead agency.

Deployment Components

Archived data warehouses can be developed as a warehouse, which consolidates all archived information into a single location, or as a virtual warehouse in which stakeholder agencies store their data within their own servers and the virtual data warehouse provides an interface to that data.

The most feasible system for the Austin Region archived data warehouse has not been determined. It is recommended that a feasibility study be completed prior to beginning the implementation of an archived data warehouse server to determine the system that would work best for Austin.

Additional information is presented at the end of Section 4.8 on a regional archived data warehouse that was developed for the Phoenix Region by Maricopa County. This information is presented to provide one concept of how a regional agency can implement an archived data warehouse.

Archived Data Warehouse Implementation

As the Austin Region implements more robust and integrated ITS systems, the need to begin archiving information gathered by these systems was recognized. Archived data can be used for planning purposes as well as for predicting future conditions for operations.

Primary stakeholders include CAMPO, who was identified as the most likely agency to lead the implementation of an archived data warehouse, as well as all agencies that have deployed ITS and could provide archived data into a data warehouse.

An archived data warehouse meets the regional need to improve data sharing among agencies for operational and planning initiatives.

Timeframe

Of the eight regional ITS deployment areas presented in Section 4, archived data warehouse was perhaps the lowest priority for stakeholders. While still seen as important, implementation of an archived data warehouse within the next five years would meet regional goas for the warehouse.

Regional ITS Architecture Conformance

The implementation of a regional archived data warehouse directly conforms to two ITS service packages in the Austin Regional ITS Architecture:

- AD2 ITS Data Warehouse
- AD3 Virtual ITS Data Warehouse

These two ITS service packages both show how an archived data warehouse could be used to archive data from stakeholders throughout the Austin Region. Adequate research had not been done to decide if a data warehouse or virtual data warehouse would be most feasible for the Austin Region, therefore both AD2 and AD3 were selected for the Austin Region.

Case Study of the Maricopa County (Phoenix Region) Archived Data Server

Maricopa County DOT (MCDOT) Regional Archived Data Server (RADS) was developed in 2003 as a data archive for ITS data from the transportation system in the Phoenix metropolitan area. As a central repository, RADS was well equipped to also function as a tool to collect and disseminate real-time ITS data that could help support the traveling public, thus RADS is now used as both a historical warehouse and a real-time center-to-center (C2C) data integration system for the Region. RADS takes ITS data from systems throughout the Phoenix metropolitan area, stores the data in a centralized archived data server, and then makes the data available for users through a web-based interface.

There are three major components of RADS that have been added to the system over time; these include freeway and arterial data (RADS-FMS); public safety data (RADS-EMS); and traffic signal data (RADS-TS). Initially, the system was comprised of freeway devices, such as CCTV images or RWIS data, which fed the Arizona DOT (ADOT) Highway Conditions Reporting System (HCRS) that provided information to the public via 511 and the ADOT FTP site. The development of RADS allowed for FMS data and travel times to be included in the data repository, with the RADS system serving as the central system that would collect and integrate the additional data to then feed the ADOT HCRS and eventually the 511. The addition of public safety data into the system came from the integration of the Phoenix Fire Department Computer Aided Dispatch (CAD) system, which provided filtered data on emergency dispatch and 911 calls. Finally, local jurisdictions began to implement centralized traffic management systems that created a way to integrate local data into the RADS system. With RADS providing the centralized warehouse and method for integration, most of the available ITS data in the region can be stored and disseminated in one place.

RADS includes real-time data that is automatically populated into the system as well as static data that is manually entered or uploaded. Types of data that is collected and archived through the RADS system includes FMS detector station data (volumes and speeds), travel times, ADOT HCRS events (road conditions, closures and incidents), Phoenix Fire incident data, and traffic signal C2C data such as volume, speed, occupancy, timing plan, and historical data from local municipalities (Scottsdale, Chandler, Gilbert, Tempe, Glendale, Surprise, Peoria, and Phoenix) and Maricopa County.

The centralization of this data allows for improved coordination between agencies for the operation and management of the freeways and arterials in the Region. For example, freeway and arterial DMS signs can be coordinated to provide better and more consistent traveler information including incident information or travel times. 511 systems can disseminate public safety information that is collected and filtered from CAD to provide reliable, real-time data for travelers and agencies. Finally, RADS provides the ability for local agencies to share their signal timing data so that signal timing can be coordinated throughout the region, rather than just locally.

The original RADS was funded through Federal CMAQ funds with a local match. Since 2010, the RADS system has gone through $700,000 worth of upgrades, including the installation of the AZTech Regional Information System (ARIS), which provided a more focused and streamlined incident management tool for

traffic managers in the Phoenix Metropolitan Area. The ongoing maintenance of RADS is funded by MCDOT, and MCDOT is responsible for the management and oversight of RADS. The RADS server is housed at the ADOT TOC, and ADOT provides IT support for the maintenance and operations of the server.

5. MAINTAINING THE REGIONAL ITS DEPLOYMNET PLAN

The Regional ITS Architecture and the Regional ITS Deployment Plan are considered living documents. They represent the vision of stakeholders in the Austin Region for ITS deployment, integration, and operation at the time the plans were developed. However stakeholder needs will change over time as systems are deployed, new capabilities are developed, and regional traveler needs change. These changes will create new deployment opportunities and necessitate changes in existing deployments shown in the Regional ITS Architecture and Deployment Plan.

Stakeholders agreed on a procedure for updating the Regional ITS Architecture and Deployment Plan during the update of the plans. The procedure, presented in the Austin Regional ITS Architecture, outlines how to document architecture changes for inclusion in the next plan update. CAMPO will lead the effort to maintain the Regional ITS Architecture for the six county Region within the MPO planning boundary, which is comprised of Bastrop, Burnet, Caldwell, Hays, Travis, and Williamson Counties. TxDOT will be responsible for maintaining the other five counties included in the Austin Regional ITS Architecture. These counties lie outside of the CAMPO planning boundaries, but within the TxDOT Austin District boundary, and include Blanco, Gillespie, Lee, Llano, and Mason Counties. A summary of the maintenance plan for the Regional ITS Architecture and Deployment Plan is included in **Table 2**.

Table 4 – Austin Regional ITS Architecture and Deployment Plan Maintenance Summary

Maintenance Details	Regional ITS Architecture and Deployment Plan	
	Modification	**Complete Update**
Timeframe for Updates	As needed	Review prior to update of Regional Transportation Plan (RTP) to determine need for update. Review annually if not updated in conjunction with the RTP update.
Scope of Update	Update ITS service packages to satisfy architecture conformity requirements of projects. Other changes to the Regional ITS Architecture and Deployment Plan as required.	Entire Regional ITS Architecture and Deployment Plan
Lead Agency	CAMPO - Responsible for Bastrop, Burnet, Caldwell, Hays, Travis, and Williamson Counties TxDOT – Responsible for Blanco, Gillespie, Lee, Llano, and Mason Counties	Joint TxDOT and CAMPO led effort
Participants	Stakeholders impacted by modifications to ITS service packages	Entire stakeholder group
Results	Documentation of changes to ITS service packages or other components of the Regional ITS Architecture and Deployment Plan	Updated Austin Regional ITS Architecture and Deployment Plan document, Appendices, and Turbo Architecture database

Stakeholders should document any changes to the Regional ITS Architecture that are necessary for project conformity, and provide those changes to TxDOT or CAMPO so they can retain a record of requested changes. The changes that are kept by CAMPO and TxDOT will be incorporated into the Regional ITS Architecture and Deployment Plan during the next complete update.

The need for a full update of the plan will be considered prior to the update of the CAMPO Regional Transportation Plan (RTP), which occurs approximately every four years. TxDOT and CAMPO will review the Regional ITS Architecture to determine if a complete update is needed based on the status of ITS deployments in the Region, as well as changes to the National ITS Architecture. If it is determined that a complete update of the Regional ITS Architecture and Deployment Plan is not needed at that time, TxDOT and CAMPO will review the Regional ITS Architecture and Deployment Plan on an annual basis to determine when an update will be required.

A very important aspect for future ITS projects deployed in the Region will be demonstrating ITS architecture conformity. This is required by the FHWA and FTA for all transportation and transit projects that use federal funding. The projects identified in this ITS Deployment Plan have been carefully reviewed and each conforms with the current Regional ITS Architecture. However, if future projects are developed that do not conform to the Regional ITS Architecture, then either the project, or more likely the Regional ITS Architecture, should be modified to establish conformity. In the Regional ITS Architecture document, a process is described for how stakeholders can modify the Regional ITS Architecture to demonstrate ITS architecture conformity. As noted earlier is this section, CAMPO and TxDOT will serve as the maintainers of the Regional ITS Architecture and any changes that are needed for conformity should be submitted to CAMPO if the project is located within any of the six counties in the CAMPO planning boundaries, and to TxDOT if the project is located in any other county within the Austin Regional ITS Architecture Region.