LAWRENCE-DOUGLAS COUNTY REGIONAL ITS ARCHITECTURE
STRATEGIC DEPLOYMENT PLAN

Submitted to

Lawrence-Douglas County Metropolitan Planning Organization

Submitted by

ITERIS Innovation for better mobility

In association with

Vireo

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GLOSSARY

Acronym	Description
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADMS	Archival Data Management System – refers to technologies designed to collect and store roadway related data for planning and/or for sharing with other agencies.
ANSI	American National Standards Institute
APTA	American Public Transportation Association
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information Systems – provide travelers with information from various sources through one user interface such as the phone (511) or the Internet.
ATMS	Advanced Traffic Management Systems - to enhance mobility on roadways by incorporating the latest technological advancements such as Variable Message Signs (VMS)
AVL	Automatic Vehicle Location – used for real time tracking of emergency vehicles, transit vehicles and school buses.
BNSF	Burlington Northern Santa Fe Railroad
CAD	Computer Aided Dispatching – used for emergency and fleet dispatching.
CCTV	Closed Circuit Television - cameras placed to observe traffic conditions. These are only used for observation and have no automatic speed enforcement capabilities.
CVAS	Commercial Vehicle Administrative Systems – a subpart of the Commercial Vehicle Information System, see CVISN.
CVRIA	Connected Vehicle Reference Implementation Architecture
DMS	Dynamic Message Signs – electronic message signs used to provide real-time traffic warnings and Amber Alert messages. Other names are Variable Message Signs (VMS) and Changeable Message Signs (CMS).
EM	Emergency Management, or Emergency Managers – Douglas County has an emergency management agency.
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System – used to provide information tied to specific physical locations, such as road segments.
HRI	Highway-Rail Intersection – refers to technologies designed to make at-grade

Acronym	Description
	highway/rail crossings safer.
IEEE	Institute of Electrical and Electronics Engineers
ISP	Information Service Provider – usually the radio or television or other private organization that provides road conditions or other information for travelers.
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
KANROAD	KDOT GIS-based traveler information system.
KDOT	Kansas Department of Transportation
KHP	Kansas Highway Patrol
KTA	Kansas Turnpike Authority
L-DC FM	Lawrence-Douglas County Fire-Medical
L-DC MPO	Lawrence-Douglas County Metropolitan Planning Organization
LPD	Lawrence Police Department
MCO	Maintenance and Construction Operations – refers to ITS solutions designed to make highway maintenance and construction safer for travelers and more efficient for highway agencies.
MDT	Mobile Data Terminal
MPA	Metropolitan Planning Area
MTP	Metropolitan Transportation Plan – The L-DC MPO's current MTP is the Transportation 2040 (T-2040) Plan.
NEMA	National Electrical Manufacturers Association
NWS	National Weather Service
OS/OW	Oversize, Overweight pertaining to commercial vehicles using public highways.
PD	Police Department
PW	Public Works
RWIS	Road-Weather Information Systems, also called environmental sensors. Used to measure pavement temperature (potential for icing), wind, and other weather-related conditions. RWIS is also used to support highly accurate weather forecasting systems.
SAE	Society of Automotive Engineers
SDO	Standard Development Organization
SDP	Strategic Deployment Plan

Acronym	Description
TMC	Traffic Management Center
TOC	Traffic Operations Center
TOMC	Traffic Operations and Management Center
UPRR	Union Pacific Railroad

1. Strategic Deployment Plan Overview

The Lawrence-Douglas County Metropolitan Planning Organization (L-DC MPO) updated the Intelligent Transportation System (ITS) Architecture and ITS Strategic Deployment Plan (SDP) for the Lawrence and Douglas County Metropolitan Region. The Architecture is a framework for defining the Region's ITS plans and how future projects will integrate and interoperate with existing and new systems. The SDP defines a strategy for sequencing and deploying ITS in the Region.

The goal of the Update Project was ***to develop a framework for the planning and development of Intelligent Transportation Systems that improve the safety and efficiency of travel in the Lawrence-Douglas County Region***. The goal will be achieved through the following objectives:

- Meet all federal and state architecture requirements.
- Engage the stakeholders in defining the Region's needs and ITS goals.
- Provide a comprehensive strategy that integrates ITS planning into the Region's transportation planning.
- Plan ITS solutions that complement and are consistent with the Region's other plans.
- Update the Regional ITS Architecture and plan with the Region's transportation professionals' support and understanding in order to ensure that the architecture and plan are user-friendly and easy to use and maintain by the Region's stakeholders.

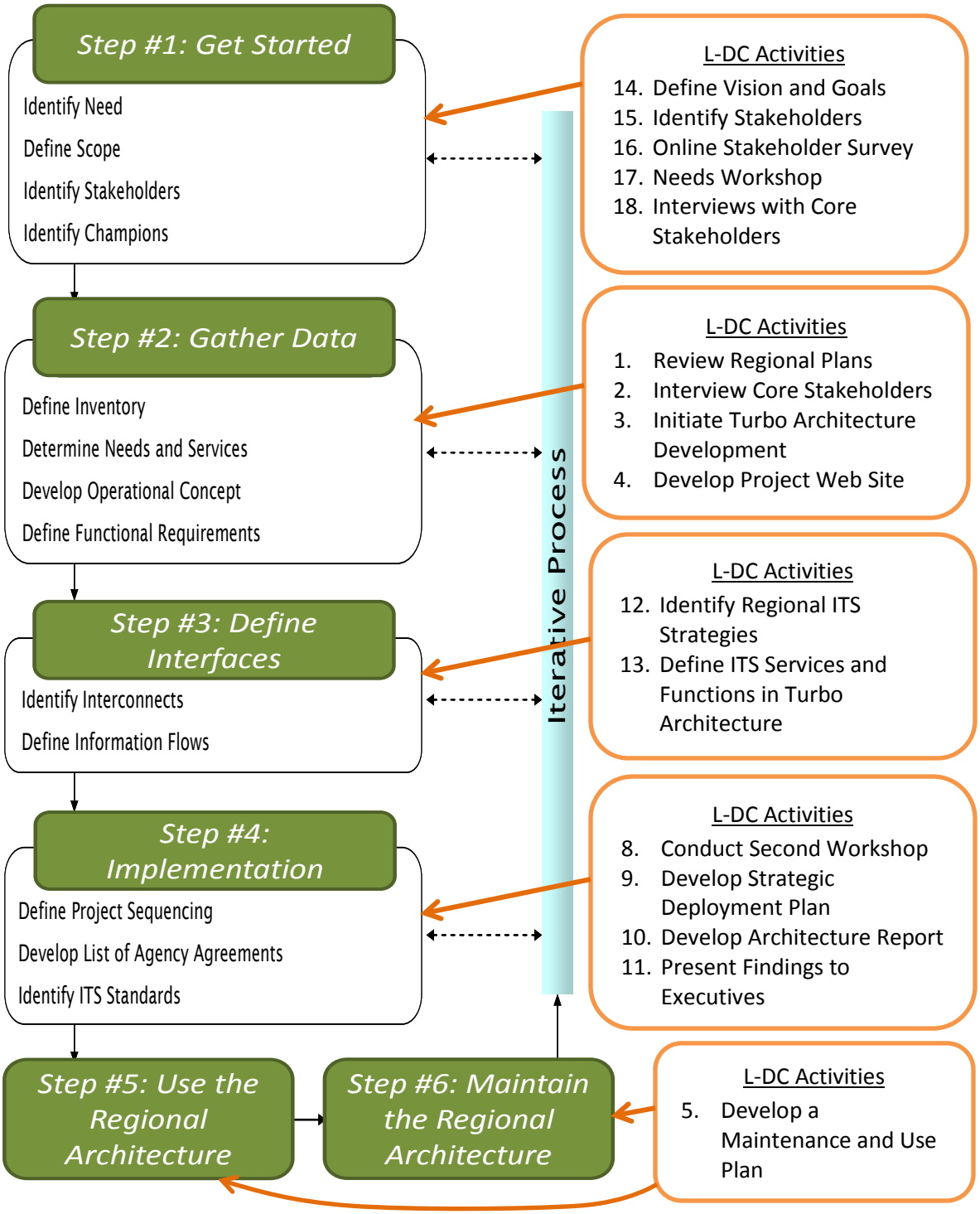
Throughout the Update Project, the stakeholders were involved to identify and prioritize the Region's needs, and to identify and sequence potential transportation technologies. The Update Project followed the Federal Highway Administration Guidance for Regional ITS Architecture[1] development as illustrated in **Figure 1**. **Figure 1** also indicates the specific activities undertaken in the Region during each step. The SDP covered the processes represented by Steps #1 through #4. The Architecture Maintenance and Use Plan developed as part of this Project provide guidance for Steps #5 and #6.

This document is the L-DC Region's ITS SDP and Architecture Report. It is the final project of the Update Project. The SDP describes the Region's plans for ITS in terms of:

- Stakeholders
- Regional transportation needs
- Existing and Planned ITS Elements
- ITS User Services
- Functional Requirements
- Information Flows
- Roles and Responsibilities
- ITS Projects
- Needed Project Agreements
- Applicable Operating Standards

[1] Regional ITS Architecture Guidance Document, http://ops.fhwa.dot.gov/publications/regitsarchguide/

Figure 1: Regional ITS Architecture Development Process



The L-DC Regional ITS Architecture Update began in November, 2014 and was completed in May, 2015.

1.1 Description of the Project Process

The L-DC Regional ITS Architecture Update was completed through eight tasks. The tasks are:

1. **Project Management** including management of communications, progress reporting, quality control and assurance, and the development of a Project Management Plan that describes key concepts of how the project will be completed.
2. **ITS Inventory and Regional Data** including a review of the 2008 architecture, interviews with regional stakeholders, and a review of other regional transportation planning documents that identify the region's goals, objectives and plan for transportation improvements. A Stakeholder workshop was held to present this Project and gather the Region's transportation needs.
3. **Stakeholder Consultation and ITS Vision** identified the region's transportation stakeholders and engaged them in identifying the Region's transportation needs through a workshop, surveys and interviews.
4. **Key Regional ITS Strategies** determined the priority of stakeholder needs and define how ITS can address the Region's needs in a manner consistent with the Region's transportation goals and plans. This task included defining ITS services, projects and the roles and responsibilities of stakeholders in deploying and operating ITS.
5. **Regional ITS Architecture and Web Site** included a physical representation of the architecture in the software program Turbo Architecture, and a report on the Architecture in this document. The architecture is available to Stakeholders through an interactive web site.
6. **Maintenance Strategy** described how the architecture will be maintained to stay current with the region's other planning and current status of ITS projects.
7. **Strategic Deployment Plan** is the task that developed this document. The SDP summarizes the previous steps and describes the Region's planned ITS projects, how they may be funded and deployed consistent with the Region's objectives.
8. **Presentations and Workshop** provided executive and detailed PowerPoint slide presentations of the architecture process, the resulting projects and how they will benefit the region. This task included a second workshop for stakeholders to illustrate how their needs were been addressed through ITS and gather their feedback on proposed ITS projects.

1.2 Project Boundaries

The L-DC Regional ITS Architecture has established boundaries for transportation services, geographic region and timeframe. This section describes each of the boundaries.

1.2.1 Transportation Services Boundaries

The L-DC Regional ITS Architecture describes transportation services in the following categories:

1. Arterial Traffic Management
2. Freeway Traffic Management
3. Traveler Information
4. Transit Management and Information
5. Commercial Vehicle Operations
6. Emergency Management

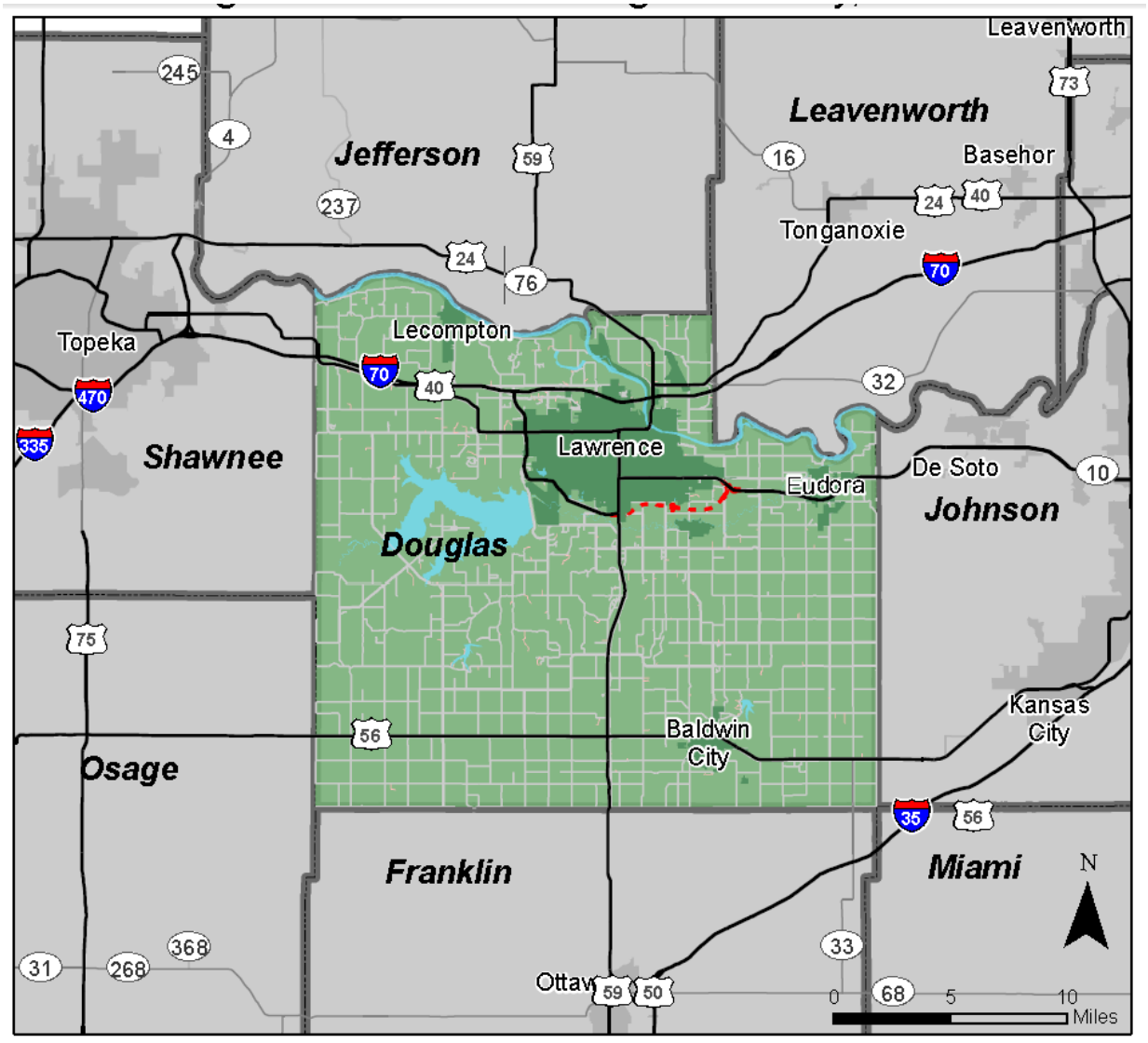
7. Maintenance and Construction

Planned ITS Projects and existing systems in the region will fall into these categories.

1.2.2 Geographic Boundaries

The L-DC Regional ITS Architecture will cover the L-DC MPO Metropolitan Planning Area (MPA) planning boundaries, as shown in **Figure 2**. The boundary encompasses all of Douglas County including the four cities in the MPA (Baldwin City, Eudora, Lawrence, and Lecompton).

Figure 2: Geographic Boundaries for the L-DC Regional ITS Architecture



1.2.3 Timeframe

The L-DC Regional ITS Architecture complements the region's current Metropolitan Transportation Plan (MTP), *Transportation 2040* (T-2040), developed in 2013. The MTP provides a vision of the region's transportation services through the year 2040. A Regional ITS Architecture typically does not plan as far ahead as a MTP, but needs to be consistent with the MTP over a shorter timeframe. The L-DC Regional ITS Architecture will have a ten-year horizon, looking forward to 2025, and to be updated in coordination with the MTP.

Projects in the L-DC Regional ITS Architecture are placed in three timeframes. They are:

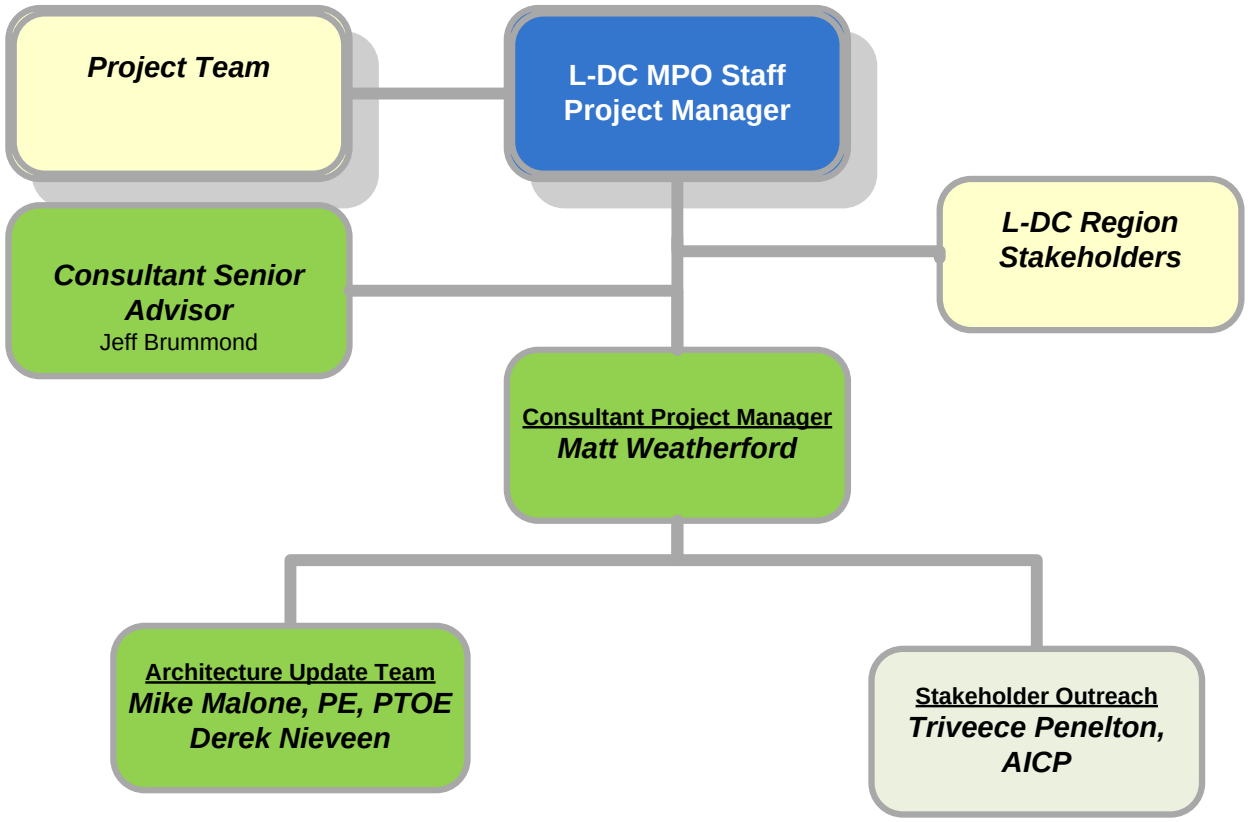
1. ***Near-term*** – Near-term projects are needed in the next three years (2018). These projects address the Region's highest-priority needs using realistic and mature technologies. Funding may not presently be available for the near-term projects, but they represent those projects that should be considered first as funding becomes available.
2. ***Medium-term*** – Medium-term projects should be deployed within the next six years (2021). Medium-term projects address needs in the region that may not be as critical as those identified for the near-term. A project may also be programmed for the medium-term if its deployment is dependent upon other projects not yet deployed, or if funding opportunities will not become available in the near-term.
3. ***Long-term*** – Long-term projects should be deployed in the next ten years (2025). These projects address Regional needs that are not currently high priorities but can be addressed through ITS. They may also be considered long-term because their deployment depends on other projects planned in the near- and medium-term, are unfunded, or are dependent upon technologies that are still evolving.

1.3 Project Organization

L-DC MPO staff served as the Project Manager. He was supported throughout the project by a Project Team that consisted of representative members of key local entities. A broad group of the Region's transportation Stakeholders participated throughout the Project as described in **Section 3** of this SDP.

The consultants (Iteris and Vireo) supported the project by facilitating the update, leading the outreach activities and developing the project documentation, including the physical ITS architecture. **Figure 3** is an Organizational Chart for the Project Team. It is followed by a brief summary of the roles and responsibilities of each chart element.

Figure 3: Organization Chart for the L-DC Regional ITS Architecture Project Team



Project Manager – L-DC MPO Staff – The L-DC MPO Staff oversaw the project and directed the consultants in the development of all project deliverables. The L-DC MPO Staff also coordinated the efforts of the Project Team and any resources the L-DC MPO and the area's local governments provided for the project, such as meeting facilities.

Project Team – The Team was comprised of key members of the L-DC Region's transportation community. The Team provided input on the project, insight into the Region's needs, and access to key documents and stakeholders. The Team also provided the project consultant with an understanding of the Region's transportation network and transportation plans. **Appendix A** lists the Project Management Team members.

Project Stakeholders – The Project Stakeholders provided input through two workshop, online tools and through ongoing dialog with the Project Team. Project Stakeholders provided the Project with the Region's needs and additional information about existing ITS in the region. Additional information about stakeholders is provided in **Section 3** of this SDP.

Consultant Project Manager – Matt Weatherford, Iteris – The Consultant Project Manager worked under the direction of the L-DC MPO Staff and was the main point of contact for the consultant team. He was directly responsible for all project deliverables. The Consultant Project Manager directed the

consultant and sub-consultant staff. He coordinated with the L-DC MPO Staff and Project Team on the project schedule, identifying issues, and needs of the project.

Senior Advisor – Jeff Brummond, Iteris – The Senior Advisor provided oversight to the consultant team. He reviewed project progress and provided insight from the National ITS Architecture Program and from other architecture activities taking place throughout the country.

Architecture Update Team –The Architecture Update Team worked directly under the Consultant Project Manager to develop the project deliverables. The Architecture Update Team was responsible for gathering data, identifying regional needs, and developing the ITS Architecture and SDP.

Stakeholder Outreach, Triveece Penelton, Vireo – Stakeholder Outreach was responsible for developing the outreach strategy and interacting with stakeholders at workshops and through online tools. The outreach effort helped to assess ITS activity and needs in the region. The outreach activities are described in more detail in the **Section 3** of this SDP.

2. L-DC Regional ITS Vision and Goals

The ITS Vision and Goals have been defined by the Project Team. They describe the guiding principles for how ITS should be planned, developed and implemented in the Region. They have been established to be consistent with, and complement, the goals of the MTP[2].

2.1 Transportation 2040 Goals

T-2040 provides a long-range vision of the Region's transportation strategies for all modes. The L-DC Regional ITS Architecture must stay consistent with the MTP in order to help achieve the Region's transportation goals. T-2040 identifies four goals that are consistent with federal planning guidelines. They are:

1. Improve Safety and Security.
2. Focus on System Preservation and Economic Efficiency.
3. Maximize Accessibility and Mobility.
4. Consider the Environment and Quality of Life.

2.2 L-DC Regional ITS Vision

The ITS Vision is the guiding principle for the development of the Regional ITS Architecture and SDP, and for investment in ITS in the Region. The Vision has been developed based on input from the Project Team.

Lawrence-Douglas County Regional ITS Vision

The Lawrence-Douglas County Region will use Intelligent Transportation Systems to provide cost-effective and practical technologies that enhance the safety, capacity, operations and evaluation of the area's modes of transportation.

2.3 L-DC Regional ITS Goals

The ITS Goals describe how the Region will achieve its vision of improved transportation through ITS. **Table 1** lists the ITS goals as developed by the Project Team. Each ITS goal is mapped to the related T-2040 goals.

[2] L-DC MPO MTP, http://www.lawrenceks.org/mpo/t2040

Table 1: L-DC Regional ITS Goals

ITS Goal	Related MTP Goals
1. Integrate efficient and effective ITS into regional transportation planning and project development.	1, 2, 3, 4
2. Improve information sharing among the region's transportation agencies and with the public.	1, 2, 3
3. Increase the safety and security of all modes of transportation through improved infrastructure monitoring and emergency management.	1
4. Improve the utilization of existing facilities and infrastructure.	2, 4
5. Improve the ability to evaluate and measure the performance of the transportation network through the effective use of technology.	2, 3

3. Regional ITS Stakeholders

The success and accuracy of the L-DC Regional ITS Architecture depends upon the input and support of the Region's Stakeholders. Because this is an update of the L-DC Regional ITS Architecture, the Project Manager and Consultant reviewed the Stakeholder list from the 2008 Architecture as a first step toward identifying a set of potential Stakeholders representing the region's transportation network.

Table 2 is a summary of the types of groups and examples of key stakeholders that have been invited to participate in this ITS planning effort. Stakeholders were identified as either Core or Community Stakeholders. Core stakeholders are those who materially participate in the programming, deployment and operation of ITS in the L-DC Region. Examples of Core Stakeholders are Cities, KDOT, Douglas County and federal agencies. Community Stakeholders are organizations and individuals with an interest in the Region's transportation network and who have defined their need for improved transportation safety and efficiency. Examples of Core Stakeholders are the advisory and advocacy groups who represent users for the Region's transportation agencies.

Table 2: L-DC Regional ITS Architecture Stakeholders

Stakeholder Group	L-DC Stakeholders
Federal Transportation Agencies	- Federal Highway Administration (FHWA) - Federal Transit Administration (FTA)
State, County, and City Street, Highway and Traffic Agencies	- Kansas Department of Transportation (KDOT) - Kansas Turnpike Authority (KTA) - KC Scout - Baldwin City - City of Eudora - City of Lawrence - City of Lecompton - Douglas County
Public and Private Transportation Providers	- Lawrence Transit - KU on Wheels (Kansas University) - Cottonwood, Inc. - Independence, Inc. - Kansas Motor Carrier Association - Major regional goods movement companies

Stakeholder Group	L-DC Stakeholders
State, County, and City Public Safety Agencies and Emergency Service Providers	- Kansas Highway Patrol (KHP) - Kansas Department of Emergency Management (KDEM) - Douglas County Emergency Communications - Douglas County Emergency Management - Douglas County Sheriff's Office - KU Public Safety - Lawrence-Douglas County Fire Medical - Lawrence Police - Baldwin City - City of Eudora - City of Lecompton
Universities, Colleges and Schools	- Kansas University (KU) - Haskell Indian Nations University - Lawrence Public Schools, USD497 - Baldwin Public Schools, USD348 - Eudora Public Schools, USD491 - Lecompton Public Schools, USD343
Media and Information Service Providers	- WOW Broadband Service Provider - AT&T Telecommunication - iNet Interactive
Advisory and Advocacy Groups	- Horizon 2020 - Technical Advisory Committee – MPO - Regional Transit Advisory Committee - MPO - Lawrence-Douglas County Bicycle Advisory Committee - Lawrence Pedestrian Coalition - Lawrence Sustainability Advisory Committee - Lawrence Traffic Safety Commission - Lawrence Public Transit Advisory Committee - LiveWell Lawrence

3.1 Stakeholder Involvement

Core and Community Stakeholders were invited to participate in the L-DC Regional ITS Architecture Update Project through the following means:

1. Project web site that contains project information, deliverables and announcements. The site is located at https://secure.iteris.com/share/LDC.
2. Online survey that allows stakeholders to identify their travel behavior and their perceived needs. The online survey is accessible through the project web site.
3. Stakeholder workshops where stakeholders interacted and defined Regional needs and potential project ideas. The first workshop was held in Lawrence in December 2014. The second in Lawrence in April 2015. More detail is provided on Stakeholder Workshops in **Sections 6 and 13** of this SDP.

4. Stakeholder interviews conducted in-person and by telephone. The interviews followed the workshops and were designed to gain a better understanding of the plans, operations and needs of key stakeholders.

In addition to the Consultant contacting Stakeholders, the Project Team identified, invited and engaged additional Stakeholders the Project Team members felt could provide insight for this Update Project.

3.2 L-DC Regional ITS Architecture Stakeholders

Table 3 lists the Core L-DC Regional ITS Architecture Stakeholders and indicates the categories in which they currently, or in the future materially participate in the region's ITS. The Architecture Stakeholders represent agencies who will program, develop, deploy and/or operate ITS.

As previously discussed, Core Stakeholders do not include advisory and advocacy groups who support the planning process. This in no way is meant to diminish the contribution or importance of advisory and advocacy groups. Instead, the Core Stakeholders represent those who are depicted in the Architecture as having an ownership role in ITS.

Table 3: Core L-DC Region ITS Stakeholders

Stakeholder	Transportation Services Category(ies)	Stakeholder Description
City of Lawrence Planning and Development Services	• Regional Planning	The City of Lawrence Planning and Development Services Department provides planning oversight for the region's transportation system and supports funding and implementation efforts.
City of Lawrence Public Works	• Maintenance and Construction • Parking Management • Surface Street Management	The City of Lawrence Public Works develops, builds, operates and maintains the transportation network owned by the City. They operate the City Traffic Operations Center (TOC).
City of Lawrence Police Department	• Emergency Management	The City of Lawrence Police Department provides emergency and law enforcement services within the City.
Douglas County Public Works	• Maintenance and Construction • Surface Street Management	Douglas County develops, builds, operates and maintains the transportation network owned by Douglas County.
Douglas County Emergency Communications	• Emergency Management	Douglas County Emergency Communications serves the citizens of Douglas County by providing enhanced 911 telephone services for the entire county (except the University of Kansas Campus), radio dispatching personnel and equipment for the law enforcement, fire, and medical response agencies Region.
Douglas County Emergency Management	• Emergency Management	Douglas County Emergency Management provides 24 hour service to the Region. It protects citizens from various hazards by providing and coordinating resources, expertise, leadership, and advocacy through risk-based emergency preparedness programs involving mitigation, management, response, and recovery.
Douglas County Sheriff's Office	• Emergency Management	The Douglas County Sheriff's Office provides public safety services for Douglas County.

Stakeholder	Transportation Services Category(ies)	Stakeholder Description
Federal Highway Administration (FHWA – Region 7)	• Regional Planning	The FHWA assists states, local governments, and tribal/federally owned lands in the design, construction, and maintenance of the Nation's highway system. The Kansas division of the FHWA provides leadership, guidance, and direction in the planning, construction, and maintenance of Kansas' transportation projects.
Federal Transit Administration (FTA – Region 7)	• Regional Planning	The FTA provides financial and technical assistance to local public transit systems. Currently the State of Kansas (and the L-DC Region) falls under Region 7 of the FTA.
Google	• Traveler Information	Google provides real-time traffic information and transit information in the L-DC Region through its web site.
KC Scout	• Freeway Management • Traveler Information	Kansas City Scout is a bi-state traffic management operation for the Kansas City area. KDOT and MoDOT designed Scout to lessen traffic jams by improving rush-hour speeds, to increase safety by decreasing the number of rush-hour accidents, and to improve emergency response to traffic situations.
Kansas Department of Emergency Management (KDEM)	• Emergency Management	The KDEM is a subgroup of the Kansas Adjutant General's Department. The main goal of the Kansas Department of Emergency Management is to create sustainable capabilities across all phases of Emergency Management in Kansas. KDEM works with local Kansas communities to assist one another in times of disaster response, and to ensure proper disaster agencies and proper Emergency Operation Plans are in effect in all Kansas counties.

Stakeholder	Transportation Services Category(ies)	Stakeholder Description
Kansas Highway Patrol (Troop B)	• Emergency Management	The Kansas Highway Patrol (Troop B) has the primary responsibility of maintaining the safety of the State, Federal, and Interstate highways within the Region.
Kansas Turnpike Authority (KTA)	• Electronic Toll Collection • Freeway Management • Maintenance and Construction • Traveler Information	The Kansas Turnpike Authority (KTA) provides highway transportation services for all turnpike users. KTA is responsible for all repairs and upgrades for the roadway, and for toll collection on the Turnpike. KTA is part of the Kansas Department of Transportation (KDOT).
Kansas Department of Transportation (KDOT)	• Commercial Vehicle Operations • Freeway Management • Maintenance and Construction • Traveler Information	KDOT is a state government organization responsible for the maintenance of Kansas public roadways. Currently KDOT District 1 is the district that is responsible for the L-DC Region.
KTA Highway Patrol (Troop G)	• Emergency Management	The KTA Highway Patrol [Troop G] is responsible for the patrolling of the Kansas Turnpike. The Kansas Turnpike Highway Patrol is headquartered in Wichita, Kansas and operates 24/7. Other responsibilities of the Kansas Turnpike Highway Patrol include providing security at interchange and service areas, managing unpaid tolls, and performing special projects when contracted out.
University of Kansas (KU)	• Parking Management • Surface Street Management	KU manages parking and traffic on the KU campus.
KU Public Safety	• Emergency Management	KU Public Safety provides law enforcement services on the KU campus and coordinates with other regional agencies for event management.
Kansas University Transit (KU on Wheels)	• Transit Services	KU On Wheels (KUOW) provides fixed-route and demand-response bus service for the KU community.

Stakeholder	Transportation Services Category(ies)	Stakeholder Description
Lawrence-Douglas County Fire Medical	• Emergency Management	Lawrence-Douglas County Fire Medical provides fire suppression services to the City of Lawrence and emergency medical services to all of Douglas County, Kansas.
Lawrence Transit	• Transit Services • Traveler Information	Lawrence Transit provides fixed-route and demand-response bus service within Lawrence.
Local Cities Emergency Services	• Emergency Management	Local city emergency response agencies providing fire and police services in Baldwin City, the City of Eudora and the City of Lecompton.
Local Cities Public Works	• Maintenance and Construction • Surface Street Management	Local Cities Public Works develop, build, operate and maintain the transportation network owned by Baldwin City, the City of Eudora and the City of Lecompton.
Local Transit	• Transit Services	Local transit providers, such as Independence Inc., provide demand-response transit (shuttle) services to the Region's residents.
Media	• Information Services	The media includes private parties that provide information to the Region, including broadband, cable, wireless, television and print journalism.
National Weather Service (NWS)	• Weather Information	NWS provides current and forecasted weather condition information for the Region and nation.
Private Sector Information Services	• Traveler Information	Private companies that aggregate and collect traffic and traveler information for dissemination to the public via mobile applications and the Internet.

Stakeholder	Transportation Services Category(ies)	Stakeholder Description
Schools	• Transit Services	Schools represent the Region's school districts and other schools who transportation services for students.
Traveling Public	• Electronic Toll Collection • Traveler Information	The traveling public in the L-DC Region.

4. L-DC Region ITS Inventory

ITS Architecture inventory defines the physical entities of the L-DC Region's ITS. As defined in the FHWA Regional ITS Architecture Rule[3], an ITS inventory is a list of systems/elements and the elements that interface with them. An element is defined as the name used by the Region's stakeholders to describe a transportation technology system or piece of a system.

A system in the L-DC Region ITS inventory may be used throughout the Region and be interconnected to many stakeholders, such as the Douglas County Dispatch Center, which dispatches vehicles for multiple emergency responders. Or, a system may be connected to only one stakeholder, such as KDOT's maintenance vehicles.

Because the L-DC Regional ITS Architecture defines information exchanges, the inventory only includes systems that are able to send and receive information to/from other systems. For example, standalone systems, such as a flashing stop light that is not connected to other signals or a center, are not part of the inventory. However, traffic signals that can communicate with other signals, a traffic management center or any other system are included.

4.1 Collection Methodology

The L-DC Regional ITS Architecture depicts existing ITS inventory and new ITS inventory that is needed to deploy the project planned in the Region. This section discusses the existing inventory. In addition to the existing inventory, new inventory has been identified through the Architecture development process and is represented in the Regional ITS Architecture.

The methodology used to compile the existing ITS inventory for the L-DC Region consisted of document review, meetings, telephone interviews and e-mail exchanges.

Previous Studies, Reports, and ITS Architectures

The process of creating an inventory of ITS systems in the L-DC Region started with a review of the previous (2008) L-DC Regional ITS Architecture, the region's MTP and the stakeholders' plans for traffic, emergency, public transportation and other activities. In addition, other architectures in the state of Kansas were reviewed for overlap and to ensure consistency in naming conventions. However, it should be noted that the Kansas Statewide Architecture is more than five years old and does not accurately reflect the current State and Regional ITS inventory.

The MTP was reviewed to identify projects that are planned and funded for the region, and that contain ITS elements. An example of a project identified in the MTP is improved signal coordination on specific corridors, which requires connected signal controllers with that capability.

Other plans from the Region were also reviewed to identify existing and planned ITS. These include plans such as the Region's commuter transit and pedestrian facilities and KDOT's plans for freeway ITS

[3] FHWA Rule / FTA Policy on Regional ITS Architecture, http://ops.fhwa.dot.gov/its_arch_imp/policy.htm

elements. Many of the ITS elements found in these plans are not identified as existing and are, therefore, not documented here. However, those planned elements are incorporated into the Regional ITS Architecture as planned elements in later tasks.

Stakeholder Interaction

Core Stakeholders who are known to operate ITS in the Region were invited to participate in the project and many were also contacted by the Consultant and interviewed about their operations. The direct interaction with Stakeholders took place through in-person meetings, teleconferences and e-mail exchanges. The Core Stakeholders provided summaries of their ITS devices, including locations and quantities, where applicable. The stakeholders also identified upcoming, funded plans that will be completed by the completion of the ITS Architecture Update project.

4.2 Turbo Architecture

Turbo Architecture[4] (Turbo) is an interactive software application that assists ITS planners and system integrators, both in the public and private sectors, in developing regional and project architectures. Turbo is provided by FHWA to architecture developers. Turbo uses the National ITS Architecture as a starting point to support developing architectures that are consistent with federal requirements.

Turbo was specifically designed to support development of ITS inventories. Turbo was functionally designed to identify connections between ITS systems or elements in the inventory that support selected services. Although the software tool identifies all potential connections between ITS systems based on the National ITS Architecture, it will pre-select those connections required to support the desired services. The inputs to Turbo are based on the systems inventory. The existing inventory and services were entered into Turbo based on the responses to the document review and surveys. The outputs of Turbo are saved in Microsoft Access-compatible data files.

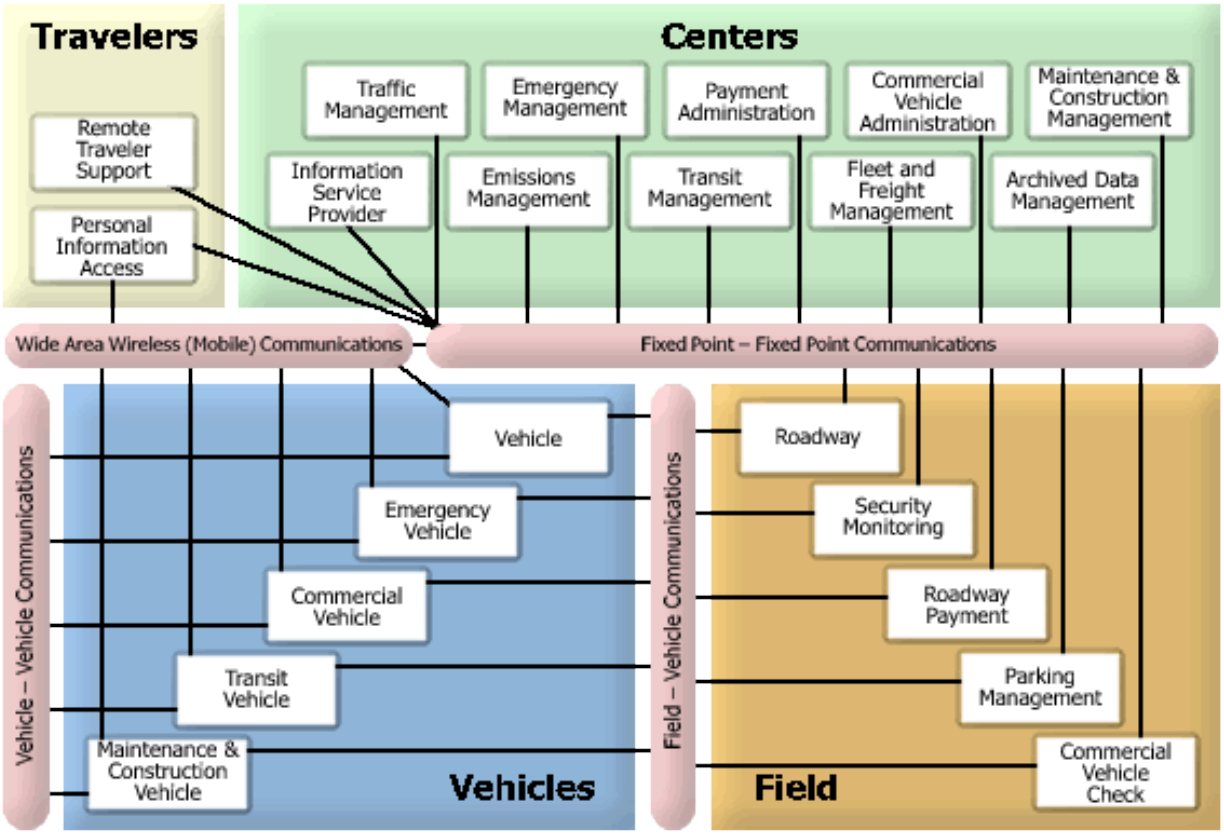
Turbo has been used to develop the L-DC Regional ITS Architecture. The stakeholders and inventory in this report have been entered into Turbo to support the further development of services and functions that utilize the inventory. The Turbo output matches the existing inventory described in **Section 4.4**.

4.3 Inventory Element Types

ITS Architecture inventory defines the physical entities of the region's ITS. **Figure 4** provides a high-level view of the National ITS Architecture.

[4] Turbo Architecture Software Tool, http://www.iteris.com/itsarch/html/turbo/turbomain.htm

Figure 4: National ITS Architecture Physical Entities



As **Figure 4** shows, there are four types of entities: Centers, Field, Travelers and Vehicles. Following are definitions of each type. The Region's existing elements do not encompass all types of entities shown in the diagram; however, all of the region's elements are contained within National ITS Architecture. For example, the Region does not include or interact with any emissions management systems, but it does include transit management for Lawrence Transit and KU on Wheels, and maintenance and construction management through KDOT and the Region's various public works offices.

Centers provide management, administrative, and support functions for the transportation system. A center represents a collection of functionality and not necessarily a physical facility. Examples of centers in the L-DC Region are the City of Lawrence Traffic Operations Center and Douglas County Emergency Communications.

Field entities are connected infrastructure along the transportation network that perform surveillance, information provision, and plan execution control functions. A field entity's operation is typically governed by a center subsystem. They may also directly interface to vehicles. Field elements examples in the L-DC Region are City of Lawrence Traffic Signals and KTA Dynamic Message Signs (DMS).

Travelers refer to the devices used by travelers to access ITS services to plan a trip and during a trip. This includes devices owned and operated by travelers, as well as devices owned by transportation and

information providers. Examples of traveler-owned devices are smart phones and personal computers. Examples of a device owned by a transportation system operator may be an information kiosk.

Vehicles refer to ITS related elements on vehicles and include general driver information and safety systems applicable to all vehicle types. These may include the vehicle radio, navigation system or other onboard computer system. There are four fleet vehicle subsystems (Transit, Emergency, Commercial and Maintenance and Construction Vehicles) with each having unique capabilities defined in the Architecture. Examples of vehicles in the L-DC Region include passenger vehicles, buses, maintenance vehicles, commercial vehicles and police and fire vehicles.

For all types, entities are not defined by their size or physical presence, but by their functionality. For example, a traffic management center may be a large facility with a video wall, multiple workstations and other amenities where an agency controls its devices and monitors traffic conditions. A traffic management center may also be a single laptop that remotely exchanges information with field devices, disseminates traffic information and controls signs and signals. A single ITS element may also function as multiple types of centers. For example, a city may have a single system to manage both traffic and emergency response, making it both a traffic management center and emergency management center.

The L-DC Region's existing ITS inventory is listed in **Section 4.4**. Each element description includes its type and whether it is a subsystem or terminator in the Region. Subsystems and Terminators are described in more detail in **Section 5**.

4.4 L-DC Region Existing ITS Inventory

The L-DC Region ITS Inventory is a summary of known existing ITS in the region that currently, or have the capability to, exchange information outside of their operating agency. The inventory is intentionally broad and includes devices that may not physically be in the Region, but with which Regional ITS elements may interact. The inclusion of many devices is to insure that the L-DC Regional ITS Architecture is able to accurately identify all opportunities to use ITS to improve the Region's transportation system.

Although every regional inventory varies based on specific needs, there are several general "best practices" guidelines that have been applied during the development of the L-DC region inventory. They are:

Appropriate Level of Detail

The inventory is managed to provide the appropriate level of detail while identifying key integration opportunities in the region. Grouping was used to simplify the inventory. For example, instead of listing each individual signals owned and operated by the City of Lawrence, the L-DC Regional ITS Architecture inventory reflects one regional ITS element identified as "City of Lawrence Traffic Signals."

Elements Outside the Region

The L-DC Regional ITS Architecture inventory includes element(s) representing operations centers in areas outside the Region wherever there are important interfaces from the Region to these operations

centers. These include inventory such as the Kansas Highway Patrol dispatch center in Salina, KC Scout in Kansas City, Missouri and the Kansas Department of Transportation's 511 traveler information system based in Topeka.

The inter-regional interfaces should be coordinated across Regional ITS Architectures in Kansas to avoid duplicate and/or conflicting definitions of the same interface.

Table 4 lists the existing L-DC Region ITS inventory. Each inventory item is listed by the stakeholder who owns it.

Table 4: L-DC Existing ITS Inventory

Stakeholder	Element	Description	Element Type
City of Lawrence Public Works	City of Lawrence CCTV Cameras	Closed circuit television cameras operated by the City of Lawrence for traffic condition monitoring and management of incidents.	Roadway Subsystem
	City of Lawrence Maintenance Center	Maintenance center used to track and dispatch maintenance vehicles, to manage maintenance and construction projects, and to share maintenance and construction information.	Maintenance and Construction Management Subsystem
	City of Lawrence Maintenance Vehicles	Maintenance vehicles used in maintenance operations and snow removal that are owned and operated by the City of Lawrence. Vehicles have automated vehicle location (AVL).	Maintenance and Construction Vehicle Subsystem
	City of Lawrence Parking Management	City of Lawrence Parking Management tracks the usage and collects payment at City of Lawrence parking facilities.	Parking Management Subsystem
	City of Lawrence Traffic Operations Center	Lawrence Traffic Operations Center (TOC) is responsible for the operation of the signal system, CCTV cameras and any other City ITS deployments.	Traffic Management Subsystem
	City of Lawrence Traffic Field Equipment	Equipment used to monitor traffic and road conditions, identify incidents, and collect data for long range planning within the City of Lawrence.	Roadway Subsystem
	City of Lawrence Traffic Signals	Traffic signal system operated by the City of Lawrence.	Roadway Subsystem
	City of Lawrence Website	Transportation information website for the City of Lawrence.	Information Service Provider Subsystem
City of Lawrence Police Department	City of Lawrence Police Center	Center used for police operations, monitoring vehicles, incidents and traffic cameras.	Emergency Management Subsystem

Stakeholder	Element	Description	Element Type
	City of Lawrence Police Vehicles	Patrol vehicles owned and operated by the City of Lawrence Police Department. Vehicles have automated vehicle location (AVL) and mobile data terminals (MDT).	Emergency Vehicle Subsystem
Douglas County Public Works	Douglas County Maintenance Center	Maintenance center used to track and dispatch maintenance vehicles, to manage maintenance and construction projects, and to share maintenance and construction information.	Maintenance and Construction Management Subsystem
	Douglas County Maintenance Vehicles	Maintenance vehicles used in maintenance operations and snow removal that are owned and operated by Douglas County. Vehicles have automated vehicle location (AVL).	Maintenance and Construction Vehicle Subsystem
	Douglas County Website	Website for Douglas County.	Information Service Provider Subsystem
Douglas County Emergency Communications	Douglas County Emergency Communications Center	Answers all 911 calls made from within the county, except calls made from the KU campus, and dispatches appropriate emergency response. The 911 Dispatch center serves as primary dispatch for the City of Lawrence, Eudora, Baldwin City, and Lecompton.	Emergency Management Subsystem
Douglas County Emergency Management	Douglas County Emergency Operations Center (EOC)	Emergency Operations Center (EOC) for Douglas County. Responsible for communications and coordination of local resources during a disaster or large scale incident.	Emergency Management Subsystem
Douglas County Sheriff's Office	Douglas County Sheriff Vehicles	Patrol vehicles owned and operated by the Douglas County Sheriff's Department.	Emergency Vehicle Subsystem
Google	Google Transit	Web site operated by Google.com that provides transit information in the Region, including Lawrence Transit route and schedule information.	Information Service Provider Subsystem

Stakeholder	Element	Description	Element Type
KC Scout	KC Scout Traffic Center	Scout manages traffic on more than 125 miles of continuous freeways in the greater Kansas City metropolitan area. Scout uses cameras to monitor the highways from its traffic management center in Lee's Summit, relies on sensors to gage traffic flow, uses large electronic message boards to send urgent traffic notices to drivers along the freeways, and activates a Highway Advisory Radio system that motorists in Missouri can tune to in the event of a freeway incident.	Traffic Management Subsystem
Kansas Department of Emergency Management	KDEM Virtual Emergency Operation Center	Kansas Department of Emergency Management (KDEM) virtual EOC provides statewide function for emergency response and management.	Emergency Management Subsystem
Kansas Highway Patrol	KHP Communications Center	Statewide center for KHP communications for Highway Patrol operations.	Emergency Management Subsystem
	KTA Communications Center	Center for communications for KTA Highway Patrol operations.	Emergency Management Subsystem
	KHP Troop G Vehicles	Vehicles used by the KHP Troop G (KTA). Includes patrol cars and service patrol vehicles.	Emergency Vehicle Subsystem
	KHP Troop B Vehicles	Vehicles used by the KHP Troop B.	Emergency Vehicle Subsystem
Kansas Turnpike Authority (KTA)	KTA Communications Center	Center for communications for KTA Highway Patrol operations.	Emergency Management Subsystem
	KTA Dynamic Message Signs	Dynamic Message Signs (DMS) operated by KTA for traffic information dissemination.	Roadway Subsystem

Stakeholder	Element	Description	Element Type
	KTA Maintenance Center	KTA center responsible for managing maintenance and construction on the Turnpike.	Maintenance and Construction Management Subsystem
	KTA Maintenance Vehicles	Maintenance vehicles used in maintenance operations and snow removal that are owned and operated by KTA.	Maintenance and Construction Vehicle Subsystem
	KTA Payment Management	KTA management of toll payments.	Payment Administration Subsystem
	KTA Toll Plazas	Toll collection locations used by KTA.	Roadway Payment Subsystem
	KTA Traffic Cameras	Cameras operated by KTA used for traffic surveillance, incident management, and toll enforcement.	Roadway Subsystem
	KTA Traffic Field Equipment	Equipment operated by KTA that measures the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure.	Roadway Subsystem
	KTA Traffic Operations Center	KTA TOC is responsible for the daily operations of the turnpike.	Traffic Management Subsystem
	KTA Traveler Advisory Radio	Highway Advisory Radio (HAR) system operated by KTA to provide current weather and traffic information along the Kansas Turnpike.	Roadway Subsystem
	KTA Website	Website operated by KTA for the dissemination of traveler information.	Information Service Provider Subsystem
Kansas Department of Transportation (KDOT)	KDOT 511 Traveler Information	511 telephone system and web site that provide up-to-date traveler information about road conditions, construction detours and weather information.	Information Service Provider Subsystem

Stakeholder	Element	Description	Element Type
	KDOT District 1 Maintenance Center	KDOT center responsible for managing maintenance and construction on state-maintained highways in KDOT District 1.	Maintenance and Construction Management Subsystem
	KDOT District 1 Maintenance Vehicles	Maintenance vehicles used in maintenance operations and snow removal that are owned and operated by KDOT.	Maintenance and Construction Vehicle Subsystem
	KDOT Road Weather Information Systems	Data collection equipment that gathers environmental conditions in the field, such as roadway temperature, ambient temperature, and moisture levels.	Roadway Subsystem
University of Kansas (KU)	KU Maintenance Center	Function at the KU Maintenance Department responsible for construction and maintenance on the KU campus, including roads.	Maintenance and Construction Management Subsystem
	KU Parking Management System	Monitors parking usage in lots and collects fees for parking usage. Includes the ability for people to pay using their smart phone.	Parking Management Subsystem
	KU Parking Vehicles	Vehicles used for parking enforcement that include License Plate Readers to identify vehicles parked on campus.	Vehicle Subsystem
	KU Parking and Transit Website	Website for the University of Kansas.	Information Service Provider Subsystem
KU Public Safety	KU Dispatch	Dispatch center that answers all 911 calls made from the KU campus and dispatches KU Police and City of Lawrence Fire/EMS as appropriate. The dispatch center serves as the backup center for Douglas County 911 Dispatch.	Emergency Management Subsystem
	KU Police Vehicles	Patrol vehicles owned and operated by KU police.	Emergency Vehicle Subsystem

Stakeholder	Element	Description	Element Type
Kansas University Transit (KU on Wheels)	KU on Wheels Vehicles	Fixed route and demand-response transit vehicles providing KU on Wheels service. Include AVL and on-board security cameras.	Transit Vehicle Subsystem
	KU on Wheels Website	Website for KU on Wheels with information about fares and schedules.	Information Service Provider Subsystem
Lawrence-Douglas County Fire Medical	Fire Medical Center	Center used for fire and medical operations, monitoring vehicles and incidents.	Emergency Management Subsystem
	Fire Medical EMS Vehicles	Fire and EMS vehicles owned and operated by the Lawrence-Douglas County Fire Department.	Emergency Vehicle Subsystem
Lawrence Transit	Lawrence Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling, and dispatching of fixed route and demand-response vehicles operated by Lawrence Transit and KU on Wheels.	Transit Management Subsystem
	Lawrence Transit Vehicles	Fixed and flex route and demand-response transit vehicles operated by Lawrence Transit. Include AVL and on-board security cameras.	Transit Vehicle Subsystem
	Lawrence Transit System Website	Website operated by Lawrence Transit with information about fares and schedules. Currently static information only.	Information Service Provider Subsystem
Local Cities Emergency Services	Local Cities Emergency Vehicles	Local law enforcement, fire, and EMS vehicles not specifically called out in the Regional ITS Architecture.	Emergency Vehicle Subsystem
Local Cities	Local Cities Maintenance Centers	Function at the local cities responsible for construction and maintenance in the local cities.	Maintenance and Construction Management Subsystem
	Local Cities Maintenance Vehicles	Public works departments responsible for the maintenance of roadways in municipalities not specifically called out in the Regional ITS Architecture.	Maintenance and Construction Vehicle Subsystem

Stakeholder	Element	Description	Element Type
	Local Cities Website	Local city websites not specifically called out in the Regional ITS Architecture.	Information Service Provider Subsystem
Local Transit	Local Transit Vehicles	The vehicles of other transit providers in the Region not specifically identified in the Regional ITS Architecture. Provide demand-response service.	Transit Vehicle Subsystem
	Local Transit Centers	The operation centers of other transit providers in the Region not specifically identified in the Regional ITS Architecture. Manage demand-response service.	Transit Management Subsystem
Media	Local Print and Broadcast Media	Local media that provides traffic or incident information to the public.	Information Service Provider Terminator
National Weather Service (NWS)	National Weather Service	Service that provides official US weather, marine, fire and aviation forecasts and warnings.	Information Service Provider Terminator
Private Information Services	Traveler Information Services	Third-party solutions that provide basic and interactive traveler information to the public, including al modes.	Information Service Provider Terminator
Schools	School Buses	Local school buses in L-DC Region.	Transit Vehicle Subsystem
	Unified School District	School districts that represent elementary, secondary, and high schools in the Region.	Transit Management Subsystem
Traveling Public	Commercial Vehicles	Privately owned commercial vehicles that travel throughout the Region.	Commercial Vehicle Terminator
	Personal Computing Devices	Computing devices that travelers use to access public information in the Region.	Remote Traveler Support Terminator
	Private Vehicles	Vehicles operated by a private individual in the Region.	Vehicle Subsystem and Traffic Terminator

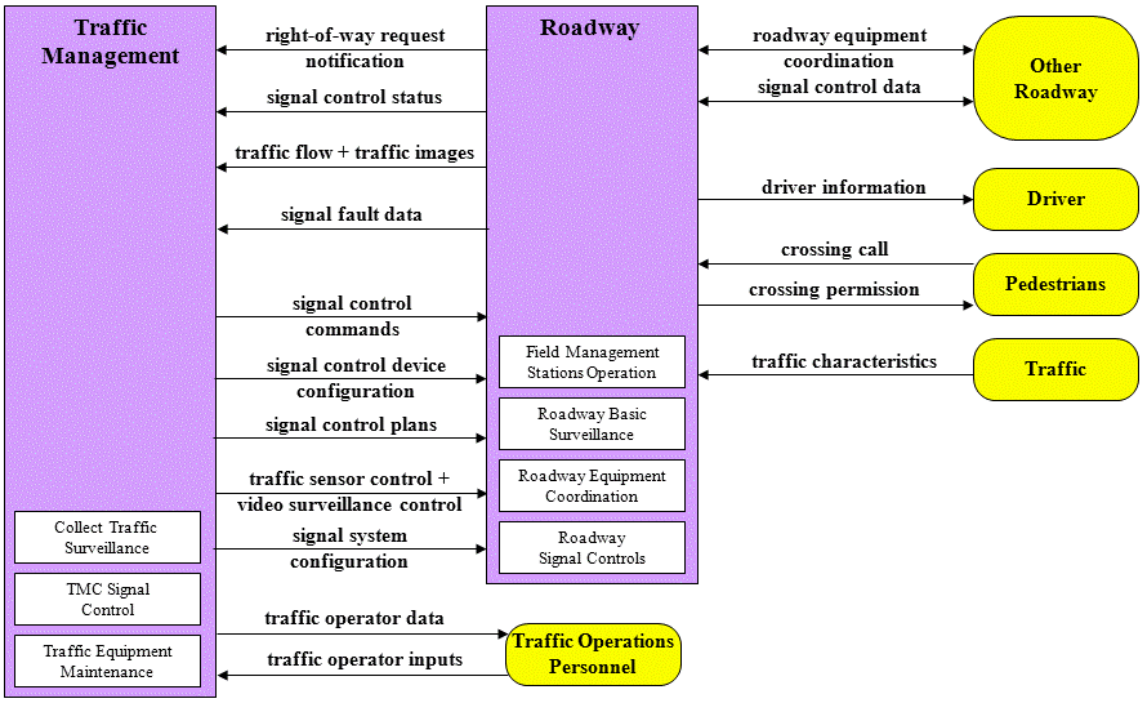
5. Existing L-DC Region ITS Services

ITS User Services describe what functions ITS perform from the user's perspective. The National ITS Architecture defines 97 Service Packages that "bundle" ITS elements to address specific services, such as surface street control or traveler information.

An ITS Service Package does not always directly translate to an ITS project. Instead, Service Packages are the "building blocks" of ITS, and a specific ITS project may include several service packages that provide multiple related functions. For example, a transit ITS project designed to improve service efficiency may include Service Packages for vehicle tracking, fixed-route management and automated passenger counting.

Figure 4 is an example of a National ITS Service Package. Following the diagram is a description of each element in the package.

Figure 4: Service Package ATMS03: Traffic Signal Control



Subsystem

Subsystems are defined functionally, not physically. As discussed previously, they are grouped into four classes: Centers, Field, Vehicles, and Travelers. The subsystems in **Figure 4** are the Traffic Management Subsystem and the Roadway Subsystem. These correspond to the physical world: respectively traffic operations centers and roadside signal controllers.

Subsystems, as defined by the National ITS Architecture, are typically related to transportation management or information processing.

Terminators define the boundaries of an ITS Architecture. They represent the people, systems, and general environment that interface to ITS, and often perform a function. The interfaces between terminators and subsystems are defined, but the region's ITS Architecture generally does not define the functionality of the terminators. Examples of terminators could include a Driver, or more specifically, the means with which the drivers may exchange information from roadway devices. A Terminator example is also Other Roadway, which may be devices on the roadway that exchange information with other systems but whose functionality is not defined by the architecture. These may include devices such as signals for school crossings that provide information to a traffic management center, but are not controlled by or coordinated with the center.

Information Flows are the information and data exchange between and among various subsystems and terminators. Information Flows allow for coordinated system operation by using predefined interfaces between ITS elements that may be owned and operated by different stakeholders. A key component of ITS Architecture development is identifying existing open, non-proprietary standards for these information flows wherever possible to maximize interoperability. Examples of information flows are Signal Control Data that starts at the Traffic Management Subsystem (traffic operations center) and flows to the Roadway Subsystem (the traffic signal controller in the field). Signal Control Data is the information used to configure and control traffic signal systems, such as phases and timing.

5.1 National ITS Service Packages

Appendix A lists all ITS Service Areas and Service Packages in the National ITS Architecture Version 7.0. The 97 service packages in **Appendix A** represent the entire spectrum of ITS services that are defined by the National ITS Architecture. Only a small portion of these Service Packages are currently deployed in the L-DC Region.

In the electronic version of this document, each Service Package is hyperlinked to detailed descriptions and diagrams. They may also be accessed at the National ITS Architecture Web Site[5].

[5] http://www.iteris.com/itsarch/html/mp/mpindex.htm

5.2 Existing L-DC Region ITS Service Packages

The L-DC has not and will not deploy all National ITS Services Packages. **Table 5** identifies the existing ITS Service Packages in the Region. The existing Service Packages have been derived from the current services provided by the Region's Stakeholders, and from the inventory documented in **Section 4**. Note that not all of the stakeholders listed as owning the Region's ITS inventory are represented in Table 6. This is because some stakeholders own ITS elements with the potential to be integrated into ITS, but currently the elements are not.

Table 5: L-DC Region Existing ITS Service Packages

Existing Service Package	Stakeholders
APTS01: Transit Vehicle Tracking	▪ Lawrence Transit ▪ KU on Wheels
APTS02: Transit Fixed-Route Operations	▪ Lawrence Transit ▪ KU on Wheels
APTS03: Demand Response Transit Operations	▪ Lawrence Transit ▪ KU on Wheels
APTS04: Transit Fare Collection Management	▪ Lawrence Transit ▪ KU on Wheels
APTS05: Transit Security	▪ Lawrence Transit ▪ KU on Wheels
APTS08: Transit Traveler Information	▪ Google Transit ▪ Lawrence Transit ▪ Traveling Public
ATIS01: Broadcast Traveler Information	▪ KC Scout ▪ KDOT ▪ KTA ▪ Traveling Public
ATMS01: Network Surveillance	▪ City of Lawrence Public Works ▪ KC Scout
ATMS03: Traffic Signal Control	▪ City of Lawrence Public Works
ATMS06: Traffic Information Dissemination	▪ KTA ▪ KC Scout
ATMS10: Electronic Toll Collection	▪ KTA

Existing Service Package	Stakeholders
ATMS16: Parking Facility Management	▪ KU
EM01: Emergency Call-Taking and Dispatch	▪ Douglas County Emergency Communications ▪ KHP ▪ KU Public Safety
EM02: Emergency Routing	▪ City of Lawrence ▪ Douglas County ▪ Douglas County Emergency Communications ▪ Lawrence-Douglas County Fire Medical ▪ Local Cities Emergency Services
EM04: Roadway Service Patrols	▪ KTA
EM08: Disaster Response and Recovery	▪ Douglas County Emergency Management ▪ Kansas Department of Emergency Management
EM09: Evacuation and Reentry Management	▪ Douglas County Emergency Management ▪ Kansas Department of Emergency Management
EM10: Disaster Traveler Information	▪ KDOT ▪ KTA
MC01: Maintenance and Construction Vehicle and Equipment Tracking	▪ City of Lawrence Public Works ▪ Douglas County
MC03: Road Weather Data Collection	▪ KDOT ▪ KTA
MC04: Weather Information Processing and Distribution	▪ KDOT ▪ KTA
MC06: Winter Maintenance	▪ City of Lawrence Public Works ▪ Douglas County ▪ KDOT ▪ KTA

6. L-DC Regional ITS Needs

The existing ITS inventory provides an overview of the current ITS in the Region. The project's next step was to determine the needs that can be addressed by ITS but are not, either in part or whole, addressed by the existing ITS.

6.1 Needs Gathering Process

In order to identify and understand the L-DC Region's needs, the Project Team developed multiple strategies for engaging Stakeholders. The purposes of the needs gathering activities were:

- To identify the Stakeholders and their transportation roles and responsibilities.
- To identify the range of needs identified by different Stakeholder types.
- To define the geographic and service scope of the Stakeholders' needs.
- To understand the priority of the Region's needs.

The Stakeholder outreach strategies included the following:

Interactive Web Site

The project established an interactive web site in which Stakeholders could participate and provide input on the Region's transportation needs through a survey. Stakeholders were asked about their background, and their roles and responsibilities in the Region's transportation systems, and then they were asked to identify their key transportation concerns. The interactive survey also included a range of potential ITS solutions for the Stakeholders to consider.

The following two methods were used to advertise the survey to Stakeholders:

- A direct link placed on the MPO web page[6] of the City's website.
- Two group e-mails sent to the Project's identified nearly 200 potential Stakeholders

The survey was available through the Digicate[7] web platform from November 26, 2014 to December 31, 2014. The Project Team invited the Region's Stakeholders to complete the survey and a total of 78 people responded. Over 80% of the respondents completed the survey using a personal computer, and more than half of the respondents completed the survey in the first two weeks it was available. Over 80% of the respondents also indicated that their primary mode of travel was by car or van, ten percent were pedestrian, bicyclist or transit riders, and the remainder traveled by truck or multiple modes.

The survey focused on the following key items:

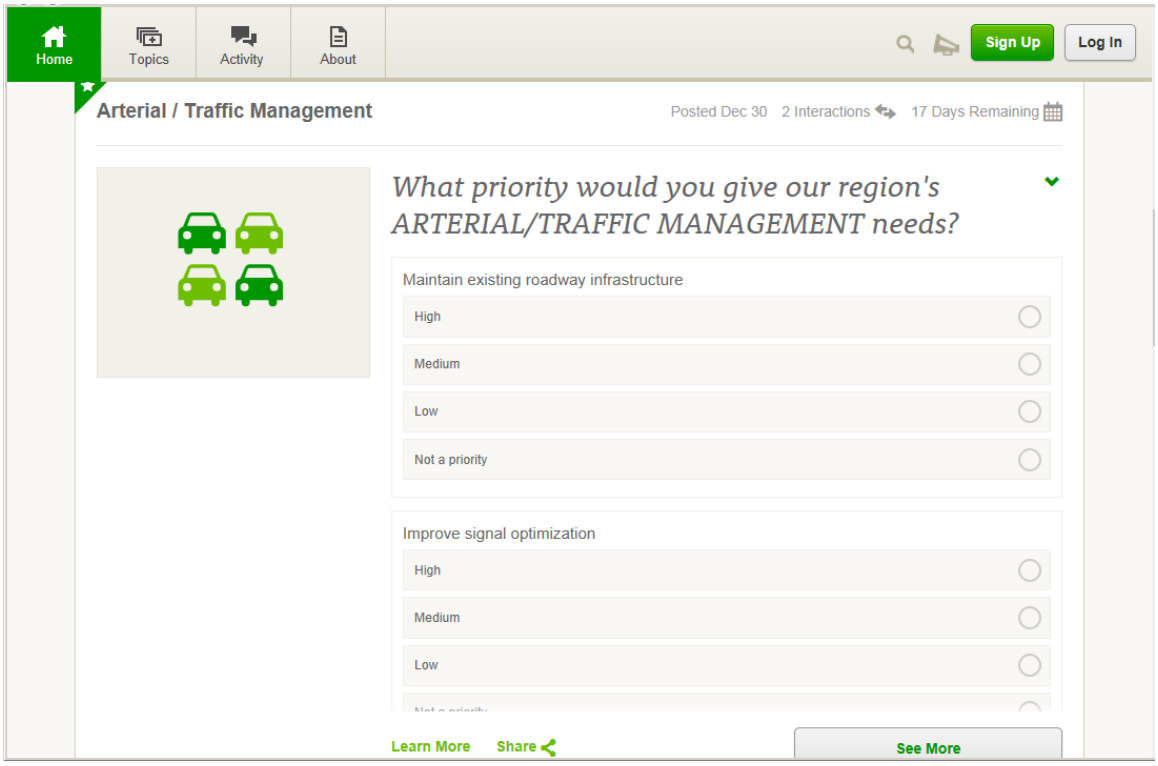
- The travel information that was most important to the Region.

[6] http://www.lawrenceks.org/mpo
[7] http://digicate.com/main.php

- The respondent's degree of familiarity with ITS.
- The respondent's travel habits (frequency, timeframe, and mode).
- The respondent's perception of what key issues affect L-DC travel.
- General information about the survey respondents.

Figure 5 provides a sample screenshot from the interactive web site.

Figure 5: Interactive Project Web Site



The results of the survey included the respondents' perception of the types of traveler information for the Region. As can be seen in **Figure 6**, construction, multi-modal and congestion information were rated most important by the Stakeholders.

Figure 6: Stakeholder Response to Most Important Traveler Information

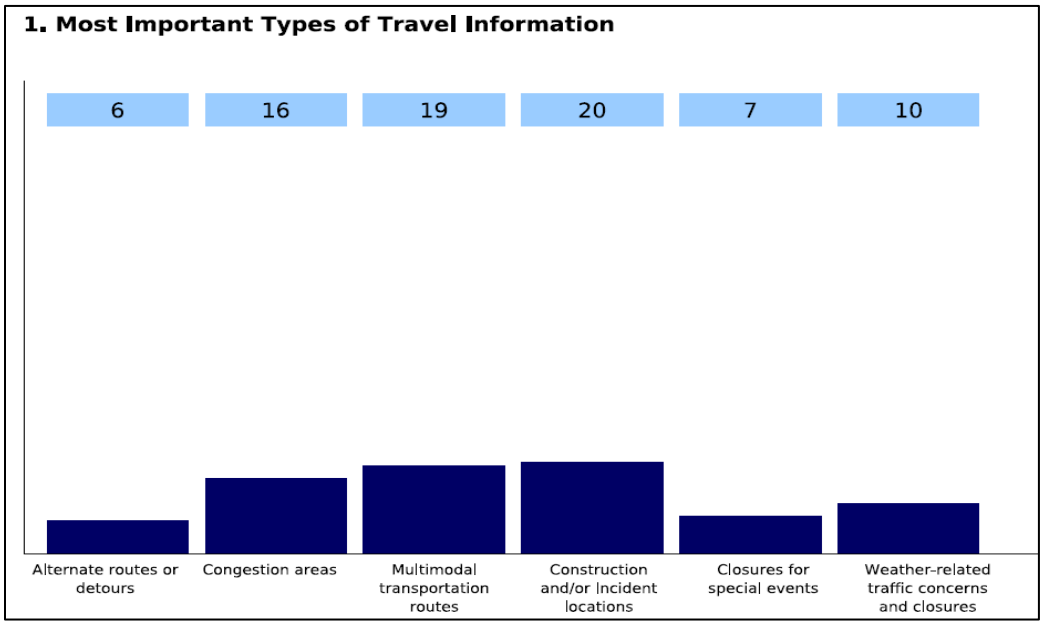
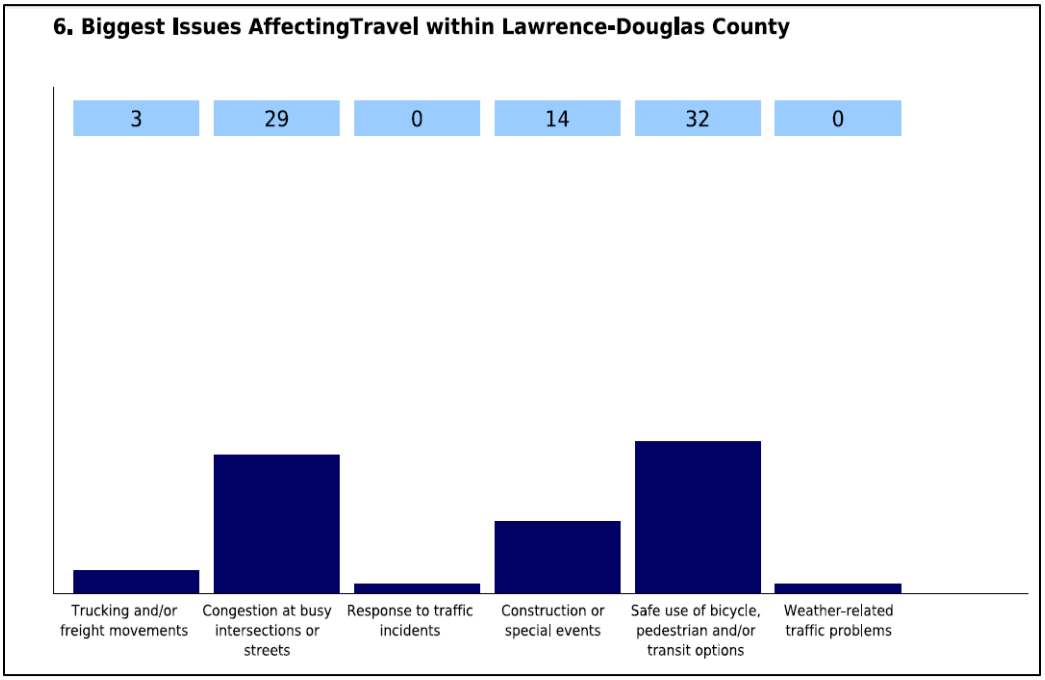


Figure 7 shows that the Stakeholders' biggest travel issues in the Region were the ability to safely use and interact with bicycles and transit, congestion, and construction and special events.

Figure 7: Stakeholder Response to Biggest Issues Affecting Travel in the Region



The web site survey was not intended to collect detailed information about the Stakeholders' needs. Instead, the online survey was intended to educate the Project Team about the Stakeholders, introduce the concepts of ITS to the Stakeholders, and to collect general information about transportation needs. That general information was used by the Project Team used to focus needs discussions and Stakeholder outreach activities, including the first Stakeholder Workshop.

Stakeholder Workshop

An ITS Stakeholder Workshop was held on December 8, 2014 in the Heritage Room of the Carnegie Building (200 W. 9th Street) in Lawrence, Kansas. Invitations were provided via email to over 100 Core and Community Stakeholders as described in **Table 2**. Individuals representing the following entities attended and participated:

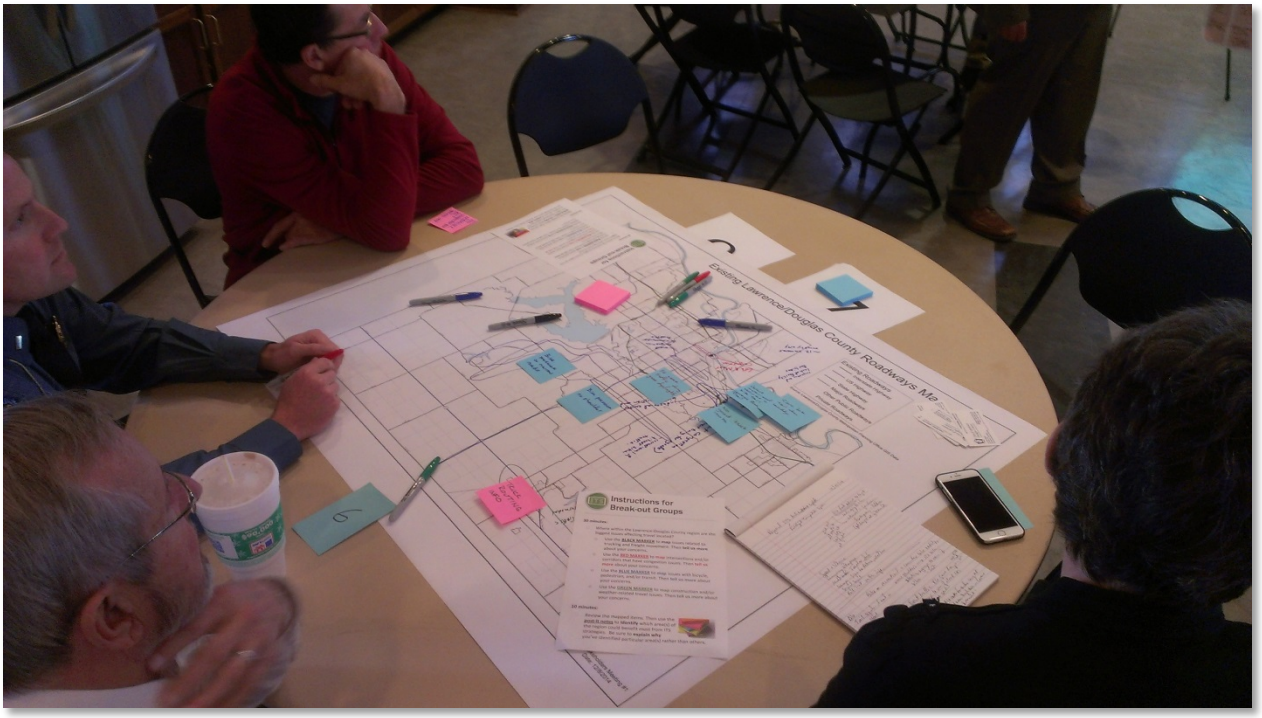
- City of Lawrence Police
- City of Lawrence Public Works
- Cottonwood, Inc. (developmental disabilities services)
- Douglas County
- Douglas County Health Department
- Federal Highway Administration
- Kansas Department of Transportation
- Kansas Highway Patrol
- L-DC MPO Policy Board and Regional Transit Advisory Committee
- Lawrence/University of Kansas Transit
- Lawrence-Douglas County Bicycle Advisory Committee

The Workshop was used to build upon the preliminary results from the online survey. After a review of ITS and the Region's current transportation network status, the Stakeholders participated in an exercise to identify the Region's specific transportation needs.

The Stakeholders were randomly assigned to small groups to ensure that each group consisted of individuals with a diversity of roles in the Region's transportation. Each group was given a map to mark up with transportation needs. The needs could be region-wide, or specific to a location or corridor. Following this exercise, each group presented their needs to all of the workshop attendees. The Project Team collected the maps and documented the needs by group and by Stakeholders.

Figure 8 shows a group of Stakeholders at the Workshop documenting Regional transportation needs.

Figure 8: Stakeholders at the Worskhop Mapping Needs



Specific feedback was gathered from the Stakeholders about issues regarding:

- Congested intersections and corridors.
- Event-related congestion and management issues.
- Bicycle, pedestrians and transit needs.
- Construction activities.
- Bicycle and pedestrian interactions with vehicles.
- Weather-related issues impacting travel.
- Geographic locations or types of issues that may benefit most from ITS.

Stakeholder Interviews

Following the Stakeholder Workshop, the Project Team met with Core Stakeholders for one-on-one meetings. The meetings were conducted in person and via telephone. The Core Stakeholders interviewed included:

- Local Cities Public Works and Police
- City of Lawrence Police
- City of Lawrence Public Works
- City of Lawrence Information Technology
- Douglas County Public Works
- Douglas County Emergency Communications Center

- KC Scout
- KDOT Bureau of Transportation Planning
- Lawrence-Douglas County Fire Medical
- University of Kansas Parking and Transit

The purposes of these interviews were to:

- Interact with Core Stakeholders, some of whom who could not participate in the Workshop.
- Learn how ITS is currently used in the Region.
- Understand the transportation capabilities, roles and responsibilities of the Core Stakeholders.
- Identify the transportation needs of Core Stakeholders.

The information from these interviews was used to help refine and prioritize the Region's transportation needs. The information gathered during the interviews will also be used throughout the remainder of the L-DC Regional ITS Architecture Update Project to identify potential future ITS that have the support of the Region's Stakeholders and can be deployed, operated and maintained.

6.2 L-DC Regional ITS Needs

Based on the Stakeholder input from the survey, workshop and interviews, the highest priority transportation needs for the L-DC Region are:

1. ***Improve information sharing among agencies***. The Stakeholders indicated that better information sharing was a high priority need for the Region. They stated that better sharing of existing information, including traffic and maintenance data and video images, can help address the Region's issues.
2. ***Improve traffic information dissemination***. The Stakeholders stated that the Region would benefit from improved dissemination of information regarding real-time traffic conditions. This includes providing information about congestion, incidents, directions for detours, and routing to events. Improved traffic information may require improved collection of traffic conditions.
3. ***Improve event management.*** This need addresses the coordination of agencies for events in the Region. It may include better interagency planning of road closures and restrictions, management of parking facilities, and interagency coordination for traffic control and incident response.
4. ***Improve multi-modal information.*** The Region's traveling public indicated a significant need for improved and coordinated information regarding all modes, including transit, bicycle, motorized vehicles, pedestrian and parking, to help them make intelligent decisions regarding how and when they travel. The need for information included pre-trip and en-route.

5. ***Improve traffic flow at intersections through improved signal timing and control***. The City of Lawrence has coordinated signals on some corridors. This Stakeholder need is specifically to improve flow at high-volume intersections during peak hour traffic in Lawrence.
6. ***Improve incident detection***. This need includes being able to more rapidly detect incidents as well as more rapidly gathering information in order to respond appropriately. Improved incident detection also includes the need that all relevant Stakeholders have access to incident information, primarily existing video images.
7. ***Improve inter-agency coordination***. Improved coordination would result in Lawrence Transit receiving better and more complete information about road closures, restrictions and maintenance that impact their fixed-route and paratransit routing and schedules. The interagency coordination could also help emergency responders be aware of closures and restrictions that could delay their responses.
8. ***Improve incident response coordination among agencies***. This need is closely related to the needs for improved inter-agency coordination and improved information sharing. To improve response coordination will require better information sharing and for the agencies to be able to communicate their plans and activities.
9. ***Improve transit efficiency and information sharing***. This need is for the transit agency to be better able to monitor the location of its vehicles, and thereby monitor the vehicle performance and provide better information to transit riders about vehicle schedules.

The above list highlights the highest priority needs for the Region. However, there were many more needs identified by the Stakeholders. The detailed listing of prioritized needs are contained in **Appendix B**. This complete list is referenced in the SDP as the needs addressed by each candidate ITS project in the Region.

7. L-DC Region ITS Strategies

The ITS strategies are high-level descriptions of how ITS may be used to address the L-DC Region's needs. The strategies are generated with consideration for several factors, including:

1. ***Needs and their priorities***. High priority needs are those that the strategies will most directly address. In many cases the strategies that address the highest priority needs also address other needs.
2. ***Feasibility***. The strategies are developed to align with the unique characteristics of the Region and its Stakeholders. For example, strategies specifically do not describe solutions that are not supported or are not feasible for technical or institutional reasons. However, the strategies do complement existing transportation infrastructure, services and ITS as well as the roles and responsibilities of the Stakeholders.
3. ***ITS Goals***. The strategies, and subsequently the ITS projects, align with the Region's ITS Vision and Goals.

The ITS strategies have some overlap among the service areas, just as the needs and ITS Service packages that address them will have.

7.1 Arterial / Traffic Management Strategies

The strategies for improving arterial and traffic management will expand upon the City of Lawrence's existing traffic cameras, coordinated signals, and Traffic Operations Center, as well as the Douglas County Emergency Communications Center ability to track and dispatch emergency services. Many significant corridors are already coordinated, and the City has a robust and expanding fiber optic network that can be used for ITS. Arterial / Traffic Management strategies are:

- Deploy traffic signal coordination and/or adaptive signals in key Lawrence corridors.
- Increase the use of traffic cameras for traffic management and incident detection.
- Share real-time information by sharing traffic images with the public and other agencies.
- Provide en-route traffic information to travelers through strategically-placed Dynamic Message Signs (DMS).
- Share event, maintenance and incident information among agencies for planning and response.
- Manage parking facilities and share parking information with the public to improve event management.
- Increase performance monitoring through increased data collection and analysis.

7.2 Freeway Management Strategies

There are two operators of highways in the Region: KTA and KDOT. Additionally, KC Scout is located in Kansas City, but operates systems throughout Kansas. KTA operates the turnpike through the L-

DC Region and has traffic cameras, traffic sensors and Highway Advisory Radio (HAR) in the L-DC Region, as well as DMS in adjacent areas. These are managed from the KTA Traffic Management Center and information is also shared through the KTA website. KDOT maintains the other state and US Highways in the L-DC Region. Both agencies will benefit from better information dissemination to the public through their web sites and KDOT's 511 system. In addition, both agencies can improve incident response and event coordination through information sharing with other local transportation agencies. Freeway Management strategies are:

- Provide en-route traffic information to travelers through strategically-placed DMS.
- Share event, maintenance, and incident information among agencies for planning and response.
- Increase the use of traffic cameras for incident detection.
- Increase performance monitoring through increased data collection and analysis.

7.3 Public Transportation Strategies

Lawrence Transit and Kansas University's KU on Wheels have a considerable amount of existing advanced public transportation technology for their fixed-route and paratransit services, such as vehicle tracking and real-time bus arrival information for passengers. The Region also has a limited number of other providers delivering paratransit services to focused groups, such as the disabled and senior citizens. The public transportation strategies expand on the existing technologies and coordinate with traffic management to improve multi-modal transportation. The Public Transportation strategies are:

- Develop traveler information tools that inform the public of traffic, transit, parking, pedestrian and bicycle travel.
- Share event, maintenance and incident information with transit for planning service.
- Deploy transit traveler information, including real-time web information, trip planning and roadside real-time bus arrival information.
- Deploy transit signal priority at signals near the Lawrence Transit center.
- Deploy advanced fixed-route operations management systems.
- Implement smart-card fare payment and potentially integrate the card with other electronic payment systems, such as for parking or social services.

7.4 Emergency Management Strategies

The Douglas County Emergency Communications Center is responsible for 911 call answering and dispatching most of the Region's police, fire and medical responders. The Highway Patrol dispatches its own troopers in the Region, and KU has emergency dispatch on the university campus. The Region's strategies for improving emergency management involve improved coordination among the emergency responders as well as with maintenance, traffic, and transit agencies. This includes

improved information sharing and shared responsibility for management during incidents and events. The Emergency Management strategies are:

- Share event, maintenance, and incident information among agencies for planning and response.
- Share traffic images with emergency responders.
- Share transit vehicle locations with emergency responders.
- Deploy bicycle/pedestrian warning systems on major roadways.
- Share traffic information with emergency responders to improve emergency vehicle response and routing.
- Deploy flood monitoring devices at key roadway locations, such as East 900th Road at Clinton Lake.

7.5 Maintenance and Construction Operation Strategies

Many of the Region's maintenance vehicles already utilize vehicle tracking to monitor location and to optimize winter maintenance routing. The Region also has sensors for road weather conditions on the Turnpike. The maintenance and construction strategies expand on the existing ITS to address the key need for improved information about construction and maintenance activities in order to improve traffic management, transit operations and emergency response. Other strategies address improved winter maintenance operations and efficient, safe work zones. The Maintenance and Construction Operation strategies are:

- Share maintenance and constructions plans with agencies for planning and response.
- Share real-time information by sharing traffic images with the public and other agencies.
- Deploy signal preemption on snow plows for winter maintenance operations.
- Deploy smart work zone systems to better manage maintenance and construction zones.

7.6 Regional Traveler Information Strategies

Currently, L-DC Region travelers access information through web sites and through KDOT's 511 system. The needs indicate more integrated and local traveler information that is tailored for multiple modes and can be used to help manage traffic and events in the Region, such as at KU and regional parks. The Regional Traveler Information strategies are:

- Deploy DMS for event, traffic and work zone information.
- Centralize information from multiple agencies for coordination and sharing.
- Deploy a multi-modal trip planning tool via the web and mobile devices.

7.7 Commercial Vehicle Operations Strategies

Commercial Vehicle Operations (CVO) needs are largely aligned with the needs of other groups in the L-DC Region. The primary CVO need that can be addressed locally regarded improved real-time information about traffic and roadway conditions that would impact truckers' travel. Other identified needs, such as wide-area traveler information are addressed at the Kansas State level through the 511 System and the Kansas Truck Routing and Intelligent Permitting System[8] (K-TRIPS), which provides detailed routing for oversize/overweight commercial vehicles. The Commercial Vehicle Operations strategies are:

- Provide en-route traffic information to travelers through strategically-placed DMS.
- Deploy DMS for event, traffic and work zone information.

7.8 Integration Strategies

The L-DC Region's Integration needs largely entail improved coordination among agencies during the planning and deployment of ITS, and ensuring the infrastructure is in place for successful ITS deployment. The resulting strategies include approaches that complement the strategies described in the seven other Service Areas. The Integration strategies are:

- Share event, maintenance and incident information among agencies for planning and response.
- Manage parking facilities and share parking information with the public to improve event management.
- Increase performance monitoring through increased data collection and analysis.
- Coordinate the development of ITS projects among agencies.
- Continue to engage Stakeholders to increase awareness in the Region of the planned and deployed ITS.

[8] https://www.k-trips.org/ - truck routing system for Kansas state highways.

8. Planned L-DC ITS Services

ITS Services were identified to address the L-DC Region's ITS needs that were consistent with the ITS Strategies. As described in **Section 5**, Service Packages are deployable units of ITS Service. The projects that were developed for the L-DC Region and that are described in **Section 13** of the SDP are developed to include one or more of the ITS Service Packages that address the Region's needs.

Table 6 lists the ITS Service Packages planned for the L-DC Region and the Stakeholders who may participate in them. In some cases these Service Packages exist in the Region but are planned to include new functionality or Stakeholders.

Appendix B provides a map of each need in the Region to the appropriate ITS Service Packages.

Table 6: L-DC Region Planned ITS Service Packages

Planned Service Package	Stakeholders
AD2: ITS Data Warehouse	▪ City of Lawrence Public Works ▪ Douglas County ▪ Douglas County Emergency Communications ▪ Douglas County Emergency Management ▪ Lawrence-Douglas County Fire Medical ▪ KC Scout ▪ KDEM ▪ KDOT ▪ KHP ▪ KTA ▪ University of Kansas ▪ Lawrence Transit ▪ Local Cities ▪ National Weather Service ▪ Traveling Public
APTS02: Transit Fixed-Route Operations	▪ Lawrence Transit ▪ KU on Wheels
APTS04: Transit Fare Collection Management	▪ Lawrence Transit ▪ KU on Wheels
APTS06: Transit Fleet Management	▪ Lawrence Transit ▪ KU on Wheels

Planned Service Package	Stakeholders
APTS08: Transit Traveler Information	▪ Lawrence Transit ▪ KU on Wheels
APTS09: Transit Signal Priority	▪ City of Lawrence Public Works ▪ Lawrence Transit
APTS10: Transit Passenger Counting	▪ Lawrence Transit ▪ KU on Wheels
ATIS01: Broadcast Traveler Information	▪ City of Lawrence Public Works ▪ City of Lawrence Police ▪ Douglas County Emergency Communications ▪ Douglas County Emergency Management ▪ Lawrence-Douglas County Fire Medical ▪ KC Scout ▪ KDEM ▪ KDOT ▪ KHP ▪ KTA ▪ University of Kansas ▪ Lawrence Transit ▪ Local Cities ▪ National Weather Service ▪ Private Sector Information Services ▪ Traveling Public

Planned Service Package	Stakeholders
ATIS02: Interactive Traveler Information	▪ City of Lawrence Public Works ▪ City of Lawrence Police ▪ Douglas County Emergency Communications ▪ Douglas County Emergency Management ▪ Lawrence-Douglas County Fire Medical ▪ KC Scout ▪ KDEM ▪ KDOT ▪ KHP ▪ KTA ▪ University of Kansas ▪ Lawrence Transit ▪ Local Cities ▪ National Weather Service ▪ Private Sector Information Services ▪ Traveling Public
ATIS05 – ISP Based Trip Planning and Route Guidance	▪ City of Lawrence Public Works ▪ Douglas County Emergency Communications ▪ Douglas County Emergency Management ▪ Lawrence-Douglas County Fire Medical ▪ KC Scout ▪ KDEM ▪ KDOT ▪ KHP ▪ KTA ▪ University of Kansas ▪ Lawrence Transit ▪ Local Cities ▪ National Weather Service ▪ Traveling Public

Planned Service Package	Stakeholders
ATIS06 – Transportation Operations Data Sharing	▪ City of Lawrence Public Works ▪ City of Lawrence Police ▪ Douglas County ▪ Douglas County Emergency Communications ▪ Douglas County Emergency Management ▪ Lawrence-Douglas County Fire Medical ▪ KC Scout ▪ KDEM ▪ KDOT ▪ KHP ▪ KTA ▪ University of Kansas ▪ Lawrence Transit ▪ Local Cities
ATMS01 – Network Surveillance	▪ City of Lawrence ▪ KC Scout ▪ KTA
ATMS03 – Traffic Signal Control	▪ City of Lawrence Public Works
ATMS06 – Traffic Incident Management System	▪ City of Lawrence ▪ KC Scout ▪ KTA
ATMS07 – Regional Traffic Management	▪ City of Lawrence ▪ KC Scout ▪ KTA
ATMS16 – Parking Facility Management	▪ City of Lawrence Public Works ▪ University of Kansas ▪ Traveling Public
ATMS17 – Regional Parking Management	▪ City of Lawrence Public Works ▪ University of Kansas
ATMS24 – Dynamic Roadway Warning	▪ City of Lawrence Public Works ▪ Douglas County Public Works ▪ KDOT

Planned Service Package	Stakeholders
ATMS26 – Mixed Use Warning Systems	▪ City of Lawrence Public Works ▪ Traveling Public
EM02 – Emergency Routing	▪ City of Lawrence ▪ Lawrence – Douglas County Fire Medical
MC03 – Road Weather Data Collection	▪ City of Lawrence Public Works ▪ Douglas County ▪ KDOT ▪ National Weather Service
MC04 – Weather Information Processing and Distribution	▪ City of Lawrence Public Works ▪ Douglas County ▪ KDOT ▪ National Weather Service
MC08 – Work Zone Management	▪ City of Lawrence Public Works
MC09 – Work Zone Safety Monitoring	▪ City of Lawrence Public Works

9. L-DC Region Operational Concept

The ITS Operational Concept is a Stakeholder–oriented view of the operational characteristics of ITS. While the Service Packages show the information flowing between ITS elements to perform functions, the operational concept describes the Stakeholder roles and responsibilities in developing, operating and maintaining the Region's ITS.

Within the operational concept are each Stakeholder's roles and responsibilities. For ITS, these are related to the implementation and operation of ITS. The Operational Concept is what is expected of each Stakeholder, at a management and operational level, in order for the ITS to function, provide value and be used for its intended purpose.

The process of documenting the Operational Concept for the Region develops existing roles and allows the Stakeholders to identify what they are capable of, must prepare for, or will need support in performing. The process also assists in identifying gaps and duplication of efforts. Ultimately, the roles and responsibilities will be the basis for interagency agreements for the development, deployment and operation of ITS.

The entire list of existing and future roles and responsibilities is too long to include in the body of this document. They are documented for all Stakeholders and Service Areas in the L-DC Regional ITS Turbo Architecture database. However, to provide an understanding of typical roles and responsibilities, **Table 6** lists the current and future roles and responsibilities for surface street management for the City of Lawrence Public Works. It should be noted **Table 7** represents only a small portion of the City of Lawrence Public Works' roles and responsibilities because it does not include maintenance, parking and incident coordination.

Table 7: Surface Street Management Roles and Responsibilities for the City of Lawrence Public Works

Role and Responsibility	Status
Collect traffic data, including speed and volumes.	Existing
Maintain and operate centralized traffic signal software.	Existing
Develop and operate coordinated signals within designated corridors.	Existing
Manage traffic control during emergency events, evacuation and reentry.	Existing
Manage traffic on city-owned arterials using traffic signals.	Existing
Monitor traffic via closed circuit television.	Existing
Operate and maintain the closed circuit camera system.	Existing
Operate and maintain traffic signals in the City.	Existing

Role and Responsibility	Status
Operate and maintain the Traffic Operations Center.	Existing
Grant signal preemption to emergency vehicles.	Near-term
Coordinate traffic control response to incidents with emergency responders and other transportation agencies.	Near-term
Share traffic operations information, including camera images with other agencies in the Region.	Near-term
Coordinate with other agencies for event and incident management.	Near-term
Operate DMS from the Traffic Operations Center and provide field maintenance to DMS.	Near-term
Provide access to traffic camera views for other selected agencies in the Region.	Near-term
Redistribute traffic images from local closed circuit television cameras.	Near-term
Exchange traffic information with emergency responders and other traffic agencies to support coordinated incident response.	Medium-term
Grant transit vehicles signal priority at key intersections.	Medium-term
Monitor work zone operations.	Medium-term
Operate and maintain work zone information and safety systems.	Medium-term
Collect parking information and use it to inform the public and manage facilities and event traffic.	Medium-term
Exchange transportation data with the local data warehouse.	Long-term
Maintain local data warehouse.	Long-term
Provide multi-modal information to the public.	Long-term
Operate and maintain pedestrian/bicycle warning systems.	Long-term
Equip maintenance vehicles with signal preemption equipment and grant signal pre-emption to snow plows during winter maintenance.	Long-term
Monitor road-weather conditions and use the information to respond to weather incidents and inform the public.	Long-term

10. L-DC Region ITS Functional Requirements

To effectively deliver the ITS services in the L-DC Region, each system must perform certain functions. While the Operational Concept focused on how people and agencies will interact with ITS, functional requirements focus on what the ITS elements are required to do in order to accomplish the region's ITS objectives.

A functional requirement is a declarative "shall statement" that precisely states a task or activity performed by an ITS element in the region. Each functional requirement is specific and discrete, defining a function that an ITS system must perform. For example, the KDOT roadside devices "shall include dynamic messages signs for dissemination of traffic information and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/closed)."

The functional requirements for the L-DC Regional ITS Architecture have been selected based on the ITS Services, using the Turbo Architecture software tool. The selection has been tailored based on the particular stakeholders, inventory and the region's objectives.

The L-DC Regional TS Architecture functional requirements are very detailed and comprehensive and total in the hundreds. They are not included in the body of this report, but can be viewed at the project level in the Turbo Architecture software and its output. **Table 8** is a small subset of the Region's functional requirements meant to serve as an example. They are the functional requirements for the City of Public Works Maintenance Center and Vehicles for ITS Service Packages MC08 – Work Zone Management and MC09 – Work Zone Safety Monitoring.

Table 8: Example City of Lawrence Maintenance Functional Requirements

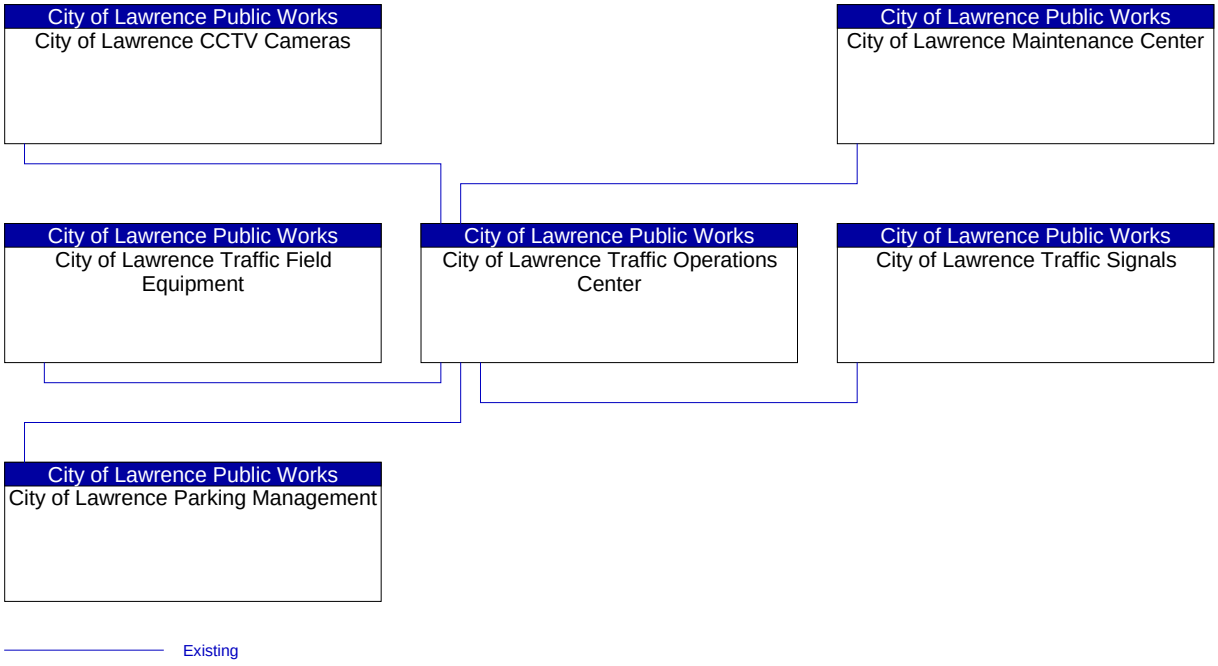
ITS Element	Planned Functional Requirement
City of Lawrence Public Works Maintenance Center	The center shall generate new work zone activity schedules for use by maintenance and construction vehicles, maintenance and construction operators, and for information coordination purposes.
	The center shall control the collection of work zone status information including video images from cameras located in or near the work zone.
	The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.
	The center shall control traffic in work zones by providing remote control of dynamic message signs, highway advisory radio systems, gates, and barriers located in or near the work zone.
	The center shall provide remote monitoring and control of work zone safety devices - including intrusion detection devices that have been installed in work zones or maintenance areas.
	The center shall provide remote monitoring and control of intrusion alert devices that have been installed in work zones or maintenance areas.
	The center shall collect status information of work zone safety device status from field equipment or the maintenance and construction vehicles.
	The center shall collect and store work zone data collected from work zone monitoring devices (such as intrusion detection or alert devices and speed monitoring devices) on-board the vehicle and at the roadside.
City of Lawrence Public Works Maintenance Vehicles	The maintenance and construction vehicle shall monitor, operate, and control work zone devices located at or alongside the roadway. The devices operated on board the vehicle include driver information devices (e.g. dynamic message signs) and work zone intrusion detection and alert devices.
	The maintenance and construction vehicle shall provide an interface for field personnel to input status of their work zone activities.
	The maintenance and construction vehicle shall collect inputs from field personnel and from work zone devices on-board the maintenance and construction vehicle and send them to the controlling center.

11. L-DC Region Interconnects and Information Flows

The various ITS elements must connect and exchange information in order for the L-DC Regional ITS Architecture to perform the functions required to and meet the Region's transportation needs. Connections between the elements of the L-DC Regional ITS Architecture are defined at two levels, interconnects and information flows.

Interconnects are the data connections between the Region's ITS elements. For example, a transit will have an interconnect to the transit center via wireless communication. The Lawrence Traffic Operation Center will be connected to traffic signals, traffic cameras, other centers and, potentially to the traveling public. Figure 9 shows the City of Lawrence Traffic Operations Center's existing interconnects. Note that the Regional ITS Architecture contains both existing and planned interconnects, but Figure 9 only shows the existing for the sake of keeping the diagram simple.

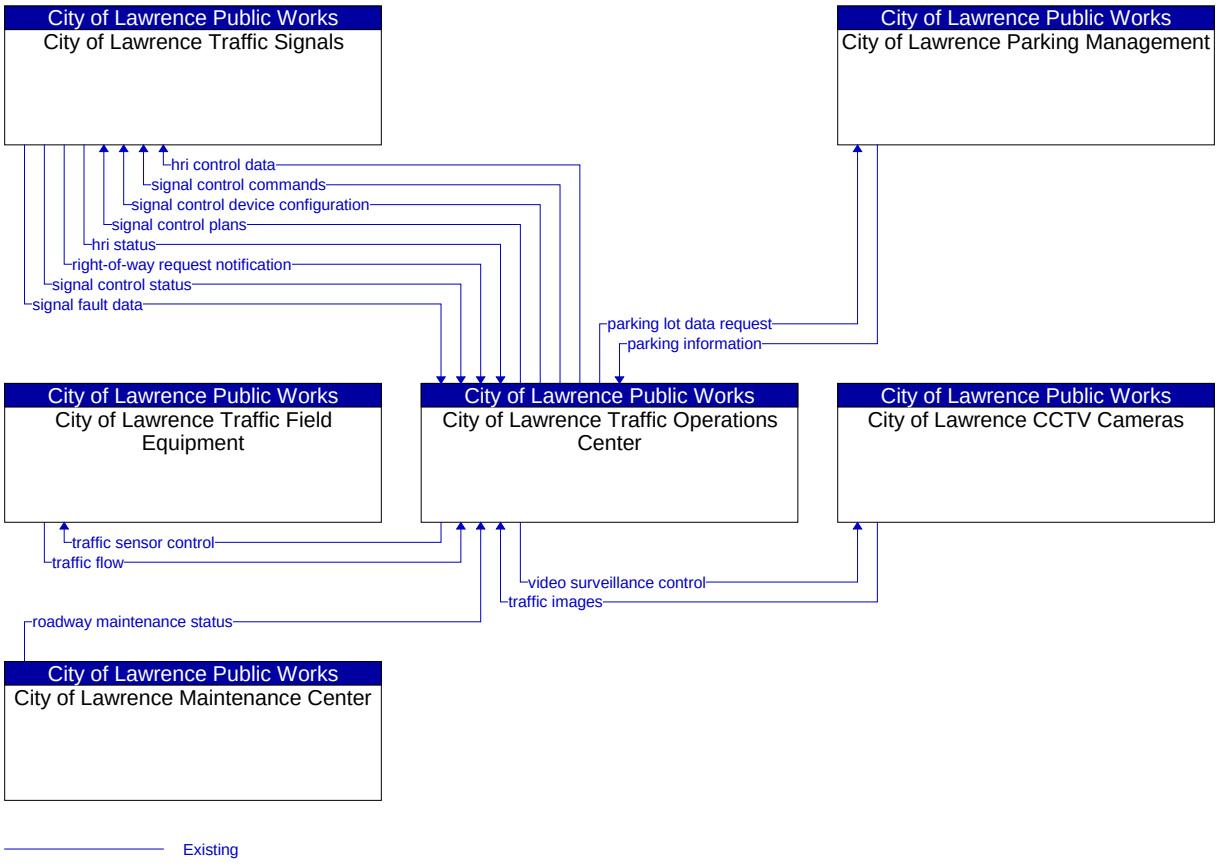
Figure 9: Existing City of Lawrence Traffic Operations Center Interconnects



Each interconnect contains specific information flows. Information flows define each type of information that will be exchanged between ITS elements. Information flows are significant because they define what data they each system will send and receive. The Regional ITS Architecture also defines open, non-proprietary standards for most information flow formats and protocols. The standards allow the Region to build systems that are interoperable and able to exchange information with other existing and new ITS. Standards are discussed in more detail in **Section 12**.

Figure 10 shows some of the existing information flows that occur among the City of Lawrence Traffic Operations Center and other ITS elements. As with interconnects, the Regional ITS Architecture has all existing and planned information flows, but **Figure 10** is a limited view for the sake of simplicity.

Figure 10: Existing City of Lawrence Traffic Operations Center Information Flows



The L-DC Regional ITS Architecture contains all existing and planned interconnects and information flows among the region's ITS elements. Diagrams of all information flows are available on the L-DC Regional ITS Architecture web site. The diagrams represent multiple contexts, including being able to view any ITS device with all existing and planned flows to and from that ITS device.

12. L-DC Region ITS Standards

This section provides a summary of ITS standards. It discusses the following topics:

- A discussion of national ITS standards and how they are developed.
- A description of when and how ITS standards may be applied in ITS project in the L-DC.
- The benefits of using ITS standards in ITS procurement and deployment.
- The standards applicable to the ITS identified for the L-DC Region.

12.1 National ITS Standards Development

ITS standards are fundamental to the establishment of an open ITS environment, a goal originally envisioned by the architecture developers. It is an important component of the information flows in a Regional ITS Architecture. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances and new approaches evolve.

Establishing regional and national standards for exchanging information among ITS deployments is important not only from an interoperability point of view. It also reduces risk and cost since a region can select among multiple vendors for products and applications. Standards help create competition, better products, and lower prices. Eight Standards Development Organizations (SDO) are responsible for defining ITS standards. **Table 9** identifies the SDOs and the types of interfaces for which they define standards.

Table 9: ITS Standard Development Organizations

Standard Development Organization	Interfaces Addressed
AASHTO (American Association of State Highway and Transportation Officials)	• Traffic Management Center to Other Centers • Traffic Management Center to Field Devices
ANSI (American National Standards Institute)	• Commercial Vehicle Operations related system interfaces
APTA (American Public Transportation Association)	• Transit Center to Other Centers • Transit Center to Transit Vehicles
ASTM (American Society for Testing and Materials)	• Archived Data Management Center Interfaces • Vehicle to Vehicle • Field to Vehicle
IEEE (Institute of Electrical and Electronics Engineers)	• Vehicle to Vehicle • Field to Vehicle
ITE (Institute of Transportation Engineers)	• Traffic Management Center to Other Centers • Traffic Management Center to Field Devices
NEMA (National Electrical Manufacturers Association)	• Traffic Management Center to Other Centers • Traffic Management Center to Field Devices
SAE (Society of Automotive Engineers)	• Traveler Information Interfaces • Location Referencing

Not all of the standards defined by the SDOs will be used in the L-DC Region. Even within the Region, not all agencies will use standards. In order to conform to federal requirements, however, the Regional ITS Architecture is required to reference those standards that are applicable to the Region's ITS elements and information flows.

The standards that are most widely applicable to ITS deployments are the National Transportation Communications for ITS Protocol (NTCIP) family that define interfaces for Traffic Management Centers to Other Centers and to Field Devices. NTCIP is a group of communication protocols and data definition standards that have been designed for use in all types of systems dealing with the transportation environment, including those for freeways, traffic signals, emergency management, traveler information, and data archiving. It has been adopted by the FHWA to meet the needs and requirements for ITS communication and to insure that inter-network connectivity is done through industry standard interfaces.

NTCIP standards provide both the rules for communicating and the vocabulary necessary to allow electronic traffic control equipment from different manufacturers to operate with each other as a system. NTCIP is the first set of standards for the transportation industry that allows traffic control systems to be built using a mix and match approach with equipment from different manufacturers. The proper use of other standards besides those of NTCIP is important for several reasons:

- standards influence design requirements such as interchangeability, interoperability and ease of integration.
- standards offer increased flexibility and eliminates barriers to interagency coordination by reducing the need for reliance on specific equipment vendors and customized one-of-a-kind products.
- standards also allow the future expansion of the system to benefit from true competitive bidding, as well as allow other types of ITS elements to be added.

12.2 ITS Standards in Procurement Specifications

The use of ITS standards in procurement specifications often depends on how much risk can be afforded. Because the ITS standards are always evolving, there is the risk of a standard changing during a regional ITS project's development. Also, early deployers will often identify improvements to the standard that are not addressed by the current version of the standard. However, many standards are now mature and stable. Also, there is a FHWA Testing Program underway to speed up testing of ITS Standards. The use of standards in procurement should be decided on a project-by-project basis.

Making the best choices for standards depends on multiple factors, including throughput (how much data must be transmitted or received on the interface), network topology (how the ITS systems are connected to each other), and infrastructure (fiber optic lines, leased land lines, etc.), among others. The exact process for making this decision will be a function of project Stakeholders, with the

support of the Architecture Maintenance Team. The Architecture Maintenance Team is discussed in the *L-DC Regional ITS Architecture Use and Maintenance Plan*.

In determining when and how to incorporate ITS standards for a given interface, it's critical to understand the relative maturity of the standards. Currently, many of the exact standards for specific projects have not been formally published, but the process for making those decisions are developing. For each potential standard that may be applicable, the project Stakeholders and Architecture Maintenance Team should consider:

- Has the ITS standard been approved or published by the SDOs?
- Has the ITS standard been adopted by multiple vendors?
- Has the ITS standard been tested, whether informally by vendors or through the formal ITS Standards Testing Program funded by FHWA?
- Is there an amendment to the ITS standard currently in the works, and if so how much of the standard will change as a result?

12.3 Standards Availability

Standards are available directly from the SDOs, as described earlier in this Report. Standards documentation is available for purchase as individual copies and as sets, where a set is a series of standards. However, the purchase price does not allow copying of the standard, use by more than one entity concurrently, and it does not include updates. Additionally, region-wide licensing is not available.

Detailed knowledge or the possession of standards is not necessary for the Region's ITS Stakeholders. However, Stakeholders and the Architecture Maintenance Team should be aware of the standards identified as applicable for each information flow, and understand which standards they will use.

12.4 ITS Standards for the L-DC Region

The ITS standards for the region are based on the information flows, as described in **Section 11**. **Appendix C** presents the relevant standards for the L-DC Region based on the most currently available definitions.

In reviewing and applying these standards, the user should be aware of the following:

- The standards only need to be applied where there will be an exchange of data or monitoring/control functions between systems.
- The specific standards listed are not static. As the standards are implemented, changes are being made. In addition, the standards are being changed as technology evolves. Typically, these changes result in standards that are backward compatible, although new functionality may not be supported with the older versions of the relevant standard.

13. L-DC Region ITS Projects

ITS projects are deployable bundles of ITS Services that will achieve the Region's ITS strategies and map directly to the Region's needs. The projects represent ITS that may occur over the course of at least ten years. The projects are defined in a logical, or ordered, sequence. The project sequencing contributes to the integrated regional transportation system depicted in the architecture.

Note that the ITS projects are described at a high level. The descriptions are general, any location information has not been committed to at this time, and the cost estimates are accurate to an order of magnitude. More specific detail, such as precise costs, specific locations and device quantities are established in each project's planning process.

13.1 Project Definition Process

The development of the ITS projects for the L-DC Region was performed in coordination with the Stakeholders, who provided needs, existing ITS inventory and their capabilities. As described in this Technical Memorandum, the first step involved mapping the needs to ITS Services that address them.

The next step was to identify ITS strategies that aligned with the Stakeholders' capabilities and operations. Then, the Strategies and ITS User Services were reviewed in detail by the Project Team to define Candidate ITS Projects. The Candidate ITS Projects represented realistic and deployable groupings of the ITS Services. In some cases, a single strategy resulted in a Candidate Project. In others, a single Candidate Project was defined to achieve several ITS strategies.

The Candidate Project definition stage was followed by a Stakeholder review as discussed in the next section.

13.2 Project Review

The Candidate ITS Projects were presented to the Stakeholders at a Workshop on April 9, 2015. The following Stakeholders participated at the workshop:

- City of Eudora
- City of Lawrence Police
- City of Lawrence Public Works
- Cottonwood, Inc.
- Douglas County Emergency Management
- Douglas County Public Works
- Horizon 2020
- KC Scout
- Kansas Department of Transportation
- Kansas Department of Transportation – District 1
- Kansas Turnpike Authority

- Lawrence-Douglas County Fire Medical
- Lawrence-Douglas County Bicycle Advisory Committee
- L-DC MPO Policy Board and Regional Transit Advisory Committee
- Lawrence Transit
- KU on Wheels

At this workshop, Stakeholders were randomly assigned to small groups and asked to take on various stakeholder roles and discuss the Candidate Projects from those perspectives. The objective was to review the Candidate Projects from several perspectives, including:

1. **Need** – The need for a particular ITS function for the Region is critical to the timing of a project. Information on High, Medium and Low priority needs identified in this study has been carried forward in the project sequencing process. The second factor is a logical ordering of projects based on dependencies. For example, in order for emergency responders to be able to improve their incident response, they will need to be able to better monitor incidents. So, incident management projects benefit more from being planned after incident detection systems such as traffic cameras.
2. **Feasibility** – The feasibility of a project is based upon the maturity of the underlying technology and the ability of the Region's Stakeholders to operate and maintain the equipment. While some ITS solutions may address the Region's needs, they may not be based on mature technologies that can be reliably deployed. Similarly, some technologies may not be supported by the Region's communications network, the technical capabilities of the Stakeholders, or align with the Stakeholders' roles and responsibilities.
3. **Dependencies** – The success of some projects is dependent upon the technologies in other projects. For example, deploying a traveler information system in the Region would have limited success if it happened before there was a data warehouse from which the information can be collected and disseminated.

An additional objective for the Stakeholders was to identify Regional needs that were not addressed through the Candidate ITS Projects. The Stakeholders were asked to suggest changes that included modifying Candidate ITS Projects and to propose new ITS Project ideas.

Figure 11 shows the Stakeholders interacting at the Workshop.

Figure 11: Stakeholders Discussing Candidate ITS Projects at the April Workshop

13.3 Project Sequencing

Stakeholder feedback was incorporated into the definition of ITS Projects, and into how they would be sequenced. Sequencing determines when projects should be planned to most effectively:

- Maximize the benefit of ITS in the Region.
- Build upon existing and other planned ITS.
- Deploy mature and proven technologies.

Each project has been designated as Near-Term, Medium-Term and Long-Term as defined in **Section 1.2.3**. The sequencing created groups of near-, medium- and long-term Projects instead of attempting to establish specific decreasing priority ranking for all identified Projects.

Sequencing is preferable to prioritizing Projects because it does not discretely identify near-term "Project A" as being a higher priority than near-term "Project B," which would potentially pit one project or agency against another when competing for funding. Sequencing Projects also brings

structure to the planning process and gives focus to eventual Project selection and deployment without establishing a "pre-defined" funding priority.

It is important to understand that the Project Sequencing is intended as a guide and not an inflexible prescription. Some Projects should be considered longer-term efforts because near-term deployment may represent an unacceptable risk or capital cost, or because there is no near-term funding available. In some cases, major events in a region may shift a region's priorities and an ITS Project identified as medium- or long-term can be shifted to the near-term to address the newly high-priority needs. In other cases, an early opportunity to deploy a medium- or long-term Project in the Region, with relatively low risk, may present itself. Or perhaps, a technology or system advanced more quickly than was originally anticipated by this SDP.

13.4 L-DC Region ITS Projects

Table 10 lists the sequenced ITS projects for the L-DC Region. Following this table is a more detailed description of each near-, medium- and long-term project identified for the L-DC Region. The project descriptions in this section provide the following:

- A brief Project description.
- Potential Project Location.
- Planned deployment timeframe.
- The Stakeholders who will participate.
- The ITS Service Packages the project utilizes.
- The need(s) the Project addresses.
- Estimated cost range.
- Measures for evaluating the effectiveness of the Project.

As previously discussed, the inclusion of a project in this list does not mean that it has been programmed in other regional transportation plans. Neither do the vast majority of Projects on this list have committed funding. This Plan is a means for identifying potential ITS Projects that should be considered and possibly programmed into the Region's funding processes.

One ITS Project identified in this Plan is an exception. The Signal Coordination and Control Project has been funded and is in development at the City of Lawrence. Funding for the Project has been programmed though City and KDOT ITS Set-Aside funds.

It should also be noted that cost estimates for near-term Projects are more precise than the estimates for the medium-term and long-term Projects. Near-term projects assume the use of current technologies whose costs are better known. Medium-term and long-term projects are not as clearly defined because stakeholder participation has not been committed, and technologies may change before the Projects are designed.

Table 10: L-DC Regional ITS Projects

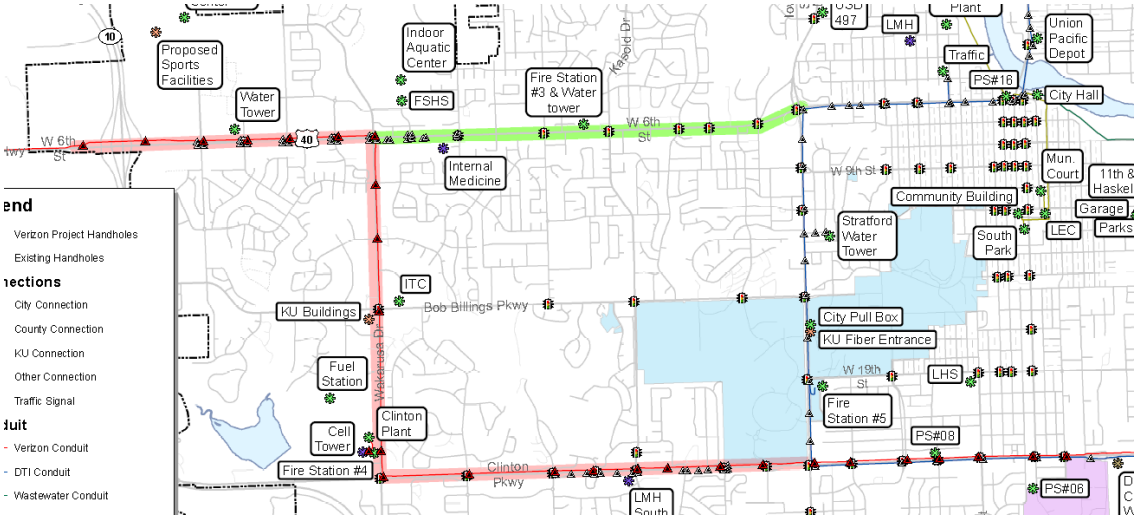
Projects		Estimated Cost
Near-term (*planned for the next three years*)	Signal Coordination and Control Expansion	$ 740,000
	Camera Sharing	$60,000
	Transit Traveler Information Improvements	$96,000 to $144,000
	Interagency Information Sharing	$100,000
	Work Zone Management	$120,000 to $174,000
	Dynamic Message Signs	$900,000 to $1,200,000
	Total Estimated Near-Term Cost	**$2,016,000 to $2,418,000**
Medium-term (*planned for three to six years*)	Communications Expansion	$839,400
	Event and Incident Management Improvements	$800,000 to $2,000,000
	Transit Management Improvements	$300,000 to $392,000
	Lawrence Transit Signal Priority	$46,000 to $98,000
	Signal Beacon Deployment	$84,000 to $120,000
	Parking Management System	$250,000 to $1,000,000
	Total Estimated Medium-Term Cost	**$2,319,400 to $4,449,400**
Long-term (*planned for six to ten years*)	Emergency Signal Preemption Improvements	$166,000 to $360,000
	Bicycle/Pedestrian Warning Systems	$108,000 to $152,000
	Weather Monitoring	$207,000 to $309,000
	Regional Virtual Data Warehouse	$15,000 to $300,000
	Journey Trip Planner	$300,000 to $570,000
	Traffic Detection Improvements	$774,000 to $1,444,000
	Total Estimated Long-Term Cost	**$1,570,000 to $3,135,000**
	Total Cost of All Projects	**$5,905,400 to $10,002,400**

13.4.1 Signal Coordination and Control Expansion Project

Table 11: Signal Coordination and Control Expansion Project

Description:

This project will expand the use of signal coordination in specific corridors in the City of Lawrence. The City is expanding its fiber optic network and will connect twelve more intersections along two corridors to the Traffic Operations Center, for a total of 31 connected intersections. The project will add multiple cameras along the connected intersections. This project will enable signal coordination and adaptive control of signals at these intersections through control at the Traffic Operations Center.



Timeframe:	*Project Areas:*
Near-term (next three years)	• 6th Street from Wakarusa to Iowa Street. • 6th St from K-10 to Wakarusa; on Wakarusa from 6th Street to Clinton Parkway; and on Clinton Parkway/23rd St from Wakarusa to O'Connell Road.
Lead stakeholder: • **City of Lawrence Public Works**	*Other Stakeholders:* • KDOT
Need(s) Addressed: • Improve traffic flow at intersections through improved signal timing and control. • Implement or improve signal coordination.	*ITS Service Packages:* ATMS03: Traffic Signal Control

Estimated Cost:

The project cost is approximately **$740,000**. This cost includes cameras, controllers, fiber optic network, design and installation.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Travel times in the corridors.
- Congestion levels in the corridors.

- Vehicle delay at intersections.

13.4.2 Camera Deployment and Image Sharing Project

Table 12: Camera Sharing Project

Description:

This project expands upon the Traffic Signal Control Coordination Expansion Project by adding the new cameras to the City's available inventory of traffic images.

The project will implement improved image-sharing technology at the City of Lawrence Traffic Operations Center to improve real-time sharing of images with other agencies in the Region. This will allow the Traffic Operations Center to view images from KTA's two cameras on the Turnpike in Douglas County, and be able to share real-time images to the Region's emergency responders and traffic management agencies via the Internet.

The City of Lawrence will be able to share camera images but will not share control of City cameras. Only the Traffic Operations Center will be able to control their pan-tilt-zoom functions.

Timeframe:	*Project Areas:*
Near-term (next three years)	• Citywide. • Turnpike Exits 202 and 217
Lead stakeholder: • **City of Lawrence Public Works**	*Other Stakeholders:* • City of Lawrence Police • Douglas County Emergency Communications • KTA • KDOT • KC Scout
Need(s) Addressed: • Improve arterial roadway traffic surveillance. • Improve access to regional cameras. • Improve incident detection. • Improve freeway traffic surveillance. • Improve information sharing among agencies.	*ITS Service Packages:* • ATMS01: Network Surveillance • ATIS06: Transportation Operations Data Sharing

Estimated Cost:

The project cost is related only to new control software for existing cameras. The estimated cost for implementation of image sharing technology is **$60,000**.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Travel times in the corridors.
- Incident response times.
- Impact of images on traffic management.

13.4.3 Transit Traveler Information Improvements Project

Table 13: Transit Traveler Information Improvements Project

Description:

This project will provide real-time transit vehicle arrival times to transit passengers at bus stops and through the Internet. Lawrence Transit and KU on Wheels are already able to provide this information via an app to passengers' phones, and this project will increase information distribution through the use of electronic signs and the web.

The electronic signs will be deployed at key stops that are heavily used or are frequent transfer points. An example location is the planned transit center. The signs display "next bus" arrival times. The web site will allow passengers to track the actual location of buses.

Timeframe:

Near-term (next three years)

Project Areas:

- Up to twelve bus stops, locations to be determined.

Lead stakeholders:

- **KU on Wheels**
- **Lawrence Transit**

Need(s) Addressed:

- Improve multi-modal traveler information.
- Improve transit traveler information.
- Expand traveler information delivery methods.
- Improve transit efficiency and information sharing.
- Monitor transit vehicle locations.
- Enable dissemination/ display of real-time bus arrival times.

ITS Service Packages:

- APTS08: Transit Traveler Information

Estimated Cost:

The estimated cost for this project is approximately $1500 per vehicle for a fleet of 18 vehicles, and up to twelve signs costing between $6,000 and $10,000 per location. **The total estimated cost is $96,000 to $144,000**. This cost assumes that existing vehicle location technology on the buses will be used.

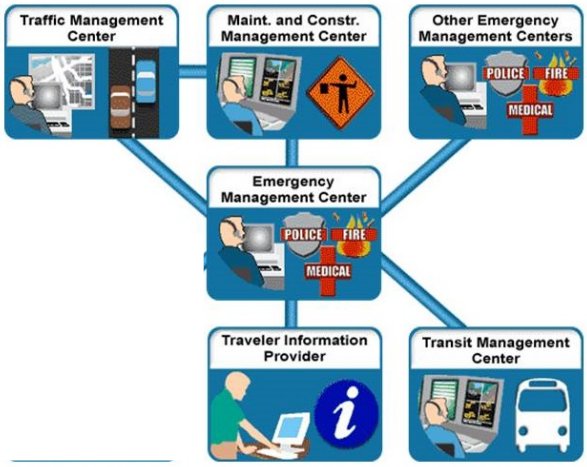
Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Transit ridership.
- Transit passenger satisfaction.

13.4.4 Interagency Information Sharing Project

Table 14: Interagency Information Sharing Project

<table>
<tr><td colspan="2"><u>Description</u>:
This project will provide a platform for the Region's agencies to improve inter-agency information sharing about incidents and events occurring in real-time and planned in the Region with other agencies. The Region's agencies will work together to develop strategies for communicating incident and event information.
It is envisioned that the platform may be simple, but used by all key Stakeholders to share information.
Note that the City of Topeka is currently deploying a similar solution using KDOT funding. The L-DC Region may benefit from coordinating with and gaining insight from Topeka and Shawnee County.
 
</td></tr>
<tr><td><u>Timeframe</u>:
Near-term (next three years)</td><td><u>Project Area:</u>
• Lawrence-Douglas County Region</td></tr>
<tr><td><u>Lead stakeholder:</u>
• City of Lawrence Public Works</td><td><u>Other Stakeholders:</u>
• City of Lawrence Police
• Douglas County Emergency Communications
• Douglas County Public Works
• Douglas County Sheriff's Office
• KDOT
• KTA
• KU on Wheels
• University of Kansas
• Lawrence Transit
• Local Cities
• Local Cities Emergency Services
• KC Scout</td></tr>
<tr><td><u>Need(s) Addressed</u>:
• Improve information sharing among agencies.
• Improve event management.
• Improve inter-agency coordination.
• Improve incident response coordination among agencies.
• Improve incident response times and routing.
• Improve coordination on construction notification and information distribution.
• Interagency coordination on most advantageous placement of maintenance vehicles (prior to anticipated need).</td><td><u>ITS Service Packages</u>:
• ATIS06: Transportation Operations Data Sharing
• ATMS08: Traffic Incident Management System
• MC10: Maintenance and Construction Activity Coordination</td></tr>
</table>

Estimated Cost:

The estimated cost of Interagency Information Sharing is **$100,000**. This estimate is based on the amount The City of Topeka and KDOT agreed to for the Topeka-Shawnee County solution and it is assumed that a similar cost will apply in the L-DC Region.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Incidence clearance times.
- Incident response times.
- Satisfaction of emergency response agencies.

13.4.5 Work Zone Management Project

Table 15: Work Zone Management Project

Description:

Work Zone Management will create an integrated implementation of technologies to improve the safety and efficiency of work zones. Devices include existing portable message signs, cameras to monitor traffic and operations in work zones, radio broadcasts to inform travelers of maintenance and construction activities and potential delays, portable barriers that can be controlled by maintenance crews, and locally-controlled signals to improve flow and manage traffic.

The work zone management systems will be portable and allow for monitoring of conditions at the Traffic Operations Center.

Timeframe:	*Project Area:*
Near-term (next three years)	• Work zones in the City of Lawrence

Lead stakeholder:

- **City of Lawrence Public Works**

Need(s) Addressed:	*ITS Service Packages:*
• Improve/enhance work zone traffic handling plans. • Increase use of portable traffic control equipment (Dynamic Message Signs, Highway Advisory Radio, etc.).	• MC08: Work Zone Management • MC09: Work Zone Safety Monitoring

Estimated Cost:

The estimated costs for work zone management assume each unit includes a video camera, Highway Advisory Radio, portable Dynamic Message Sign, and portable Traffic Management System for a unit cost of $102,000 to $152,000. Work Zone Management may also require a software upgrade at the Traffic Operations Center to manage the mobile equipment at a cost of $18,000 to $22,000. **Total estimated cost for a work zone management system is $120,000 to $174,000**. This estimate is based on the federal ITS Knowledge database[9].

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Reduced crashes and injuries in work zones.
- Traffic flow in work zones.
  - Traffic speeds in work zones.

[9] http://www.itsknowledgeresources.its.dot.gov/its/benecost.nsf/files/bclldepl2011update/$file/ben_cost_less_depl_2011%20update.pdf

13.4.6 Dynamic Message Signs Project

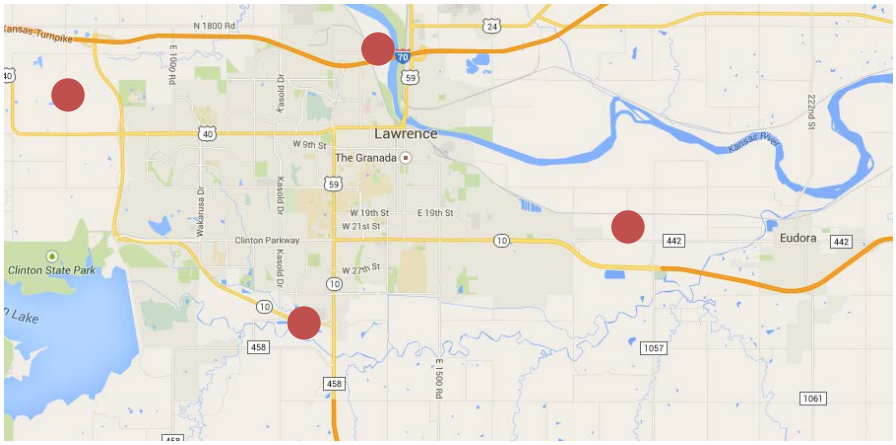
Table 16: Dynamic Message Signs Project

Description:

This project will deploy approximately four permanent Dynamic Message Signs at strategic locations in the Region to aid in providing traffic information to the public and managing congestion and event traffic. The signs will be owned by KDOT and operated by KC Scout through its center in Kansas City. The City of Lawrence Public Works and KTA will also be able to post messages to the signs from the City's Traffic Operation Center.

The DMS will provide event, detour, parking and other information to travelers as they enter the City of Lawrence. Locations will be selected prior to critical travel decision points to encourage travelers to take alternate routes when there is congestion on main roads.

A camera will also be installed at each DMS location. The cameras will be used to monitor the status of the DMS. They will also be able to provide traffic images to KC Scout, KTA and the City of Lawrence.



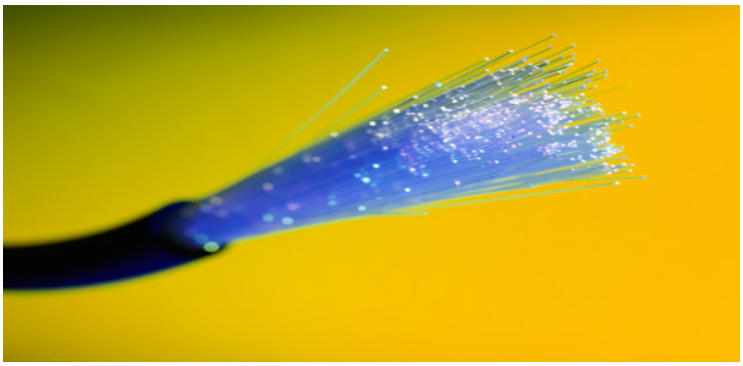
Timeframe:	*Project Areas:*
Near-term (next three years)	• Southbound US-59 south of the Turnpike • Westbound K-10 east of the City • Eastbound K-10 north of K-40 • Northbound US-59 south of the South Lawrence Trafficway
Lead stakeholder: • **City of Lawrence Public Works**	*Other Stakeholders:* • KDOT • KTA • KC Scout

Need(s) Addressed:	*ITS Service Packages:*
• Provide quality real time congestion related information. • Improve traffic information dissemination. • Provide better road construction information and notification. • Disseminate better information regarding limited alternative routes. • Improve congestion management during seasonal/local events.	• ATMS01: Network Surveillance • ATMS06: Traffic Information Dissemination
Estimated Cost: The estimated cost of the DMS and camera deployments **is $225,000 to $300,000 per site, for a total estimated cost of $900,000 to $1,200,000**. This estimate is based on the cost of KDOT's recent DMS deployments.	
Performance Measures: The effectiveness of this project can be measured through the following measures: • Traffic flow during events. • Level of usage of signs. • Survey of travelers to determine changes in travel behavior.	

13.4.7 Fiber Communications Expansion Project

Table 17: Communications Expansion Project

Description:



This project will expand the deployment of the Region's communications network that is available for the exchange of transportation data. It will primarily use fiber optic, but also use alternative data communications where fiber is not feasible or cost-effective. Alternate technologies may include cellular and microwave. The purpose is to increase the connectivity of devices and agencies in the Region for improved data collection, device management and information sharing.

The City of Lawrence already has significant fiber connectivity, including to 31 signals and all of its traffic cameras. This project would expand that network to integrate other agencies and devices. It is important to note that the deployment of fiber will be done with other Stakeholders who will also benefit from using the communications network.

Timeframe:	*Project Areas:*
Medium-term (three to six years)	• 23rd & Iowa (10/59 Hwy) south to the South Lawrence Traffic Way • 19th & Haskell to 19th & Iowa Streets • 9th & Massachusetts Streets to 9th & Iowa • 15th & Iowa to 15th & Wakarusa Streets
Lead stakeholder: • **City of Lawrence Public Works**	*Other Stakeholders:* • Douglas County Public Works • KDOT • KTA • University of Kansas • KC Scout • Private communications providers
Need(s) Addressed: • Provide quality real time congestion related information. • Improve traffic information dissemination. • Improve information sharing among agencies. • Improve event management. • Improve inter-agency coordination. • Improve incident response coordination among agencies.	*ITS Service Packages:* No specific ITS Service Packages are directly addressed by this project. However, improved communications significantly improves virtually all other ITS Projects in the Region.

Estimated Cost:

The estimated cost of the Communications Expansion is:

- $144,000 for 23rd & Iowa (10/59 Hwy) south to the South Lawrence Traffic Way
- $169,000 for 19th & Haskell to 19th & Iowa Streets
- $113,600 for 9th & Massachusetts Streets to 9th & Iowa
- $212,800 for 15th & Iowa to 15th & Wakarusa Streets

The total estimated cost is $839,400. This cost estimate has been developed by the City of Lawrence.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Number of devices connected.
- Number of agencies sharing information.
- Data exchange rates among devices and centers.

13.4.8 Event and Incident Management Project

Table 18: Event and Incident Management Project

Description:

The Incident and Event Management Improvements Project will expand upon several near-term projects: the deployment of DMS, the increased collection and sharing of traffic images, and the improved information sharing among agencies. It will also utilize the expanded communications network to link management centers.

This project will improve the real-time communication and coordination among emergency responders and traffic management to coordinate event traffic management plans, respond to incidents in real-time, and provide travelers with congestion, parking and alternative transportation mode information. The project will define means for all agencies in the Region to exchange information as needed.

KC Scout currently performs regional event and incident management in the Kansas City and provides a solid template for the L-DC Region to emulate. In addition, software used by KC Scout may be suitable for the L-DC Region and provide interoperability among the regions.

Timeframe:	*Project Areas:*
Medium-term (three to six years)	• Lawrence-Douglas County Region
Lead stakeholder: • **Douglas County Emergency Communications**	*Other Stakeholders:* • City of Lawrence Police • City of Lawrence Public Works • Douglas County Public Works • Douglas County Sheriff's Office • KDOT • KTA • KU on Wheels • KU • Lawrence Transit • Local Cities • Local Cities Emergency Services • KC Scout

Need(s) Addressed:	*ITS Service Packages:*
• Improve incident management in urban areas. • Improve event management. • Improve incidence response coordination between agencies. • Improve coordination on construction notification and information distribution. • Provide quality real time congestion related information. • Improve maintenance response to incidents and requests.	• ATIS06: Transportation Operations Data Sharing • MC10: Maintenance and Construction Activity Coordination
Estimated Cost: The estimated cost for this Project includes improved software to detect incidents at the Traffic Operations Center, increased use of portable and fixed message signs, Highway Advisory Radio and interagency data integration. **Costs of similar projects in other states have ranged from $800,000 to $2,000,000.** This estimate is based on the federal ITS Knowledge database.	
Performance Measures: The effectiveness of this project can be measured through the following measures: • Traffic flow during events. • Level of usage of signs. • Survey of travelers to determine changes in travel behavior.	

13.4.9 Transit Management Improvements

Table 19: Transit Management Improvements Project

Description:

Transit Management Improvements will be a series of technology upgrades to both Lawrence Transit and KU on Wheels vehicles. The improvements include systems that allow transit to better manage and plan its services though better data collection and analysis tools. Improved software will help develop more efficient and scheduling and route plans.

Electronic fareboxes will reduce the use of cash on transit and more efficiently collect fares, leading to shorter dwell times at stops. The electronic fareboxes will also be linked to the existing vehicle location tracking and collect data on ridership by route, location and time.

Timeframe:	*Project Areas:*
Medium-term (three to six years)	• City of Lawrence

Lead stakeholders:

- **Lawrence Transit**
- **KU on Wheels**

Need(s) Addressed:	*ITS Service Packages:*
• Automate passenger counting. • Improve service planning (scheduling and run-cutting). • Improve fare payment systems.	• APTS02: Transit Fixed-Route Operations • APTS04: Transit Fare Collection Management • APTS10: Transit Passenger Counting • APTS06: Transit Fleet Management

Estimated Cost:

The estimated cost of the transit management improvements includes approximately $12,000 to $14,000 per vehicle for on-board technology that includes electronic fareboxes, and $60,000 to $100,000 for improved fixed-route management software. The cost also includes an estimated $1,500 to $2,500 per vehicles for transit information onboard vehicles through signs or audio. **The total estimated cost is $300,000 to $392,000.**

Performance Measures:

The effectiveness of this project can be measured through the following measures:

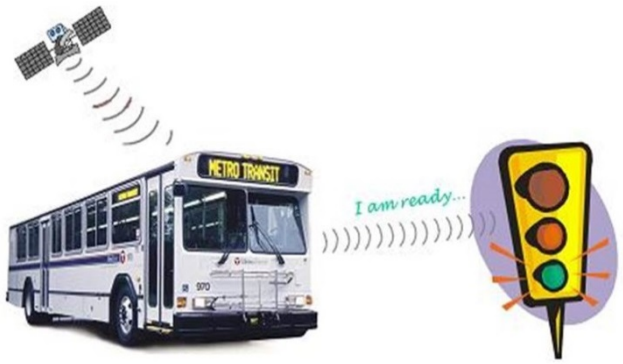
- Transit ridership.
- Operations cost per transit trip.
- Survey of transit passenger satisfaction.

13.4.10 Transit Signal Priority Project

Table 20: Transit Signal Priority Project

Description:

The Transit Signal Priority will equip Lawrence Transit fixed-route buses with a device that alerts a traffic signal controller that the bus is present and would like an early or extended green light. The signal controller, or Traffic Operations Center determines whether it is feasible to shift the signal cycle at the intersection in order to expedite the bus's movement through the intersection.



Transit Signal Priority will only be deployed around the Lawrence Transit Center, the location of which has not been determined. The purpose of signal priority near the Center will be to help prevent buses from being delayed or overflowing the Center, as well as to keep buses on schedule and ensure transfer connections can be made. Transit Signal Priority requests from buses may be based on a variety of factors that include a bus's current adherence to schedule, the number of riders on the bus, or the headway between buses on the same route.

Note that this project will require a review of State and City law regarding the use of devices to provide green lights to vehicles.

Timeframe:	*Project Areas:*
Medium-term (three to six years)	• Lawrence Transit Center (location to be determined)
Lead stakeholders:	*Other stakeholders:*
• **Lawrence Transit**	• City of Lawrence Public Works
Need(s) Addressed:	*ITS Service Packages:*
• Reduce transit vehicle delay at key intersections.	• APTS09: Transit Signal Priority

Estimated Cost:

The estimated cost of this project includes on-board technology ranging in cost from $900 to $2,100 per vehicle, and intersection control hardware and software that ranges from $5,000 to $10,000. Assuming 18 vehicles and up to six intersections, **the estimated total cost is $46,000 to $98,000**. This estimate is based on the federal ITS Knowledge database.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Transit ridership.
- Transit schedule adherence.
- Impact on traffic flow and congestion.

13.4.11 Signal Beacons Project

Table 21: Signal Beacons Project

Description:

The Signal Beacons Project provides a low-technology to provide travelers of alerts of roadway conditions. The beacons will be located along the roadway ahead of points of safety concern, such as potential roadway flooding locations, or an upcoming traffic signal that a driver should be made aware of.

The beacons will be connected to other field devices. For example, a flood warning beacon will be connected to a weather sensor that detects water level on the roadway. The beacon will trigger when the sensor detects water higher than a preset threshold. In the case of a traffic signal warning beacon, the beacon may only alert drivers when the signal they are approaching is red. Or, it may simply warn at all times of the presence of the signalized intersection ahead.

Timeframe:	*Project Areas:*
Medium-term (three to six years)	• Locations throughout the Lawrence-Douglas County Region
Lead stakeholder:	*Other stakeholders:*
• **City of Lawrence Public Works**	• Douglas County Public Works • KDOT
Need(s) Addressed:	*ITS Service Packages:*
• Improve incident detection. • Improve road/weather condition information. • Improve ability to monitor and provide information about flooding.	• ATMS24: Dynamic Roadway Warning

Estimated Cost:

The estimated cost of this project is approximately $7,000 to $10,000 per site for roadway and environmental sensors, and for the flashing beacon that is triggered by the sensor. Costs may vary based on the availability of power and communications at beacon sites. **The total estimated cost for twelve sites is $84,000 to $120,000**. This estimate is based on the federal ITS Knowledge database.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Reduction in stranded vehicles.
- Accuracy of flood detection.
- Change in travel behavior.

13.4.12 Parking Management Systems Project

Table 22: Parking Management Systems Project

Description:

This project will improve the management of parking in the City of Lawrence and on the KU campus through the use of advanced technologies to track usage and space availability.

Vehicle count systems will monitor the usage of parking at City and KU lots. This information will be shared with the public to help them travel directly to where parking is located.

The system may also be able to dynamically control parking pricing to encourage travel patterns to parking lots with the most availability.

The parking management system will collect data to help parking management agencies develop parking plans. Information generated by the Parking Management Systems can also be shared by trip planning tools and through Regional traveler information systems.

Timeframe:

Medium-term (three to six years)

Project Areas:

- City of Lawrence parking structures and lots
- KU parking structures and lots

Lead stakeholders:

- **City of Lawrence Public Works**
- **KU Parking and Transit**

Need(s) Addressed:

- Improve parking management and parking information.

ITS Service Packages:

- ATMS16: Parking Facility Management
- ATMS17: Regional Parking Management

Estimated Cost:

The estimated cost of this project is between $250,000 and $1,000,000. The cost is based on up to five parking structures participating and is dependent upon the technology deployed at each facility. The estimated cost is based on the range of costs for similar recent deployments reported in the federal ITS Knowledge database..

Performance Measures:

The effectiveness of this project can be measured through the following measures:

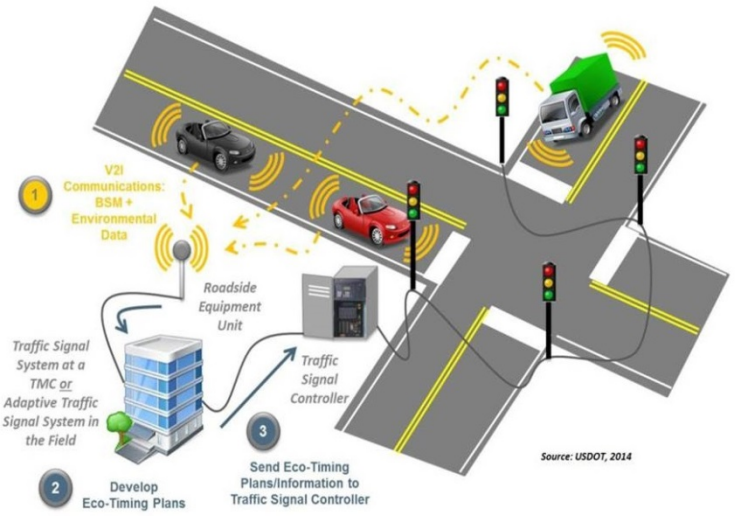
- Parking usage.
- Parking revenue.
- Traffic congestion during events.

13.4.13 Emergency Signal Preemption Improvements Project

Table 23: Emergency Signal Preemption Improvements Project

Description:

The Emergency Signal Preemption Improvements Project will upgrade the Lawrence-Douglas County Fire-Medical vehicle ability to preempt signals by replacing the existing strobe-based system with vehicle-to-signal controller wireless communication.



Currently, fire and medical vehicles are able to preempt a signal as they approach it by sending a strobe light signal to a receiver near the signal. The receiver then sends a message to the signal controller to grant an immediate green light. The current system can be susceptible to security breaches, and may not function when the line of sight between vehicle and the receiver is blocked.

The upgraded system will use wireless communications that send an encrypted signal directly from the vehicle to the signal controller. The wireless communication is more reliable and can provide a more rapid response for the approaching emergency vehicle.

Timeframe:	*Project Areas:*
Long-term (six to ten years)	• Locations throughout the City of Lawrence
Lead stakeholder:	*Other stakeholders:*
• **Lawrence-Douglas County Fire Medical**	• City of Lawrence Public Works
Need(s) Addressed:	*ITS Service Packages:*
• Reduce emergency vehicle delays at signals. • Enable remote emergency control of signals.	• EM02: Emergency Routing

Estimated Cost:

The estimated cost of this project includes on-board technology ranging in cost from $800 to $2,000 per emergency vehicle, and intersection control hardware and software that ranges from $5,000 to $10,000. Assuming 20 vehicles and up to 30 intersections, **the estimated total cost is $166,000 to $360,000**. This estimate is based on the federal ITS Knowledge database.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Incident response times.
- Impact on traffic flow and congestion.

13.4.14 Bicycle/Pedestrian Warning Systems Project

Table 24: Bicycle/Pedestrian Warning Systems Project

Description:

Bicycle-Pedestrian Warning Systems will provide advanced notice of the presence of bicycles and pedestrians on or near the roadway to traffic. This will improve awareness by drivers and the safety of bicyclists and pedestrians.

The systems may be deployed in locations with heavy pedestrian and bicycle traffic, such as the downtown Lawrence area. The systems will automatically detect bicyclists and pedestrians and provide a warning, such as a flashing beacon or lights embedded in the roadway. The systems may also automatically trigger walk signals at intersections when pedestrians are present.

Note that this project may be coordinated with the long-term project for video detection, which can include the ability to detect and classify bicycles and pedestrians at intersections.

Timeframe:	*Project Areas:*
Long-term (six to ten years)	• Locations throughout the City of Lawrence
Lead stakeholder:	*Other stakeholders:*
• **City of Lawrence Public Works**	• Traveling Public
Need(s) Addressed:	*ITS Service Packages:*
• Improve bicycle/pedestrian warning systems.	• ATMS26: Mixed Use Warning Systems

Estimated Cost:

The estimated cost of a pedestrian/bicycle detection system is approximately $1,000 per intersection. The cost for a pedestrian crossing illumination system is $23,000 to $35,000 per location. Assuming twelve intersections with detection and four illuminated crosswalks, **the total estimated cost for this project is $108,000 to $152,000**. This estimate is based on the federal ITS Knowledge database.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Reduction in bicycle/pedestrian crashes.
- Impact on traffic flow and congestion.

13.4.15 Weather Monitoring Project

Table 25: Weather Monitoring Project

Description:

This project will deploy road-weather sensors in the Region to improve the monitoring and response to weather conditions. The weather sensors will be able to collect wind, precipitation, images of the roadway, pavement conditions and ice or snow accumulation.

Information collected from the sensors throughout the Region will be shared to provide maintenance crews the ability to observe conditions at remote locations, and be able to plan and respond to severe weather.

The information can be used to determine when and how many winter maintenance vehicles to deploy, and what types of materials will be needed to clear the roadways for travel. The information may also be used by the 911 dispatch center to identify conditions and provide better routing to emergency vehicles.

Timeframe:

Long-term (six to ten years)

Project Areas:

- Lawrence-Douglas County Region

Lead stakeholder:

- **City of Lawrence Public Works**

Other stakeholders:

- Douglas County Emergency Communications Center
- Douglas County Public Works
- KDOT
- KTA

Need(s) Addressed:

- Improve weather and road condition information.
- Improve maintenance response to incidents and requests.
- Improve ability to monitor and provide information about flooding.

ITS Service Packages:

- MC03: Road Weather Data Collection
- MC04: Weather Information Processing and Distribution

Estimated Cost:

The estimated cost of the environmental weather stations including cameras is $33,000 to $50,000 per unit. Software for collecting and processing road weather information is approximately $9,000. Assuming six stations in the Region, **the estimated total cost is $207,000 to $309,000**. This estimate is based on the federal ITS Knowledge database.

Performance Measures:

The effectiveness of this project can be measured through the following measures:

- Time to clear roadways.
- Usage of maintenance equipment and materials.
- Incident response time.

13.4.16 Regional Virtual Data Warehouse Project

Table 26: Regional Virtual Data Warehouse Project

Description:

This project will develop a virtual method for agencies to share traffic, maintenance, transit, emergency and incident information. The Virtual Data Warehouse does not create a centralized location for data storage. Instead, each agency maintains its own data, but is able to share the data it chooses with other agencies though a Regional integration system.

Data may include both archives and real-time data such as signal timing, incident responses and video images. Authorized agencies will be able to use the information and images for managing traffic and incidents, and for maintenance planning.

Key functions of the virtual warehouse will be to provide a standardized format for sharing and retrieving Regional data in order to make it usable and to ensure that all regional Stakeholders are using the same information for their operations. The data will also have the potential for sharing with the general public.

While this project is important, its value is limited until the Region increases its ability to collect information through other ITS Projects identified in the near-, medium- and long-term.

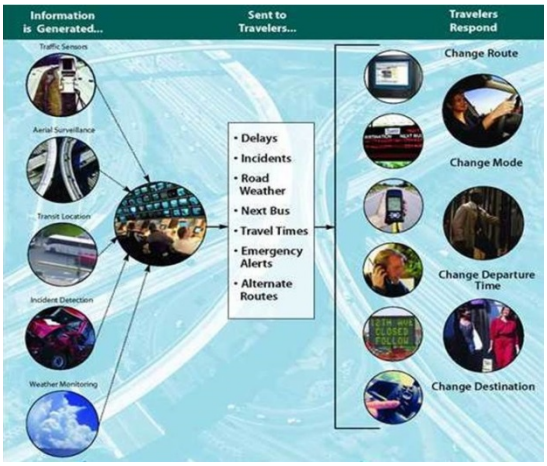
Timeframe:	*Project Areas:*
Long-term (six to ten years)	• Lawrence-Douglas County Region
Lead stakeholder: • **KDOT**	*Other stakeholders:* • City of Lawrence Police • City of Lawrence Public Works • Douglas County Emergency Communications • Douglas County Public Works • Douglas County Sheriff's Office • KTA • KU on Wheels • KU • Lawrence Transit • Local Cities • Local Cities Emergency Services
Need(s) Addressed: • Improve information sharing among agencies. • Improve system operation monitoring. • Improve coordination on construction notification and information distribution. • Improve maintenance response to incidents and requests. • Provide central information clearinghouse.	*ITS Service Packages:* • AD3: ITS Virtual Data Warehouse • ATIS06: Transportation Operations Data Sharing • MC10: Maintenance and Construction Activity Coordination

Estimated Cost: The estimated cost of this project varies widely depending upon the level of deployment and standardization of data in the Region. **The cost of similar efforts in other parts of the United States ranged from a low of $15,000 to a high of $300,000**. It should be noted that an effort such as this requires a high level of effort to keep operational after deployment. This estimate is based on the federal ITS Knowledge database.
Performance Measures: The effectiveness of this project can be measured through the following measures: • Amount of Regional information available to agencies. • Amount of Regional information available to the public.

13.4.17 Journey Trip Planner Project

Table 27: Journey Trip Planner Project

Description:



The Journey Trip Planner will be an online tool available to travelers through their computers and personal devices that allows them to plan trips using one or more modes, including personal vehicle, transit, bicycle and pedestrian.

The Journey Trip Planner will be interactive and allow the user to enter their origin and destination as well as the planned time of travel and preferred mode(s) of travel. The Trip Planner will provide information such as traffic conditions, real-time parking availability, routing, schedules and costs for various modes.

The Trip Planner can encourage travelers to use transit, carpool, use park-and-ride facilities and complete trips by foot, bicycle and bus for events and commutes.

Note that for the Trip Planner to be useful it will require reliable information on all modes of travel and parking from the Region's Stakeholders. Much of the needed information will be collected through other projects in this Plan. Also note that significant efforts have been made by the private sector to develop Journey Planners that use publicly available data. The L-DC Region may benefit from leveraging private-sector applications that use data provided by the Region's Stakeholders through a Virtual Data Warehouse.

Timeframe:	*Project Areas:*
Long-term (six to ten years)	• Lawrence-Douglas County Region
Lead stakeholder: • **City of Lawrence Public Works**	*Other stakeholders:* • Douglas County Public Works • KDOT • KTA • KU on Wheels • KU • Lawrence Transit • Local Cities • Private Sector Information Services • Traveling Public
Need(s) Addressed: • Improve multi-modal traveler information. • Provide interstate/inter-region traveler information covering a wide area. • Improve transit traveler information. • Improve multi-modal information. • Expand traveler information delivery methods.	*ITS Service Packages:* • ATIS01: Broadcast Traveler Information • ATIS02: Interactive Traveler Information • APTS07: Multi-modal Coordination • APTS08: Transit Traveler Information

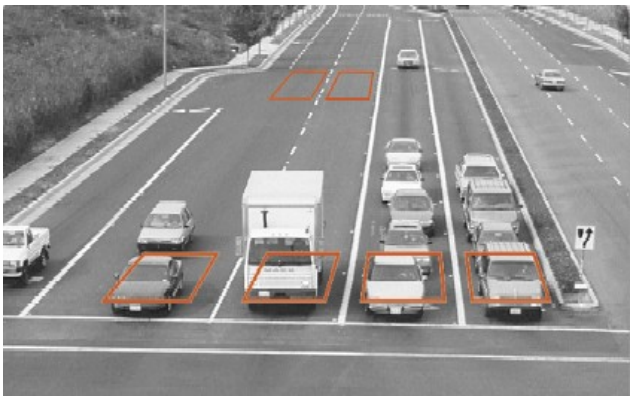
Estimated Cost: The estimated cost of similar projects in the United States have ranged from approximately $300,000 to $570,000 for hardware, software and deployment. Additional hardware, such as DMS or kiosks can significantly increase the overall project cost. For the L-DC Region, it is assumed that DMS deployed in previous projects will be used, and **the total estimated cost is $300,000 to $570,000**. This estimate is based on the federal ITS Knowledge database.
Performance Measures: The effectiveness of this project can be measured through the following measures: • Use of modes other than personal vehicle. • Average travel time in the Region

13.4.18 Traffic Detection Improvements Project

Table 28: Traffic Detection Improvements Project

Description:

The Traffic Detection Improvements Project will replace existing traffic detection devices with advanced detection equipment at intersections to better classify vehicles and pedestrians and provide better response. The improved detection equipment may include video detection or other devices that can not only detect the presence of vehicles, but also be to identify what types of vehicles they are, including commercial trucks and buses.



The detection equipment may also be able to identify and classify pedestrians and bicycles at intersections. Once bicyclists and pedestrians are detected, the intersection can respond accordingly by providing a green when only a bicycle is present, or automatically triggering a walk sign for the pedestrian.

The Traffic Detection Improvement Project can be coordinated with the Bicycle/Pedestrian Warning Systems Project to detect bicycles and pedestrians.

Timeframe:	*Project Areas:*
Long-term (six to ten years)	• City of Lawrence

Lead stakeholder:

- **City of Lawrence Public Works**

Need(s) Addressed:	*ITS Service Packages:*
• Improve traffic flow at intersections through improved signal timing and control. • Improve bicycle/pedestrian warning systems.	• ATMS01: Network Surveillance

Estimated Cost:

The estimated cost of video detection at intersections is approximately $32,000 to $64,000 per intersection. The hardware and software to process traffic information from images and use it to manage signals is $134,000 to $164,000. Assuming twenty intersections will be equipped, **the total cost of this project is estimated to be $774,000 to $1,444,000**. This estimate is based on the federal ITS Knowledge database.

Performance Measures:

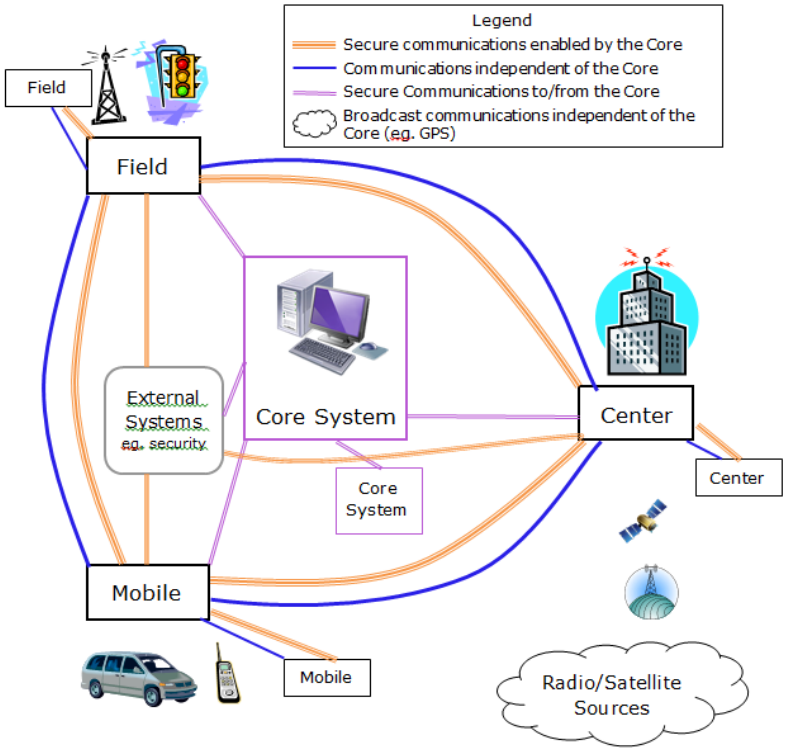
The effectiveness of this project can be measured through the following measures:

- Traffic flow at intersections.
- Reduced bicycle/pedestrian crashes.

13.5 Connected Vehicles

The ITS Projects identified in this plan encompass the plans of the L-DC Region as of 2015. It is important to note that transportation technologies are rapidly evolving and the Region should be aware of changes that are coming from both the public and private sectors. Specifically, the transition to "connected vehicles" may significantly impact the way vehicles and the transportation network interact. Figure 12 provides a conceptual illustration of connected vehicles.

Figure 12: Conceptual Image of Connected Vehicles



Federal Connected Vehicle Research can be viewed at the United States Department of Transportation ITS Joint Program Office web site.[10] The following excerpt highlights the connected vehicle research.

> …Critical improvements are needed to make surface transportation safer, smarter, and greener and ultimately enhance livability for Americans. Part of this transformation to our transportation system can be achieved through connectivity. Connected vehicles have the potential to transform the way Americans travel through the creation of a safe, interoperable wireless communications network that includes cars, buses, trucks, trains, traffic signals, cell phones, and other devices. Like the Internet, which provides information

[10] ITS JPO Connected Vehicle Research - http://www.its.dot.gov/connected_vehicle/connected_vehicle_research.htm

connectivity, connected vehicle technology provides a starting point for transportation connectivity that will potentially enable countless applications and spawn new industries.

Connected vehicle applications provide connectivity:

- Among vehicles to enable crash prevention
- Between vehicles and the infrastructure to enable safety, mobility, and environmental benefits
- Among vehicles, infrastructure, and wireless devices to provide continuous real-time connectivity to all system users.

The National ITS Architecture used to update the L-DC Regional ITS Architecture is Version 7.0. However, it is expected that the advances in connected vehicles will have significant impacts on the National ITS Architecture. Version 7.0 was superseded by Version 7.1 after this project began, and eventually Version 8.0 will be developed. Version 8.0 will likely have significant changes regarding connected vehicles.

There is also a Connected Vehicle Reference Implementation Architecture (CVRIA)[11] that is in development. The CVRIA is "being developed as the basis for identifying the key interfaces across the connected vehicle environment which will support further analysis to identify and prioritize standards development activities. CVRIA will also support policy considerations for certification, standards, core system implementation, and other elements of the connected vehicle environment."

Because the CVRIA is in development, it is not appropriate to reference at the Regional level. However, the L-DC Region must be aware of connected vehicles activities at the national and state level and incorporate them as they are completed and adopted.

[11] CVRIA web site - http://www.iteris.com/cvria/index.html

14. L-DC Region ITS Project Funding

The L-DC Region ITS Projects may be eligible for funding from a variety of sources, including some specifically for the deployment of advanced technologies. ITS Projects should also compete for transportation funds against other, more traditional transportation projects, such as road-widening and expansion.

The SDP does not identify specific funds that may be available for each ITS Project, however, it does identify potential funding sources. The potential funding sources each has its own funding process that the Project Stakeholders should explore and follow.

Table 29 lists each L-DC Region ITS Project and indicates the known potential funding resources that may be applicable. For some projects, a single funding source is applicable. For most, multiple sources are applicable, and Project Stakeholders are encouraged to apply for as many funding opportunities as needed.

As previously stated, **Table 29** does not indicate funding sources with money set aside for the L-DC Region's ITS Projects. Also, the SDP does not indicate that funding has been committed or programmed for any of the Projects.

Table 29: Potential L-DC Region ITS Project Funding Sources

Project Name	Locally Administered		State Administered		Federally Administered		
	Local Transportation Funds	Local Emergency Funds	KDOT	ITS Earmark Funds	Homeland Security	Federal Highway Funds	Federal Transit Funds
Signal Coordination and Control Expansion	●		●				
Camera Deployment and Image Sharing	●	●	●			●	
Transit Traveler Information Improvements	●						●
Interagency Information Sharing	●	●	●		●		
Work Zone Management	●		●			●	
Dynamic Message Signs	●		●			●	
Fiber Communications Expansion	●		●			●	
Event and Incident Management Improvements	●	●	●	●	●	●	
Transit Management Improvements	●			●			●
Lawrence Transit Signal Priority	●			●			●
Signal Beacon Deployment	●		●	●		●	
Parking Management System	●		●	●		●	
Emergency Signal Preemption Improvements	●	●		●	●	●	
Bicycle/Pedestrian Warning Systems	●		●	●		●	
Weather Monitoring	●		●	●		●	
Regional Virtual Data Warehouse	●		●	●		●	
Journey Trip Planner	●		●	●		●	
Traffic Detection Improvements	●		●	●		●	

Local Transportation Funds – These funds are administered for transportation projects, including maintenance and operations, at the local level. The funds may come from a range of sources, including local tax revenue, but are administered at the discretion of local agencies such as the City of Lawrence and Douglas County.

Local Emergency Funds – These funds are administered at the local level for emergency management projects, including ongoing maintenance and operations of emergency responders. Similar to local transportation funds, they may come from a range of sources, but are administered at the discretion of local agencies.

KDOT Funds – This is a funding plan of highway and transit projects for the state. The plan is published every year and includes transportation projects on the state, city, and county highway systems, as well as projects in the national forests and Indian reservations. These projects use various federal and state funding programs. KDOT funds include the state's ITS set-aside funds.

ITS Earmark Funds – Earmarks are federal funds that are administered by KDOT. Local agencies work with KDOT to apply for earmark funds. Earmark funds may be subject to limitations, such as the purpose and project defined in the federal application, and matching local or state funds. Near-term projects are not considered eligible for earmarks because they are planned for deployment sooner than an earmark can be applied for and designated.

Homeland Security – Homeland Security funds are administered by the Federal Department of Homeland Security. To date, they have infrequently been disbursed to regional transportation projects. However, as security and transportation management become more integrated in Traffic Control Centers and Emergency Operations Centers, it is possible that more funds will be used to support coordinated emergency management.

Federal Highway Funds – Federal Highway Funds are comprised of several potential sources that are administered at the national level. They may include matching funds, grants, and other sources, such as operational tests or model deployments. In order for these funds to be used for ITS, a Regional ITS Architecture must be in place. This project addresses that federal Architecture requirement.

Federal Transit Funds – Transit funds administered by the Federal Transit Administration (FTA) can come in the form of grants, matching funds, disbursement of other transit funds, or special monies for specific projects. In recent history, the FTA has made rural and small urban transit systems a priority, and it has allocated significant funds for transit technologies through grant applications and model deployments. Similar to FHWA funds, a Regional ITS Architecture must be in place before FTA funds can be spent on transit ITS projects.

15. L-DC Region ITS Project Interagency Agreements

Agreements among the stakeholder agencies and organizations in the L-DC Region may be required to realize the integration proposed in the ITS Architecture. Each connection between systems owned by different Stakeholders represents cooperation among Stakeholders and a potential need for an agreement.

One of the first steps of any ITS Project development should be to review existing Stakeholder agreements that support sharing information, funding, or specific ITS projects. The review should assess if the existing agreements can be extended and used to support the cooperative implementation and operation of ITS in the region. The L-DC Region's existing interagency agreements may already address some of the agreements identified in this Plan.

The list of the necessary L-DC Region ITS Project agreements was developed based on the stakeholder roles and responsibilities, awareness of the types of existing or planned ITS for implementation by the region, and the information that will be exchanged among systems for the ITS Projects.

15.1 Agreement Types

There is a wide range of agreement types that may be necessary to develop and implement an ITS project. The nature of existing interagency relationships and existing "local practices" may influence the types of agreements various agencies enter into. For example, two agencies that are co-located or frequently work together may have a working relationship that simplifies the need for detailed agreements. Other Stakeholders, brought together for the first time by an ITS Project, may need a more clearly defined agreement that helps each understand the responsibilities and capabilities of each Stakeholder.

Table 30 contains descriptions of common types of agreements relevant to the Region's ITS projects as identified in the *FHWA Regional ITS Architecture Guidance Document*.

Table 30: Common ITS Project Agreement Types

Type of Agreement	Description
Handshake Agreement	• Early agreement between one or more partners. • Not recommended for long term operations. • Does not require formal documentation.
Memorandum of Understanding (MOU)	• Initial agreement used to provide minimal detail and usually demonstrates a general consensus. • Used to expand a more detailed agreement like an Interagency Agreement, which may be broad in scope but contains all of the standard contract clauses required by a specific agency. • May serve as a means to modify a much broader agreement, allowing the master agreement to cover various ITS projects throughout the region and the MOUs to specify the scope and differences between the projects.
Interagency Agreement (IA)	• Between local public agencies (e.g. transit authorities, cities, counties, etc.) for operations, services, or funding. • Documents responsibility, functions, and liability at a minimum.
Operational Agreement (OA)	• Between any agency involved in funding, operating, maintaining or using the right-of-way of another public or private agency. • Identifies respective responsibilities for all activities associated with shared systems being operated and/or maintained.
Funding Agreement (FA)	• Documents the funding arrangements for ITS projects (and other projects). • Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements (MA)	• Standard contract and/or legal verbiage for a specific agency and serves as a master agreement by which all business is done. It can be found in the legal department of many public agencies • Allows states, cities, transit agencies, and other public agencies that do business with the same agencies over and over (e.g., cities and counties) to have one Master Agreement that uses smaller agreements (e.g., MOUs, Scope-of-Work and Budget Modifications, Funding Agreements, Project Agreements, etc.) to modify or expand the boundaries of the larger agreement to include more specific language

15.2 Agreement Focus

Rather than focus on specific technologies in an agreement, the focus is typically on the scope-of-service and specific agency responsibilities for various components of the service. The agreement should also describe the high-level information that each agency needs to exchange in order to

meet the objectives of the ITS Project. The agreement should not focus on how the delivery of that information will occur.

A simple handshake agreement may be enough for some L-DC Region ITS planning activities. Once interconnections and integration of systems occur, however, agencies may want a more formal agreement in place to document items such as how operations will occur and who will maintain the system. Documented agreements will aid agencies in planning their operational costs, understanding their respective roles and responsibilities, and in building trust for future projects. Formal agreements are necessary where funding or financial arrangements are defined, or where participation in large regionally-significant projects is required.

15.3 Needed L-DC ITS Project Agreements

A few ITS Projects planned for the L-DC Region do not require agreements because they involve a single Stakeholder or involve multiple agencies each acting independently. The projects that are not foreseen as requiring Stakeholder agreements are:

- Work Zone Management
- Transit Traveler Information Improvements
- Transit Management Improvements
- Signal Beacons
- Bicycle/Pedestrian Warning Systems
- Traffic Detection Improvements

The ITS Projects listed in **Table 31** involve two or more Stakeholders, where agreements will be needed. For most Projects, it is recommended that a Memorandum of Understanding (MOU) be the first step in project planning. The purpose of an initial MOU is to confirm that all Stakeholders are in support of the project and in agreement on what the objectives are. Stakeholders becoming a party to the MOU will then pursue further agreements, as needed, for development, deployment, operations, and funding. In some cases, an MOU is not listed as needed. These ITS Projects are generally those with clear objectives or among Stakeholders with an existing working relationship.

Table 31: L-DC Regional ITS Architecture Agreement Types

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Signal Coordination and Control Expansion	• **City of Lawrence Public Works (lead)** • KDOT	• Interagency Agreement	**IA:** The IA may incorporate the funding arrangement that describes the role of funding provided by the participating Stakeholders. The IA may also include the expectations of each agency for the operation and use of the expanded signal control, and how the Project's performance will be measured. Because the project includes cameras, the IA may indicate KDOT and the City's expectations for sharing images with other agencies and the public.
Camera Sharing	• **City of Lawrence Public Works (lead)** • City of Lawrence Police • Douglas County Emergency Communications • KTA • KDOT • KC Scout	• MOU • Interagency Agreement	**MOU**: Because the City of Lawrence will be solely responsible for deploying upgraded software and the operation and maintenance of the cameras, a simple MOU is recommended among agencies to agree upon the sharing of images from the cameras. The MOU may describe the expectation of the City in how other agencies use the images, and the agencies' expectation of availability of camera images. **IA**: The IA should describe specifically how agencies will connect to the camera software, such as through a direct connection with the Traffic Operations Center, or via a private or public web site. The IA may also include any funding arrangements that describe the sharing of costs for operating and maintaining the camera sharing software.
Transit Traveler Information	• **KU on Wheels (co-lead)** • **Lawrence Transit (co-lead)** • City of Lawrence Public Works	• IA	**IA:** The IA should address access to power and communications at the roadside needed by the transit agencies to connect digital signs. The IA should identify the specific locations, the type of power required and access to communications. The IA should also clearly indicate the responsibility for the costs of using power and communications.

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Inter-agency Information Sharing	• **City of Lawrence Public Works (lead)** • City of Lawrence Police • Douglas County Emergency Communications • Douglas County Public Works • Douglas County Sheriff's Office • KDOT • KTA • KU on Wheels • University of Kansas • Lawrence Transit • Local Cities • Local Cities Emergency Services • KC Scout	• Memorandum of Understanding • Interagency Agreement	**MOU**: The MOU should be used in describing how emergency responders and transportation management agencies will coordinate to share resources and information. A key element of this MOU should be defining at a high-level the types of information that will be shared, and how they will be used. In addition, if emergency responders will have some say in how traffic is managed during emergencies, the MOU should describe the level of input and how instructions should be exchanged. **IA:** An incrementally developed IA should address how agencies will actually work together for information sharing, operations, etc. The primary purposes of the agreement are to describe agency expectations and roles for information and resource sharing across jurisdictional boundaries.

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Dynamic Message Signs	• **City of Lawrence Public Works (lead)** • KDOT • KTA • KC Scout	• MOU • Interagency Agreement	**MOU**: The four proposed DMS will be controlled by KC Scout but with considerable input from the City of Lawrence and KTA. An MOU will be needed to define the types of messages each agency may place on the signs, the hierarchy of authority for the signs, and the shared expectations for the signs in performing traffic, event and incident management. The MOU is critical because the City and KC Scout currently do not jointly operate any devices in the Region. **IA**: The IA should describe specifically how agencies will connect to the signs, either directly or through the DMS. The IA should also establish funding arrangements for operating and maintaining the signs and the software required to control them.
Communications Expansion	• **City of Lawrence Public Works (lead)** • Douglas County Public Works • KDOT • KTA • University of Kansas • KC Scout • Private communications providers	• Interagency Agreement • Operating Agreement	**IA:** The IA should address the access of each agency to the communications network, the bandwidth available to each agency, and the agencies' authority to connect devices. The IA may also address issues such as right-of-way access for installation and maintenance of communications hardware. **OA:** The OA should address the ongoing maintenance and operation of the communications network. It may include the expectations of the agencies and private communications providers to keep the system operational, and the expectations of stakeholders in performing other roadway construction and maintenance that may impact the network. The OA may also address the sharing of fiber and how the strands may be distributed by Stakeholder or function.

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Event and Incident Management	• **Douglas County Emergency Communications (lead)** • City of Lawrence Police • City of Lawrence Public Works • Douglas County Public Works • Douglas County Sheriff's Office • KDOT • KTA • KU on Wheels • KU • Lawrence Transit • Local Cities • Local Cities Emergency Services • KC Scout	• Interagency Agreement	**IA:** An IA may be the only agreement required for this Project because the MOU established for the Interagency Information Sharing Project has established the roles and responsibilities of the Stakeholders. The IA should address the standards and formats agreed to for the electronic exchange of event and incident information. The IA should also establish any platform or software that will be used by all participating Stakeholders. In addition, the IA should address the funding needed to purchase the software, develop a plan and operate and maintain information sharing systems.
Transit Signal Priority	• **Lawrence Transit (lead)** • City of Lawrence Public Works	• Memorandum of Understanding • Interagency Agreement	**MOU**: The MOU should address expectations and roles regarding priority signal control for Lawrence Transit. The MOU should define preliminary goals and system functional requirements. **IA**: The IA is needed to formally document how the signal priority system will work, to exclude unauthorized users, and to report system usage and impact on timing plans. The IA may include funding, depending on the source of funds and how costs are distributed between controller hardware/software upgrades, on-bus equipment, and Traffic Operations Center improvements.

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Parking Management Systems	• **City of Lawrence Public Works (co-lead)** • **KU Parking and Transit (co-lead)**	• Memorandum of Understanding • Interagency Agreement	**MOU:** The MOU should outline the roles and responsibilities of the City and KU in collecting and sharing parking information. The MOU should also provide basic guidelines that define the types of parking management systems to be implemented in order to ensure interoperability and similar data collection. **IA**: The IA should establish how information will be exchanged between the parking systems and the Traffic Operations Center, or with traveler information systems and a virtual regional data warehouse. The IA should also describe how data will be used by each stakeholder, and interagency operation of parking facilities during events.
Emergency Signal Preemption Upgrade	• **Lawrence-Douglas County Fire Medical (lead)** • City of Lawrence Public Works	• Interagency Agreement	**IA**: Any existing agreement between the City and Fire Medical addresses how emergency signal preemption is used in the City of Lawrence. That agreement can remain in place to describe each agency's roles and responsibilities and when signal preemption is used. An IA is needed to define the technology that will be used in the improved signal preemption. It will describe what is expected of the City to implement wireless communications with fire and medical vehicles, and the system that will be deployed on-board vehicles.

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Weather Monitoring	• **City of Lawrence Public Works (lead)** • Douglas County Emergency Communications Center • Douglas County Public Works • KDOT • KTA	• Memorandum of Understanding • Interagency Agreement	**MOU:** The MOU should define the roles and responsibilities of each stakeholder, and define the purpose of the deployment of multiple weather sensors in the Region. The MOU should also identify the agreed upon data to be collected and how it will be shared among the participating Stakeholders. The MOU should also address the type of sensors to be deployed by multiple agencies to ensure interoperability with central software. **IA**: The IA should address specific standards and data formats to be collected and exchanged by the weather sensors. The IA should also define who will operate the central software and how information will be shared from that central software to other participating Stakeholders. The IA should also address operations and maintenance obligations for each participating Stakeholder.

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Virtual Regional Data Warehouse	• **KDOT (lead)** • City of Lawrence Police • City of Lawrence Public Works • Douglas County Emergency Communications • Douglas County Public Works • Douglas County Sheriff's Office • KTA • KU on Wheels • KU • Lawrence Transit • Local Cities • Local Cities Emergency Services	• Memorandum of Understanding • Interagency Agreement	**MOU:** This MOU should develop high-level expectations for what types of data will be exchanged through the virtual warehouse, how they will be used, and the responsibilities of each agency in providing accurate and usable information. The MOU should also describe at a high-level who will be granted access to data, and for what purposes. **IA**: The IA is needed to formally document how the data warehouse will operate and the formats and protocols used for data exchange. The IA should define the level of access by Stakeholders, as well as how the system will be maintained. The IA can also define any warehouse functionality for data reporting and display. For funding participation, the IA should define development, deployment and operation funding sources.

L-DC Region ITS Project	Stakeholders	Agreement Type(s)	Agreement Objectives
Journey Trip Planner	• **City of Lawrence Public Works (lead)** • KDOT • KTA • KU on Wheels • KU • Lawrence Transit • Local Cities • Private Sector Information Services	• Memorandum of Understanding • Interagency Agreement • Operations Agreement	**MOU**: This MOU should develop high-level expectations for disseminating information from the regional stakeholders to the public. It should expand on the understanding that much of the disseminated information may come from the Virtual Regional Data Warehouse. **IA**: The IA should formally document the types of information the participating public-sector Stakeholders agree to share through a regional traveler information system. The IA should also expand upon the IA for the Virtual Regional Data Warehouse to ensure that traveler information, including incident and emergency information, is provided for dissemination. **OA**: The OA should be developed between the public and private sectors to define the types of information to be shared with services that will provide commercial traveler information. The OA should define the quality and frequency of public information and the limitations placed on the private sector in processing and disseminating that information.

16. L-DC Regional ITS Architecture Use and Maintenance

The Lawrence-Douglas County (L-DC) Regional Intelligent Transportation System (ITS) Architecture is a valuable tool for Stakeholders to use in developing consistent, interoperable and effective ITS. The success of the L-DC Regional ITS Architecture is dependent upon its proper use.

A separate *L-DC Regional ITS Architecture Use and Maintenance Plan* has been developed to provide the Region's Stakeholders guidance on both the use and maintenance of the Regional ITS Architecture. This section briefly summarizes the complete *Use and Maintenance Plan*.

16.1 Architecture Use

There are three key times that the L-DC Regional ITS Architecture can be used:

1. **Planning** – The Architecture should be used to assist in the traditional transportation planning process for all L-DC Region Stakeholders. The planning process defines projects that include ITS elements. The Architecture can be used to determine the sequence of ITS deployment and provide high-level descriptions that complement the Region's other transportation planning efforts, such as updates to the Metropolitan Transportation Plan (MTP) by the L-DC Metropolitan Planning Organization (MPO).
2. **Design** – The Architecture should be followed during the design of ITS projects in order to ensure that the ITS elements will be interoperable and able to communicate with other systems in the Region. In addition, the Architecture can be used in design to verify that the desired functions will be provided by the project's ITS elements.
3. **Implementation** – During implementation, the Architecture can provide information to support the procurement and testing of ITS. Architecture elements of use include the functional requirements that define what the ITS should do, and the information exchange standards, which define open, non-proprietary protocols and formats for data exchange with other systems.

To help maximize the Architecture's value for the Region, this document provides a strategy for how the L-DC Regional ITS Architecture will be maintained to support those processes in the future.

16.2 Architecture Maintenance

The L-DC Regional ITS Architecture is a living document and will be modified as the Region's plans and priorities change, ITS projects are implemented, and the Region's ITS needs and services evolve. The Architecture was developed with a ten-year time horizon, as reflected by the project time frames:

- near- (zero to three years).
- medium- (three to six years).
- long-term (six to ten years).

The goal of maintaining the Architecture is to keep the L-DC Regional ITS Architecture accurate, accessible and easy to use for ITS planning, design and implementation. If the Architecture's

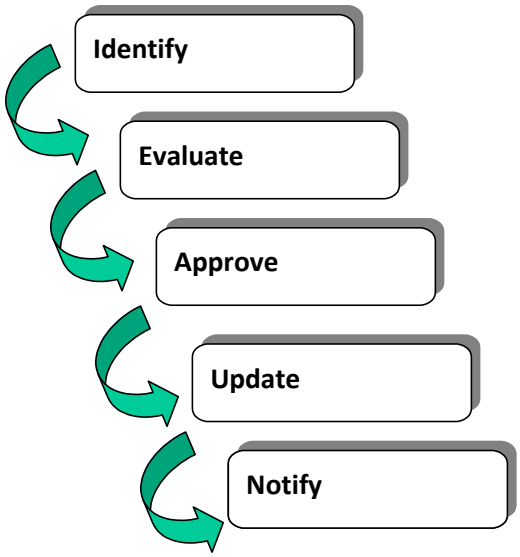
information is not consistent with the MTP and TIP, it is less likely to be used by the Region's Stakeholders.

The key aspects of the Architecture maintenance process are:

- Architecture ownership.
- Maintenance responsibility and staffing.
- Maintenance skills and training.
- Maintenance elements.
- Maintenance schedule.
- Identifying needed Architecture changes.
- Change Management Process.

The L-DC Regional ITS Architecture is owned by the L-DC MPO. The MPO is responsible for the Architecture's maintenance. The maintenance process is described in detail in the complete Use and Maintenance Plan. The process follows the steps shown in Figure 12.

Figure 12: Architecture Maintenance Process



Identify – Any of the Region's Stakeholders can identify a change in the Architecture and submit a request to the L-DC MPO. Change requests should be maintained in a change log (or change database) that would track each potential change

Evaluate - Each significant change request needs to be evaluated to determine what impact it has upon the Architecture Baseline. Change evaluation happens through Stakeholder consensus as part of the overall Architecture update.

Approval - The next step is for approval, deferral, or rejection of a change request. If a change request is rejected or deferred, the requester will be notified with an explanation.

Update Baseline - This activity involves updating the L-DC Regional ITS Architecture Turbo database and documentation. This step requires the skill and expertise described in the Maintenance Skills and Training section.

Notify Stakeholders - The final part of the maintenance process is to notify Stakeholders of changes or updates to the Architecture.

APPENDIX A – NATIONAL ITS SERVICE AREAS AND PACKAGES

Service Package ID	Service Package Name
Service Area: Archived Data Management provides ITS historical data for relevant ITS data and will incorporate the planning, safety, operations, and research communities into ITS. It will provide the data collection, manipulation, and dissemination functions of these groups, as they relate to data generated by ITS.	
AD1	ITS Data Mart
AD2	ITS Data Warehouse
AD3	ITS Virtual Data Warehouse
Service Area: Public Transportation provides services for the management, security, maintenance and operation of public transportation systems, such as bus and rail.	
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

Service Package ID	Service Package Name
Service Area: Traveler Information provides information to travelers pre-trip and en-route concerning traffic and weather conditions.	
ATIS01	Broadcast Traveler Information
ATIS02	Interactive Traveler Information
ATIS03	Autonomous Route Guidance
ATIS04	Dynamic Route Guidance
ATIS05	ISP Based Trip Planning and Route Guidance
ATIS06	Transportation Operations Data Sharing
ATIS07	Travel Services Information and Reservation
ATIS08	Dynamic Ridesharing
ATIS09	In Vehicle Signing
ATIS10	Short Range Communications Traveler Information
Service Area: Traffic Management provides for the surveillance and maintenance and operation of traffic control devices in order to improve efficiency and safety of traffic flow.	
ATMS01	Network Surveillance
ATMS02	Traffic Probe Surveillance
ATMS03	Traffic Signal Control
ATMS04	Traffic Metering
ATMS05	HOV Lane Management
ATMS06	Traffic Information Dissemination

Service Package ID	Service Package Name
ATMS07	Regional Traffic Management
ATMS08	Traffic Incident Management System
ATMS09	Transportation Decision Support and Demand Management
ATMS10	Electronic Toll Collection
ATMS11	Emissions Monitoring and Management
ATMS12	Roadside Lighting System Control
ATMS13	Standard Railroad Grade Crossing
ATMS14	Advanced Railroad Grade Crossing
ATMS15	Railroad Operations Coordination
ATMS16	Parking Facility Management
ATMS17	Regional Parking Management
ATMS18	Reversible Lane Management
ATMS19	Speed Warning and Enforcement
ATMS20	Drawbridge Management
ATMS21	Roadway Closure Management
ATMS22	Variable Speed Limits
ATMS23	Dynamic Lane Management and Shoulder Use
ATMS24	Dynamic Roadway Warning
ATMS25	VMT Road User Payment

Service Package ID	Service Package Name
ATMS26	Mixed Use Warning Systems
Service Area: Vehicle Safety provides advanced safety and warning systems for vehicles to alert drivers and reduce the risk of crashes.	
AVSS01	Vehicle Safety Monitoring
AVSS02	Driver Safety Monitoring
AVSS03	Longitudinal Safety Warning
AVSS04	Lateral Safety Warning
AVSS05	Intersection Safety Warning
AVSS06	Pre-Crash Restraint Deployment
AVSS07	Driver Visibility Improvement
AVSS08	Advanced Vehicle Longitudinal Control
AVSS09	Advanced Vehicle Lateral Control
AVSS10	Intersection Collision Avoidance
AVSS11	Automated Vehicle Operations
AVSS12	Cooperative Vehicle Safety Systems
Service Area: Commercial Vehicle Operations provides services for commercial vehicle fleet management, administrative functions, advanced screening and inspection and goods movement security.	
CVO01	Carrier Operations and Fleet Management
CVO02	Freight Administration

Service Package ID	Service Package Name
CVO03	Electronic Clearance
CVO04	CV Administrative Processes
CVO05	International Border Electronic Clearance
CVO06	Weigh-In-Motion
CVO07	Roadside CVO Safety
CVO08	On-board CVO Safety
CVO09	CVO Fleet Maintenance
CVO10	HAZMAT Management
CVO11	Roadside HAZMAT Security Detection and Mitigation
CVO12	CV Driver Security Authentication
CVO13	Freight Assignment Tracking
Service Area: Emergency Management provides services to manage emergency detection and response and improve coordination among transportation entities and emergency responders.	
EM01	Emergency Call-Taking and Dispatch
EM02	Emergency Routing
EM03	Mayday and Alarms Support
EM04	Roadway Service Patrols
EM05	Transportation Infrastructure Protection
EM06	Wide-Area Alert

Service Package ID	Service Package Name
EM07	Early Warning System
EM08	Disaster Response and Recovery
EM09	Evacuation and Reentry Management
EM10	Disaster Traveler Information
Service Area: Maintenance and Construction Management provides services to manage maintenance and construction, including managing weather, incident response and work zones.	
MC01	Maintenance and Construction Vehicle and Equipment Tracking
MC02	Maintenance and Construction Vehicle Maintenance
MC03	Road Weather Data Collection
MC04	Weather Information Processing and Distribution
MC05	Roadway Automated Treatment
MC06	Winter Maintenance
MC07	Roadway Maintenance and Construction
MC08	Work Zone Management
MC09	Work Zone Safety Monitoring
MC10	Maintenance and Construction Activity Coordination
MC11	Environmental Probe Surveillance
MC12	Infrastructure Monitoring

APPENDIX B – PRIORITIZED L-DC REGION ITS NEEDS

The Appendix lists all identified ITS needs for the L-DC Region within service areas that parallel the service areas of the National ITS Architecture. The National ITS Architecture service areas are:

- Arterial Traffic Management
- Freeway Traffic Management
- Public Transportation
- Emergency Management
- Maintenance and Construction Operations
- Traveler Information
- Commercial Vehicle Operations
- Data Management and Integration

Within the service areas, the needs have been prioritized as high, medium or low based on Stakeholder input. High priority needs are those that were identified by a broad cross-section of Stakeholders and were considered very important to improving the efficiency and safety of the transportation network. Medium priority needs were those that were identified by fewer Stakeholders, or were identified as less critical. Low-priority needs are those that were identified by specific Stakeholders or were considered important to the Region but not critical at the present.

There is significant overlap of needs among the different service areas. This is because many needs impact more than one area of transportation operations. For example, the management of events involves managing traffic as well as managing emergency response during events, and planning for the additional need for transportation services prior to major events.

In the following tables, the ITS Service Packages that may be applicable to address each need are listed. Many ITS Service Packages address multiple needs. The ITS Service Packages provide the "building blocks" of ITS projects, and proposed ITS projects for the Lawrence-Douglas County Region will include the Service Packages that most effectively address the Region's needs. A more detailed description of ITS Service Packages is provided in *Technical Memorandum #1: L-DC Region ITS Inventory*. A complete listing of ITS Services can be found on the National ITS Architecture web site[12]. Each Service Package in the following tables is hyperlinked to its description and diagram in the National ITS Architecture.

Arterial / Traffic Management Needs

Examples of arterial/traffic management include: Signal Coordination; Centralized Control; Traffic Information Systems; Vehicle Detection Systems; Video Systems; Adaptive Signal Control; Traffic Management Systems/Centers; and Highway Rail Intersection Technologies.

[12] National ITS Architecture: http://www.iteris.com/itsarch

Table B-1: L-DC Region Arterial / Traffic Management Needs

Arterial / Traffic Management Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve traffic flow at intersections through improved signal timing and control.	H	• ATMS01: Network Surveillance • ATMS03: Traffic Signal Control
Improve traffic information dissemination.	H	• ATMS06: Traffic Information Dissemination
Improve event management.	H	• ATMS07: Regional Traffic Management • ATMS08: Traffic Incident Management System
Implement or improve signal coordination.	H	• ATMS03: Traffic Signal Control
Improve incident detection.	H	• ATMS01: Network Surveillance • ATMS08: Traffic Incident Management System
Improve parking management and parking information.	M	• ATIS01: Broadcast Traveler Information • ATMS06: Traffic Information Dissemination • ATMS16: Parking Facility Management • ATMS17: Regional Parking Management
Improve information sharing among agencies.	M	• AD2: ITS Data Warehouse • ATIS06: Transportation Operations Data Sharing • ATMS06: Traffic Information Dissemination • ATMS07: Regional Traffic Management • MC10: Maintenance and Construction Activity Coordination
Improve system operation monitoring.	M	• AD2: ITS Data Warehouse
Improve arterial roadway traffic surveillance.	L	• ATMS01: Network Surveillance

Arterial / Traffic Management Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Reduce transit vehicle delay at key intersections.	L	• APTS09: Transit Signal Priority
Reduce emergency vehicle delays at signals.	L	• ATMS03: Traffic Signal Control • EM02: Emergency Routing

Freeway Management Needs

Examples of freeway management systems include: Vehicle Speed Detection Systems; Video Systems; Ramp Metering; Variable Message Signs; Highway Advisory Radio; and Traffic Management Systems/Centers.

Table B-2: L-DC Region Freeway Management Needs

Freeway Management Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve traffic information dissemination.	H	• ATMS06: Traffic Information Dissemination
Improve information sharing among agencies.	H	• AD2: ITS Data Warehouse • ATIS06: Transportation Operations Data Sharing • ATMS06: Traffic Information Dissemination • ATMS07: Regional Traffic Management • MC10: Maintenance and Construction Activity Coordination

Freeway Management Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve inter-agency coordination.	H	• AD2: ITS Data Warehouse • ATMS06: Traffic Information Dissemination • ATMS07: Regional Traffic Management • ATMS08: Traffic Incident Management System • MC10: Maintenance and Construction Activity Coordination
Improve incident detection.	M	• ATMS01: Network Surveillance • ATMS08: Traffic Incident Management System
Improve system operation monitoring.	M	• AD2: ITS Data Warehouse
Improve freeway traffic surveillance.	L	• ATMS01: Network Surveillance
Improve incident management in urban areas.	L	• ATMS07: Regional Traffic Management • ATMS08: Traffic Incident Management System

Public Transportation Needs

Examples of public transportation systems include: Public Transportation Management; En-route Transit Information; Personalized Public Transit; Public Traveler Safety; Traveler Service Information; Ride Matching and Reservations; Smart Card Payment/Transaction Systems.

Table B-3: L-DC Region Public Transportation Needs

Public Transportation Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve multi-modal traveler information.	H	• ATIS01: Broadcast Traveler Information • ATIS02: Interactive Traveler Information • APTS07: Multi-modal Coordination

Public Transportation Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
		• APTS08: Transit Traveler Information
Improve information sharing among agencies.	H	• AD2: ITS Data Warehouse • ATIS06: Transportation Operations Data Sharing • MC10: Maintenance and Construction Activity Coordination
Improve transit traveler information.	H	• APTS08: Transit Traveler Information
Reduce transit vehicle delay at key intersections.	M	• APTS09: Transit Signal Priority
Enable dissemination/display of real-time bus arrival times.	M	• APTS08: Transit Traveler Information
Improve service planning (scheduling and run-cutting).	M	• APTS02: Transit Fixed-Route Operations
Improve fare payment systems.	M	• APTS04: Transit Fare Collection Management
Improve regional and interregional trip planning.	L	• APTS11: Multimodal Connection Protection
Automate passenger counting.	L	• APTS10: Transit Passenger Counting
Improve fleet management.	L	• APTS06: Transit Fleet Management

Emergency Management Needs

Examples of emergency management systems include: Incident Detection; Incident Management; Hazardous Materials Response and Handling; Emergency Notification and Personal Security; Emergency Vehicle Management; Advanced Dispatching and Response Systems.

Table B-4: L-DC Region Emergency Management Needs

Emergency Management Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve event management.	H	• ATMS07: Regional Traffic Management • ATMS08: Traffic Incident Management System
Improve incident response coordination between agencies.	H	• ATIS06: Transportation Operations Data Sharing • ATMS08: Traffic Incident Management System
Improve information sharing among agencies.	H	• AD2: ITS Data Warehouse • ATIS06: Transportation Operations Data Sharing • ATMS06: Traffic Information Dissemination • ATMS07: Regional Traffic Management • MC10: Maintenance and Construction Activity Coordination
Improve incident detection.	M	• ATMS01: Network Surveillance • ATMS08: Traffic Incident Management System
Improve incident response times and routing.	M	• ATMS03: Traffic Signal Control • EM02: Emergency Routing
Improve transportation system performance monitoring.	M	• AD2: ITS Data Warehouse
Improve road/weather condition information.	M	• MC03: Road Weather Data Collection • MC04: Weather Information Processing and Distribution
Improve bicycle/pedestrian warning systems.	M	• AVSS05: Intersection Safety Warning
Improve ability to monitor and provide information about flooding.	M	• MC03: Road Weather Data Collection • MC04: Weather Information Processing and Distribution

Emergency Management Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve access to regional cameras.	M	• ATIS06: Transportation Operations Data Sharing
Enable remote emergency control of signals.	L	• ATMS03: Traffic Signal Control • EM02: Emergency Routing
Monitor transit vehicle locations.	L	• APTS05: Transit Security

Maintenance and Construction Operations Needs

Examples of maintenance and construction operation systems include: Advanced Work Zone Management and Traffic Control; Vehicle Detection Systems; Video Systems; Vehicle/Speed Detection Systems; Variable Message Signs; Highway Advisory Radio; Integration with Traffic Management Systems/Centers; Advanced Dispatching and Routing Systems; Advanced Vehicle Tracking Systems; Fleet Maintenance and Management Systems.

Table B-5: L-DC Region Maintenance and Construction Operations Needs

Maintenance and Construction Operations Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve coordination on construction notification and information distribution.	H	• ATIS06: Transportation Operations Data Sharing • MC10: Maintenance and Construction Activity Coordination
Provide quality real time congestion related information.	H	• ATMS06: Traffic Information Dissemination
Provide signal preemption for some maintenance fleet vehicles.	M	• EM02: Emergency Routing
Improve/enhance work zone traffic handling plans.	M	• MC08: Work Zone Management • MC09: Work Zone Safety Monitoring
Increase use of portable traffic control equipment (Dynamic Message Signs, Highway Advisory Radio, etc.).	M	• MC08: Work Zone Management

Maintenance and Construction Operations Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve maintenance response to incidents and requests.	M	• MC10: Maintenance and Construction Activity Coordination
Improve fleet information/management (maintenance schedules, mileage accumulations, tracking snow removal vehicles w/AVL).	L	• MC01: Maintenance and Construction Vehicle and Equipment Tracking
Interagency coordination on most advantageous placement of maintenance vehicles (prior to anticipated need).	L	• MC10: Maintenance and Construction Activity Coordination

Regional Traveler Information Needs

Examples of regional traveler information systems include: En-route Traveler Information; Pre-trip Traveler Information; Portable Event Management Systems; In-vehicle Route Guidance; Traffic Information; Variable Message Signs; Highway Advisory Radio; Internet, Media; Tourist Information Systems.

Table B-6: L-DC Region Traveler Information Needs

Regional Traveler Information Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve multi-modal information.	H	• APTS08: Transit Traveler Information • ATIS01: Broadcast Traveler Information • ATIS02: Interactive Traveler Information
Improve traffic information dissemination.	H	• ATMS06: Traffic Information Dissemination
Provide quality real time congestion related information.	M	• ATIS01: Broadcast Traveler Information • ATMS06: Traffic Information Dissemination

Regional Traveler Information Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Expand traveler information delivery methods.	L	• ATIS01: Broadcast Traveler Information • ATIS02: Interactive Traveler Information
Provide better road construction information and notification.	L	• ATIS01: Broadcast Traveler Information • ATMS06: Traffic Information Dissemination
Improve weather and road condition information.	L	• ATIS01: Broadcast Traveler Information • MC03: Road Weather Data Collection • MC04: Weather Information Processing and Distribution

Commercial Vehicle Operations Needs

Examples of commercial vehicle operations systems include: Commercial Vehicle Electronic Clearance; Automated Roadside Safety Inspection; On-board Safety Monitoring; Commercial Vehicle Administration Processes; Hazardous Material Incident Response; Commercial Vehicle Fleet Management; Services to Assist Agricultural Harvesting and Migration.

B-7: L-DC Commercial Vehicle Operations Needs

Commercial Vehicle Operations Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Disseminate better information regarding limited alternative routes.	M	• ATIS01: Broadcast Traveler Information • ATMS06: Traffic Information Dissemination
Provide interstate/inter-region traveler information covering a wide area (targeted to commercial vehicle operators).	M	• ATIS01: Broadcast Traveler Information

Commercial Vehicle Operations Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve congestion management during seasonal/local events.	M	• ATMS06: Traffic Information Dissemination
Improve truck routing in rural / small-towns.	L	• ATIS01: Broadcast Traveler Information • ATMS06: Traffic Information Dissemination
Provide quality real time congestion related information.	L	• ATMS07: Regional Traffic Management • ATMS08: Traffic Incident Management System
Improve truck storage/parking information (during major road closures).	L	• ATIS01: Broadcast Traveler Information

Integration Needs

Examples of Integration include: Integration of Systems; Integration with Traffic Management Centers; Determining Central vs. Distributed Control; Communications Infrastructure; Integration of Agencies; Resolution of Institutional Issues.

Table B-8: L-DC Region Integration Needs

Integration Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve information sharing among agencies.	H	• AD2: ITS Data Warehouse • ATIS06: Transportation Operations Data Sharing • ATMS06: Traffic Information Dissemination • ATMS07: Regional Traffic Management • MC10: Maintenance and Construction Activity Coordination

Integration Need	Relative Priority (High, Medium, Low)	Applicable ITS Service Packages
Improve fiber optic network.	M	No specific ITS Service Package, but the impact is relevant across all ITS data exchange.
Develop interagency governmental agreements that would allow sharing of information, etc.	M	No specific ITS Service Package, but agreements are required for the successful implementation of any multi-agency ITS project.
Improve system compatibility.	M	No specific ITS Service Package, but the use of data exchange standards recommended through the ITS Architecture will promote system compatibility.
Provide central information clearinghouse.	L	• AD2: ITS Data Warehouse

APPENDIX C – ITS STANDARDS APPLICABLE TO THE L-DC REGION

NOTE: The ITS standards presented in this report may represent a superset of options, and in some cases, provide redundant capabilities. In addition, these ITS standards are at different maturity levels. Care should be taken to select the standards that best meet the needs of the region or project.

Lead SDO	Standard Name	Version	Document ID
AASHTO/ITE	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)		ITE TMDD
AASHTO/ITE/NEMA	NTCIP Center-to-Center Standards Group		(See Footnote)
AASHTO/ITE/NEMA	NTCIP Center-to-Field Standards Group		(See Footnote)
AASHTO/ITE/NEMA	Global Object Definitions		NTCIP 1201
AASHTO/ITE/NEMA	Object Definitions for Actuated Traffic Signal Controller (ASC) Units		NTCIP 1202
AASHTO/ITE/NEMA	Object Definitions for Dynamic Message Signs (DMS)		NTCIP 1203
AASHTO/ITE/NEMA	Object Definitions for Environmental Sensor Stations (ESS)		NTCIP 1204
AASHTO/ITE/NEMA	Object Definitions for Closed Circuit Television (CCTV) Camera Control		NTCIP 1205
AASHTO/ITE/NEMA	Object Definitions for Closed Circuit Television (CCTV) Switching		NTCIP 1208
AASHTO/ITE/NEMA	Data Element Definitions for Transportation Sensor Systems (TSS)		NTCIP 1209
AASHTO/ITE/NEMA	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters		NTCIP 1210
AASHTO/ITE/NEMA	Object Definitions for Signal Control and Prioritization (SCP)		NTCIP 1211
AASHTO/ITE/NEMA	Object Definitions for Conflict Monitor Units (CMU)		NTCIP 1214
APTA	Standard for Transit Communications Interface Profiles		APTA TCIP-S-001 3.0.4
ASTM	Dedicated Short Range Communication at 915 MHz Standards Group		(See Footnote)

Lead SDO	Standard Name	Version	Document ID
ASTM/IEEE/SAE	Dedicated Short Range Communication at 5.9 GHz Standards Group		(See Footnote)
IEEE	Incident Management Standards Group		(See Footnote)
IEEE	Standard for Message Sets for Vehicle/Roadside Communications		IEEE 1455-1999
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Over- the-Air Data Exchange Protocol for Intelligent Transportation Systems (ITS)		IEEE P1609.11
SAE	Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group		(See Footnote)
SAE	Advanced Traveler Information Systems (ATIS) General Use Standards Group		(See Footnote)

Lead SDO	Standard Name	Version	Document ID

Footnotes:

Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group

SDO	Standard Name	Document ID
SAE	Location Referencing Message Specification (LRMS)	SAE J2266
SAE	Message Set for Advanced Traveler Information System (ATIS)	SAE J2354
SAE	Standard for ATIS Message Sets Delivered Over Reduced Bandwidth Media	SAE J2369
SAE	Messages for Handling Strings and Look-Up Tables in ATIS Standards	SAE J2540
SAE	RDS (Radio Data System) Phrase Lists	SAE J2540/1
SAE	ITIS (International Traveler Information Systems) Phrase Lists	SAE J2540/2
SAE	National Names Phrase List	SAE J2540/3

Advanced Traveler Information Systems (ATIS) General Use Standards Group

SDO	Standard Name	Document ID
SAE	Location Referencing Message Specification (LRMS)	SAE J2266
SAE	Message Set for Advanced Traveler Information System (ATIS)	SAE J2354
SAE	Messages for Handling Strings and Look-Up Tables in ATIS Standards	SAE J2540
SAE	RDS (Radio Data System) Phrase Lists	SAE J2540/1
SAE	ITIS (International Traveler Information Systems) Phrase Lists	SAE J2540/2
SAE	National Names Phrase List	SAE J2540/3

Dedicated Short Range Communication at 5.9 GHz Standards Group

SDO	Standard Name	Document ID
ASTM	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications	ASTM E2213-03
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Resource Manager	IEEE 1609.1-2006
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Security Services for Applications and Management Messages	IEEE 1609.2-2006
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services	IEEE 1609.3
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-Channel Operation	IEEE 1609.4-2006

Lead SDO	Standard Name	Version	Document ID
Dedicated Short Range Communication at 5.9 GHz Standards Group			
SDO	**Standard Name**		**Document ID**
IEEE	Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part II: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification		IEEE 802.11p
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Architecture		IEEE P1609.0
Dedicated Short Range Communication at 915 MHz Standards Group			
SDO	**Standard Name**		**Document ID**
ASTM	Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band		ASTM E2158-01
Incident Management Standards Group			
SDO	**Standard Name**		**Document ID**
IEEE	Standard for Common Incident Management Message Sets for use by Emergency Management Centers		IEEE 1512 -2006
IEEE	Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers		IEEE 1512.1-2006
IEEE	Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers		IEEE 1512.2-2004
IEEE	Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers		IEEE 1512.3-2006
IEEE	Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers		IEEE P1512.4
NTCIP Center-to-Center Standards Group			
SDO	**Standard Name**		**Document ID**
AASHTO/ITE/NEMA	Octet Encoding Rules (OER) Base Protocol		NTCIP 1102
AASHTO/ITE/NEMA	Center-to-Center Naming Convention Specification		NTCIP 1104
AASHTO/ITE/NEMA	Ethernet Subnetwork Profile		NTCIP 2104
AASHTO/ITE/NEMA	Internet (TCP/IP and UDP/IP) Transport Profile		NTCIP 2202
AASHTO/ITE/NEMA	File Transfer Protocol (FTP) Application Profile		NTCIP 2303
AASHTO/ITE/NEMA	Application Profile for DATEX-ASN (AP-DATEX)		NTCIP 2304
AASHTO/ITE/NEMA	Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (C2C XML)		NTCIP 2306
NTCIP Center-to-Field Standards Group			
SDO	**Standard Name**		**Document ID**
AASHTO/ITE/NEMA	Octet Encoding Rules (OER) Base Protocol		NTCIP 1102
AASHTO/ITE/NEMA	Transportation Management Protocols (TMP)		NTCIP 1103
AASHTO/ITE/NEMA	Point to Multi-Point Protocol Using RS-232 Subnetwork Profile		NTCIP 2101
AASHTO/ITE/NEMA	Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile		NTCIP 2102
AASHTO/ITE/NEMA	Point-to-Point Protocol Over RS-232 Subnetwork Profile		NTCIP 2103

Lead SDO	Standard Name	Version	Document ID

NTCIP Center-to-Field Standards Group

SDO	Standard Name	Document ID
AASHTO/ITE/NEMA	Ethernet Subnetwork Profile	NTCIP 2104
AASHTO/ITE/NEMA	Transportation Transport Profile	NTCIP 2201
AASHTO/ITE/NEMA	Internet (TCP/IP and UDP/IP) Transport Profile	NTCIP 2202
AASHTO/ITE/NEMA	Simple Transportation Management Framework (STMF) Application Profile	NTCIP 2301
AASHTO/ITE/NEMA	Trivial File Transfer Protocol (TFTP) Application Profile	NTCIP 2302
AASHTO/ITE/NEMA	File Transfer Protocol (FTP) Application Profile	NTCIP 2303