# KIPDA Regional ITS Architecture
# Final Report

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Prepared for

KIPDA
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## Revision History

| Filename | Version | Date | Author | Comment |
|---|---|---|---|---|
| KIPDA Regional ITS Architecture Doc Draft | 0.1 | 03/21/2017 | K. Sadallah/ B. Eisenhart | 1st draft |
| KIPDA Regional ITS Architecture Final Report | 1.0 | 05/31/2017 | K. Sadallah/ B. Eisenhart | Final |
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# 1. Introduction

The ***Kentuckiana Regional Planning & Development Agency (KIPDA) Regional Intelligent Transportation Systems (ITS) Architecture*** is a roadmap for transportation systems integration in the Louisville-Jefferson County Metropolitan Planning Area over the next 20 years. The architecture, originally developed in 2004, has been updated through a cooperative effort by the region's transportation agencies, covering all modes and all roads in the region. The architecture represents a shared vision of how each agency's systems will work together in the future, sharing information and resources to provide a safer, more efficient, and more effective transportation system for travelers in the region.

The architecture is an important tool that will be used by:

- Operating Agencies to recognize and plan for transportation integration opportunities in the region.
- Planning Agencies to better reflect integration opportunities and operational needs into the transportation planning process.
- Other organizations and individuals that use the transportation system in the region.

The architecture provides an overarching framework that spans all of these organizations and individual transportation projects. Using the architecture, each transportation project can be viewed as an element of the overall transportation system, providing visibility into the relationship between individual transportation projects and ways to cost-effectively build an integrated transportation system over time. The architecture is described by this document, by a Turbo Architecture database and by a hyperlinked website that can be found at http://www.consystec.com/kipda/web/index.htm.

## *1.1. Document Overview*

This document is organized into twelve main sections. Section 1 provides introductory information. Section 2 describes the process used to develop the regional ITS architecture. The stakeholders are identified in Section 3, while their systems are inventoried in Section 4. The transportation services, information exchanges, functional requirements, and standards associated with the systems are discussed in Sections 5, 6, 7, and 8, respectively. Section 9 describes regional projects and sequencing, while Section 10 discusses the agreements needed between stakeholders to maximize system benefits. Finally, Section 11 provides guidance on using the regional ITS architecture and Section 12 summarizes the architecture maintenance plan. Because this document contains a number of architecture terms that may be unfamiliar to the reader a Glossary of these common terms is provided in Appendix A.

## *1.2. Scope of the Architecture*

The geographic scope of the KIPDA Regional ITS Architecture is the Kentuckiana region, also defined as the Louisville-Jefferson County Metropolitan Planning Area. The region considered in the update of this regional ITS architecture includes all of the following five counties:

Jefferson, Oldham, Bullitt, Clark, and Floyd as well as parts of Harrison County in Indiana and Shelby County in Kentucky. This bi-state region covers the area served by KIPDA. The primary east-west Interstate in the region is Interstate 64. The primary north-south Interstates in the region I-65 and I-71. In addition, connector interstates I-264, and I-265 which connects to KY-841, provide ring roads around the Louisville metro area. US Route 31 is a key north-south arterial from Louisville into southern Indiana. US 60 is a primary east-west arterial.

The regional ITS architecture for the Kentuckiana metro area provides a 20-year outlook for ITS activities in the region. The architecture addresses existing ITS systems as well as those planned for development over the next 20 years. It represents a snapshot of the currently anticipated projects based on information from stakeholders. As such, the architecture will require regular updates to ensure that it maintains accurate representation of the region. The architecture covers services across a broad range of ITS, including traffic management, transit management, traveler information, emergency services, archived data management, maintenance and construction operations, and electronic payment. Commercial vehicle services are covered as they relate to regional integration, but a more complete coverage of these would be expected at a statewide architecture level.

There is one additional ITS architecture that “borders” the KIPDA Regional ITS Architecture, which is the Kentucky Statewide ITS Architecture. This architecture addresses services that are statewide in nature, such as commercial vehicle administration.

# 2. Regional ITS Architecture Update Process

## *2.1. Process used to update the architecture.*

The update of the KIPDA Regional ITS Architecture relied heavily on stakeholder input to ensure that the ITS architecture reflected local and regional needs and plans. A seven-step process was used to update the previous version of the ITS architecture:

1. Update the regional ITS architecture to the current version of the National ITS Architecture (NITSA), version 7.1
2. Conduct stakeholder outreach through an interactive group interview with key stakeholders
3. Create a draft ITS architecture for review
4. Conduct a stakeholder workshop to review the draft architecture
5. Update the draft ITS architecture based on input from the workshop
6. Conduct a one-month stakeholder review period of the draft ITS architecture
7. Finalize the ITS architecture based on review comments.

**1) Update the regional ITS architecture to the current version of the National ITS Architecture (NITSA), version 7.1.**

First, the project team reviewed the 2004 version of the KIPDA Regional ITS Architecture. This version of the ITS architecture was created using NITSA version 4.0. First, the Turbo Architecture database was updated to the current version of NITSA 7.1. Conversion reports were created during this process, and the project team reviewed these reports to ensure that no data was lost in the conversion process.

Once this was confirmed, the customized service package diagrams created as part of the 2004 ITS architecture effort were updated to NITSA 7.1. Each diagram was reviewed, and any subsystems, information flows, or service package names were updated to conform with NITSA 7.1.

**2) Conduct stakeholder outreach through an interactive group interview with key stakeholders.**

The project team, using the 2004 ITS architecture as a starting point, developed a list of stakeholders. This stakeholder list included identification of key regional stakeholders that warranted an interactive group interview with the project team.

Remaining stakeholders on the stakeholder list had the opportunity to provide input at the stakeholder workshop and during the architecture review period. This stakeholder list was reviewed and updated by KIPDA staff before interviews were conducted, and stakeholder representatives were identified for each key stakeholder.

Next, the project team reached out to key stakeholder representatives and scheduled interviews, which were held via webinar. The key stakeholders interviewed were:

- Louisville Metro Traffic
- TRIMARC
- INDOT
- KYTC
- TARC

The agenda for these interviews were as follows:

- Review relevant portions of the 2004 KIPDA Regional ITS Architecture
- Current ITS systems deployed since 2004
- Review short and long term projects for inclusion in the ITS architecture update

Meeting notes were provided for each stakeholder interview and stakeholder representatives were given the opportunity to review inputs recorded by the project team.

**3) Create a draft ITS architecture.**

Following the interviews, a draft architecture was created. This involved the following activities:

- Updating regional stakeholders, including roles and responsibilities
- Updating the ITS inventory
- Revising the customized service packages
- Developing a list of regional projects.

The updated details of the draft architecture were put into the Turbo database and into a Visio file that contains the set of customized service packages. In addition, the project team created a set of regional projects. These projects were collected through the stakeholder interviews. In addition to a project name and brief description, each project was mapped to a customized service package diagram in the Draft KIPDA Regional ITS Architecture Update, and assigned a time frame:

- Near-term projects were defined as projects that would be completed in the next five years
- Long-term projects were defined as projects that would be completed in more than 5years.

**4) Conduct a stakeholder workshop to review the draft ITS architecture.**

A full day draft ITS architecture review meeting was held on November 30th, 2016. At the workshop, stakeholders reviewed the updated inventory, service packages, roles and responsibilities (e.g. the operational concept), and regional projects.

**5) Update the draft ITS architecture based on input from the workshop.**

Following the architecture review workshop, the draft architecture was revised based on comments from the workshop. The project team updated the inventory, service packages, operational concept, and regional projects based on stakeholder inputs. Next, the complete draft architecture was created by, developing a set functional requirements for each system in the inventory, and creating individual projects architectures for each project. These updates were entered into the Turbo Architecture database. Finally, a draft ITS architecture website was created based on the customized service packages and updated Turbo Architecture database.

**6) Conduct a stakeholder review period of the draft ITS architecture.**

All stakeholders identified during the ITS architecture update process were provided with a link to the Draft KIPDA Regional ITS Architecture, as well as instructions on how to review their individual portions of the ITS architecture. Stakeholders were given one month to provide comments. At the end of a month, all comments were collected by the project team in a spreadsheet.

**7) Finalize the ITS architecture based on review comments**

Finally, the ITS architecture was updated based on stakeholder feedback. A review webinar with the stakeholders was held to review the changes. This final version of the ITS architecture serves as input to this document, and a final ITS architecture website was created.

## 2.2. Requirements of the Final FHWA Rule and FTA Policy on Architecture

The FHWA Final Rule (23CFR 940) and FTA Policy on Intelligent Transportation System Architecture and Standards, which took effect on April 8, 2001 defines a set of requirements that regional ITS architectures must meet. Table 1 shows how the requirements of the rule are met by the outputs developed for the KIPDA Regional ITS Architecture.

**Table 1: Mapping of Requirements to Architecture Outputs**

| Regional ITS Architecture Requirements | Where Requirements documented |
|---|---|
| Description of scope of the architecture | Description of the scope of the architecture, including the geographic definition, as well as timeframe and scope of services are given in Section 1.2 of this document. |
| Identification of participating agencies and other stakeholders | Listing of stakeholders and their definitions is given in Section 3.1 of this document. An inventory of the elements operated by the stakeholders is contained in Section 4 of this document. The same information is also available in the hyperlinked web site and in the Turbo Architecture database. |
| An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders | The operational concept is discussed in Section 4.2 of this document. The complete set of roles and responsibilities can be found in the Turbo Architecture file and on the website. |
| A list of any agreements (existing or new) required for operations | A discussion of existing and agreements is given in Section 11 of this document. |
| System functional requirements; | The functional requirements of the ITS systems are provided in detail in the hyperlinked web site and in the turbo architecture database. |
| Interface requirements and information exchanges with planned and existing systems and subsystems | The Interfaces and information flows are described in detail in the hyperlinked web site and in the Turbo Architecture database. |
| Identification of ITS standards supporting regional and national interoperability | An overview of the ITS standards is given in Section 8 of the document. The detailed listing of ITS standards applicable to each interface in the architecture is described in the hyperlinked web site and in the Turbo Architecture database. |
| The sequence of projects required for implementation | Projects and their sequencing are covered in Section 10 of this document as well as the hyperlinked website and the Turbo Architecture database. |

# 3. ITS Architecture Concepts

The KIPDA Regional ITS Architecture is an example of a Regional ITS Architecture, which has been defined by FHWA Rule 940 as a "regional framework for ensuring institutional agreement and technical integration for implementation of ITS projects". Regional ITS architectures, including the KIPDA Regional ITS Architecture, are developed in order to provide a guide for the integration of transportation systems. The updated architecture is based upon the US National ITS Architecture Version 7.1. A complete description of this architecture can be found at http://www.iteris.com/itsarch. The KIPDA Regional ITS Architecture Update uses a set of common concepts or terms drawn from the National ITS Architecture to describe the parts of the Kentuckiana region. This section will provide a description of the most common concepts or terms as an aid to the understanding the remainder of the document.

What are some of the main parts of an ITS architecture? They are made of the following:

- Organizations
- Systems operated
- Services provided
- Functions performed
- Information exchanged

The organizations that operate systems in the region covered by the architecture are referred to as **stakeholders**. These are public agencies, private organizations or the traveling public with a vested interest, or a "stake" in one or more transportation elements within a Regional ITS Architecture.

The systems operated by the stakeholders are referred to as **elements**. In the KIPDA Regional ITS Architecture the elements represent actual systems, such as *Louisville Metro Traffic Management Center*. An element may also represent field devices, for example the element *Louisville Metro Traffic CCTV's.* A more thorough discussion of the architecture elements is contained in Section 5. As mentioned above, the KIPDA Regional ITS Architecture Update is based upon the National ITS Architecture which contains general terms for these systems (elements). Since these National ITS Architecture terms show up repeatedly in later discussion they will be defined here. The National ITS Architecture uses two terms to describe the systems that make up an architecture. They are:

- **Subsystems**, which represent the primary systems described by the architecture. For example, the Traffic Management Center element mentioned above represents a regional ITS architecture example of the Traffic Management Subsystem defined in the National ITS Architecture. The National ITS Architecture has 22 subsystems defined.

- **Terminators**, which represent systems that are on the boundary of the National ITS Architecture. In general, only interfaces to the terminators are described in the National ITS Architectures. An example of a terminator from the National ITS Architecture is the Weather Service. The National ITS Architecture has 79 terminators defined. Some of the elements in the Regional ITS Architecture are mapped to these terminators.

As a part of developing a regional ITS architecture, each element of the region is mapped to the subsystems and/or terminators that most closely define the functions of the element. This mapping allows the regional version to use the details associated with the subsystems and terminators in the National ITS Architecture. As an example, the element in the KIPDA Regional ITS Architecture Update called *National Weather Service* is mapped to the National ITS Architecture Terminator called Weather Service.

The information exchanged between elements (in the KIPDA Regional ITS Architecture Update) or between subsystems and terminators in the National ITS Architecture is described by **information flows** or **architecture flows.** There are hundreds of these flows defined in the National ITS Architecture, and it is this information that is used to create the interface definitions in the KIPDA Regional ITS Architecture. For example, in Figure 1 the top two boxes show an interface between two subsystems, with its information flows defining the exchange of information. A corresponding interface in the KIPDA Regional ITS Architecture is shown in the bottom two boxes.

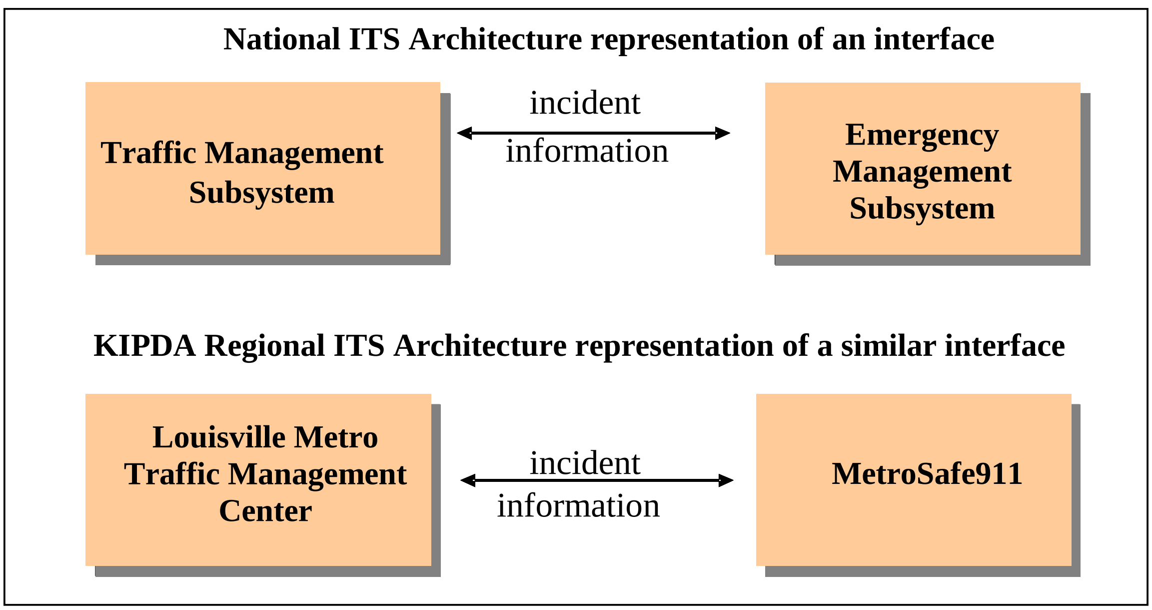



**Figure 1. Information flows**

By mapping the KIPDA Regional ITS Architecture elements (e.g. Louisville Metro Traffic Management Center) to National ITS Architecture subsystems (or terminators) (e.g. Traffic Management Subsystem), the interfaces defined in the National ITS architecture can be used as the basis for defining the interfaces in the KIPDA Regional ITS Architecture.

The next key concept used by the architectures is that of **service packages**. These represent slices of an architecture that provide a transportation service. In the National ITS Architecture, these service packages are combinations of subsystems and information flows that are used to provide the service. An example of a National ITS Architecture service package is shown in Figure 2. This shows the subsystems and information flows (some of which go to terminators) that perform the collection and distribution of traffic flow and traffic images used to monitor a road network. In the development of the KIPDA Regional ITS Architecture, a set of customized service packages were created that define the elements and interfaces used to provide the transportation services in the Kentuckiana Metro Area Region.

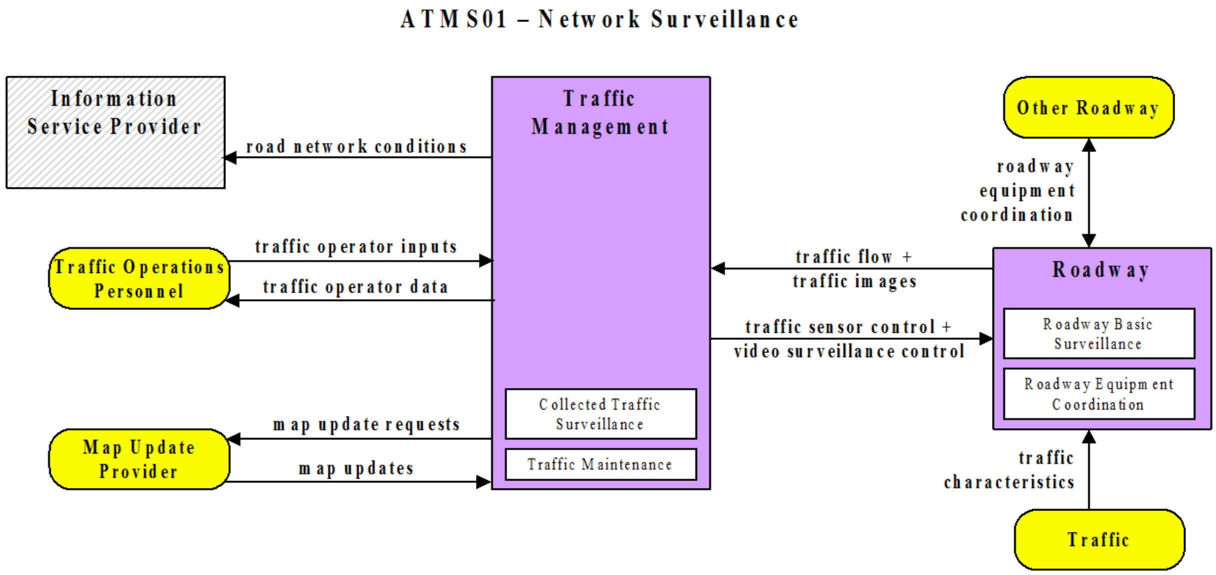



**Figure 2. Example of a National ITS Architecture Service Package**

Figure 3 shows one of the customized service packages within the KIPDA Regional ITS Architecture (in this case for Louisville Metro). This diagram shows how the city might implement this service. There are four interfaces shown in the customized service package:

- Traffic Management Center to/from CCTV's
- Traffic Management Center to/from Traffic Detectors
- Traffic Management Center to Information Service Provider (Traveler Website)
- Traffic Management Center to/from Information Service Provider (Private Systems (i.e.) WAZE)

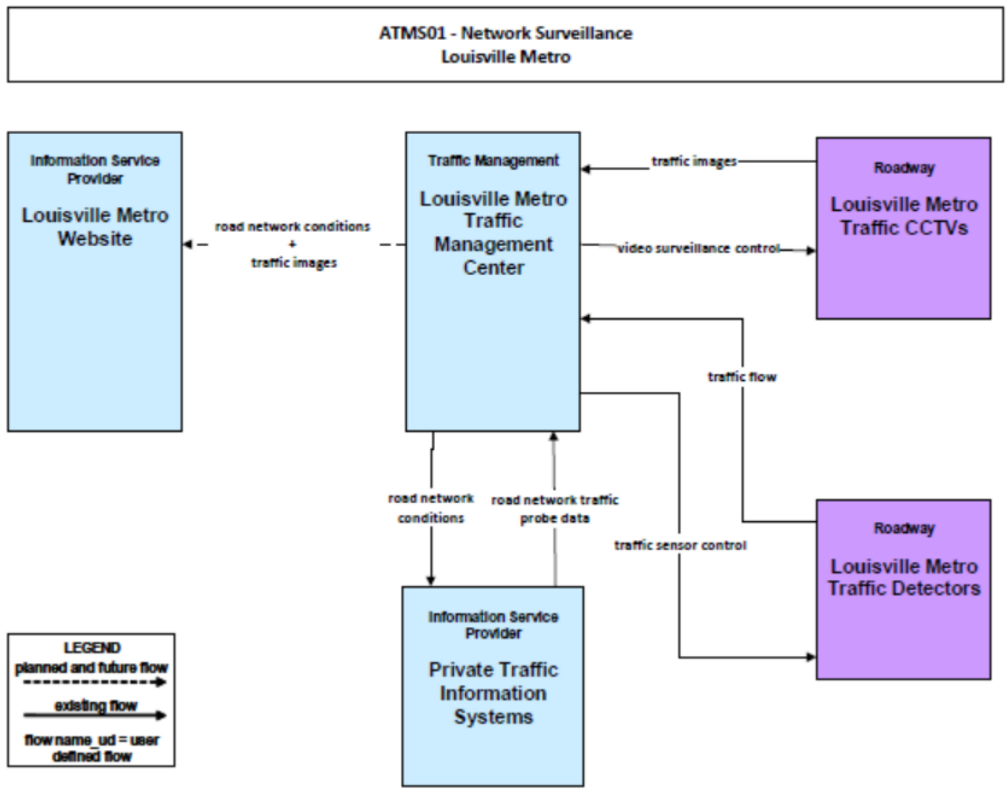



**Figure 3. Example of KIPDA Regional ITS Architecture Customized Service Package**

Notice that the customized service package includes only some of the interfaces that were in the National ITS Architecture service package. It does not include interfaces to personnel or a map update provider element. Elements mapping to these are not included in the KIPDA Regional ITS Architecture. Also, it includes an additional interface for probe data, which usually shows up in another service package, but which the stakeholders wished to have shown in this diagram. The inclusion of this additional interface is indicative of the fact that Regional ITS Architectures use the National ITS Architecture as a template, but can be extended as needed be to fully address regional operations.

One final concept to mention relates to the functions performed by the elements in the architecture. The National ITS Architecture has the concept of an **equipment package,** which defines a piece of a subsystem (within the service package) that performs a specific function. For example, in Figure 2, *Collect Traffic Surveillance* (identified by the white box within the Traffic Management Subsystem) is a function (or equipment package) that is performed by the Traffic Management Subsystem when performing the Network Monitoring Transportation Service. In the KIPDA Regional ITS Architecture functions have been identified for the key elements from a mapping of equipment packages to elements using a mapping of equipment packages to each element. For example, the Louisville Metro Traffic Management Center (shown in Figure 3) will implement the Collect Traffic Surveillance equipment package (shown in Figure 2 as functionality in the Traffic Management Subsystem). Further information regarding how functions are defined for each element is found in Section 8 on Functional Requirements.

# 4. Identification of Stakeholders

## *4.1. Regional Stakeholders*

Stakeholder coordination and involvement is one of the key elements of the development of a regional ITS architecture. Because ITS often transcends traditional transportation infrastructure, it is important to consider a range of stakeholders beyond the traditional traffic, transit, and maintenance areas. In addition, it is important to consider stakeholders at a statewide level or stakeholders in adjoining regions.

The complete KIPDA Regional ITS architecture includes a wide range of stakeholders. Table 2 identifies the stakeholders that have been identified for inclusion in the architecture and provides a description of the agency, department, or organization represented by the stakeholder. This table includes the full range of stakeholders who own, operate or maintain elements (i.e. systems) in the regional ITS architecture.

**Table 2: Stakeholders**

| Stakeholder Name | Stakeholder Description |
|---|---|
| Event Promoters | Special Event Sponsors that have knowledge of events that may impact travel on roadways or other modal means. Examples of special event sponsors include sporting events, conventions, motorcades/parades, and public/political events. |
| FHWA | State Division of the Federal Highway Administration providing financial and technical assistance in support of the transportation infrastructure. |
| Financial Institutions | Financial and banking institutions that play a role in the transfer of funds for fare collection as well as for other fee based transportation services. |
| Human Transportation Services | Agencies providing various human transportation services within the region. |
| Indiana Department of Homeland Security | State agency in charge of Emergency Operations at the state and local level. |
| Indiana State Police | Stakeholder responsible for emergency response and commercial vehicle enforcement on Indiana highways. |
| INDOT | The Indiana Department of Transportation (INDOT) is the agency responsible for planning, building, maintaining, and operating the transportation system for the State of Indiana. |
| Jefferson County Fire Service | Fire service that provides fire and incident response to county areas outside of Louisville. |
| Kentucky Justice Cabinet | The Kentucky Justice Cabinet is the state level agency responsible for protecting the public, including operation of the statewide Emergency Operations Center, in cooperation with the Kentucky State Police. |

| Stakeholder Name | Stakeholder Description |
|---|---|
| KIPDA | The Kentuckiana Regional Planning and Development Agency, metropolitan planning organization for the region. |
| KYTC | The Kentucky Transportation Cabinet (KYTC) is the state level agency responsible for the planning, designing, building, and maintaining the transportation infrastructure in Kentucky. |
| KYTC/INDOT | Partnership between Kentucky and Indiana for the Ohio River Bridges Project. |
| Local Governments | Represents the various government departments and agencies of municipalities and counties other than those specifically called out in the architecture that provide goods and services in support of the transportation infrastructure. |
| Local Media | Represents both print (newspaper) and broadcast (TV, radio) news media. |
| Louisville Fire Department | Local fire department servicing the Louisville community. |
| Louisville Metro Air Pollution Control District | The Air Pollution Control District (APCD) is the air quality agency for Jefferson County, Kentucky. They enforce all federal and state laws and regulations. They can also create and enforce local regulations. |
| Louisville Metro Emergency Services | Louisville Metro Emergency Services is responsible for operation of MetroSafe911, the regional PSAP; operation of the regional Emergency Operations Center, which coordinates the work of 95 agencies during disasters; and the operation of emergency medical services (EMT services) for the region. |
| Louisville Metro Government | Louisville Metro Government |
| Louisville Metro Police | Louisville Metro Police Department |
| Louisville Metro Public Works | Louisville Metro Public Works builds, operates, and maintains roadways, traffic signals, and signage within the city. |
| Louisville Metro Traffic | Louisville Metro Traffic, part of the Division of Public Works, operates and maintains traffic signals and other ITS devices in metro Louisville. |
| Mid America Association of State Transportation Officials | MAASTO is an association of 10 state DOTs to foster the development, operation, and maintenance of an integrated and balanced transportation system that adequately serves the transportation needs of the member states. |
| NOAA | National Oceanic and Atmospheric Administration, which includes the National Weather Service. |
| PARC | The Parking Authority of River City (PARC) provides public parking to meet the existing and future needs of the community. |
| Private Commercial Carriers | Private commercial vehicle operators. |
| Private Traffic Information Providers | Represents the privately-owned companies, such as WAZE, who provide real-time and/or historic traffic data and roadway information. |

| Stakeholder Name | Stakeholder Description |
|---|---|
| Railroad Companies | Represents the various railroad companies providing goods and services in support of the economy. |
| Regional Hospitals | Represents the agencies responsible for hospitals and other care facilities in the region. |
| Regional Utilities | Regional Agencies that provide utilities such as electricity, gas, water, telephone, and cable. |
| TARC | The Transit Authority of River City (TARC) provides public transportation in the Greater Louisville area with bus routes in Jefferson, Bullitt and Oldham counties in Kentucky and Clark and Floyd counties in Indiana. |
| Travelers | Travelers are the motoring public operating private, commercial, or public conveyances. |
| TRIMARC | TRIMARC, Traffic Response and Incident Management Assisting the River Cities, is a project of the KYTC. The purpose of TRIMARC is to improve the performance of the existing Freeway system in the Metropolitan Louisville and Southern Indiana area. |
| US Coast Guard | Federal Agency charged with monitoring and protecting waterways. |

The stakeholders listed in Table 2 represent a mix of specific agencies or organizations and generic names used to represent a variety of stakeholders.  Examples of specific agency or organizations would be Parking Authority of River City (PARC).  An example of a generic stakeholder name would be Local Media, which represents any print or broadcast news broadcast within KIPDA.

## 4.2. Operational Concept

An Operational Concept documents each stakeholder's current and future roles and responsibilities in the operation of the regional ITS systems. The operational concept documents these roles and responsibilities across a range of transportation services.  The services covered are:

- Traffic Signal Control: the development of signaling systems that react to changing traffic conditions and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions.
- Freeway Control: the development of systems to monitor freeway (or tollway) traffic flow and roadway conditions, and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. Includes systems to provide information to travelers on the roadway.
- Incident Management: the development of systems to provide rapid and effective response to incidents. Includes systems to detect and verify incidents, along with coordinated agency response to the incidents.
- Transit Management: the development of systems to more efficiently manage fleets of transit vehicles or transit rail. Includes systems to provide transit traveler information both pre-trip and during the trip.

- Traveler Information: the development of systems to provide static and real time transportation information to travelers.
- Emergency Management: the development of systems to provide emergency call taking, public safety dispatch, and emergency operations center operations.
- Maintenance and Construction Management: the development of systems to manage the maintenance of roadways in the region, including winter snow and ice clearance. Includes the managing of construction operations.
- Archive Data Management: the development of systems to collect transportation data for use in non-operational purposes (e.g. planning and research).
- Electronic Payment: the development of electronic fare payment systems for use by transit and other agencies (e.g. parking).

Roles and Responsibilities may be found on the KIPDA Regional ITS Architecture Update website at http://www.consystec.com/kipda/web/opsconstake.htm. To access the Roles and Responsibilities, select the Operational Concept tab under the Stakeholder pulldown.

# 5. Inventory

Each stakeholder agency, company, or group owns, operates, maintains or plans ITS systems in the region. A regional ITS architecture inventory is a list of "elements" that represent all existing and planned ITS systems in a region as well as non-ITS systems that provide information to or get information from the ITS systems. The focus of the inventory is on those systems that support, or may support, interfaces that cross stakeholder boundaries (e.g., inter-agency interfaces, public/private interfaces).

The vast majority of the inventory represents ITS systems in the Louisville metro area, but the inventory does contain some elements that represent systems in adjoining regions, or systems that exist at a statewide level. An example of an element in an adjoining region would be the INDOT TMC which represents the traffic management center in Indianapolis, which monitors and controls INDOT field equipment in the region. An example of a statewide element is the KYTC State TOC, which is a Traffic Operations Center that monitors and controls traffic and the road network at a statewide level. It performs management of a broad range of transportation facilities including freeway systems, rural and suburban highway systems, and urban and suburban traffic control systems. As part of the long-term maintenance of the KIPDA Regional ITS Architecture it will be necessary to coordinate the "inter-regional" interfaces with these elements that are outside the region.

Each element in the inventory is described by a name, the associated stakeholder, a description, general status (e.g. existing or planned), and the associated subsystems or terminators from the National ITS Architecture.

## *5.1. Inventory by Stakeholder*

The KIPDA Regional ITS Architecture Update website sorts the inventory by stakeholder so that each stakeholder can easily identify all the relevant elements that are defined in the architecture. For each element in the inventory the webpage provides an element description and an indication of whether the element exists or is planned. The inventory by stakeholder can be found at http://www.consystec.com/kipda/web/invstake.htm.

The majority of elements in the inventory represent a specific existing or planned system. Some examples of specific systems are the TRIMARC Traffic Management System and TARC Maintenance Garage.

Some of the elements represent sets of devices, rather than a single specific system or device. An example of this type of element is the element "TRIMARC CCTVs". This element represents all of the CCTVs, that TRIMARC has deployed in the region.

A third type of element in the inventory is a "generic" element that represents all of the systems of a certain type in the region. An example of this type of element is Local Public Safety Dispatch, which represents the various dispatch centers for police, fire, or EMS for municipalities in the region. These generic elements have been created for two primary reasons.

First, they represent elements with similar types of interfaces, so from a standardization standpoint, describing how one of the major elements in the region (e.g. the KYTC State TOC) interfaces with various PSAPs would be the same. Second, describing many systems with a single element helps keep the architecture from growing too large.

# 6. Service Packages

The ITS systems in the region currently provide a wide array of transportation services and that list will grow as more systems are developed or upgraded. The services can be described by Services Packages, which is a term borrowed from the National ITS Architecture. In the 2004 version of the KIPDA Regional ITS Architecture, Service Packages were known as "Market Packages" but this term has been updated in more recent versions of the National ITS Architecture.

Service Packages represent collections of subsystems and terminators that exchange information to do a specific service. The service packages are customized to represent the operational concept for service delivery specific to this region. Each subsystem or terminator in a service package diagram is labeled with both its generic National ITS Architecture name and the name of the local regional element that participates in the customized service package. In this way, the service package identifies the information exchange (using architecture flows) between specific stakeholder's elements in the region to affect a particular service or set of services. For additional information on Service Packages refer to the National ITS Architecture website, which can be found at http://www.iteris.com/itsarch.

Figure 4 is an example of an Advanced Traffic Management System (ATMS) service package for Traffic Signal Control that has been customized for the KIPDA. This service package shows the two subsystems, Traffic Management and Roadway, and the associated elements. Information flows (called "architecture flows" in the National ITS Architecture) between the subsystems indicate what information is being shared.

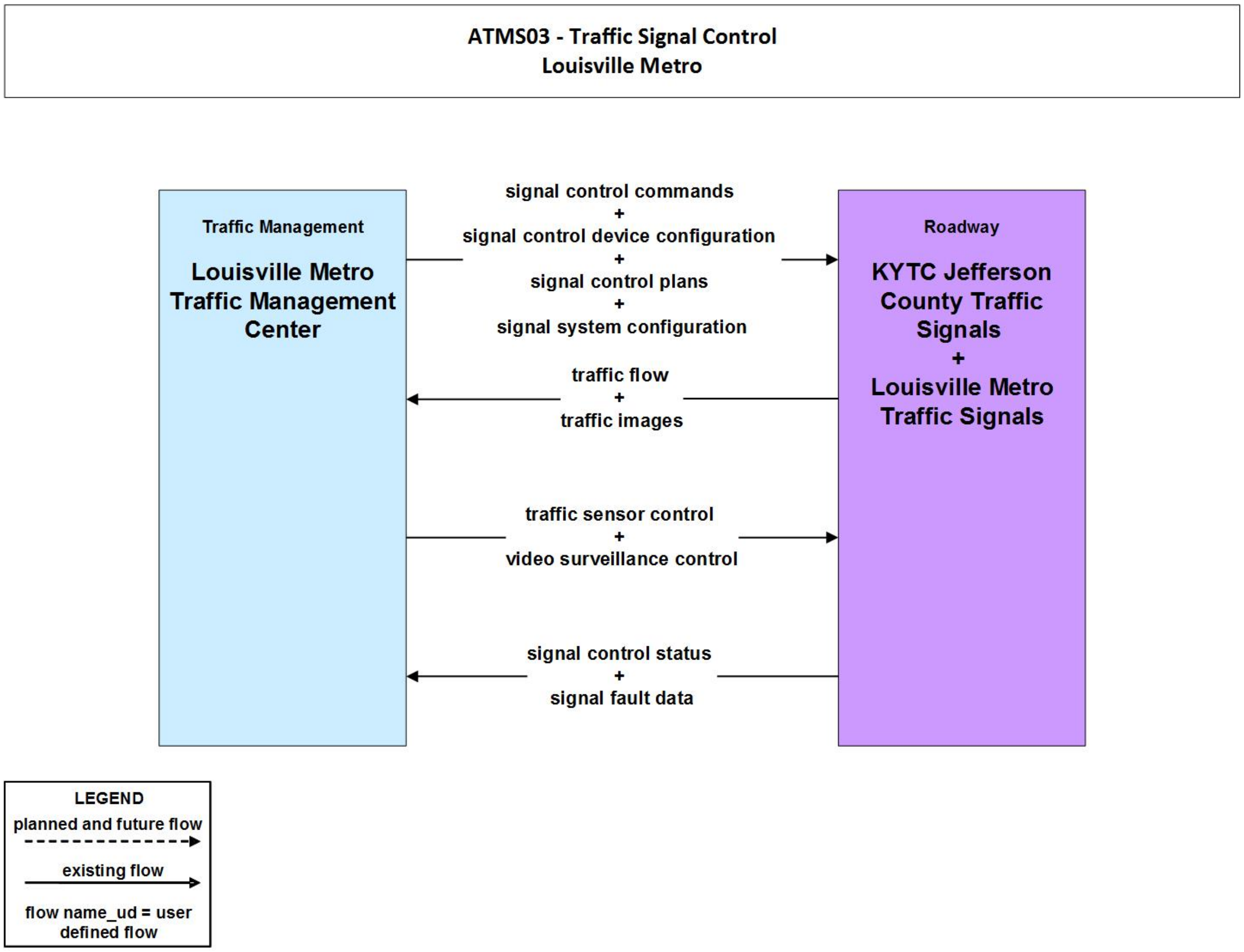



**Figure 4: Example of Customized Service Package**

The Service Packages for the KIPDA Regional ITS Architecture can be found at: http://www.consystec.com/kipda/web/services.htm.

In addition, service packages are organized by stakeholder on the following webpage: http://www.consystec.com/kipda/web/servstake.htm.

# 7. Interfaces and Information Exchanges

While it is important to identify the various systems and stakeholders as part of a regional ITS architecture, a primary purpose of the architecture is to identify the *connectivity* between transportation systems in the region. The customized service packages represent services that can be deployed as an integrated capability, and the service package diagrams show the information flows between the subsystems and terminators that are most important to the operation of the service packages. How these systems interface with each other is an integral part of the overall architecture.

There are 123 different elements identified as part of the KIPDA Regional ITS Architecture. These elements include city, county, and state traffic operations centers, transit centers, transit vehicles, public safety dispatch centers, media outlets, and others—essentially all of the existing and planned physical components that contribute to the regional intelligent transportation system. Interfaces have been defined for each element in the architecture. For example, the TRIMARC Traffic Management Center has existing or planned interfaces with 34 other elements in the region ranging from field equipment to transit centers. Some of the interfaces are far less complex. For example, Archived Data User Systems has interfaces with only four other elements in the architecture.

Elements and their interfaces are accessible via the KIPDA Regional ITS Architecture web page by clicking on the “Architectures Interfaces” button under "Architecture". On the web page, elements are listed alphabetically in the column on the left, and each entry in the Interfacing Element column on the right is a link to more detailed information about the particular interface.

Architecture flows between the elements define specific information that is exchanged by the elements. Each architecture flow has a direction, name and definition. Most of the architecture flows match ones from the National ITS Architecture (the mapping of elements to National ITS Architecture entities allowed the developers to match the architecture flows to the appropriate interfaces.) In some cases, new user defined flows have been created for interfaces or connectivity’s that are not expressed in the National ITS Architecture. These architecture flows define the interface requirements between the various elements in the regional architecture. An example of the architecture flows between two elements is shown in Figure 5.

In this interface the flows that go between the TARC Fixed Route Dispatch Center and TARC CCTV’s cameras are shown. There is an existing electronic connection between these two centers, so all the flows on this interface are shown as “existing.” A planned or future flow would represent a connection that may be implemented in the future, but just has not been implemented yet.

Each of the individual element interfaces can be accessed on the KIPDA Regional ITS Architecture web page by clicking on the “Interfaces” button. Selecting any of the interfacing elements from the column on the right will display an interface diagram and architecture flows between two specific elements, similar to the diagram shown in Figure 5.
Each architecture flow is defined, and any standards associated with that data flow are noted.

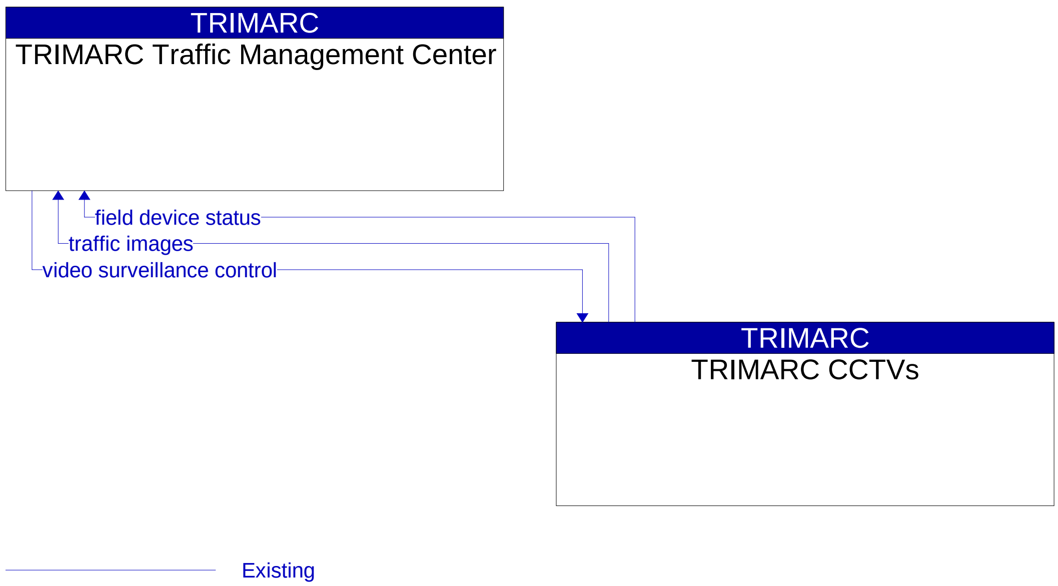



**Figure 5: Example of Architecture Flows Between Elements**

# 8. Functional Requirements

Functional requirements are a description of the functions or activities that are currently performed by the ITS elements or that are planned to be performed in the future. For the KIPDA Regional ITS Architecture, these functions have been developed by using the functional assignments underlying the National ITS Architecture and the mapping from transportation services to elements.

In the National ITS Architecture a service package is defined by subsystems, equipment packages, and architecture flows, all of which operate together to perform a particular transportation service. Equipment Packages represent pieces of a subsystem that perform a single function. (Note there are no equipment packages defined for the Terminators of the National ITS Architecture, since they represent systems on the boundary of the architecture and do not have functional descriptions within the architecture.) For example, the Traffic Signal Control service package is composed of the three Traffic Management Subsystem equipment packages -- TMC Signal Control, Collect Traffic Surveillance and Traffic Equipment Maintenance and the Roadway Subsystem includes four equipment packages Field Management Stations Operation, Roadway Basic Surveillance, Roadway Signal Control and Roadway Equipment Coordination. The definitions of these seven equipment packages, copied from version 7.1 of the National ITS Architecture are:

- **TMC Signal Control-** This equipment package provides the capability for traffic managers to monitor and manage the traffic flow at signalized intersections. This capability includes analyzing and reducing the collected data from traffic surveillance equipment and developing and implementing control plans for signalized intersections. Control plans may be developed and implemented that coordinate signals at many intersections under the domain of a single traffic management subsystem and are responsive to traffic conditions and adapt to support incidents, preemption and priority requests, pedestrian crossing calls, etc.
- **Collect Traffic Surveillance -** This equipment package remotely monitors and controls traffic sensors and surveillance (e.g., CCTV) equipment, and collects, processes and stores the collected traffic data. Current traffic information and other real-time transportation information is also collected from other centers. The collected information is provided to traffic operations personnel and made available to other centers.
- **Traffic Equipment Maintenance -** This equipment package monitors the operational status of field equipment and detects failures. It presents field equipment status to Traffic Operations Personnel and reports failures to the Maintenance and Construction Management Subsystem. The equipment package tracks the repair or replacement of the failed equipment. The entire range of ITS field equipment may be monitored by this equipment package including sensors (traffic, infrastructure, environmental, security, speed, etc.) and devices (highway advisory radio, dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, beacons, security surveillance equipment, etc.).
- **Roadway Signal Controls -** This equipment package includes the field elements that monitor and control signalized intersections. It includes the traffic signal controllers, signal heads, detectors, and other ancillary equipment that supports traffic signal control. It also includes field masters, and equipment that supports communications with a central monitoring and/or control system, as applicable. The communications link supports upload and download of signal timings and other parameters and reporting of current intersection status. This equipment package represents the field equipment used in all levels of traffic signal control from basic actuated systems that operate on fixed timing plans through adaptive systems. It also supports all signalized intersection configurations, including those that accommodate pedestrians.
- **Roadway Equipment Coordination -** This equipment package supports direct communications between field equipment. It includes field elements that control and send data to other field elements. This includes coordination between remote sensors and field devices (e.g., Dynamic Message Signs) and coordination between the field devices themselves (e.g., direct coordination between traffic controllers that are controlling adjacent intersections.).
- **Roadway Basic Surveillance -** This equipment package monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras.
- **Field Management Station Operation -** This equipment package supports direct communications between field management stations and the local field equipment under their control.

The approach used in the KIPDA Regional ITS Architecture is to begin with the mapping of equipment packages to service packages to elements as an initial definition of the functions being performed by each element. Then this mapping is tailored to provide a more accurate picture of the functions performed by the element.

The details of this functional definition are provided on the hyperlinked web site version of the architecture. Each element that has been mapped to a subsystem entity (e.g. traffic management subsystem) has a set of Functional Areas (e.g. equipment packages) assigned to it.

For example, the TRIMARC Traffic Management System element has the following functional areas (e.g. equipment packages) assigned to it:

- Collect Traffic Surveillance
- Service Patrol Management
- TMC Environmental Monitoring
- TMC Evacuation Support
- TMC Incident Detection
- TMC Incident Dispatch Coordination/Communication
- TMC Probe Information Collection
- TMC Regional Traffic Management
- TMC Traffic Information Dissemination
- TMC Traffic Metering
- Traffic Data Collection
- Traffic Equipment Maintenance

This represents a first level of detail that can be obtained in the hyperlinked web site in connection with functionality. For each of the functional areas (e.g. equipment packages) assigned to an element, selecting that functional area will take the user to additional levels of detail about the function. The hyperlinked web site uses the relationships inherent in the National ITS Architecture (equipment packages are mapped to functional requirements) to provide the additional levels of detail.

# 9. Standards

## *9.1. Discussion of key standards in the region*

ITS standards establish a common way in which devices connect and communicate with one another. This allows transportation agencies to implement systems that cost-effectively exchange pertinent data and accommodate equipment replacement, system upgrades, and system expansion. Standards benefit the traveling public by providing products that will function consistently and reliably throughout the region. ITS standards contribute to a safer and more efficient transportation system, facilitate regional interoperability, and promote an innovative and competitive service for transportation products and services.

Use of ITS standards is very important to project development in the KIPDA region.
Table 3 identifies the ITS standards that are potentially applicable to the region. This table was created by taking the standards information available in the Turbo Architecture database (which identifies standards applicable to each architecture flow) and taking the total set of standards that

result from all of the selected flows. The table provides the status of the standards effort as of November 2015, (the most recent update of the information).

The following section explains how to identify the specific applicable standards for an individual interface. The table lists the Standards Development Organization (SDO) in the first column, the name of the standard in the second, and the standard document ID in the third. Regular updates of SDO activities will help ensure that the latest standards are utilized. The SDOs listed below include:

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

**Table 3: Applicable ITS Standards**

| SDO | Standard Title | Standard Doc ID |
|---|---|---|
| AASHTO/ITE | Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) | ITE TMDD |
| 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 | Global Object Definitions | NTCIP 1201 |
| **AASHTO/ITE/NEMA** | **NTCIP Center-to-Center Standards Group** | **NTCIP C2C** |
| **AASHTO/ITE/NEMA** | **NTCIP Center-to-Field Standards Group** | **NTCIP C2F** |
| AASHTO/ITE/NEMA | Object Definitions for Actuated Traffic Signal Controller (ASC) Units | NTCIP 1202 |
| 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 | Object Definitions for Conflict Monitor Units (CMU) | NTCIP 1214 |
| AASHTO/ITE/NEMA | Object Definitions for Data Collection and Monitoring (DCM) Devices | NTCIP 1206 |
| AASHTO/ITE/NEMA | Object Definitions for Dynamic Message Signs (DMS) | NTCIP 1203 |

| SDO | Standard Title | Standard Doc ID |
|---|---|---|
| AASHTO/ITE/NEMA | Object Definitions for Environmental Sensor Stations (ESS) | NTCIP 1204 |
| AASHTO/ITE/NEMA | Object Definitions for Ramp Meter Control (RMC) Units | NTCIP 1207 |
| AASHTO/ITE/NEMA | Object Definitions for Signal Control and Prioritization (SCP) | NTCIP 1211 |
| APTA | Standard for Transit Communications Interface Profiles | APTA TCIP-S-001 3.0.4 |
| ASTM | Dedicated Short Range Communication at 915 MHz Standards Group | DSRC 915MHz |
| ASTM | Standard Practice for Metadata to Support Archived Data Management Systems | ASTM E2468-05 |
| ASTM | Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data | ASTM E2665-08 |
| ASTM/IEEE/SAE | Dedicated Short Range Communication at 5.9 GHz Standards Group | DSRC 5GHz |
| IEEE | Incident Management Standards Group | IEEE IM |
| IEEE | Standard for Message Sets for Vehicle/Roadside Communications | IEEE 1455-1999 |
| IEEE | Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection | IEEE 1570-2002 |
| SAE | Advanced Traveler Information Systems (ATIS) General Use Standards Group | ATIS General Use |
| SAE | Dedicated Short Range Communications (DSRC) Message Set Dictionary | SAE J2735 |

***Notes:***
The following definitions come from Version 7.1 of the National ITS Architecture. For a more up to date description of the following standards groups, please refer to the National ITS Architecture website.

Two key standards "groups" are listed in the table above. The descriptions of the specific standards that are included in these groups are given below:

**NTCIP C2F: NTCIP Center-to-Field Standards Group**

The table above specifies the NTCIP Center-to-Field Standards Group, which addresses the communications protocols between a center and the ITS field devices it manages. The family includes the communications profiles that cover the interfaces between a traffic management center and dynamic message signs, ramp meters, environmental sensors, or CCTVs under its control. These protocols are common across all Center-to-Field interfaces in the National ITS

Architecture, and rather than repeat the entire list for each architecture flow, we have created this summary entry – the NTCIP C2F Group of communications standards.

The "vocabulary" (objects) is specific to the actual architecture flow in the National ITS Architecture and is therefore mapped to the corresponding Data Object standard. (In the example above, the "Object Definitions for Dynamic Message Signs" standard would be mapped to the specific control and data flows between the Traffic Management Subsystem and the Roadway DMS equipment).

In order to satisfy a wide spectrum of system and regional communications requirements, Center-to-Field ITS deployments should each implement the combinations of the following NTCIP C2F communications protocols that best meet their needs.

This Group includes the following Standard:

NTCIP 1101: Simple Transportation Management Framework (STMF)
NTCIP 1102: Base Standard: Octet Encoding Rules (OER)
NTCIP 1103: NTCIP Transportation Management Protocols (TMP)
NTCIP 2101: Point to Multi-Point Protocol Using RS-232 Subnetwork Profile
NTCIP 2102: Subnet Profile for PMPP Over FSK modems
NTCIP 2103: Subnet Profile for Point-to-Point Protocol using RS 232
NTCIP 2104: Subnet Profile for Ethernet
NTCIP 2201: Transportation Transport Profile
NTCIP 2202: Internet (TCP/IP and UDP/IP) Transport Profile
NTCIP 2301: Application Profile for Simple Transportation Management Framework (STMF)
NTCIP 2302: Application Profile for Trivial File Transfer Protocol
NTCIP 2303: Application Profile for File Transfer Protocol (FTP)

**NTCIP C2C: NTCIP Center-to-Center Standards Group**

The table above specifies the NTCIP Center-to-Center (NTCIP C2C) Group of Standards, which address the communications protocols between two centers (e.g. two traffic management centers exchanging information to facilitate regional coordination of traffic signals). Some of the communication protocols covered by this family are DATEX-ASN and FTP. These protocols are common across all Center-to-Center interfaces in the National ITS Architecture, and rather than repeat the entire list for each architecture flow, we have created this summary entry – the NTCIP C2C Group of communications standards.

The standards that describe the "vocabulary" (data elements and messages) are mapped to specific architecture flows rather than the entire set of NTCIP C2C interfaces. In the regional traffic coordination example above, the "Traffic Management Data Dictionary" and the "Message Set for External TMC Communications" standards would be mapped to the specific flows between two Traffic Management Subsystems.

In order to satisfy a wide spectrum of system and regional communications requirements, Center-to-Center ITS deployments should each implement the combinations of the following NTCIP C2C communications protocols that best meet their needs.

This Group includes the following Standards:

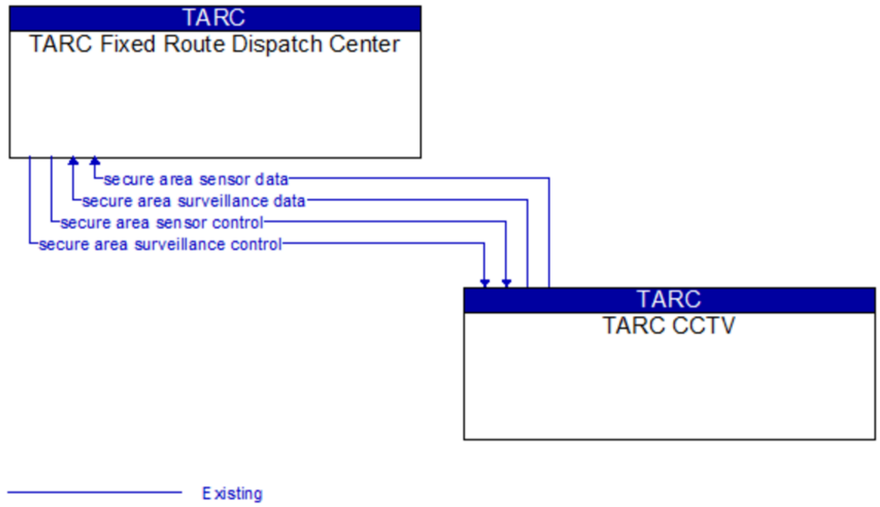
NTCIP 1102 Octet Encoding Rules (OER) Base Protocol
NTCIP 1104 Center-to-Center Naming Convention Specification
NTCIP 2104 Ethernet Subnetwork Profile
NTCIP 2202 Internet (TCP/IP and UDP/IP) Transport Profile
NTCIP 2303 File Transfer Protocol (FTP) Application Profile
NTCIP 2304 Application Profile for DATEX-ASN (AP-DATEX)
NTCIP 2306 Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (C2C XML)

## *9.2. Reference to the detailed standards information on the Web Site*

The previous section provides a general discussion of the standards environment in the region. However, the architecture does contain a far more detailed standard view, one that maps applicable standards to the individual information flow that goes from one element to another. This detailed information is contained in the hyperlinked web site and can be accessed in two different ways. Each element description page has a set of links that describe the information flowing to and from the element to other elements of the architecture. Selecting any of these interface links brings the user an interface page. For example, the interface between the TARC Fixed Route Dispatch Center and the TARC CCTV field devices shown in Figure 6. The information flow in this diagram is defined at the bottom of the same webpage, and also shown below in Figure 7. Name of the architecture flow will provide the applicable standards for the flow. An example, for the *secure area surveillance control* flow, is shown in Figure 8.

INTERCONNECT: TARC FIXED ROUTE DISPATCH CENTER - TARC CCTV

(Click on image to view full-size)




(E) = Existing Flow
(P) = Planned/Future Flow
(E/P) = Existing and Planned Flow - Flow appears as Existing and Planned

**Figure 6: Example of Interface to discuss standards**

| Source | Architecture Flows | Destination |
|---|---|---|
| TARC Fixed Route Dispatch Center | secure area surveillance control (E)<br>secure area sensor control (E) | TARC CCTV |
| TARC CCTV | secure area surveillance data (E)<br>secure area sensor data (E) | TARC Fixed Route Dispatch Center |

**Figure 7: Information flows on example interface to discuss standards**

FLOW: SECURE AREA SURVEILLANCE CONTROL

| Description: | | | |
|---|---|---|---|
| Information used to configure and control audio and video surveillance systems used for transportation infrastructure security in secure areas. The provided information controls surveillance data collection, aggregation, filtering, and other local processing. | | | |
| **Communications Standards:** | | | |
| NTCIP C2F | AASHTO-17 | File Transfer Protocol (FTP) Application Profile | NTCIP 2303 |
| NTCIP C2F | AASHTO-18 | Trivial File Transfer Protocol (TFTP) Application Profile | NTCIP 2302 |
| NTCIP C2F | AASHTO-21 | Octet Encoding Rules (OER) Base Protocol | NTCIP 1102 |
| NTCIP C2F | AASHTO-28 | Ethernet Subnetwork Profile | NTCIP 2104 |
| NTCIP C2F | AASHTO-30 | Point-to-Point Protocol Over RS-232 Subnetwork Profile | NTCIP 2103 |
| NTCIP C2F | AASHTO-31 | Transportation Transport Profile | NTCIP 2201 |
| NTCIP C2F | AASHTO-38 | Transportation Management Protocols (TMP) | NTCIP 1103 |
| NTCIP C2F | AASHTO-47 | Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile | NTCIP 2102 |
| NTCIP C2F | NEMA-TS3.p | Point to Multi-Point Protocol Using RS-232 Subnetwork Profile | NTCIP 2101 |
| NTCIP C2F | S-85 | Simple Transportation Management Framework (STMF) Application Profile | NTCIP 2301 |
| NTCIP C2F | S-88 | Internet (TCP/IP and UDP/IP) Transport Profile | NTCIP 2202 |
| **Message Standards:** | | | |
| AASHTO1-5 | AASHTO1-5 | Object Definitions for Closed Circuit Television (CCTV) Camera Control | NTCIP 1205 |
| AASHTO-35 | AASHTO-35 | Object Definitions for Closed Circuit Television (CCTV) Switching | NTCIP 1208 |
| NEMA TS3.4 | NEMA TS3.4 | Global Object Definitions | NTCIP 1201 |
| **Data Standards:** | | | |
| No Data Standards | | | |

**Figure 8: Example of Standards Mapping**

# 10. Project Implementation Plan

The regional ITS architecture defines a number of planned elements, interfaces, and information flows. As regional plans are developed these parts of the regional ITS architecture will be implemented by a series of projects. Table 4 provides a summary of regional projects that have been identified. The Timeframe column represents the following information about when the project is planned for implementation:

- Short Term- 1-5 years
- Long Term- over 5 years.

The projects listed will be implemented by key interfaces in the architecture as defined by the service packages identified with these projects. The full architecture contains many additional planned interfaces that represent possible interfaces for the future that have not yet been defined in projects. Over time additional projects will be developed to address further aspects of the architecture.

**Table 4: Kentuckiana Regional Planning and Development Agency Area Projects**

| Project Name | Project Description | Stakeholder | Service Package | Timeframe |
|---|---|---|---|---|
| INDOT Connected Vehicle Applications | This project aims to implement a current smartphone application, which uses 3rd party probe data in order to detect queues - within police, maintenance, and emergency vehicles on the Indiana roadways. | INDOT | AVSS12-7 | Long |
| INDOT I-64 ITS Expansion | This project will expand the ITS devices along Interstate 64 west of Georgetown, Indiana. | INDOT | ATMS01-3, ATMS06-3 | Long |
| INDOT ITS Field Device Expansion | This project will increase the number of ITS devices on the Indiana roadway, such as CCTVs, DMS, and sensors. | INDOT | ATMS06-3, ATMS01-3 | Short |
| INDOT ITS Field Device Replacement | This project will replace old, damaged CCTVs, DMS, and sensors with new ones. | INDOT | ATMS06-3, ATMS01-3 | Long |
| INDOT Signal Interconnect Upgrade | This project will add new additional interconnects, to and from traffic signal controllers, along the Indiana roadways. | INDOT | ATMS03-2 | Long |
| INDOT Signal Modernization | This project plans to maximize the use of existing traffic signals by (1) increasing communications from the TMC to the signals, either through an improved wireless network or through fiber and by (2) optimizing signal timing in relation to the new downtown bridge volume counts. | INDOT | ATMS03-2 | Long |

| Project Name | Project Description | Stakeholder | Service Package | Timeframe |
|---|---|---|---|---|
| INDOT Travel Time DMS Expansion | This project aims to add DMS showing travel times and alternate routes available, based on demand, within the Southern tier of Indiana. | INDOT | ATMS06-3 | Long |
| INDOT Variable Speed Sign Upgrade | This project will introduce variable speed limit signs to Indiana arterials in order to manage and control the flow of traffic. | INDOT | ATMS22-1 | Long |
| Utility Coordination | Coordination between the transportation and utility sectors in regards to asset maintenance and construction. | KYTC | ATMS08-13, ATMS08-17 | Long |
| KYTC Maintenance Vehicle AVL | This project will add AVL capability for KYTC Maintenance Vehicles. | KYTC | MC01-1 | Short |
| KYTC/INDOT RiverLink Tolling | The new tolling system is in effect in each direction, to/from Kentucky and to/from Indiana. Toll rates depend on the size of the vehicle, determined by the number of axles and the height of the vehicle. Drivers with transponders and prepaid RiverLink accounts pay the lowest rates. The operation is all-electronic tolling, with no cash tolls. Drivers must set up a prepaid RiverLink account to get a transponder, or use an E-Z Pass transponder. Drivers without accounts and transponders receive an invoice in the mail. | KYTC/INDOT | ATMS10-1 | Short |

| **Project Name** | **Project Description** | **Stakeholder** | **Service Package** | **Timeframe** |
|---|---|---|---|---|
| Regional Truck Parking Information and Management System (TPIMS) | Interstate truck parking system that will provide parking information to commercial vehicles. | KYTC/INDOT | ATMS17-1 | Short |
| La Grange Local Transit Expansion | This project will expand local transit within La Grange. | Local Governments | APTS03-2 | Short |
| Oldham County Arterial DMS | This project will provide drivers with up to date information in order to influence travel patterns to avoid congestion when there is an incident, special event, etc., along I-71. | Local Governments | ATMS06-4 | Short |
| Shelby County Early Warning Signs | This project will add DMS before freeway ramp entrances, telling drivers whether or not to take another route due to congestion, construction, etc. | Local Governments | ATMS06-4 | Long |
| Louisville Metro BikeShare | This project develops a bikeshare capability allowing users to pickup and dropoff bicycles at a series of bike stands. | Louisville Metro Government | ATIS08-1 | Long |

| Project Name | Project Description | Stakeholder | Service Package | Timeframe |
|---|---|---|---|---|
| Louisville Metro Adaptive Signal System | This project allows signal timing optimization based on live traffic demands. In addition, this project will use video to analyze traffic flow at intersections and adjust timing based on historical data obtained by the video. This video can also be utilized for traffic counts. Currently, one system exists on KY-1747 Hurstbourne, 5 signals from Linn Station to Bluegrass. | Louisville Metro Traffic | ATMS03-1 | Short |
| Louisville Metro and WAZE Coordination | The objective of this project is to provide seamless real-time and historic data exchange between Louisville Metro and WAZE, the world's largest community based traffic and navigation application. This data can then be used for traffic counts and also for planning purposes. | Louisville Metro Traffic | ATMS01-2 | Short |
| Louisville Metro Arterial Technology Expansion | This project will add new cameras and dynamic message signs along the Louisville arterials. | Louisville Metro Traffic | ATMS06-2, ATMS01-2 | Short |
| Louisville Metro Connected Vehicle Applications | This project will install CV applications along the Louisville arterial network. | Louisville Metro Traffic | AVSS12-5 | Long |
| Louisville Metro Controller Replacement | This project aims to replace outdated and/or broken controller units with new ones in the Louisville metro area. | Louisville Metro Traffic | ATMS03-1 | Short |

| Project Name | Project Description | Stakeholder | Service Package | Timeframe |
|---|---|---|---|---|
| Louisville Metro Electrical Vehicle Charging System | Louisville Metro will partner with LG&E to develop Electric Vehicle Charging stations. | Louisville Metro Traffic | AVSS12-9 | Long |
| Louisville Metro Enhanced Data Collection Capabilities | This project will enhance Louisville Metro's data collection capabilities, which would incorporate data collection from city, state, and counties as well as third party data vendors. | Louisville Metro Traffic | AD01-4 | Long |
| Louisville Metro Fiber Upgrade | This project will install new, upgraded fiber to connect additional CCTV and signals in the Louisville metro area. | Louisville Metro Traffic | ATMS01-2, ATMS03-1 | Short |
| Louisville Metro New Dixie Highway | This project aims to achieve a Bus Rapid Transit (BRT) like system, which will have 40 signals equipped with Transit Signal Priority (TSP), new cameras, new DMS, and new BRT stops located from City Hall in Louisville to the end of Dixie Highway. Hardened Fiber will also run along this 17 mile stretch. The project will also provide safer pedestrian connectivity facilities and roadway design improvements which will increase driver safety. | Louisville Metro Traffic | APTS09-1, ATMS01-2, ATMS06-2 | Short |
| Louisville Metro Smart City Data Integration | This project will form a connection between all agencies within the Louisville metro and Southern Indiana area, enabling data integration and data sharing to support Smart City applications. | Louisville Metro Traffic | AD02-2 | Long |

| **Project Name** | **Project Description** | **Stakeholder** | **Service Package** | **Timeframe** |
|---|---|---|---|---|
| Louisville Metro Travel Information Kiosks | This project will implement generic traveler information stations, including bikeshare and traffic info, within the Louisville metro area. | Louisville Metro Traffic | ATIS02-2 | Long |
| Louisville Metro Vehicle Detection Upgrade | This project aims to replace induction loop detectors with new forms of detection technology. | Louisville Metro Traffic | ATMS01-2 | Short |
| TARC Automatic Annunciators | This project will place automatic annunciators, complete with voice and visual display, in each ITS system on every TARC transit vehicle. | TARC | APTS08-1 | Long |
| TARC Dixie BRT | This project will develop new stops, with signage, transit signal priority, and kiosks at major stations. | TARC | APTS09-1 | Short |
| TARC Electrical Vehicle Charging Expansion | Project will expand on street charging capabilities for the TARC fleet. | TARC | AVSS12-10 | Long |
| TARC Fare System Improvement | This project will implement a single smart card, between the TARC system and its four partner companies, for ease of access. | TARC | APTS04-1 | Long |
| TARC ITS Hardware Replacement | This project will assess current hardware along the TARC system and make replacements based on life cycle age and ability to perform. | TARC | APTS05-1 | Long |
| TARC Passenger Counters | This project will place additional passenger counters within the TARC system. | TARC | APTS10-1 | Long |
| TARC Real Time | This project aims to integrate Real Time information at transit stops. | TARC | APTS08-1 | Long |

| Project Name | Project Description | Stakeholder | Service Package | Timeframe |
|---|---|---|---|---|
| TARC Wireless Router Expansion | This project aims to provide passenger Wi-Fi on TARC transit vehicles, at stops, and at main stations. Currently 102 buses have already been equipped with Wi-Fi capability. | TARC | APTS08-1 | Long |
| TRIMARC Arterial Dynamic Message Signs (ADMS) | This project will provide drivers with up to date information in order to influence travel patterns to avoid congestion when there is an incident, special event, etc. | TRIMARC | ATMS06-1 | Short |
| TRIMARC CCTV Expansion | This project will install new cameras to enhance coverage area and monitor all interstate miles in the Metro area. | TRIMARC | ATMS01-1 | Short |
| TRIMARC Connected Vehicle Implementation | This project will implement connected vehicle applications to provide safety and mobility improvements. | TRIMARC | AVSS12-1, AVSS12-2, AVSS12-3, AVSS12-4 | Long |
| TRIMARC Dedicated Communications Network with Fiber Backhaul | This project will upgrade current system to fiber optic (in order to simplify operations, increase capacity, improve reliability, flexibility, and decrease reoccurring costs). | TRIMARC | ATMS06-1, ATMS01-1 | Short |
| TRIMARC DMS Expansion and Refurbishment | This project will expand TRIMARC DMS coverage, specifically along the outbound lanes from downtown Louisville, and along circumferential Routes I-264 and I-265. | TRIMARC | ATMS06-1 | Short |
| TRIMARC Dual ITS/Homeland Security CCTV | This project will install cameras to cover traffic on the bridges between Louisville and Indiana, and could also be used by the Coast Guard use for homeland security purposes. | TRIMARC | EM05-1, ATMS01-1 | Short |

| Project Name | Project Description | Stakeholder | Service Package | Timeframe |
|---|---|---|---|---|
| TRIMARC Expansion of devices beyond Jefferson County | This project will add surveillance and DMS devices on interstates outside of Jefferson County. | TRIMARC | ATMS06-1, ATMS01-1 | Long |
| TRIMARC Expansion of devices on Outbound Lanes | This project will add CCTV and DMS on outbound interstate. | TRIMARC | ATMS01-1, ATMS06-1 | Long |
| TRIMARC Expansion of Freeway Service Patrol Program (FSP) | This project will expand the FSP program to improve coverage and operations. | TRIMARC | EM04-1 | Short |
| TRIMARC Expansion of Traffic Sensors | This project will install sensors to enhance monitored coverage area and provide data for travel time calculations to be co-located with CCTV devices. Additionally, these sensors can be standalone or co-located with other state owned equipment. It is recommended radar units also have embedded video. | TRIMARC | ATMS01-1 | Short |
| TRIMARC Highway Advisory Radio (HAR) and Flasher Units | This project will install additional Highway Advisory Radio Transmitters (to boost signal strength and enhance coverage throughout the Metro area). Existing transmitters would be redistributed and receive an auxiliary power system, with a fiber backhaul (decrease HAR download times). | TRIMARC | ATMS06-1 | Short |

| Project Name | Project Description | Stakeholder | Service Package | Timeframe |
|---|---|---|---|---|
| TRIMARC I-265 Coverage | This project will add surveillance and DMS devices on I-265. | TRIMARC | ATMS01-1, ATMS06-1 | Short |

# 11. Agreements

Agreements were collected from stakeholders in the KIPDA region during the one-on-one stakeholder interviews, as well as at the ITS Architecture Update Workshop. Table 5 outlines the agreements identified by regional stakeholders during the ITS Architecture Update process.

**Table 5: Agreements**

| Number | Title | Type | Description | Stakeholders |
|---|---|---|---|---|
| 1 | Agreement to build, finance ORB Project | Agreement | KY, IN and FWHA agreement to build the two bridges over the Ohio River. | • FHWA<br>• INDOT<br>• KIPDA<br>• KYTC<br>• Louisville Metro Government<br>• Louisville Metro Traffic<br>• TARC<br>• TRIMARC |
| 2 | GIS Data Sharing | Agreement | Agreement between all agencies in Jefferson County to share all GIS data obtained by any of the partner agencies. | • Kentucky Justice Cabinet<br>• KIPDA<br>• KYTC<br>• Louisville Metro Traffic<br>• TARC<br>• TRIMARC |
| 3 | Traffic Signal Operation and Maintenance | MOU | Agreement for operations and maintenance of traffic signals | • Louisville Metro<br>• KYTC |
| 4 | Air Quality Conformity Data Sharing | MOU | Data Sharing agreement for air quality data | • KIPDA<br>• KYTC<br>• LMAPCD<br>• IDEM<br>• FHWA |
| 5 | Video Sharing | MOU | Agreement for sharing of video data with media. | • TRIMARC<br>• Media |
| 6 | GTFS Data Usage | MOA | Fair use agreement for GTFS data created by TARC | • TARC<br>• Third Parties |

| Number | Title | Type | Description | Stakeholders |
|---|---|---|---|---|
| 7 | Planning Data Sharing | MOA | Sharing of transportation data to support MPO planning activities | • KIPDA<br>• TARC<br>• KYTC<br>• INDOT<br>• TRIMARC |

# 12. Using the Regional ITS Architecture

Once a regional ITS architecture has been created, it's important that it be used as a key reference in the transportation planning process. This will ensure all proposed ITS projects are consistent with the regional ITS architecture and additional integration opportunities are considered, leading to more efficient implementations.

Planning processes are used to identify projects whose implementation will respond to regional needs. The key planning document is the Metropolitan Transportation Plan (MTP). Specific projects are placed in programming documents such as a Transportation Improvement Program (TIP) in order to secure funding for the projects. The coordinated development of these documents is one of the responsibilities outlined in 23 CFR, Part 450 for MPO's including KIPDA. It should be noted that the ITS architecture can play an important support role in this process, providing the level of stakeholder input that facilitates the integration of ITS into the larger regional transportation program. Once funded, the projects are implemented. The Regional ITS Architecture supports all three of these major steps – planning, programming, and implementation

An important part of developing an ITS Architecture is identifying the best approach to using it in the aforementioned MPO's transportation planning and programming process. An ITS Architecture provides guidance for planning ITS projects within a region. It also provides information that can be used in the initial stages of project definition and development. This section presents the approach for integrating the KIPDA Regional ITS Architecture in KIPDA's transportation planning/programming process and leveraging the ITS Architecture for project definition. The approach facilitates and provides a mechanism for the projects identified in this document or in the MTP and TIP to be planned and deployed in an orderly and integrated fashion.

The primary objective of the ITS Architecture is integration. The integration of transportation systems to share information and coordinate activities provides significant benefits over the operation of systems in a stove-piped fashion. The KIPDA Regional ITS Architecture identifies the information to be exchanged between transportation systems to meet the transportation needs of the stakeholders in the region.

The ITS Architecture addresses these needs through ITS Services which are mapped to the ITS projects that address them. The ITS Architecture was developed with these objectives in mind through the definition of ITS Services or Service Packages. By defining the ITS Architecture with services that address the needs, projects can be defined through the planning process using the architecture that addresses these needs through deployment.

## *12.1. Using the KIPDA Regional ITS Architecture in the Planning Process*

One of the most important outcomes of the KIPDA Regional ITS Architecture is that it will be used to plan and deploy ITS across the region. To do this, the ITS Architecture must be integrated into the regional planning process. As a result of integrating the ITS Architecture into the planning process, the architecture will link the needs of the region with the ITS deployments in the field.

KIPDA is the designated MPO in the region and is responsible for facilitating the prioritization and programming for all projects in the region through the development of the 20-year Metropolitan Transportation Plan (MTP), and its near-term Transportation Improvement Program (TIP), the latter being a subset of the Statewide Transportation Improvement Programs (STIPs).

The member agencies of the MPO, represented by the Transportation Policy Committee (TPC) with its contributing committee structure, has designed the process consistent with federal rules to ensure that all transportation projects included on the federal transportation system are implemented consistent with the region’s mobility goals, and are consistent with all federal, state, and local rules as applicable to providing a safe and efficient transportation system. All local municipalities and counties in the KIPDA Region, including the KYTC and INDOT are members of KIPDA. In order to facilitate the connection between the Regional ITS Architecture and the local transportation program (MTP and TIP) the TPC has adopted the KIPDA Regional ITS Architecture as part of the official set of planning documents for the region.

The goal of the planning process is to make quality, informed decisions pertaining to the investment of public funds for regional transportation systems and services. Using the regional ITS architecture to support these planning activities is an important step in the mainstreaming of ITS into the traditional decision-making of planners and other transportation professionals. Once an architecture is complete, it can feed detailed ITS-specific information back into the planning process.

Figure 9 below shows some of the key steps in the general transportation planning process and the ITS Architecture interrelation to the steps in the process. These steps will be elaborated on in following sections. The process is driven by a regional vision and set of goals. These drive transportation improvement strategies that are a mix of capital improvements and operational improvements. The planning organizations evaluate and prioritize the various strategies, and the resulting output is the Metropolitan Transportation Plan (MTP). This plan is the key output of long range planning.

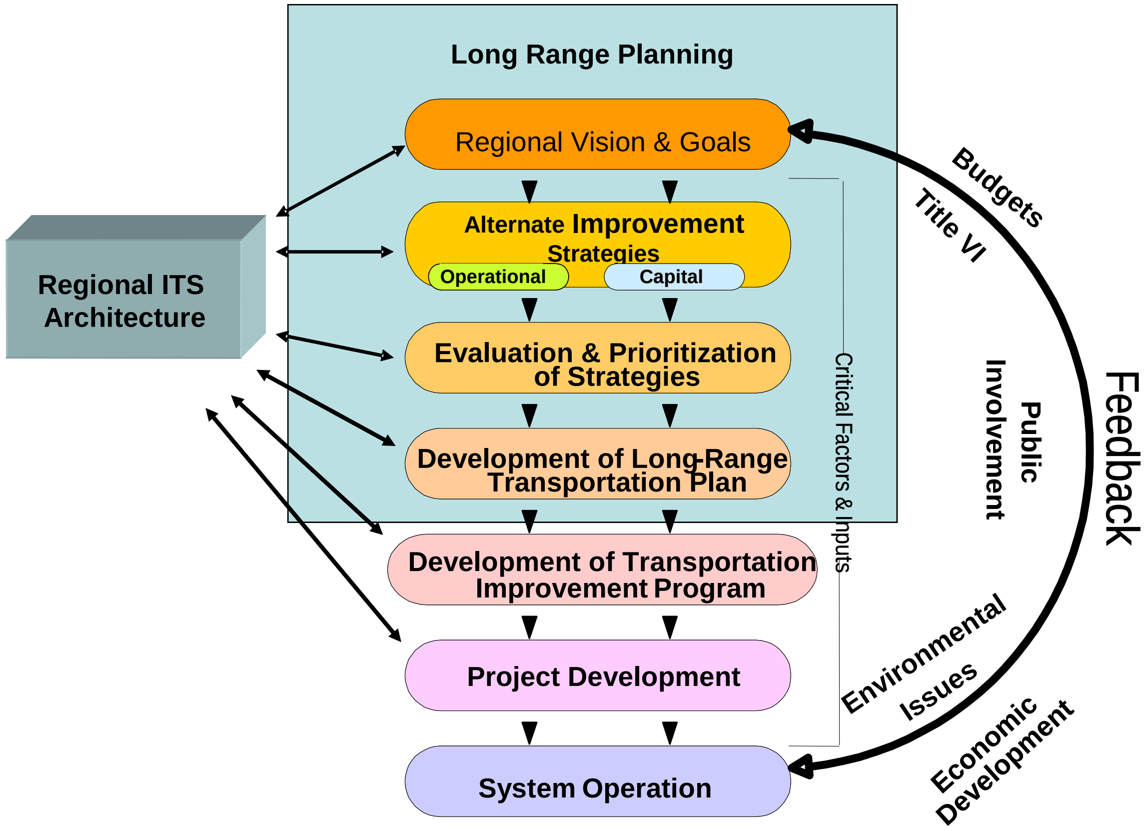



**Figure 9: ITS Architecture and the Transportation Planning Process**

For the KIPDA region the primary planning document is the *Horizon 2035: The Metropolitan Transportation Plan for the Louisville (KY-IN) Metropolitan Planning Area: Clark & Floyd Counties, Indiana and Bullitt, Jefferson, & Oldham Counties, Kentucky*. It is the long-range guide for major investments in the region's multimodal surface transportation system. The MTP recommends major projects, systems, policies and strategies designed to maintain the existing transportation system and serve the region's future travel needs. With the update of the KIPDA Regional ITS Architecture, it is recommended that the draft Metropolitan Transportation Plan be reviewed and updated as necessary to incorporate any new aspects of transportation connectivity defined in the architecture.

This document contains the following:

- MTP regional priorities. The plan contains six regional priorities which drive the development of projects for the region. The six regional priorities defined for the KIPDA region are:
    - Safety
    - Congestion Management
    - Travel Demand Management
    - Air Quality
    - Freight

- Alternative Modes

- A list of projects, programs, and strategies meant to address the regional priorities.

The MTP is the expression of KIPDA's long-range approach to planning and implementing the multimodal transportation system. It is the policy forum for balancing transportation investments among modes, geographic areas, and institutions.

How can a Regional ITS Architecture support the transportation planning process? In the following basic ways that will be expanded upon below:

- The services described in the regional ITS Architecture can provide the basis for operational strategies that can be used to improve the transportation system to meet the region's vision and goals.

- The definition of an integrated transportation system described by the regional ITS architecture can support the ITS elements of the MTP.

- The process of developing and maintaining a regional ITS architecture can help to enhance the linkage between operations and planning through closer involvement of a wider array of stakeholders from both of these areas of transportation.

The discussion above focuses on supporting the MPO transportation planning process, but the architecture can also be used to support the other planning processes used by agencies in the region (e.g. public safety agencies). As shown in Figure 10, agencies that do not use federal transportation funds (or operate through the MPO planning process) will still have some form of long range plan and capital plan whose development can be supported by the regional ITS architecture.

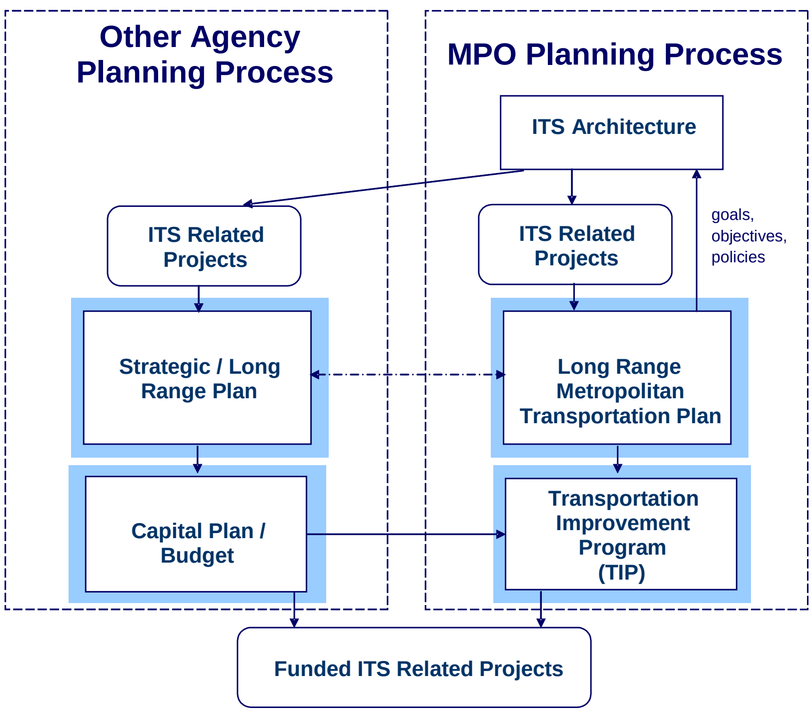



**Figure 10: Supporting the Transportation Planning Processes**

The challenge for achieving integration across planned ITS projects in the region is to know how they fit together and interact or depend on each other. The regional ITS architecture can be leveraged to bridge the MPO processes to other agencies planning processes that do not use federal transportation funding. If all the processes are using the same reference point, the regional ITS architecture, then project integration can start in the planning phase

## 12.2. Architecture Use in Project Programming

All agencies including KIPDA, KYTC, INDOT, TARC, local municipalities, etc. use a budgeting process to allocate funds to projects. The primary programming document for the region is the *Transportation Improvement Program for the Louisville/Jefferson County, KY-IN Metropolitan Planning Area.* The current version of the TIP is the FY2015- FY2018 version which, along with amendments, defines the regional transportation projects that have funds programmed for development. While most of the projects are Capital Improvement Projects (CIP), the TIP does include some ITS projects. Many ITS improvements are implemented as part of larger capital improvement projects, aka the CIP. As traditional capital projects are defined and programmed, it is important to identify the associated opportunities for efficient ITS implementation.

The KIPDA Regional ITS Architecture is a record of the ITS implementation planned by each agency that can be used to identify these opportunities. Most agencies in the region have developed policies to review each capital project to determine if ITS measures should be included before the project moves forward. One important consideration with these "locally-funded" ITS projects is the consideration of the Systems Engineering Process (discussed in the next section) that is necessary in order to integrate with the larger federally-funded ITS system. Without System Engineering, the project's ability to integrate with other deployments may be at risk.

## 12.3. Using the KIPDA Regional ITS Architecture in Project Definition

Projects that emerge from the planning process can benefit from the use of the KIPDA Regional ITS Architecture in their definition and development. ITS project implementation should follow a systems engineering process. The ITS Architecture is most effective in the early phases of systems engineering processes. Figure 11 shows a typical project implementation process for deploying ITS projects.

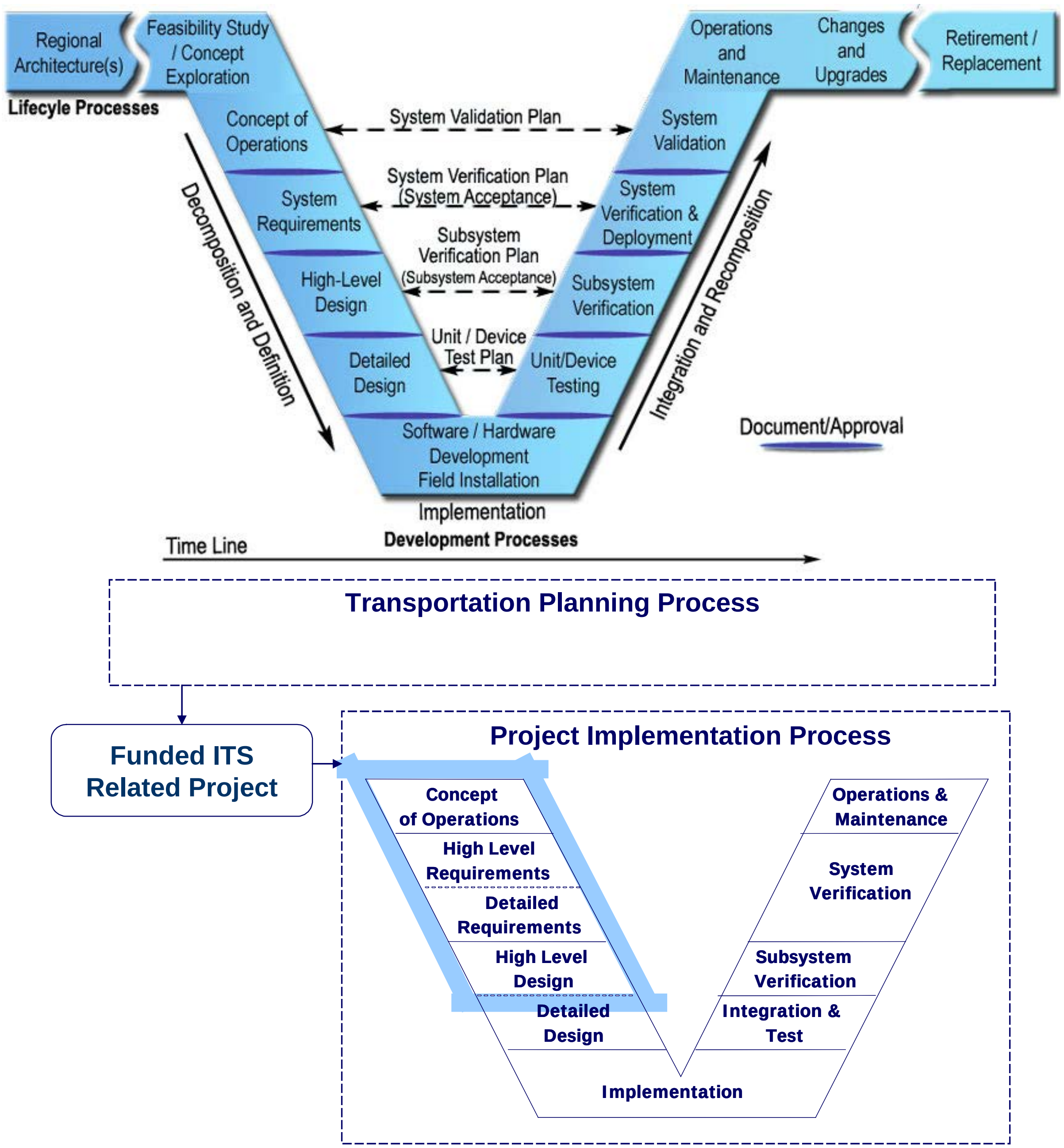



**Figure 11: Project Implementation Process**

The project implementation process shown in Figure 11 is a Systems Engineering process. It is a process that can be used to systematically deploy ITS while reducing the risks associated with deployments. The Systems Engineering process is more than just steps in systems design and implementation; it is a life-cycle process. The process recognizes that many projects are deployed incrementally and expand over time. US DOT Rule 940 requires that the systems engineering process be used for ITS projects that are funded with federal funds.

Applying the System Engineering process to ITS project development is a key requirement that must be addressed by stakeholders using federal funds.

FHWA Rule 940/FTA Policy contains a set of requirements that apply to ITS projects. The Rule indicates that a Project Systems Engineering Analysis (PSEA) be created. The requirements for the PSEA, summarized below, state:

a) All ITS projects funded with highway trust funds shall be based on a systems engineering analysis.
b) The analysis should be on a scale commensurate with the project scope.
c) The systems engineering analysis shall include, at a minimum:
    1. Portions of the Regional ITS Architecture Being Implemented
    2. Participating Agencies Roles and Responsibilities
    3. Requirements Definitions
    4. Analysis of Alternative System Configuration and Technology Options
    5. Procurement Options
    6. Applicable ITS Standards and Testing Procedures
    7. Procedures and Resources Necessary for Operations and Management of the System.

To support development of the PSEA many organizations have created ITS Project Checklist (http://dot.state.nm.us/content/dam/nmdot/ITS/ITS_Project_Checklist.pdf) that provides a relatively easy and straight forward way to meet these requirements. An example of such a checklist, created by New Mexico DOT can be found at the following link: (http://dot.state.nm.us/content/dam/nmdot/ITS/ITS_Project_Checklist.pdf)

The checklist provides for project name, description, and contact information, and leads the respondent through a series of specific project related questions where detailed project information, procurement methods, and phasing is identified. Other queries associate the project to the regional Architecture and market packages, as well as the stages included in the Systems Engineering “V Diagram”. The form allows for the attachment of all applicable service packages diagrams which can be obtained directly from the architecture website or other architecture documentation.

The following are some key references that stakeholders can access to assist in using this process:

General Resources

- FHWA Systems Engineering Website (ops.fhwa.dot.gov/int_its_deployment/sys_eng.htm)
- International Council on Systems Engineering (www.incose.org)

Training

- Systems Engineering: An Introduction for Planners, Project Development Engineers and Project Managers
- Advanced Systems Engineering for Advanced Transportation Projects (CITE - www.citeconsortium.org/courses/syseng.html)

Publications

- Building Quality Intelligent Transportation Systems through Systems Engineering (FHWA-OP-02-046): www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/13620.html
- Systems Engineering Guidebook for ITS (FHWA California Division/Caltrans): www.dot.ca.gov/research/se_guidebook_ver1-12_14_05.pdf
- Systems Engineering for Intelligent Transportation Systems, An Introduction for Transportation Professionals: http://ops.fhwa.dot.gov/publications/seitsguide/seguide.pdf

There are similarities between the systems engineering process defined in Figure 19 and the project development process followed by agencies in the region. A typical agency project development process is as follows:

- Project Selection
- Authorization to Proceed
- Project Definition
    - Purpose and Need
    - Project Scoping
    - Conceptual Design
- Project Design
    - Preliminary Plan Development
    - Semi-Final Plan Development
    - Final Plan Development
- Construction
    - Testing
- Operation and Maintenance

Table 6 shows the relationship a typical transportation project development process has to the FHWA systems engineering process.

**Table 6: Regional Project Development Process Relation to FHWA System Engineering Process**

| Traditional Project Development Process | Relation | Systems Engineering Process |
|---|---|---|
| Project Definition<br>Purpose and Need<br>Project Scoping<br>Conceptual Design | => | Concept of Operations<br>High Level Requirements<br>Detailed Requirements |
| Project Design<br>Preliminary Plan Development<br>Semi-Final Plan Development<br>Final Plan Development | =><br>=> | High Level Design<br>Detailed Design |
| Construction<br>Testing | => | Implementation<br>Integration & Test<br>Subsystem Verification<br>System Verification |
| Operation and Maintenance | => | Operations & Maintenance |

As shown by the highlights in Figure 11 and in Table 6, the KIPDA Regional ITS Architecture can be used to support development of the concept of operations, requirements and high level design in the systems engineering process.

In deployment of an ITS related project, the ITS Architecture should be used as the starting point for developing a project **concept of operations** (not to be confused with an Architecture's Operational Concepts that define the roles and responsibilities of the Architecture's stakeholders). The concept of operations shows at a high level how the systems involved in a project operate in conjunction with the other systems of the region. According to the NHI course "Introduction to Systems Engineering for Advanced Transportation", a Concept of Operations includes the following information:

- Identification of stakeholders,
- Development of a vision for the project,
- Description of where the system(s) will be used,
- Description of organizational procedures or practices appropriate to the system(s), definition of critical performance parameters associated with the systems(s),
- Description of the utilization environment (conditions under which various parts of the system(s) will be used),
- Definition of performance measures used to evaluate the effectiveness of the system(s),
- Considerations of life cycle expectations, and

- Conditions under which the system(s) must operate (e.g. environmental conditions).

The customized service package diagrams tailored by the regional stakeholders can also assist in definition of requirements for ITS systems involved in a specific project. The ITS Architecture contains high level functional requirements for all ITS elements in the region. These high-level requirements can be the starting point for developing more detailed requirements.

The ITS Architecture can support high level system design. The ITS architecture can be used by system designers to identify the ITS standards that are applicable for the interfaces included in the architecture.

While the above discussion relates the architecture to the general system engineering process, Rule 940 does have a specific set of system engineering analysis requirements (listed above) that apply to all ITS projects that use funds from the Highway Trust Fund. The required system engineering analysis steps are:

The KIPDA Regional ITS Architecture provides inputs to a number of these steps as shown in Table 7.

**Table 7: Systems Engineering Requirements supported by KIPDA Regional ITS Architecture**

| Systems Engineering Requirements | KIPDA Regional ITS Architecture Output |
|---|---|
| Identification of portions of the regional ITS architecture being implemented | Mapping project to the elements and interfaces of the regional ITS architecture |
| Identification of participating agencies' roles and responsibilities (this relates to the Concept of Operations described earlier.) | Use Operational Concept as a starting point |
| Requirements definitions | Use Functional Requirements as a starting point. |
| Identification of applicable ITS standards and testing procedures | Use regional architecture standards outputs as a starting point for the standards definition. |

One additional area that the regional ITS architecture can support is the generation of a Request for Proposal (RFP), which is the common governmental practice for initiating a contract with the private sector to implement the project. Once a contract is in place, project implementation begins and moves through design, development, integration, and testing.

The regional ITS architecture, and the products produced during its development, can support this RFP generation. First the project definition described above forms the basis for what is being procured. Mapping the project to the regional ITS architecture allows bidders to have a clear understanding of the scope of the project and of the interfaces that need to be developed. The functional requirements created as part of the regional ITS architecture can be used to describe the functional requirements for the project. In addition, a subset of the ITS Standards identified as part of the regional ITS architecture development can be specified in the RFP.

In summary, the regional ITS architecture represents a detailed plan for the evolution of the ITS systems in the region and can be used to support regional transportation planning efforts and project development efforts.

# 13. Maintaining the Regional ITS Architecture

The KIPDA Regional ITS architecture is not a static set of outputs. It must change as plans change, ITS projects are implemented, and the ITS needs and services evolve in the region. This section describes a proposed plan for the maintenance of the architecture. The plan covers the following four key areas:

- Who will be involved in the maintenance of the architecture?
- When will the architecture be updated?
- What will be maintained?
- How it will be maintained (i.e. what configuration control process will be used)?

The regional ITS architecture is created as a consensus view of what ITS systems the stakeholders in the region have currently implemented and what systems they plan to implement in the future. The regional ITS architecture will need to be updated to reflect changes resulting from project implementation or resulting from the planning process itself.

- Changes for Project Definition. When actually defined, a project may add, subtract or modify elements, interfaces, or information flows from the regional ITS architecture. Because the regional ITS architecture is meant to describe the current (as well as future) regional implementation of ITS, it must be updated to correctly reflect how the developed projects integrate into the region.
- Changes for Project Addition/Deletion. Occasionally a project will be added or deleted through the planning process and some aspects of the regional ITS architecture that are associated with the project may be expanded, changed or removed.
- Changes in Project Priority. Due to funding constraints, or other considerations, the planned project sequencing may change. Delaying a project may have a ripple effect on other projects that depend on it. Raising the priority for a project’s implementation may impact the priority of other projects that are dependent upon it.
- Changes in Regional Needs. Transportation planning is done to address regional needs. Over time these needs can change and the corresponding aspects of the regional ITS architecture that addresses these needs may need to be updated.

In addition, new stakeholders may come to the table and the regional ITS architecture should be updated to reflect their place in the regional view of ITS elements, interfaces, and information flows.

Finally, the National ITS Architecture may be expanded and updated from time to time to include new user services or better define how existing elements satisfy the user services. The National ITS Architecture may have expanded to include a user service that has been discussed in a region, but not been included in the regional ITS architecture, or been included in only a very cursory manner. A major update of the National ITS Architecture is currently underway to combine the current Version 7.1 with the current version of the Connected Vehicle Reference Implementation Architecture (CVRIA). The update, which will revise the structure of the National ITS Architecture to be similar to that used for CVRIA, is expected to be released in mid-2017.

## 13.1. Roles and Responsibilities for Maintenance

Responsibility for maintenance of the KIPDA Regional ITS Architecture will lie with KIPDA, since they are the primary planning organization for the region, and will be one of the primary users of the architecture. While they assume responsibility for maintenance, the region will also need a group of core stakeholders to act as an "institutional framework" to review proposed changes to the architecture. The regional ITS architecture is a consensus framework for integrating ITS systems in the region. As it was a consensus driven product in its initial creation, so it should remain a consensus driven product as it is maintained. An institutional framework is needed for maintaining the products. This might be an advisory committee or some similar group, convened by KIPDA and having representatives from key stakeholder agencies in the region. This section defines the stakeholder groups and their roles and responsibilities for the maintenance of the KIPDA Regional ITS Architecture.

**Definitions**

The following stakeholder groups will have a role in the maintenance of the architecture:

- Stakeholders – Any government agency or private organization that has a role in providing transportation services in the region.
- Maintenance Working Group – A group of stakeholder representatives who are responsible for the technical review of updates/changes to the KIPDA Regional ITS Architecture, and for approving changes to go into the architecture.
- Responsible Agency – The stakeholder agency with primary responsibility for maintenance of the architecture.
- Maintenance Manager – A person responsible for overseeing and guiding the maintenance efforts.

**Stakeholders**

Stakeholders are any government agency or private organization that is involved with or has an interest in providing transportation services in the state. Each stakeholder owns, operates, and/or maintains one or more ITS elements in the architecture.

The success of the change management process outlined in this Maintenance Plan is highly dependent on the participation of the stakeholders identified in the architecture. Without stakeholder's participation in tracking the development of they're ITS systems, and properly updating the architecture, the change management process will not succeed and the usefulness of the architecture will diminish over time.

The primary responsibilities of the stakeholder agencies are submitting the changes in plans or projects to the Maintenance Working Group.

If stakeholders desire more involvement, they can get involved through voluntary representation on the Maintenance Working Group.

**Maintenance Working Group**
The KIPDA Regional ITS Architecture Maintenance Working Group or the Maintenance Working Group has the following responsibilities:
- Collecting and compiling proposed changes and updates to the architecture from stakeholder agencies.
- Evaluating each proposed change from a technical standpoint, and reaching a consensus on the proposed change.
- Approving changes to the architecture.
- Making any institutional or policy related decisions that arise in the maintenance of the architecture.

The logical composition of the maintenance working group for the region is a subset of the Advisory Committee dealing with ITS in the region. The maintenance working group should have one "voting member" from each major stakeholder in the region.

**Responsible Agency**
The Responsible Agency is the government agency that will formally maintain the architecture. The Responsible Agency will assign resources for making the physical changes to the architecture baseline, and for coordinating the maintenance of the architecture. For the maintenance of the KIPDA Regional ITS Architecture, the Responsible Agency is KIPDA, since they are the primary planning organization for the region, and will be primary users of the architecture.

**Maintenance Manager**
The Responsible Agency should appoint a person to the role of Maintenance Manager to coordinate the maintenance activities of the KIPDA Regional ITS Architecture. The Maintenance Manager will be the coordinator and main point of contact for all maintenance activities, including receiving Change Requests forms, tracking Change Requests, and distributing documentation. The Maintenance Manager is ideally an employee of the Responsible Agency who is formally tasked with the described efforts, but it is not a requirement
The Maintenance Manager has the following responsibilities:
- Coordinate the activities of the Maintenance Working Group
- Receive Change Request forms and requests for documentation from Stakeholders
- Distribute the baseline documents and outputs of the architectures to stakeholders.
- Maintain the "official" records of the KIPDA Regional ITS Architecture, including the baseline documents, meeting minutes, the Change Request Database, and the list of Points of Contacts for the Stakeholder
- Ensures the status of each Change Request are properly updated in the Change Request Database

Some of these responsibilities will likely be delegated to staff or consultants.

## 13.2. Timetable for Maintenance

How often will the regional ITS architecture be modified or updated? What events or timetable will be used for making updates or changes to the architecture?

The timetable will depend on the basic approach chosen for maintaining the architecture. There are several options that could be considered:

- **Periodic Maintenance.** This approach ties the maintenance of the architecture to one of the recurring activities of the transportation planning process. For example, it's natural that the ITS architecture would be updated at the same frequency as the regional transportation plan is updated (every three to five years) or the Transportation Improvement Program is updated (at least every two years). The update of the architecture should occur several months prior to the transportation planning document update, so that the revised architecture could serve as an input to the planning update. Publication and versioning costs are minimized for the periodic maintenance approach since there is a new version only once in the maintenance cycle.
- **Exception Maintenance.** This approach considers and makes changes to the regional ITS architecture in a process that is initiated as needed. Publication and versioning costs are dependent on the frequency of changes made to the regional ITS architecture.

**Timetable Approach**

***A comprehensive architecture update should occur every four years***, concurrent with the formal update of the TIP. This is a natural result of the KIPDA Regional ITS Architecture being a component of the regional transportation planning process. The update is necessary to ensure that the architecture continues to accurately represent the regional view of ITS Systems. The comprehensive update may include adding new stakeholders, reviewing transportation needs and services for the region, updating the status of projects, and reflecting new goals and strategies, as appropriate. Operational concepts, system functional requirements, project sequencing, ITS standards, and list of agency agreements may also be updated at this time.

***Between major updates of the architecture, the following interim update actions will be performed:***

- Accept comments as they come in and make ***minor updates every 6 months if needed***. Defer any major changes to the yearly update.
- ***Actively solicit changes on an annual basis*** from each key stakeholder a set of needed updates.
- ***Perform minor or major updates as needed*** based upon the inputs and any other change requests received.

The Maintenance Plan should also be reviewed at the previously discussed times for required changes. Use of the Regional ITS Architecture and modifications to it may differ from what was anticipated during the initial development of the Maintenance Plan. Revising the Maintenance Plan may ensure that the change management process defined is effective.

## 13.3. Architecture Baseline

Establishing an architecture baseline requires clear identification of the architecture products that will be maintained, including specific format and version information. For the KIPDA Regional ITS Architecture the following outputs represent the architecture baseline:

- Architecture Document (this document)
- Turbo Architecture Database
- Visio file of Customized Service Package diagrams
- Regional ITS Architecture Web pages
- Change Request Database

Regarding the Architecture document, the source document, in Microsoft Word format, will be held by KIPDA, while a PDF version of the document can be created for general distribution. In addition, a version number and date should be included inside the cover page.

Regarding the Turbo Architecture Database, KIPDA will maintain a zipped version of the final delivered KIPDA Regional ITS Architecture database. The name, date, and size of the database file inside the zipped file should be entered into an architecture log as version 2.0 of the architecture.

## 13.4. Change Management Process

Once the baseline is defined, the process for making changes to this baseline must be established. The change management process specifies how changes are identified, how often they will be made, and how the changes will be reviewed, implemented, and released. The basic process for change management is shown in Figure 12.

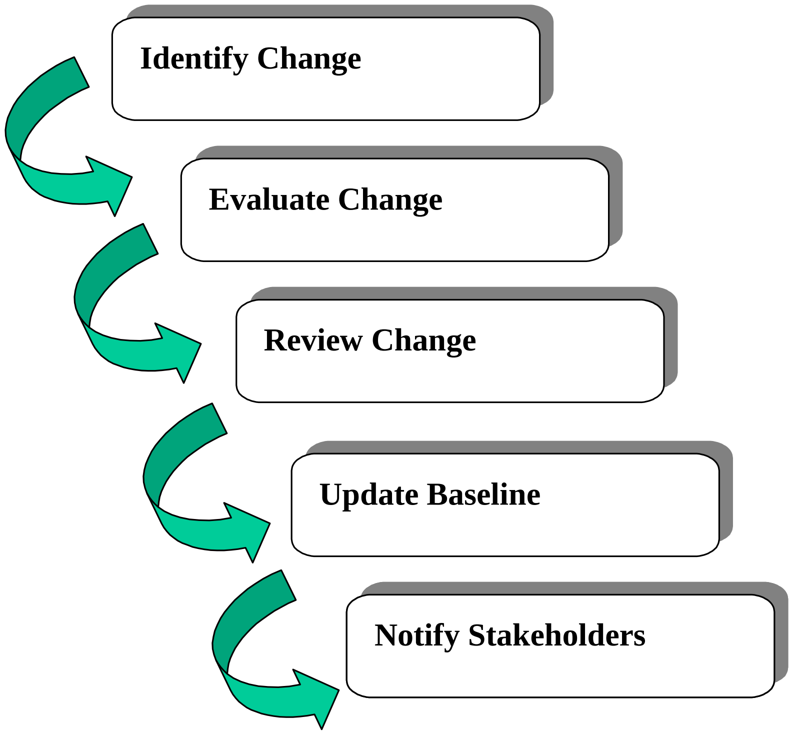



**Figure 12: Change Management Process**

**Identify Change**

This involves two issues-

- who can identify a change to the architecture? and
- how will the change request be documented?

The question of who can make change requests is an important one. If literally anyone can input requests the region runs the risk of being overrun by requests that will tax scarce resources to review and decide upon. On the other end of the spectrum, if too much formality or paperwork is added to the process then many valid or needed changes may go unexpressed. The plan is that all changes should come through a voting member of the Maintenance Working Group. This effectively means that any change suggested has the approval of a member of the working group. This has the added benefit of spreading the resources needed to generate or evaluate changes among the group.

As to how the change request should be documented—a simple change request form should be created that contains at least the following information

- Name of change
- Description of change
- Part of baseline affected (could be check boxes for document, database, web site, and not known)
- Rationale for change
- Originator name or agency

- Date of origination

This information will ultimately be added to a change database (recommended to be maintained by KIPDA personnel) that will add the following additional fields of information

- Change number (some unique identifier)
- Change disposition (accepted, rejected, deferred)
- Change type (minor or significant)
- Disposition comment
- Disposition date

**Evaluate Change**

Upon receiving a Change Request by the Maintenance Manager, an initial evaluation of the Change Request is to be made for the impact to the overall architecture or the affected document. The purpose of the evaluation is two-fold:

- Verify that the Change Request form and supporting materials is complete and correct
- Compare with other Change Request forms and determine if there are any conflicts

If the proposal for architecture modification has an impact on other stakeholders, the evaluator(s) should contact the Stakeholders to confirm their agreement with the modification. All Stakeholders directly affected by the proposed change(s) must approve and sign-off the Change Request before the Maintenance Working Group considers the Change Request.
There are several options as to who performs the initial assessment, including:

- The Maintenance Manager
- Maintenance Working Group
- The person submitting the change
- A consultant, hired to support the maintenance activities of the architecture

Each of the above options has positive and negative implications, but the evaluator must have working knowledge of the architecture to evaluate the proposed changes.

**Reviewing the Change Request**

Upon completing the initial assessment, the Change Request form should be reviewed by the Maintenance Working Group (either at a Maintenance Working Group meeting or via some electronic means). Maintenance Working Group meetings are called by the Maintenance Manager (or their designated representative).

Maintenance Working Group meetings called by the Maintenance Manager will occur at least on an annual basis. On an annual basis, the Maintenance Manager will send a reminder to all Stakeholders to update their ITS Elements and Interfaces in the architecture, if necessary. If sufficient Change Request Forms are submitted, the Maintenance Manager may call a Maintenance Working Group meeting at more frequent intervals to review the Change Request forms. The Maintenance Manager will act as Chairperson for these meetings. The Maintenance Manager will distribute the Change Request forms and all supporting materials to all Stakeholders prior to the meeting for their review and assemble an agenda.

Maintenance Working Group meetings can also be requested by one of the stakeholders if there is an urgent need to update the architecture quickly.

The Maintenance Working Group should have sufficient time to review the Change Requests before the meeting. During the meeting, the Maintenance Working Group shall review the proposed changes and offer any comments.

After each Change Request is reviewed, if no further comments are offered by the Maintenance Working Group, the Change Request will be considered approved, and the Chairperson shall sign off on the Change Request.

If additional comments are made that require action, those comments should be noted on the Change Request form. Where comments (or changes required) are minor in nature they can be made by the submitter of the change Request form, or by resources designated by the Maintenance Manager and the change considered approved. In the case of major comments or changes to the Change Request, the approval of the change may be deferred until the next meeting of the Maintenance Working Group.

If a Change Request is to be withdrawn from consideration, the Chairperson or the Maintenance Manager must sign-off on the Change Request Form to close out the Change Request.
At the end of the meeting, the Maintenance Working Group shall agree if all the approved changes to the architecture necessitate a minor revision of the appropriate baseline documents or a major revision. The decision will be based on the number of Change Requests approved and the nature of the approved changes.

Minutes should be kept for all Maintenance Working Group meetings. Minutes should include, at a minimum, an attendance list, comments made on each Change Request, and the disposition of each Change Request Form (Approved/Withdrawn/Deferred/Request More Information). Minutes are to be distributed to all members of the Maintenance Working Group meeting no less than 5 working days after the meeting. Comments are due within 10 working days to the Maintenance Manager. Approved minutes shall be signed by the Chairperson and will be distributed to all Stakeholders and posted on the website. The minutes provide a recording process for the change management process and provides traceability.

One additional procedure the region may want to consider is to streamline the review and approval process for minor Change Requests, handling via email rather than through face to face meetings.

**Update Baseline:** The decision is implemented.
If the decision is to accept the change, then the appropriate portions of the architecture baseline are updated and an updated architecture baseline is defined. In addition to updating the baseline documents, databases, or other outputs, the configuration status should be updated. In the discipline of Configuration Management this is known as Configuration Status Accounting. This accounting is performed by having a document that defines the following information for each separate output of the architecture baseline:

- Output name;
- Output revision number;
- Date of latest revision;
- File Name; and
- Location/Point of Contact.

Periodically, the information in the various outputs of the architecture baseline should be audited to assure that the different representations of the architecture information (e.g. the database and document) are in sync. This configuration auditing should be performed by someone independent of the staff or resources used to actually enter the changes.

**Notify Stakeholders**: Point of Contacts for each stakeholder should be notified by e-mail from the Maintenance Manager when baseline documents have been updated. All baseline documents shall also be available to stakeholders from a website or other electronic location, such as an ftp site. It is the responsibility of the Maintenance Manager to ensure the most recent document is available from the website. The Configuration Status Document should be one of those outputs that is available.

Request for copies or access to the baseline documents should be made to the Maintenance Manager.

After major revisions to the architecture or the baseline documents, the Maintenance Working Group may elect to also provide all baseline documents to members on CD-ROMs.

# Appendix A: Acronyms/Glossary

# APPENDIX A: ACRONYMS/GLOSSARY

***ATIS* –** Advanced Traveler Information System

***ATMS* –** Advanced Traffic Management System

***AVL* –** Automated Vehicle Location

***CCTV* –** Closed Circuit TV

***DMS* –** Dynamic Message Sign

***GPS* –** Global Positioning System

***HAR* –** Highway Advisory Radio

***IDEM* –** Indiana Department of Environmental Management

***ITS* –** Intelligent Transportation Systems

***KIPDA* -** Kentuckiana Regional Planning & Development Agency

***LMAPCD* -** Louisville Metro Air Pollution Control District

***MDT* –** Mobile Data Terminal

***MPO* –** Metropolitan Planning Organization

***MTP* –** Metropolitan Transportation Plan

***NITSA* –** National ITS Architecture

***NOAA* –** National Oceanic and Atmospheric Administration

***NTCIP* –** National Transportation Communications for ITS Protocol

***PSAP* –** Public Safety Answering Point

***TIP* –** Transportation Improvement Program

***TMC* –** Traffic Management Center

***TOC* –** Traffic Operations Center

### *Amber Alert*

Immediately after a child has been kidnapped and is considered endangered, law enforcement officers launch an Amber Alert. An Amber Alert is a notice to motorists about a child who has potentially been kidnapped. Notices are disturbed by television, radio, the Internet, and highway signs, to notify the public when a child is abducted. Some people will also receive notices through their pagers or cellular phones. An Amber Alert notice provides details about the abducted child and, when possible, information about a suspect's vehicle.

### *Architecture Flow*

Information that is exchanged among Subsystems and between Subsystems and Terminators in the Physical Architecture view of the National ITS Architecture. Architecture Flows are the primary tool that is used to define the Regional ITS Architecture Interfaces. These Architecture Flows and their communication requirements define the Interfaces, which form the basis for much of the ongoing Standards work in the National ITS program. In this document, the terms "information flow" and "architecture flow" are used interchangeably.

### *Closed Loop System*

A closed loop system connects a series of traffic signals providing communications between the individual intersections.

### *Element*

This is the basic building block of a Regional (or Statewide) ITS Architecture. It is the name used by the Stakeholders to describe a system or piece of a system.

### *Entity*

Term used in the National ITS Architecture to describe the building blocks of the architecture, specifically Subsystems and Terminators.

### *Equipment Package*

Equipment Packages are the building blocks of the Physical Architecture Subsystems. Equipment Packages group like Processes of a particular Subsystem together into an "implementable" package. The grouping also takes into account the User Services and the need to accommodate various levels of functionality. Since Equipment Packages are both the most detailed elements of the Physical Architecture view of the National ITS Architecture and tied to specific Service Packages, they provide the common link between the interface-oriented Architecture definition and the deployment-oriented Service Packages.

### *Functional requirements*

Functional requirements are statements of the capabilities that a system must have ("functions"), geared to addressing the business needs that a system must satisfy.

### *Information Flow*

Information that is exchanged between Subsystems and Terminators in the Physical Architecture view of the National ITS Architecture. In this document, the terms "Information Flow" and "Architecture Flow" are used interchangeably.

### *Inventory*

See System Inventory.

### *Multiplexer*

An electronic device which is used to combine several signals for transmission over one communications channel by varying the physical characteristics (frequency, amplitude or phase) or timing of the signals to prevent them from interfering with each other.

### *National ITS Architecture*

A common, established framework for developing integrated transportation systems. The National ITS Architecture is comprised of the Logical Architecture and Physical Architecture, which satisfy a defined set of User Services. The National ITS Architecture is maintained by the United States Department of Transportation (USDOT).

### *Probe*

Vehicle or mobile device used to derive speed and other parameters (e.g. origin and destination) for the network.

### *Process Specification (PSpec)*

The textual definition of the most detailed Processes identified in the Logical Architecture view of the National ITS Architecture. The Process Specification includes an overview, a set of functional requirements, a complete set of inputs and outputs, and a list of the User Service requirements that are satisfied by the PSpec.

### *Service Package*

Service Packages identify the pieces of the Physical Architecture that are required to implement a particular transportation Service. They provide an accessible, service oriented, perspective to the National ITS Architecture. They are tailored to fit - separately or in combination - real world transportation problems and needs. Service Packages collect together one or more Equipment Packages that must work together to deliver a given transportation Service and the Architecture Flows that connect them and other important external systems.

### *Signal Preemption*

Traffic signal preemption is an optical communications system that allows preemption-equipped vehicles, typically police, emergency response vehicles, and/or transit vehicles, to alter the normal operation of preemption-equipped traffic signals. Such systems are designed to increase safety, reduce emergency response times and enhance public transit operations.

### *Subsystem*

The principal structural element of the Physical Architecture view of the National ITS Architecture. Subsystems are individual pieces of the Intelligent Transportation System defined by the National ITS Architecture. Subsystems are grouped into four classes: Centers, Roadside, Vehicles, and Travelers. Example Subsystems are the Traffic Management Subsystem, the Vehicle Subsystem, and the Roadway Subsystem. These correspond to the physical world: respectively traffic operations centers, automobiles, and roadside signal controllers. Due to this close correspondence between the physical world and the Subsystems, the Subsystem interfaces are prime candidates for standardization.

### *System Inventory*

The collection of all ITS-related Elements in an ITS Architecture.

### *Terminator*

Terminators define the boundary of an Architecture. The National ITS Architecture Terminators represent the people, systems, and general environment that interface to ITS. The Interfaces between Terminators and the Subsystems and Processes within the National ITS Architecture are defined, but no functional requirements are allocated to Terminators. The Logical and Physical Architecture views of the National ITS Architecture both have exactly the same set of Terminators.

### *User Service*

User Services document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators. User Services form the basis for the National ITS Architecture development effort. The initial User Services were jointly defined by USDOT and ITS America with significant Stakeholder input and documented in the National Program Plan (NPP). Over time, new or updated User Services will continue to be developed and the National ITS Architecture will be updated to support these User Service changes.

### *User Service Requirement*

A specific functional requirement statement of what must be done to support the ITS User Services. The User Service Requirements were developed specifically to serve as a requirements baseline to drive National ITS Architecture development. The User Service Requirements are not requirements to system/architecture implementers, but rather are directions to the National ITS Architecture development team.

# Appendix B: Comments and Disposition

# Comments and their Disposition

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 1 | 2/16/2017 | KIPDA | We would like to update the photos to include ITS-related photos, rather than the dated photos from our main website. TRIMARC said they have some. I will pass those along if/when we get them | Website- home page | Additional pictures received. Website updated |
| 2 | 2/16/2017 | KIPDA | Nine-County Region: This is mentioned multiple times on the site. We think that we should only reference what is called the Louisville-Jefferson County Metropolitan Planning Area, which is (basically) five counties. We can't say five-county region either, because there are tiny portions of two bordering counties included in addition to the 5 full counties. | Website | Updated in final |
| 3 | 2/16/2017 | KIPDA | Please refer to this as the KIPDA Regional ITS Architecture. Remove the word Update from the end of it. This may be pertinent elsewhere in the website as well. | Web builder | Updated in final |
| 4 | 2/16/2017 | KIPDA | 2nd Paragraph: Remove the 's' in "ITS Architecture**s**" | Website | Edited in region home content page |
| 5 | 2/16/2017 | KIPDA | Under Time Horizon and Services: Should read, "This regional ITS **Architecture**…" | Website | Edited in region home content page |
| 6 | 2/16/2017 | KIPDA | Travellers vs travelers: It is spelled both ways on this page. Spell check prefers one L, which must be the American spelling. | Website | Edited in region home content page |
| 7 | 2/16/2017 | KIPDA | Can we add a link to the "How to Use Web Site" page to the home page that is highly visible for the user? Similarly, can the definition of what exactly ITS is be bolstered on this home page? | Website | Added a definition of ITS and put the link on the home page. |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 8 | 2/16/2017 | KIPDA | Change “KIPDA Home” to “Home”. KIPDA Home would seem to imply a link to our website. | Web Builder | Changed Menu bar in preamble |
| 9 | 2/16/2017 | KIPDA | Speaking of our website: An earlier version of the ITS website had a KIPDA logo on it. Can that be added back to the header? If so, can it also be a link to www.kipda.org homepage? | Web builder | Logo put on page, with link to KIPDA Website. |
| 10 | 2/16/2017 | KIPDA | KIPDA’s written name is incorrect. It should be Kentuckiana Regional Planning & Development Agency. This occurs in multiple locations throughout the site. | Turbo | Updated in final |
| 11 | 2/16/2017 | KIPDA | Louisville Metro Public Works: They do far more than maintain roads. They build, operate, and maintain roadways. Add to their description | Turbo | Revised description |
| 12 | 2/16/2017 | KIPDA | Louisville Fire Department: Empty | Turbo | Added an element for Louisville Fire Vehicles to this stakeholder. The Fire Department is separate from the new Emergency Services. |
| 13 | 2/16/2017 | KIPDA | Louisville Metro Emergency Services: the definition appears to reflect the old, pre-merger name. Louisville Metro Emergency Services is appropriate and encompasses the old city limits, plus the county. | Turbo | Revised description |
| 14 | 2/16/2017 | KIPDA | ODOT/Ohio DOT: Delete both | Turbo | done |
| 15 | 2/16/2017 | KIPDA | Tunnel Management Inc.: Delete | Turbo | done |
| 16 | 2/16/2017 | KIPDA | UPS: Empty. Delete | Turbo | done |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 17 | 2/16/2017 | KIPDA | TARC: Add a better description | Turbo | Revised description |
| 18 | 2/16/2017 | KIPDA | Local Media: Should this/could this reflect other, newer forms of electronic media as well? | Turbo | It is really not the same as social media. We usually assume social media is what people interface with on their Traveler Information Device. So the newer forms of media are covered with that interface. |
| 19 | 2/16/2017 | KIPDA | Louisville Metro Air Pollution Control District: Add their acronym, APCD, to their description | Turbo | Revised description |
| 20 | 2/16/2017 | KIPDA | KY Justice Cabinet: Write out EOC. Also, please explicitly state that this includes the KY State Police. | Turbo | Revised description |
| 21 | 2/16/2017 | KIPDA | Commercial Vehicle Enforcement functions in Kentucky: This is handled by a division of KY State Police. Has this been incorporated? | Turbo | Did not identify any services in the region the used Commercial Vehicle Enforcement, so this isn't included. |
| 22 | 2/16/2017 | KIPDA | "Local and State Governments", "Local Agencies", and "Local Governments": One is empty, and should these be consolidated into one. Is there a meaningful difference? | Turbo | Have consolidated into a single stakeholder: Local Governments. |
| 23 | 2/16/2017 | KIPDA | Various Owners: Has the same definition as "Local Agencies". Delete or consolidate. | Turbo | Have removed the generic stakeholder "various owners" and identified specific stakeholders for each element. |
| 24 | 2/16/2017 | KIPDA | Jefferson County Fire Service: Remove "Suburban" from name in the description. Tone down description a bit. | Turbo | Added an element for Jefferson County Fire Vehicles and revised stakeholder description. |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 25 | 2/16/2017 | KIPDA | On Inventory by Stakeholder page: KIPDA's written name is incorrect here too (See above). Please check/correct all instances throughout the site | Website | We did not see KIPDA written out on the referenced page, but will work to fix the spelling everywhere found. |
| 26 | 2/16/2017 | KIPDA | On Service Package Diagrams: How do we tell the difference between an existing flow and a user-defined flow? Simply by the italicized words? If so, does an italicized planned flow represent a planned, user-defined flow? | Website | We will revise the legend to clearly show the definition of "_ud" flows and "_cv" flows. |
| 27 | 2/16/2017 | KIPDA | On many Service Package Diagrams: It looks like the notes that were added while you all made changes on the fly during the workshop are still on there. It appears that at least some of the actual changes discussed in the notes have not been made. Please make the changes and delete the notes. | Website | Have reviewed the diagrams and deleted those notes no longer needed. |
| 28 | 2/16/2017 | KIPDA | On Service Package Diagrams: What do *"_ud"* and *"_cv"* mean? We assume the first means user-defined, but we're uncertain about *_cv.* Connected vehicle, perhaps? | Website | Yes, ud=user defined and cv=connected vehicle. We have revised diagram legend to clarify this. |
| 29 | 2/16/2017 | KIPDA | On RiverLink-related Service Packages: The flows should now be considered to be existing since tolling of the new bridges is now underway. We're uncertain if this is true for all of the flows, or if some of them are still planned and not fully implemented at this time | Website | ATMS10 should all be existing (since tolls are being collected). Done |
| 30 | 2/16/2017 | KIPDA | On Inventory by Stakeholder Page: In the Pdf (Printable Version), there are many redundancies. | Website | Error fixed in final. |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 31 | 2/16/2017 | KIPDA | Under the Regional Hospitals Element: The description references “downtown Indiana”. Delete. | Turbo | Revised description |
| 32 | 2/16/2017 | KIPDA | Under one or more items related to PARC: Despite their name in its acronym form, they don’t call their garages par**c**ing garages. They use the traditional spelling. | Turbo | Revised description |
| 33 | 2/16/2017 | KIPDA | Under Projects by Stakeholder (and potentially elsewhere as well): This might be worthy of a conversation, more so than a comment and a correction. But we should probably remove references to the TIP. The ITS Architecture would seem to have a far closer connection to the Metropolitan Transportation Plan (MTP) than to the TIP. When a project is in the TIP, funding must have been formally identified, which is not true for the MTP or the ITS Architecture. Further, the TIP projects are a subset of the MTP projects, so all TIP projects are MTP projects, but not the other way around. | Website | Have revised the text on the page to reference the MTP. We have also included a discussion of the MTP in the Use section of the document. |
| 34 | 2/16/2017 | KIPDA | Notify Every Truck (NET) Alert: We couldn’t find this in the Architecture. It is a notification issued by TRIMARC to truckers that opt in to it. It notifies them when there is a major interstate closure. | Turbo | Have added an element TRIMARC NET Alert that will advise truckers. Added element to traveler information diagram |
| 35 | 2/16/2017 | KIPDA | The new truck parking initiatives, TPIMS: This might be a question for KYTC about where these are proposed. Supposedly, a site on I-65 near Lebanon Junction, KY is a candidate location. If so, should this be included? | Turbo | Added project and new diagram to cover. |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 36 | 2/16/2017 | KIPDA | Waze (and other feedback): Are the data flows coming back to the operation centers from Waze and other passive data collection setups accounted for appropriately in the Architecture? | Visio | We have included the interface from Waze with the element- Private Traffic Information Systems. The interface shows up in ATMS01. |
| 37 | 2/16/2017 | KIPDA | In the Glossary, under User Needs: TMACOG is mentioned. Delete it here and anywhere else it might be found. | Website | Done |
| 38 | 2/16/2017 | KIPDA | Search function: Can a search function be added to the site? We were able to search a single page using the internet browser's search function, but we weren't able to search the whole site for a key word, stakeholder, etc. | Website | You are able to search a single page using the internet browser's search function, but we have never been able to develop the capability to search the entire website. |
| 39 | 2/16/2017 | KIPDA | At locations where there is a link to an external site: Can that be setup to open in a new tab? There may be reasons where one might one to go back and forth between the KIPDA ITS Site and the other site. | Website | Have done this in update. |
| 40 | 2/16/2017 | KIPDA | Under Resources, under ITS Architecture: This appears to be linked to a page that no longer exists and it sends you to an updated site, perhaps. If not, something odd happens when you click it. | Website | Updated the link to go the National ITS Architecture website: www.iteris.com/itsarch. |
| 41 | 2/16/2017 | KIPDA | Under Operational Concepts: KYTC does far more than the maintenance functions that are shown here. More like INDOT. | Turbo | Based on our discussion with KYTC, their primary function in the region relate to maintenance efforts. TRIMARC, whom we have defined as a separate stakeholder, handles the traffic |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| | | | | | management, incident management and traveler information functions. In Indiana, IDOT does all these functions. |
| 42 | 2/16/2017 | KIPDA | Under Interfaces, under Archived Data User Systems: Add the KYTC Data Mart, which has a wide variety of archived data. | Visio | Created a new element -"KYTC Data mart" and added a new AD service package diagram |
| 43 | 2/16/2017 | KIPDA | Very generally: If there's any way to double check that items that are holdovers from our old architecture or from the other website(s) that you might have used as a template, please delete/update these, as appropriate. | All | Have gone through the architecture to ensure only elements included in the diagrams are in Turbo |
| 44 | 2/21/2017 | TRIMARC | Element – TRIMARC DMS and HAR<br>Interfaces: – KYTC County Maintenance Garage à REMOVE<br>Interfaces: – MetroSafe911 à ADD | Visio | Revised Understand that TRIMARC does maintenance on all their equipment, not KYTC Maint. Also clarified the MetroSafe911 interface. |
| 45 | 2/21/2017 | TRIMARC | Element – TRIMARC Field Equipment<br>Interfaces: – KYTC County Maintenance Garage à REMOVE<br>Interfaces: - TRIMARC Traffic Management Center à ADD | Visio | Understand TRIMARC would have the interface, not KYTC Maintenance and modified diagram. |
| 46 | 2/21/2017 | TRIMARC | Element – TRIMARC Freeway Service Patrol Vehicles<br>Description: - replace the word "vans" with "vehicles" | Turbo | Done |
| 47 | 2/21/2017 | TRIMARC | Element – TRIMARC Infrastructure Monitoring Equipment<br>Status: - change "Planned" to "Existing" | Turbo | Done |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 48 | 2/21/2017 | TRIMARC | Element – TRIMARC Telephone Information System DOES NOT EXIST | Turbo | Done |
| 49 | 2/21/2017 | TRIMARC | Element – TRIMARC Traffic Management Center<br>Functional Areas: - TMC HOV Lane Management does not exist<br>Interfaces: - INDOT Borman TMC - REMOVE | Turbo | Functional Area removed, TRIMARC TMC does not interface w/ INDOT Borman, we removed this flow in ATMS07-1. |
| 50 | 2/21/2017 | TRIMARC | Element – TRIMARC Tunnel Monitoring Equipment<br>Interfaces: - Change "KYTC County Maintenance Garage" to "KYTC District Offices" | Visio | Please note that the "KYTC County M. Garage" was changed to "KYTC District offices". Recognize that KYTC does not do the maintenance on TRIMARCs equipment. |
| 51 | 2/21/2017 | TRIMARC | Element – TRIMARC Traffic Detectors<br>Interfaces: – KYTC County Maintenance Garage à REMOVE | Visio | Monitored by TRIMARC only, revised. |
| 52 | 2/21/2017 | TRIMARC | MC07-1 – The TRIMARC Traffic Management Center should be in the center of the picture receiving information directly from Roadway TRIMARC Assets | Visio | Diagram revised |
| 53 | 2/21/2017 | TRIMARC | MC03 & AD01-1 – Weather sensor data is sent directly to KYTC Central Office. TRIMARC does not interface directly with any Private Weather Systems. | Visio | Since KYTC central office is not central to KIPDA, the diagram has been deleted. |
| 54 | 2/21/2017 | TRIMARC | MC04 – National Weather Service information comes directly to TRIMARC. | Visio | Updated diagram |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 55 | 2/21/2017 | TRIMARC | ATMS02 – TRIMARC Traffic Detectors does not include Bluetooth at this time. | Visio | Will leave note but indicate it's an option for the future. |
| 56 | 2/21/2017 | TRIMARC | EM05-01 – Infrastructure Protection TRIMARC<br>Line for 'traffic images' from CCTV to Management Center should be 'Existing'<br>Line for 'secure area sensor control' from Management Center to Infrastructure should be 'Existing'<br>Line for 'secure area sensor data' from Infrastructure to Management Center should be 'Existing' | Visio | Flows marked as existing in both directions. |
| 57 | 2/21/2017 | TRIMARC | Element Expanded Functional Requirements: TRIMARC Website<br>Basic Information Broadcast<br>TRIMARC does not do #3<br>TRIMARC does not do #4<br>TRIMARC does not do #5<br>TRIMARC will disseminate Severe weather information to travelers<br>ISP Traveler Data Collection<br>TRIMARC does not do #4<br>TRIMARC does not do #5<br>TRIMARC does not do #9 | Turbo | This is a limitation to the website. We show links from the element to Equipment Packages. When you click on an EP, you see all the reqmts for this EP from Turbo, not just the ones selected. The ones selected do show up on Project pages. |
| 58 | 2/21/2017 | TRIMARC | Functional Requirements: Basic Information Broadcast<br>TRIMARC does not do #3<br>TRIMARC does not do #4<br>TRIMARC does not do #5 | Turbo | Refers to TRIMARC website. Revised Turbo. |
| 59 | 2/16/2017 | Riverlink | River link project definition update: Tolling is in effect on three bridges connecting Louisville | Turbo | Done |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| | | | and Southern Indiana: the I-65 Abraham Lincoln Bridge, the I-65 Kennedy Bridge and the SR 265 Lewis and Clark Bridge. Toll rates range from $2-$12, depending on the size of the vehicle and whether the driver has a prepaid account and transponder. Vehicle classification is determined by the number of axles and height of the vehicle. RiverLink is all-electronic tolling, which means there's no stopping and no cash tolls. Drivers with RiverLink prepaid accounts and transponders pay the lowest toll rates. E-ZPass transponders are accepted. Drivers without prepaid accounts and transponders receive an invoice in the mail. | | |
| 60 | 2/28/2017 | KYTC | At the link you noted below under the following: Stakeholders/Services by Stakeholders/KYTC/AD1 - ITS Data Mart -Crash Records -It would appear to me that the Kentucky State Police (KSP) should be added to this schematic as well with regards to providing crash reports. Also, KYTC obtains their crash data directly through the KSP database in which all local police agencies provide crash data. | Visio | Updated Diagram |
| 61 | 4/10/2017 | KIPDA | I-71 warrants mentioning in this paragraph. Also, I-264 is a very key interstate as well. It has (some of) the highest ADT's in the state of KY. Same is true for KY 841. | Document Section 1.2 | Updated Paragraph |
| 62 | 4/10/2017 | KIPDA | Emphasize that this is a bi-state region. This influences many parts of the ITS Arch | Document Section 1.2 | Updated Paragraph |
| 63 | 4/10/2017 | KIDPA | Provide an example of a terminator locally. | Document Section 3 | Updated Section |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| 64 | 4/10/2017 | TRIMARC | Suburban Jefferson County Fire Departments (as a group) should be called out if Louisville FD is. They don't fit under the umbrella of local governments | Document Section 4.1 | Added Jefferson County Fire Department as a stakeholder |
| 65 | 4/10/2017 | TRIMARC | Should commercial motor carriers be called out specifically as a stakeholder | Document Section 4.1 | Added Private Commercial Carriers as a stakeholder. |
| 66 | 4/10/2017 | TRIMARC | There appear to be 8 equipment packages listed, not 4. Also, Traffic Equipment Maintenance does not appear to be listed in the ATMS03 Service Package in the National ITS Architecture Version 7.1 | Document Section 8 | Revised paragraph to be consistent. |
| 67 | 4/10/2017 | KIPDA | Why are these (C2C and C2F standards) called out? Are they being used simply as examples, or are they called out since they are more important/critical? Feels very detailed as compared to the other sections of this report. | Document Section 9.1 | The standards table has several rows that are "groups" of standards, including center to center (C2C) and center to field (C2F), which contain key sets of ITS standards. |
| 67 | 4/10/2017 | KIPDA | There is no LaGrange County around here. I believe that this project will be limited to LaGrange, the city. I suppose that the City should be listed as the stakeholder. | Document Section 10 | Revised project to be City of LaGrange, an example of Local Governments. |
| 68 | 4/10/2017 | KIDPA | Is the Bike Network an ITS project that is worthy of inclusion? | Document Section 10 | Project includes Bikeshare, which we have included in a service package diagram. |
| 69 | 4/10/2017 | TRIMARC | May consider defining BRT and TSP here | Document Section 10 | Added definitions. |
| 70 | 4/10/2017 | KIPDA | TARC Dixie BRT appears to be redundant with the project called "Louisville Metro New Dixie Highway" | Document Section 10 | Left both projects in, defining the first as Louisville Metro portion of effort and the |

| ID | Date | Stakeholder | Comment from KIPDA Stakeholders | Location | Comment Response |
|---|---|---|---|---|---|
| | | | | | second as TARC portion of effort. |
| 71 | 4/10/2017 | KIPDA | Is TRIMARC Arterial Dynamic Message Signs (ADMS) redundant to the Louisville Metro and Oldham County Arterial DMS projects? | Document Section 10 | They are similar projects in scope, but with different stakeholders, so keep as separate projects. |
| 72 | 4/10/2017 | KIPDA | Are there any other (types of) agreements worth mentioning? | Document Section 11 | Additional agreements were identified and added to the document. |
| 73 | 4/10/2017 | KIPDA | Should Figure 10 be moved up by a paragraph? Seems to fit better there. | Document Section 12.1 | Agreed, figure moved forward. |
| 74 | 4/10/2017 | KIPDA | Make this a hyperlink for the report that we put out online. | Document Section 12.3 | Hyperlinks included in Document |