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Part 13 - INTELLIGENT TRANSPORTATION SYSTEMS

1300 GENERAL

This Part of the TEM will be used to address policies, guidelines, standard procedures, etc. related to Intelligent Transportation Systems (ITS).

ODOT has long used advanced technology to carry out its mission. For example, there are electronic devices in place for traffic counting and classification; signal systems control traffic on the rural highway system; some freeways have ramp metering; and weather/pavement sensors have been installed in the state.

In the mid-1990s the department invested in The Advanced Regional Traffic Interactive Management & Information System (ARTIMIS), the Cincinnati-area freeway management system, which served as a test-bed for ITS technologies and provided the department with experience in real-time freeway management. In nearly the same time period, local interests in the Columbus area promoted a freeway management system designed by the city and funded by the department. The 1990s also saw substantial planning, led by Metropolitan Planning Organizations (MPO), in regional ITS systems. This activity had the effect of creating a “grass roots” demand for ITS investment by the state.

Congestion has been increasing nationally, both in duration and area. This trend affects freeway operation by decreasing level of service, decreasing the reliability of travel times and increasing the length of travel times. It costs the public in fuel, commerce, air quality, time, frustration, and even lives, by contributing to secondary crashes. Studies have shown that motorists are more accepting of delays if they are consistent, or at least expected. Many attempts have been made to control both recurring and nonrecurring congestion. To combat these issues, ODOT has decided to take an ITS approach.

ITS benefits areas all across the state of Ohio. The Ohio ITS vision is, “ODOT will provide the template for Intelligent Transportation Systems by combining technology and advanced operational concepts. Ohio’s ITS will improve decision-making by all partner agencies by providing unprecedented levels of information to businesses and individuals while bridging political boundaries.”

The goals of ITS are to improve the overall transportation system, address congestion issues, improve response to weather events, improve response to incidents and to help inform travelers of highway conditions. To combat incident management and congestion, Freeway Management Systems (FMS) can provide travel time information to the public, reduce unexpected delays and provide the information necessary for travel adjustments. Also, programs such as QuickClear have been established to aid in the clearance of unforeseen incidents on the highways and provide coordination between multiple first response agencies.

As traffic volumes on the state highway system continue to increase, managing traffic and operations is critical to ensure mobility. By garnering real-time condition data from the field, ITS can aid the department in the following activities:

- Snow and ice removal
- Work zone traffic management
- Freeway traffic management, especially during incidents, and
- Traveler information dissemination.
While the potential of ITS is significant, deployment and operation of these systems requires specialized coordination, design and device specifications, procurement/construction, and management. The Office of Traffic Engineering (OTE) shall provide implementation plans for ITS and policies for ITS operation.
1301 23 CFR 940 Compliance

1301-1 General

Federal Regulation 23 CFR 940 requires ITS projects and traditional projects with ITS components funded through the highway trust fund to conform to the National ITS Architecture and applicable standards. The Ohio Procedures for Implementing ITS Regulations (23 CFR 940) documents the requirements to be used in Ohio for any ITS project utilizing Federal funds. This requirement applies to the ITS components.

The Ohio procedures incorporate guidance from several sources, including 23 CFR 940 and the Federal-Aid Highway Program Stewardship and Oversight Agreement. ODOT’s interpretation of the Federal policy provides a streamlined process to address project definitions, ITS architecture modifications, and systems engineering. This approach will permit ODOT and FHWA to establish conformance in the level of ITS assessment and documentation needed. Any ITS project that has advanced to final design by April 8, 2001 is exempt from these requirements.

As this is a Federal requirement for funding, it is imperative for ODOT to effectively administer this process so as to not adversely affect project delivery. ODOT will collaborate with the Ohio Division of FHWA to guide ODOT District offices and local agencies through the documentation for ITS projects.

The requirements in 23 CFR 940 include provisions for interoperability and future integration of equipment, software and systems. This FHWA requirement is similar to other separate and distinct Federal requirements which are accepted and an inherent part of the project development process. This section provides guidance for using ODOT’s Project Development Process (PDP), L&D Manual and TEM for mainstreaming these requirements.

The Traceability Matrix (see Form 1396-1 for an example) will be included in the construction documents for use by the contractor and other project personnel. The inclusion of the Traceability Matrix will provide the contractor with information about the items that will be tested and required to be operational as a part of the construction contract. It will also provide the project sponsor’s representative with the items to be tested and the format for documenting the testing results. The completed Traceability Matrix should become part of the project records.

1301-1.1 Introduction and Scope

These requirements apply to Federal Aid projects, as required by 23 CFR 940 and the Ohio Federal-aid Highway Program Stewardship and Oversight Agreement. It is recommended that State-funded projects follow the same process for regional consistency.

In accordance with 23 CFR 940, ITS projects funded through the highway trust fund shall conform to the National ITS Architecture and applicable standards. 23 CFR 940 also stipulates that “conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a Regional ITS Architecture, as applicable, and the subsequent adherence of all ITS projects to that Regional ITS Architecture.” This section outlines the ODOT procedures for implementing these requirements. The level of documentation should be commensurate with the project scope. The flowchart in Figure 1398-1 further illustrates the procedures described below.

ODOT-administered ITS projects shall follow the current Ohio Federal-aid Highway Program Stewardship and Oversight Agreement with regard to oversight of the projects. Local agency project coordination for ITS projects will be through the ODOT District with coordination through the ODOT Office of Traffic Engineering and FHWA Ohio Division Office, as applicable, for concurrence in the level of ITS assessment and documentation required.
1301-1.2 General Criteria

In accordance with 23 CFR 940.3, an ITS project is “any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services as defined in the National ITS Architecture” and summarized in Table 1397-2. In Ohio a project would be considered to be an ITS project if it meets any of the following:

1. It requires the integration of multiple separate systems.
2. It is a project that has significant potential to involve the integration of technologies on a regional basis.
3. It replaces existing or installs new centrally controlled software.

For non-Freeway Management System projects, a project, even one meeting the above criteria illustrated by the examples below and in Table 1397-1, would not be considered an ITS project if it is an expansion of an existing system and does not add functionality. However, expansion of a Freeway Management System through additional phases is always considered an ITS project. Enforcement systems and systems used primarily to gather and archive data not directly used for operational purposes are not generally considered to be ITS.

ITS Projects may be either Major ITS Projects or Minor ITS Projects. A Major ITS Project is defined in 23 CFR 940.3 as “any ITS project that implements part of a regional ITS initiative that is multi-jurisdictional, multi-modal, or otherwise affects regional integration of ITS systems.” Consequently, a Minor ITS Project means any ITS project that is not a Major ITS Project (see Table 1397-1).

The following describes the levels of ITS projects in Ohio, not to be confused with ODOT Project Development Process (PDP) major and minor project categories. The decisive factor in this determination is the scale and complexity of the project. Traffic Signal projects are the most common scale sensitive projects.

Criteria for the determination are shown in the list below.

Examples:

Major ITS

Major ITS is an ITS system that implements part of a regional ITS initiative that is multi-jurisdictional, multi-modal, or otherwise affects regional integration of ITS systems.

Multi-jurisdictional does not necessarily mean that a project termini in more than one city is major ITS. The key criteria is “regional ITS initiative.” The following are examples of Major ITS systems:

• Freeway Management Systems (FMS).
• Traffic Signal systems scoped to be centrally controlled (Closed loop systems are NOT central control systems.)
• Traffic signal projects that require the integration of signal systems with Freeway Management Systems or RWIS systems.
• An ITS system that involves multiple political jurisdictions.
• Integration of ramp meters with traffic signals on adjacent arterials.
• Regional Transit Systems.

• Transit Signal Priority Systems

**Minor ITS**
- Emergency Vehicle Preemption
- Highway Rail Intersections
- Roadway Weather Information System (RWIS).

- Roadgrip Sensor System. Various surveillance or control systems that could functionally be integrated into a FMS. The inclusion of surveillance cameras to monitor corridor operations is not ITS unless the video will be integrated into other types of systems (example – FMS).

- Highway Rail Intersection (HRI) warning systems.

- Traffic signals with emergency vehicle preemption.

- Parking Management Systems.

**Non ITS**
- System expansions (including ITS systems) that do not add new functionality. In other words, a project that by itself may have been considered ITS but if the scope of the project simply expands this system it is not considered ITS. For example – an existing signal system with preemption is added onto with new intersections. For another example, a project to add DMS devices to an FMS with existing DMS would not be an ITS project. The project adding new intersections would not be ITS because it is an expansion of an existing system within the same jurisdiction with no new functionality.

- Traffic signals including closed loop signal systems not integrated with other devices or systems. (Emergency vehicle preemption is considered to be another system.)

- Routine maintenance and operation of existing systems.

- Signal retiming even if multi-agency or multi-jurisdictional.

- Traffic signals which are either isolated, time based coordinated, or interconnected but not centrally controlled.

- Speeding or red-light running electronic enforcement systems.

- Cameras installed solely for the purpose of traffic or data collection (except if they will functionally be integrated into a system for surveillance purposes.)

- Weigh-in-motion systems (unless integrated into an FMS).

- Count and classification systems (unless integrated into an FMS).

**1301-2 Architecture**

**1301-2.1 General**

In areas served by an MPO, the MPO needs to identify potential transit and highway ITS projects to the ODOT District when reviewing local programs for inclusion in the TIP. In areas not served by an MPO, the ODOT Local Project Administrator (LPA) needs to perform this identifying function. It shall be the responsibility of the ODOT District to determine if a project is an ITS project, and if so, to identify it as a Major ITS Project or a
Minor ITS Project. If the determination of whether a project is ITS or non ITS, or whether a project is a Major ITS Project or a Minor ITS Project is not obvious, the project shall be discussed with the Office of Traffic Engineering to make a determination. The District will notify the MPO and the project sponsor of the determination in writing.

A Major ITS Project will require a comprehensive effort that analyzes several options for each type of technology selected, since these types of projects tend to be multifaceted. Generally, there are several elements that need to be evaluated and more options are analyzed in a Major ITS Project. If a consultant is used for an ITS Project, these procedures should be included in the consultant’s Scope of Work.

1301-2.2 Architecture Conformity

To ensure conformity with 23 CFR 940, several requirements must be met. The rule stipulates that conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a Regional ITS Architecture, and the subsequent adherence of all ITS projects to that Regional ITS Architecture.

According to 23 CFR 940.3, a Regional ITS Architecture is “a regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects.” It documents data flows and subsystems, roles and responsibilities, operating agreements, and ITS Standards to be used for a particular region. In Ohio, Regional ITS Architectures generally encompass an MPO area. A Statewide ITS Architecture is a form of a Regional ITS Architecture. Ohio currently does not have a statewide ITS architecture. See Table 1397-3 for a listing of Regional ITS Architectures in Ohio.

1301-2.3 Project Level ITS Architecture

A Project Level ITS Architecture, according to 23 CFR 940.3 “is a framework that identifies the institutional agreement and technical integration necessary to interface a Major ITS project with other ITS projects and systems.” The Project Level ITS Architecture indicates the data flows and subsystems that the project will implement. To achieve the significant benefits derived from the documentation, a Project Level ITS Architecture needs to be developed for all ITS Projects.

1301-2.4 If a Regional ITS Architecture Exists

If an ITS project falls within the boundaries of a Regional ITS Architecture (see Table 1397-3) the Project Level ITS Architecture should be developed as follows:

1. If the project functions exist in the Regional ITS Architecture: Copy the appropriate pages from the Regional ITS Architecture and use a highlighter to highlight the data flows that will be implemented by the project. This highlighting will satisfy the requirements for a Project Level ITS Architecture.

2. If some project functions do not exist in the Regional Architecture: The Project Level ITS Architecture must supplement the Regional ITS Architecture with any missing data flows. Copy the appropriate pages from the Regional ITS Architecture and use a highlighter to highlight the existing data flows that will be implemented by the project and add the additional data flows that will be implemented. The MPO maintaining the Regional ITS Architecture also needs to be notified of the changes, for purposes of updating the Regional ITS Architecture.

3. If none of the project functions exist in the Regional ITS Architecture: A Project Level ITS Architecture shall be created utilizing the Regional ITS Architecture and the National ITS Architecture as the basis. The MPO maintaining the Regional ITS Architecture shall be notified of the changes, for purposes of updating the Regional ITS Architecture.
The final design of all ITS projects shall accommodate the interface requirements and information exchanges as specified in the Regional ITS Architecture. If the final design of the ITS project is inconsistent with the Regional ITS Architecture, then the discrepancies shall be reconciled and the Regional ITS Architecture or the project shall be modified as appropriate.

1301-2.5 If a Regional ITS Architecture Does Not Exist

If an ITS project falls in an area not covered by the boundaries of a Regional ITS Architecture (see Table 1397-3), a few additional procedures will be required in the development of the Project Level ITS Architecture.

First, determine if the ITS project should be added to an existing Regional ITS Architecture. The decision should be based upon geographic, stakeholder, and system function considerations.

If the new ITS project will not be added to an existing Regional ITS Architecture, then Project Level ITS Architecture will need to be created using the National ITS Architecture as a basis.

If this is the first ITS project in the area, the timeframe for developing a Regional ITS Architecture begins and the Region will have four years from the date that the project advances to final design to create a Regional ITS Architecture that is “Ready for Use.” Final design is defined as entry to Stage 3 Design at the appropriate step of the PDP.

For subsequent projects in the Region, until the four years have passed or the Regional ITS Architecture is developed, whichever is earlier, Project Level ITS Architecture shall use the National ITS Architecture as a basis.

For Federal funds to be considered once the four years have passed, the Regional ITS Architecture must be completed for ITS projects to be authorized for construction.

1301-3 Systems Engineering Analysis

1301-3.1 General

In Ohio, all ITS projects shall be based on a Systems Engineering Analysis (SEA). The scale of the analysis should be on a scale commensurate with the project scope of the ITS portion of the project.

The various documents are to be developed and submitted at the appropriate point in the project. ITS projects are required to follow the Project Development Process (PDP) since SEA is not specifically addressed in the PDP, refer to Figure 1398-2 for Minor PDP and Figure 1398-3 for Major PDP. These figures depict the appropriate submittal times.

An SEA is a process or a structured approach which can control costs, lead to reduced risks, maintain the project schedule, satisfy user needs, and meet the requirements of ODOT and the Federal regulation. The SEA effort will vary based on the complexity of the project and the type of ITS project. Major ITS projects are typically larger and more complex than Minor ITS projects, and are likely to require more documentation to fully document the SEA for the project.

An SEA will provide a description of the scope of the ITS project (the general location, conceptual alternative, and logical termini or service area of the proposed project), an operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the ITS project, functional requirements of the ITS project, interface requirements and information exchanges between the ITS project and other planned and existing systems and subsystems and identification of applicable ITS standards.
The SEA is comprised of twelve items to be addressed, which further describe these elements. The twelve items are elaborated in **Subsection 1301-3.2, Documentation and Submission of All ITS Projects** section.

### 1301-3.2 Documentation and Submission of All ITS Projects

All submissions required by the PDP (see Sections 140-7 and L&D Manual Volume 1) shall be required for ITS projects.

A Project Level ITS Architecture and a Systems Engineering Analysis (SEA) are required for any ITS project, whether Major ITS or Minor ITS. The documentation will be more extensive for Major ITS projects than for Minor ITS projects, and is expected to be commensurate with the scope of the ITS work. Both the Project Level ITS Architecture and the SEA must be completed and approved prior to authorization of construction funding. For clarity, page breaks should be inserted between each of the twelve items. The SEA will consist of providing items 1 through 12, listed below:

1. Define the scope of work for the overall project and the ITS components (the general location, conceptual alternative, and logical termini or service area of the proposed project level of development) Scoping shall also include intercoordination and possible effects on neighboring jurisdictions. Include the PID, location, project description from ELLIS or other sources, description of the ITS work, and the project background (summary of purpose and need).

2. Identify portions of the Regional ITS Architecture being implemented (or if a Regional ITS Architecture does not exist, the applicable portions of the National ITS Architecture), The Ohio Project Level ITS Architecture for Minor ITS form (see Form 1396-1) may be used by marking which items are existing (E), which will be used on the project (P), which are for the future (F), and which will not be used (X). Once completed, submitted, and approved, this documentation will satisfy the Project Level ITS Architecture requirement. The form may be modified as needed using the National ITS Architecture for reference. The use of TurboArchitecture is recommended. This software can be downloaded free of charge from the Federal Highway Administration. If no Regional ITS Architecture exists for the project area, contact the ODOT Office of Traffic Engineering (OTE).

3. Provide a list of all stakeholders, including the roles and responsibilities of each. Provide a concept of operations discussing what the project is to accomplish, including identifying stakeholder needs and resources that stakeholders can provide. For complex projects, scenarios may be necessary to illustrate the operations.

4. Define the functional requirements of the project. Provide interface/communication requirements for all the stakeholders in the project. (This includes the existing systems already deployed in the region.)

5. Provide analysis of alternative system configurations and technology options to meet requirements, including rationale for technology selection.

6. Provide analysis of procurement methods considered including rationale for selected option. In some cases, the procurement methods may be determined by State law.

7. Identify the existing ITS Standards that will be used in the project. An explanation is required for not using the applicable Standards.

8. Identify the testing procedures to verify compliance with the standards as well as the requirement for interoperability. For some projects, the testing procedures may be provided by a product vendor.
Provide a traceability matrix for documenting compliance with the above. The traceability matrix provides a mechanism for ensuring that each functional requirement and specification is tested and that each item to be tested has been addressed in the specifications. A sample traceability matrix applicable to an emergency vehicle preemption project is provided on the OTE website under Miscellaneous Forms at http://www.dot.state.oh.us/Divisions/HighwayOps/Traffic/Pages/Forms.aspx. The site can also be accessed by opening the ODOT webpage, selecting Highway Operations from the Divisions dropdown menu, selecting Forms under Traffic Engineering from the left pane, and viewing the documents labeled 1396 under Miscellaneous Forms. The forms may be modified as necessary.

The traceability matrix will be included in the contract documents for use during construction. The completed traceability matrix including the results of the test and any necessary work to address failures during the test, will be included in the project construction records.

9. Project submittal cut sheets, laboratory reports and precertification may be substituted for some field testing. Devices on a Qualified Providers List (QPL) do not need to be tested. Other devices or additional functionality will be included on the traceability matrix for field testing.

10. Provide change control management, which will describe what changes were made during project development, and how changes and change orders will be processed and managed during construction, including identifying necessary approvals.

11. Provide a Maintenance Plan, an Operational Concept, and a funding analysis for the maintenance and operation of the system after completion. This includes an analysis of cost, personnel, software, utilities and anything further required to maintain and operate the system. Examples of this item are available on the OTE website.

12. Provide documentation for revising the Regional ITS Architecture after project construction. Contact the appropriate MPO for preferred or required formats for submitting this information.

1301-3.2.1 Additional Requirements

Additionally, all stand alone Major and Minor ITS Projects shall follow the PDP process for Minor Projects.

The ITS components in other projects shall follow the applicable PDP for the entire project and meet the ITS requirements.

The Ohio Federal-Aid Highway Program Stewardship and Oversight Agreement between ODOT and FHWA establishes full Federal oversight for Major ITS Projects. Minor ITS Projects are ODOT-administered. Contact the ODOT Office of Traffic Engineering (OTE) for further information about distinctions between Major ITS projects and Minor ITS projects.

It is anticipated that the documentation will be prepared by the local agency or its consultant, for submission to the appropriate ODOT District, to be forwarded on to OTE. For ODOT projects, it is anticipated that the documentation will be prepared by the ODOT District for submittal to OTE.

Contact OTE for preferred documentation formats.

Sample documents, including a simplified form for Emergency Vehicle Preemption projects are provided on the ODOT Traffic Engineering website under Miscellaneous.
Forms at http://www.dot.state.oh.us/Divisions/HighwayOps/Traffic/Pages/Forms.aspx. The site can be accessed by opening the ODOT webpage, selecting Highway Operations for the Divisions dropdown menu, selecting Forms under Traffic Engineering from the left pane, and viewing the documents labeled 1396 under Miscellaneous Forms. The forms may be modified as necessary.

Documentation should be submitted electronically whenever possible.

Local agencies shall submit all appropriate documents to the appropriate ODOT District for review and approval per the existing project administration procedures. OTE will then coordinate with and forward submittals to FHWA per the Federal-aid Highway Program Stewardship and Oversight Agreement.

In addition, when the project is covered by a Regional ITS Architecture, the as-built Project Level ITS Architecture with any modifications noted, shall be submitted by the local agency to the appropriate MPO for updating the Regional ITS Architecture.

If any uncertainty exists regarding design requirements, standards or forms, or other ITS requirements, the project sponsor should contact the District.

Project documentation shall be retained by the District in their project files.

1301-4 Ellis Requirements for ITS Projects

ITS projects shall utilize one of the two following Ellis Project Report Codes as appropriate to document progress toward completion of the required CFR 940 documentation. The report codes should be created and updated throughout the project beginning at the time the project is scoped.

During PS&E approval of a project, Ellis will be referenced to determine if documentation is complete. Should an ITS project not have the proper Ellis documentation, authorization for funding of the project could be delayed at PS&E.

Ellis Report Codes: ITS Project, Documentation in Progress; or ITS Project, Documentation Complete
A primary goal of the Freeway Management System (FMS) is to provide reliable and timely travel information. This shall be achieved through the provision of route and segment-based travel times. The public accepts delay to some degree if it is consistent, or at least expected. Valid travel times are to be provided in real time, providing easily accessible information about delays. Public trust is difficult to gain, but easy to lose, so the accuracy and timeliness of travel time information must be carefully maintained. Similarly, it is essential that information about incidents be accurate and timely.

Information dissemination will be accomplished using a variety of methods including:

- Web-based: ODOT and private websites.
- Dynamic Message Signs (DMS)
- Highway Advisory Radio (HAR)
- 511 telephone number (in Cincinnati only)
- Radio and television broadcasts (private-sector leveraging FMS information)

It is the intention of ODOT’s statewide FMS deployment to provide full coverage of six of the metropolitan areas with full instrumentation and communication to a central Traffic Management Center (TMC), in accordance with the Regional Architecture prepared by the MPO in cooperation with ODOT and FHWA. The Regional Architectures are defined in the Detailed Project Plans, prepared under the direction of these same agencies.

### 1303-2 Traffic Management Center (TMC)

This section is being reserved for future use.

### 1303-3 Closed Circuit Television (CCTV)

CCTV cameras provide an opportunity for congestion and incident management verification. FMS areas function very efficiently with the use of CCTV cameras. They provide views of the highway system that can only be otherwise obtained by first hand viewers and provide a great amount of information to Traffic Management Center (TMC) operators. CCTV camera placement is expected to be at approximately 1-mile (1.6 km) spacing to provide full coverage of the freeways. Cameras are usually located at interchanges which afford an opportunity to view not only the freeway mainline but the ramps and cross routes as well. The viewing angle of the camera shall give preference to the freeway mainline with arterial coverage included to the extent possible. CCTV camera placement is covered in each FMS project design guidelines, which are available from the Office of Traffic Engineering (OTE) upon request.

CCTV cameras are also in demand for use by local jurisdictions and other agencies, the media, and the public (via the Internet). The central video control system will be designed to accommodate external feeds of camera images, both streaming and static. In cases where a non-Internet connection is used to access video feeds from the TMC, external users of the video will be required to sign a CCTV License Agreement. There shall be no fee for use of ODOT FMS video although the users must arrange for their own communication pathway to the TMC video switch.

Information about operation of the CCTV cameras by TMC personnel, as well as remote access by authorized users, will be available from OTE. This will include general rules for routine use of the cameras such as limitations on zoom functions during incidents and scenes involving solely (January 16, 2009)
private property. When CCTV cameras are being manipulated or are zoomed in to assist with an incident, the video signal from the server is generally blocked. It may be necessary to disable the video feed manually, or it may be an automatic software function, depending on the FMS software version. Generally, CCTV camera images will not be recorded. However, DVR capability shall be designed into the TMC in terms of software and hardware and select procedures shall be developed governing the use of video recording.

1303-4 Communication

FMS communication systems are critical to successful operation. ODOT has determined that the most effective (high-level) system requirement for FMS communications is to mimic the ODOT network. Therefore field device communications shall use Ethernet and other devices compatible with equipment routinely used by ODOT. The FMS network shall be separate from the ODOT network although there will be connectivity between the two systems. ODOT network interoperability is coordinated with the Network Operations Center of the ODOT Division of Information Technology (DoIT).

Fiber optic cable is the medium of choice although many “last-mile” and point-to-point applications require wireless or other forms of wire-line communications (e.g. T-1, POTS, Coax, CDMA). Communications redundancy in the field will be limited until additional funding is available or new techniques are developed. TMC operational redundancy shall be provided via a backup TMC.

To facilitate standardized communication protocols NTCIP-compliant devices will be used when possible. Field device communication represents a significant cost in the design, deployment, and operation of an FMS. ODOT systems will use a hybrid of Ethernet-based fiber optic and wireless communications to maximize bandwidth for the least cost to support the field infrastructure. Connectivity is desired for remote operations and “pushing” video and data to a number of external users/agencies. The central software system shall be designed to provide flexibility in the provision of access by others outside the TMC and the FMS/ODOT networks. An internet connection to the FMS network will be the most effective means of providing access to the system.

1303-5 Dynamic Message Signs (DMS)

DMS are a key component to an effective FMS. The installation of Dynamic Message Signs (DMS) can help to reduce traffic congestion during incidents and will help to provide travelers with real time traffic information.

DMS shall be installed at strategic locations on urban freeways to advise drivers of incidents and warn of congestion or stopped traffic. Generally no alternate route will be specified, although DMS messages may suggest the use of alternate routes. When no particular incidents are worthy of mention, the default message with travel time through key segments of the urbanized area shall be displayed. Messages for DMS shall be chosen from a DMS message library unless a different message is truly needed. If a different message is needed it shall be created by the appropriate party. When resources limit full deployment of DMS in accordance with Detailed Project Plans and FMS Design Guidelines, first priority will be given to sites on routes inbound to a central business district, deferring outbound DMS to subsequent phases. The design plans must be in accordance with the Detailed Project Plan.

1303-6 Vehicle Detection

The conventional form of vehicle detection is for FMS loops with algorithms which manipulate the detector to develop speed, volume and occupancy or density. This data can be used for both the calculation of travel times and incident identification. In many states, the use of fixed-point detection for incident detection has proved to be costly and ineffective. Various types of detectors have been implemented with varying degrees of success. Numerous installations are likely to use other technologies such as: side-fire radar, video image detection, and acoustic detection for acquiring traffic flow information. A more recent practice is the use of cellular 911 calls and other...
cell phone technologies to locate incidents directly. Various technologies are available to provide travel times. The incidents are verified and travel times can be corroborated using CCTV.

1303-7 **Highway Advisory Radio (HAR)**

Highway Advisory Radio (HAR) is an element to the FMS which, if utilized properly, can provide a great public benefit. The HAR system provides near-real time information on the freeway system during operational hours. When systems are unattended, other valuable traveler information will be broadcast such as construction activities on-going or special events that may impact traffic.

It is essential that the HAR is reliable 24/7 and provides accurate, timely information. Similar to DMS, when no particular incident or congestion related information is applicable, the HAR will provide an accurate and timely announcement of travel times between relevant landmarks.

More information on HAR is available in Section 206-5.

1303-8 **Travel Time**

This Section is being reserved for future use.

1303-9 **Road Weather Information System (RWIS)**

A Road Weather Information System (RWIS) is comprised of Environmental Sensor Stations (ESS) in the field, a communication system for data transfer, and central systems to collect field data from numerous ESS. These stations measure atmospheric, pavement and/or water level conditions for flood information. Central RWIS hardware and software are used to process observations from ESS to develop forecasts, and display or disseminate road weather information in a format that can be easily interpreted. RWIS data are used by road operators and maintenance staff to support decision making.

There are three types of road weather information: atmospheric data, pavement data, and floodwater level data. Atmospheric data include air temperature and humidity, visibility distance, wind speed and direction, precipitation type and rate, cloud cover, tornado or waterspout occurrence, lightning, storm cell location and track, as well as air quality. Pavement data include pavement temperature, pavement freezing point, pavement condition (e.g., wet, icy, flooded), pavement chemical concentration, and subsurface conditions (e.g., soil temperature). Water level data include stream, river, and lake levels near roads, as well as tide levels (i.e., hurricane storm surge).

Transportation managers utilize weather warning systems and web sites to disseminate road weather information to travelers in order to influence their decisions. This information allows travelers to make choices about travel mode, departure time, route selection, vehicle type and equipment, and driving behavior. In Ohio, RWIS provides information on current conditions and assists with forecasting for snow, ice control and removal, flooding, etc. Information is available at the Buckeye Traffic website (http://www.buckeyetraffic.org/rwis/nosvg/) and is available via the weblink from Ohio Transportation Information System (OTIS). RWIS combined with forecasts provides District maintenance staff with the best information for snow and ice control. This information allows Districts to most efficiently allocate resources including snow plows and salt and brine applications.

1303-10 **Ramp Metering**

Ramp Metering is another key component to an FMS. Its basic function can help to greatly reduce traffic congestion in FMS areas and result in more efficient travel. There are several modes of ramp meter operation, including the following:

- Traffic-Responsive (using mainline and ramp traffic flow data from upstream and downstream stations).
Ramp Metering is currently provided in the following metropolitan areas:
Columbus      District 6 currently operational with new installations underway
Cincinnati     District 8 to be added to the ARTIMIS system in the near future

Ramp Metering may be provided in the following metropolitan areas as conditions warrant:
Toledo         District 2
Akron/Canton   District 4
Dayton         District 7
Cleveland      District 12

Special design considerations are needed for non-standard ramps or ramps with inadequate storage capacities or acceleration lengths. Decision flowcharts are provided in the Ramp Metering Guidelines as an aid to designers implementing ramp metering in nonstandard situations. Nonstandard ramps will be metered on a case by case basis, although system-wide metering is the intent. Ramp Design Guidelines which provide law enforcement pads are included in the ODOT L&D Manual. In some cases it will be necessary to provide surveillance of the ramp meters through CCTV cameras or other means to ensure congestion is not aggravated by the metered condition.

Ramp Metering guidelines are available upon request from the ITS section of ODOT’s Office of Traffic Engineering. More info is available on Ramp Metering signals in OMQCD Chapter 4H.

1303-11 Traffic Incident Management

Traffic incident management is addressed in Chapter 608.
1396 FORMS INDEX

1396-1 Minor ITS Form

As noted in Sections 1301-2.6 and 1301-3.3, Form 1396-1 may be used and modified as necessary for completing the Systems Engineering Analysis. Completed examples of this form and related documents can be found on the Office of Traffic Engineering (OTE) website under ITS.

1396-2 Minor ITS Form for Emergency Vehicle Preemption (EVP)

As noted in Sections 1301-3.3, Form 1396-2 is an abbreviated Minor ITS Form available for use in documenting the SEA for Emergency Vehicle Preemption projects. An editable copy of this form can be found on the Office of Traffic Engineering (OTE) Forms website.
Intentionally blank.
Form 1396-1. Minor ITS Form

Typical projects that may use this form include the following: Roadway Weather Information System (RWIS), Roadgrip Sensor System, Various surveillance or control systems that will functionally be integrated into a FMS.

Check all that Apply:

☐ Surveillance or control systems (i.e. coordinated Traffic Signal System) that could functionally be integrated into a FMS.
☐ Highway Rail Intersection (HRI) warning systems
☐ Emergency vehicle preemption systems
☐ Parking Management Systems
☐ RWIS
☐ Roadgrip Sensor System
☐ Other

If any of the items listed below apply, you cannot use this form and should contact ODOT Office of Traffic Engineering.

- Signal projects that require the integration of signal systems with FMS or RWIS.
- An ITS systems that involves multiple political jurisdictions.
- An ITS project that involves interagency systems.

Note: One or more of the above boxes must be filled in. If you are doing only a Signal System Interconnect Architecture, indicate on the data flow diagram (titled 2. ITS Architecture/Systems Engineering) which of the data flows will be used.

This form Completed by:

Name: 
Agency: 
Title: 
Phone: 
Email: 
Date: 

Reviewed by:

Name: 
Agency: 
Title: 
Phone: 
Email: 
Date: 

Reviewed by:

Name: 
Agency: 
Title: 
Phone: 
Email: 
Date: 

Reviewed by:

Name: 
Agency: 
Title: 
Phone: 
Email: 
Date: 

Reviewed by:

Name: 
Agency: 
Title: 
Phone: 
Email: 
Date: 

1. **Scope of work.**
   - PID:
   - Location: :
   - Project Description (from ELLIS or other sources):
   - Description of the ITS work:
   - Project Background (Summary of Purpose and Need):

2. **ITS Architecture/Systems Engineering:**

   *(Indicate on the drawing below which data flows will be implemented by this project.)*

**Instructions for using the data flow diagram:**

1. At the top of the appropriate box, fill in the names(s) of the agency responsible for the corresponding function, system, equipment or resource. (i.e. Local_Agency: Your Entry Here).
2. Review Data Flows, and mark next to each flow name with one of the following descriptors:
   - (E) Existing,
   - (P) Planned for this project,
   - (F) Future Project,
   - (X) Not Planned.
3. Definitions of the ITS data flows on the above diagram are provided below.
Data Flow Definitions:

- **Crossing Call**: Direct Pedestrian request to cross the roadway. This may be an overt (e.g., push button) request from a pedestrian or the physical presence of a pedestrian that can be detected by sensors or surveillance systems.
- **Crossing Permission**: Signal to pedestrians indicating permission to cross roadway.
- **Local Signal Preemption Request**: Direct control signal or message to a signalized intersection that results in preemption of the current control plan and grants right-of-way to the requesting vehicle.
- **Request For Right-Of-Way**: Forwarded request from signal prioritization, signal preemption, pedestrian call, multi-modal crossing activation, or other source for right-of-way.
- **Signal Control Data**: Information used to configure and control traffic signal systems.
- **Signal Control Status**: Status of surface street signal controls including operating condition and current operational state.
- **Traffic Flow**: Raw and/or processed traffic detector data which allows derivation of traffic flow variables (e.g., speed, volume, and density measures) and associated information (e.g., congestion, potential incidents). This flow includes the traffic data and the operational status of the traffic detectors.
- **Traffic Images**: High fidelity, real-time traffic images suitable for surveillance monitoring by the operator or for use in machine vision applications. This flow includes the images and the operational status of the surveillance system.
- **Traffic Operator Data**: Presentation of traffic operations data to the operator including traffic conditions, current operating status of traffic control equipment, maintenance activity status, incident status, and other information. This data keeps the operator apprised of current road network status, provides feedback to the operator as traffic control actions are implemented, and supports review of historical data and preparation for future traffic operations activities.
- **Traffic Operator Inputs**: Traffic operations requests for information, configuration changes, commands to adjust current traffic control strategies (e.g., adjust signal timing plans, change Dynamic Message Sign (DMS) messages), and other traffic operations data entry.
- **Traffic Sensor Control**: Information used to configure and control traffic sensor systems.
- **Video Surveillance Control**: Information used to configure and control video surveillance systems.
- **Intersection Blockage Notification**: Notification that a highway-rail intersection is obstructed and supporting information.
- **HRI Advisories**: Notification of Highway-Rail Intersection equipment failure, intersection blockage, or other condition requiring attention, and maintenance activities at or near highway rail intersections.
- **HRI Control Data**: Data required for HRI information transmitted at railroad grade crossings and within railroad operations.
- **HRI Operational Status**: Status of the highway-rail grade crossing equipment including both the current state or mode of operation and the current equipment condition.
- **HRI Request**: A request for highway-rail intersection status or a specific control request intended to modify HRI operation.
- **HRI Status**: Direct Status of the highway-rail intersection equipment including both the current state or mode of operation and the current equipment condition.
- **Arriving Train Information**: Information for a train approaching a highway-rail intersection that may include direction and allow calculation of approximate arrival time and closure duration.
- **Track Status**: Current status of the wayside equipment and notification of an arriving train.
3. List of Stakeholders.

(Include a list of agencies and their roles and responsibilities. Also, provide a Concept of Operations that includes a statement of goals and objectives, a statement of the responsibilities and authority of the roles played in the process, and the specific operational processes.)

AGENCIES:


CONCEPT OF OPERATIONS:

4. Functional requirement of the project.

5. Analysis of alternative system configurations and technology options.

(Provide a detailed description of the various technologies considered and why the proposed technology was selected.)

6. Describe the various procurement methods available and include rationale for the selected method.

7. Identify ITS Standards that will be used in the project.

(List all the ITS standards applicable to the ITS elements and/or components of the project, and identify on said list which of those applicable ITS standards will be implemented with this project.)

For more information:


Then scroll down and look for the link that corresponds to the ITS application(s) that the project includes. Click on the link to get to the page that has the list of applicable standards for that particular ITS application.
8. Testing Procedures.
   (All required items are included in the specifications. All elements of the specifications are included and tested in the traceability matrix.)

   “All system requirements are included in the specifications for the project and will be tested as indicated in the Traceability Matrix. Testing will be in conformance with the manufacturer’s specifications.”

   The Traceability Matrix will be included in the construction documents for use by the contractor and other project personnel. The inclusion of the Traceability Matrix will provide the contractor with information about the items that will be tested and required to be operational as a part of the construction contract. It will also provide the project sponsor’s representative with the items to be tested and the format for documenting the testing results. The completed Traceability Matrix should become part of the project records.

   Fill out traceability matrix and attach to end of this form

   The Traceability Matrix will be included in the construction documents for use by the contractor and other project personnel. The inclusion of the Traceability Matrix will provide the contractor with information about the items that will be tested and required to be operational as a part of the construction contract. It will also provide the project sponsor’s representative with the items to be tested and the format for documenting the testing results. The completed Traceability Matrix should become part of the project records.

10. Change control management.

   This section states how changes were accomplished during project development, and how change orders and project changes will be managed during construction.

11. Maintenance, operation and funding of the system after completion.
   (The maintenance plan addresses the repairs, upgrades, and plans for funding all aspects of the project, particularly during operations. The Operations Concept includes a clear statement of goals and objectives, a clear statement of the responsibilities and authority of the roles played in the process, and the specific operational processes and development and maintenance of the process.)

   MAINTENANCE PLAN:

   OPERATIONS CONCEPT:

12. Documentation for revising the Regional ITS architecture.
   (Submit the revised data flow diagram to the appropriate MPO. If no MPO exists for this area, contact the ODOT District.)
<table>
<thead>
<tr>
<th>FUNCTIONAL REQUIREMENT&lt;sup&gt;1&lt;/sup&gt;</th>
<th>SOURCE DOCUMENT&lt;sup&gt;2&lt;/sup&gt;</th>
<th>SOURCE DOCUMENT REFERENCE&lt;sup&gt;3&lt;/sup&gt;</th>
<th>TEST&lt;sup&gt;4&lt;/sup&gt;</th>
<th>PASS/FAIL&lt;sup&gt;5&lt;/sup&gt;</th>
<th>CORRECTIVE ACTION&lt;sup&gt;6&lt;/sup&gt;</th>
</tr>
</thead>
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</tr>
</tbody>
</table>

<sup>1</sup> List the Functional Requirements from Section 4.

<sup>2</sup> Source Document can be plans, specifications, special provisions, etc. where the requirement is found.

<sup>3</sup> Source Document Reference is the section, item number, page, etc. from this source document.

<sup>4</sup> How will this requirement be tested?

<sup>5</sup> (To be completed after installation) Results of the test.

<sup>6</sup> (To be completed after installation) Corrective action taken.
Form 1396-2. Minor ITS Form for Emergency Vehicle Preemption (EVP)

This form may be used to document the ITS Architecture Conformity requirements for projects that include Emergency Vehicle Preemption (Light Emitting or Acoustic), but without other ITS components that would require further conformity documentation. It may also be adapted to similar types of projects. Refer to TEM Section 1301 for more guidance.

If any of the items listed below apply, you cannot use this form and should contact ODOT Office of Traffic Engineering:

- Signal projects that require the integration of signal systems with FMS or RWIS.
- An ITS systems that involves multiple political jurisdictions.
- An ITS project that involves interagency systems.

Project sponsor should complete Sections 1, 2, 3, 5, 11 and 12 and review the remaining sections for relevance to the project and make any changes to this form that are needed.
**Reviewed by:**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Agency:</th>
<th>Title:</th>
<th>Phone:</th>
<th>Email:</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Reviewed by:**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Agency:</th>
<th>Title:</th>
<th>Phone:</th>
<th>Email:</th>
<th>Date:</th>
</tr>
</thead>
</table>
1. Scope of work

- PID:
- Location:
- Project Description (from ELLIS or other sources):
- Description of the Emergency Vehicle Preemption work:
- Project Background (summary of Purpose and Need):
2. ITS Architecture/Systems Engineering

(Indicate on the drawing below which of the following data flows will be used for this project.)

Directions for using the data flow diagram:
1. In the top of the appropriate box, fill in the name(s) of the agency responsible for the function. (i.e. Local_Agency: __Your Agency Here__.)
2. Review Data Flows, and mark next to each flow name with one of the following descriptors:
   (E) Existing,
   (P) Planned for this project,
   (F) Future Project,
   (X) Not Planned
3. Definitions of ITS data flows are provided below.
Data Flow Definitions:

Local Signal Preemption Request: Direct control signal or message to a signalized intersection that results in preemption of the current control plan and grants right-of-way to the requesting vehicle.

Request For Right-Of-Way: Forwarded request from signal prioritization, signal preemption, pedestrian call, multi-modal crossing activation, or other source for right-of-way.

Traffic Flow: Raw and/or processed traffic detector data which allows derivation of traffic flow variables (e.g., speed, volume, and density measures) and associated information (e.g., congestion, potential incidents).

Traffic Images: High fidelity, real-time traffic images suitable for surveillance monitoring by the operator or for use in machine vision applications. This flow includes the images and the operational status of the surveillance system.

Traffic Sensor Control: Information used to configure and control traffic sensor systems.

Video Surveillance Control: Information used to configure and control video surveillance systems.
3. List of Stakeholders

(Include a list of agencies and their roles and responsibilities. Also, provide a Concept of Operations that includes a statement of goals and objectives, a statement of the responsibilities and authority of the roles played in the process, and the specific operational processes. An example plan is shown below. It may be used, modified, or replaced as needed.)

AGENCIES:
Traffic: Provide for the safe and efficient operation of the city’s street system. They are responsible for traffic signal timing and adjustments and the maintenance of the signal system and other traffic control devices.

Police: Provide emergency response for safety and protection to the city. They need to arrive on the scene safely and quickly.

Fire/EMS: Provide emergency response to calls for fire, rescue, and medical aid. They need to arrive on scene safely and quickly.

Other:

CONCEPT OF OPERATIONS: An authorized emergency vehicle approaching a signalized intersection enroute to an emergency call has an activated emitter. The emitted signal is detected by an EVP detector mounted on the signal mast arm. The signal controller terminates any conflicting phases to bring up the through phase for the authorized emergency vehicle. Indicator lights mounted on the mast arms indicate that preemption is in operation.

The white/clear confirmation lights shall be mounted on the signal mast arms, one indication light facing each direction of approach. The EVP confirmatory light will remain dark (off) when the EVP Operation is not active. When the EVP is in operation, the indicator light shall flash or be steady under conditions defined below.

The approach that is preempted will receive a steady confirmation light along with the opposing approach. The controller will cycle through to bring up the circular green indications. The conflicting approaches will receive flashing confirmation lights and circular red indications.

The city will have the ability to download the database of preemption calls either from the controller or from the preemption equipment itself.

4. Functional requirement of the project
(The following is a sample listing for one particular application. It may be used, modified or replaced as needed.)

1. Vehicle based emitter is activated by emergency personnel in the vehicle.
2. Detectors mounted on the signal mast arms are responsive.
3. The traffic signal controller shall terminate any conflicting phases to bring up the through phase for the authorized emergency vehicle.
4. Indicator lights shall be mounted on signal mast arms (one for each direction).
5. Indicator lights shall indicate that preemption is in operation.
   a. The indicator light shall be steady for the preempted approach and the opposing approach during preemption activation.
   b. The indicator light shall flash for the conflicting approaches during preemption activation.
c. The indicator light shall remain dark when the preemption system is not active.

6. At the termination of the preemption phase, traffic signals shall return to the designated operation phase.

7. Preemption call history shall be available for downloading/printing via both the controller and the preemption unit for a set period of time.

5. **Analysis of alternative system configurations and technology options**

   *(Provide a description of the various technologies considered and why the proposed technology was selected. The example below is for one particular application. It may be used, modified or replaced as needed.)*

Both light emitting and acoustic emergency vehicle preemption systems were considered for this project. However, the ____________design was selected because ____________.

6. **Describe the various procurement methods available and include rationale for the selected method**

   We will follow the State of Ohio rules and regulations for procurement of all materials and services. Due to the scope and scale of the project, low bid was the only applicable contract mechanism.

7. **Identify ITS Standards that will be used in the project**

   *(Indicate on the following list of standards for Signal Priority, which standards will be implemented with this project. Typically, only NTCIP 1201 and NTCIP 1211 will be used for light emitting or acoustic designs. If other system designs will be used, the list in this table should be expanded or modified. For more information, visit http://www.standards.its.dot.gov/app_areas.asp?id=29.)*

<table>
<thead>
<tr>
<th>Standard</th>
<th>To be used on Project?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTCIP 1201: Global Object Definitions</td>
<td>Yes</td>
</tr>
<tr>
<td>NTCIP 1211: Object Definitions for Signal Control and Prioritization (SCP)</td>
<td>Yes</td>
</tr>
<tr>
<td>APTA TCIP-S-001 3.0.0: Standard for Transit Communications Interface Profiles</td>
<td>No *</td>
</tr>
<tr>
<td>ASTM E2158-01: Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band</td>
<td>No *</td>
</tr>
<tr>
<td>ASTM E2213-03: Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications</td>
<td>No *</td>
</tr>
<tr>
<td>IEEE 1609.1-2006: Standard for Wireless Access in Vehicular Environments (WAVE) - Resource Manager</td>
<td>No *</td>
</tr>
<tr>
<td>IEEE 1609.2-2006: Standard for Wireless Access in Vehicular Environments (WAVE) - Security Services for Applications and Management Messages</td>
<td>No *</td>
</tr>
<tr>
<td>IEEE 1609.4-2006: Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-Channel Operation</td>
<td>No *</td>
</tr>
<tr>
<td>IEEE P1609.3: Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services</td>
<td>No *</td>
</tr>
</tbody>
</table>

* Does not apply to light emitting or acoustic emergency vehicle preemption systems

8. **Testing Procedures**

   All functional requirements are included in the specifications for the project and will be tested as indicated in the Traceability Matrix. Testing will be in conformance with the manufacturer’s specifications.
9. Traceability matrix

See traceability matrix attached to the end of this form.

10. Change control management

The City Engineer (or designated representative) will review shop drawings prior to installation. Any change orders will be handled per ODOT’s Change Order Policy.

11. Maintenance, operation and funding of the system after completion

(The maintenance plan addresses the repairs, upgrades, and plans for funding all aspects of the project. The Concept of Operations includes a clear statement of goals and objectives, a clear statement of the responsibilities and authority of the roles played in the process, and the specific operational processes and development and maintenance of the process. Example plans are shown below. If you prefer a different plan, insert it in place of the one below.)

MAINTENANCE PLAN: (Agency) will own, operate, and maintain the preemption system after its installation. The __________ Department will be responsible for operation and maintenance of all traffic signal and control equipment. The Department is also responsible for software upgrades and replacement of broken equipment. The Department has sufficient staffing, equipment, and tools for the required maintenance. Utility and maintenance costs for the preemption equipment are negligible and will be absorbed by the city. No additional staff will be required for maintenance of this equipment. Utility costs and maintenance of the traffic signal equipment are also the responsibility of ____________________.

12. Documentation for revising the Regional ITS architecture

(Submit the revised data flow diagram to the appropriate MPO. If no MPO exists for this area, contact the ODOT District.)

The revised data flow diagrams will be submitted to __________ after completion of the project. The estimated contract completion date is __________.
<table>
<thead>
<tr>
<th>FUNCTIONAL REQUIREMENT</th>
<th>SOURCE DOCUMENT</th>
<th>SOURCE DOCUMENT REFERENCE</th>
<th>TEST</th>
<th>PASS/FAIL</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vehicle based emitter is activated by emergency personnel in the vehicle</td>
<td></td>
<td></td>
<td>Signal reception verified in controller and by detectors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Detectors mounted on the signal mast arms are responsive</td>
<td></td>
<td></td>
<td>Signal reception verified in controller and by detectors. This is done for each approach of the intersection.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The traffic signal controller shall terminate any conflicting phases to bring up the through phase for the authorized emergency vehicle</td>
<td></td>
<td></td>
<td>Signal reception verified in controller and by detectors. This is done for each approach of the intersection. Visually verify that signal phasing has been preempted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Indicator lights shall be mounted on signal mast arms (one for each direction)</td>
<td></td>
<td></td>
<td>Visual inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Indicator lights shall indicate that preemption is in operation</td>
<td></td>
<td></td>
<td>Visually verify confirmation light operation in the field. This is done for each approach of the intersection. The lights should be wired through the controller to confirm true preemption; not through phase selector.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. The indicator light shall be steady for the preempted approach and the opposing approach during preemption activation</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. The indicator light shall flash for the conflicting approaches</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. List the Functional Requirements from Section 4
2. Source Document can be plans, specifications, special provisions, etc. where the requirement is found
3. Source Document Reference is the section, item number, page, etc. from this source document
4. How will this requirement be tested?
5. (To be completed after installation) Results of the test
6. (To be completed after installation) Corrective action taken
<table>
<thead>
<tr>
<th>during preemption activation</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>c. The indicator light shall remain dark when the preemption system is not active</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. At the termination of the preemption phase, traffic signals shall return to the designated operation phase</th>
<th>Visually verify timing and phasing operation on site</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>7. Preemption call history shall be available for downloading/printing via both the controller and the preemption unit for a set period of time</th>
<th>Verify that preempt calls are logged for data download. Check software for accuracy during the on-site testing</th>
</tr>
</thead>
</table>

|  |  |  |  |
1397 TABLES INDEX

1397-1 Major and Minor ITS Projects

As noted in Section 1301-1.2, Table 1397-1 presents examples of major ITS, minor ITS, or non-ITS projects.

1397-2 ITS User Services

Table 1397-2 presents a list of all the ITS User Services available.

1397-3 Regional ITS Architecture in Ohio

As noted in Sections 1301-2.1, 1301-2.3, and 1301-2.4, Table 1397-3 presents a list of the locations with MPO’s in Ohio, as well as the MPO contact information.
Intentionally blank.
**Table 1397-1. Major and Minor ITS Projects**

<table>
<thead>
<tr>
<th>Major ITS</th>
<th>Non ITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Freeway Management Systems (FMS)</td>
<td>- System expansions that do not add new functionality</td>
</tr>
<tr>
<td>- Traffic Signal systems scoped to be centrally controlled (Closed loop systems are NOT central control systems.)</td>
<td>- Closed loop signal systems not integrated with other devices or systems. (Emergency vehicle preemption is considered to be another system)</td>
</tr>
<tr>
<td>- Integration of ramp meters with traffic signals on adjacent arterials</td>
<td>- Routine maintenance and operation of existing systems</td>
</tr>
<tr>
<td>- Regional Transit Systems</td>
<td>- Signal retiming even if multi-agency or multi-jurisdictional</td>
</tr>
<tr>
<td>- Traffic signal projects that require the integration of signal systems with Freeway Management Systems or RWIS systems.</td>
<td>- Traffic signals which are either isolated, time based coordinated, or interconnected but not centrally controlled</td>
</tr>
<tr>
<td>- Transit Signal Priority Systems</td>
<td>- Speeding or red-light running electronic enforcement systems</td>
</tr>
<tr>
<td>- Roadway Weather Information System (RWIS)</td>
<td>- Cameras installed solely for the purpose of traffic or data collection (except if it will functionally be integrated into a system for surveillance purposes.)</td>
</tr>
<tr>
<td>- Roadgrip Sensor System</td>
<td>- Weigh-in-motion systems (unless integrated into an FMS)</td>
</tr>
<tr>
<td>- Various surveillance or control systems that could functionally be integrated into a FMS</td>
<td>- Count and classification systems (unless integrated into an FMS)</td>
</tr>
<tr>
<td>- Highway Rail Intersection (HRI) warning systems</td>
<td></td>
</tr>
</tbody>
</table>
Table 1397-2. ITS User Services

<table>
<thead>
<tr>
<th></th>
<th>Travel and Traffic Management</th>
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<tbody>
<tr>
<td>1.1</td>
<td><strong>Pre-trip Travel Information:</strong> ITS shall include a Pre-Trip Travel Information (PTTI) capability to assist travelers in making mode choices, travel time estimates, and route decisions prior to trip departure. It consists of four major functions, which are, (1) Available Services Information, (2) Current Situation Information, (3) Trip Planning Service, and (4) User Access. Information is integrated from various transportation modes and presented to the user for decision making.</td>
</tr>
<tr>
<td>1.2</td>
<td><strong>En-route Driver Information:</strong> ITS shall include an En-Route Driver Information (DI) function. Driver Information provides vehicle drivers with information, while en-route, which will allow alternative routes to be chosen for their destination. Driver Information consists of two major functions, which are, (1) Driver Advisory and (2) In-vehicle Signing. The potential decrease in traffic may also provide benefits in highway safety, reduced air pollution, and decreased congestion.</td>
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<tr>
<td>1.3</td>
<td><strong>Route Guidance:</strong> ITS shall include a Route Guidance (RG) function. Route Guidance will provide travelers with directions to selected destinations. Four functions are provided, which are, (1) Provide Directions, (2) Static Mode, (3) Real-Time Mode, and (4) User Interface.</td>
</tr>
<tr>
<td>1.4</td>
<td><strong>Ride Matching And Reservation:</strong> ITS shall include a Ride Matching and Reservation (RMR) function. Ride Matching and Reservation will provide travel users with information on rideshare providers. Three major functions are provided, which are, (1) Rider Request, (2) Transportation Provider Services, and (3) Information Processing. This will also include a billing service to the providers.</td>
</tr>
<tr>
<td>1.5</td>
<td><strong>Traveler Services Information:</strong> ITS shall include a Traveler Services Information (TSI) function. Traveler Services Information provides travelers with service and facility data for the purpose of assisting prior to embarking on a trip or after the traveler is underway. The functions which are included in this capability are Information Receipt and Information Access. This will provide the traveler with a &quot;yellow pages&quot; type of capability.</td>
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<td>1.6</td>
<td><strong>Traffic Control:</strong> ITS shall include a Traffic Control (TC) function. Traffic Control provides the capability to efficiently manage the movement of traffic on streets and highways. Four functions are provided, which are, (1) Traffic Flow Optimization, (2) Traffic Surveillance, (3) Control, and (4) Provide Information. This will also include control of network signal systems with eventual integration of freeway control.</td>
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<td>1.7</td>
<td><strong>Incident Management:</strong> ITS shall include an Incident Management (IM) function. Incident Management will identify incidents, formulate response actions, and support initiation and ongoing coordination of those response actions. Four major functions are provided, which are, (1) Incidents Identification, (2) Response Formulation, (3) Response Implementation, and (4) Predict Hazardous Conditions.</td>
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<tr>
<td>1.8</td>
<td><strong>Travel Demand Management:</strong> ITS shall include a Travel Demand Management (TDM) function. Travel Demand Management will generate and communicate management and control strategies that will support and facilitate the implementation of TDM programs, policies and regulations. It consists of two major functions, which are, (1) Increase Efficiency of Transportation System and (2) Provide Wide Variety of Mobility Options.</td>
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<tr>
<td>1.9</td>
<td><strong>Emissions Testing And Mitigation:</strong> ITS shall include an Emission Testing and Mitigation (ETAM) Function. The ETAM function will provide state and local governments with the capability to enhance their air quality control strategies. The ETAM will provide both wide area and roadside emissions monitoring. Information gleaned from ETAM will be used by Traffic Demand Management (TDM) in the Traffic Management Center (TMC) to mitigate pollution and may be provided to enforcement agencies to compel offenders to comply with standards.</td>
</tr>
<tr>
<td>1.10</td>
<td><strong>Highway Rail Intersection:</strong> ITS shall include a Highway-Rail Intersection (HRI) function to control highway and rail traffic in at-grade HRIs. Two sub-services are supported: Standard Speed Rail Subservice which is applicable to light rail transit, commuter rail and heavy rail trains with operational speeds up to 79 miles per hour (MPH); and High Speed Rail Subservice which is applicable to all passenger and freight trains with operational speeds from 80 to 125 MPH.</td>
</tr>
</tbody>
</table>
## Public Transportation Management

| 2.1 | **Public Transportation Management**: ITS shall include a Public Transportation Management (PTM) function. PTM shall include an Operation of Vehicles and Facilities (OVF) function that provides computer assisted control of the operation of vehicles and their associated facilities. |
| 2.2 | **En-route Transit Information**: ITS shall include an En-Route Transit Information (TI) function. En-Route Transit Information provides travelers with real-time transit and high-occupancy vehicle information allowing travel alternatives to be chosen once the traveler is en-route. It consists of three major functions, which are, (1) Information Distribution, (2) Information Receipt, and (3) Information Processing. This capability integrates information from different transit modes and presents it to travelers for decision-making. |
| 2.3 | **Personalized Public Transit**: ITS shall include a Personalized Public Transit (PPT) function. The PPT shall include a Rider Request function. The PPT shall include a Vehicle Assignment function. |
| 2.4 | **Public Travel Security**: ITS shall include a Public Travel Security (PTS) function to create an environment of safety in public transportation. PTS shall include specific Secure Areas. |

## Electronic Payment

| 3.1 | **Electronic Payment Services**: ITS shall include an Electronic Payment capability. Electronic Payment Services allows travelers to pay for transportation services by electronic means. Four functions are provided, which are, (1) Electronic Toll Collection, (2) Electronic Fare Collection, (3) Electronic Parking Payment, and (4) Electronic Payment Services Integration. |

## Commercial Vehicle Operations

| 4.1 | **Commercial Vehicle Electronic Clearance**: ITS shall include a Commercial Vehicle Electronic Clearance (CVEC) capability. CVEC shall include a Fixed Facility consisting of those structures and equipment to include Ports Of Entry, Inspection Stations, Weigh Stations and Toll Booths. |
| 4.2 | **Automated Roadside Safety Inspection**: Vehicle System shall provide the capability for each individual vehicle's or carrier's participation in the process to be on a voluntary basis. ITS shall include an Automated Roadside Safety Inspection (ARSI) capability. The ARSI capability shall include a Roadside Facility (RF) function that improves the ability to perform safety inspection through the use of automation. |
| 4.3 | **On-board Safety Monitoring**: ITS shall include an On-Board Safety Monitoring (OBSM) function, that provides monitoring and warnings of safety problems. Of primary importance is to inform the driver, as soon as possible, of any problem that has been detected. Of secondary importance is notifying the carrier of detected safety problems. Last in importance is the notification of appropriate enforcement agencies. |
| 4.4 | **Commercial Vehicle Administrative Processes**: ITS shall include a Commercial Vehicle Administrative Process (CVAP) function consisting of 3 subservices to include Electronic Purchase Of Credentials, Automated Mileage and Fuel Reporting and Auditing, and International Border Electronic Clearance. |
| 4.5 | **Hazardous Material Incident Response**: ITS shall include a Hazardous Materials (HAZMAT) Incident Response (HIR) service. HIR shall include a HAZMAT Incident Notification (HIN) function. HIN shall include the capability to provide enforcement and HAZMAT response teams with timely and accurate information on cargo contents when the vehicle is involved in an incident. |
| 4.6 | **Commercial Fleet Management**: ITS shall include a Commercial Fleet Management (CFM) function. CFM shall include the capability for users to provide commercial drivers and dispatchers with real-time routing information in response to congestion or incidents. |
### Emergency Management

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
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<tbody>
<tr>
<td>5.1</td>
<td><strong>Emergency Notification And Personal Security:</strong> ITS shall include an Emergency Notification and Personal Security (ENPS) function that provides for faster notification when travelers are involved in an incident.</td>
</tr>
<tr>
<td>5.2</td>
<td><strong>Emergency Vehicle Management:</strong> ITS shall include an Emergency Vehicle Management (EVM) Service. EVM Service shall include an Emergency Vehicle Fleet Management System. EVM Service shall include a Route Guidance System. EVM Service shall include a Signal Priority System.</td>
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### Advanced Vehicle Safety Systems

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<tr>
<th>Section</th>
<th>Description</th>
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<tbody>
<tr>
<td>6.1</td>
<td><strong>Longitudinal Collision Avoidance:</strong> ITS shall include a Longitudinal Collision Avoidance Service. Longitudinal Collision Avoidance Service shall include a Backing Subservice. Longitudinal Collision Avoidance Service shall include a Head-On/Passing Subservice.</td>
</tr>
<tr>
<td>6.2</td>
<td><strong>Lateral Collision Avoidance:</strong> ITS shall include a Lateral Collision Avoidance Service. Lateral Collision Avoidance Service shall include a Lane Change/Merge Subservice. Lateral Collision Avoidance Service shall include a Single Vehicle Roadway Departure (SVRD) Subservice.</td>
</tr>
<tr>
<td>6.3</td>
<td><strong>Intersection Collision Avoidance:</strong> ITS shall include an Intersection Collision Avoidance Service. Intersection Collision Avoidance Service shall include an Advisory System. Intersection Collision Avoidance Service shall include a Driver Action System. Intersection Collision Avoidance Service shall include an Automatic Control System.</td>
</tr>
<tr>
<td>6.4</td>
<td><strong>Vision Enhancement For Crash Avoidance:</strong> ITS shall include a Vision Enhancement for Crash Avoidance Service. Vision Enhancement for Crash Avoidance Service shall include an Enhanced Vision System, which augments the vehicle operator's capability to see pedestrians and hazardous situations, where driving visibility is low.</td>
</tr>
<tr>
<td>6.5</td>
<td><strong>Safety Readiness:</strong> ITS shall include a Safety Readiness Service. Safety Readiness Service shall include a Driver Monitor Subservice. Safety Readiness Service shall include a Vehicle Condition Subservice. Safety Readiness Service shall include an Infrastructure Condition Subservice.</td>
</tr>
<tr>
<td>6.6</td>
<td><strong>Pre-crash Restraint Deployment:</strong> ITS shall include the Pre-Crash Restraint Deployment Service. Pre-Crash Restraint Deployment Service shall include an Automatic Activation System.</td>
</tr>
<tr>
<td>6.7</td>
<td><strong>Automated Vehicle Operation:</strong> ITS shall include an Automated Vehicle Operation Service (AVO). AVO service shall include an Automated Highway System (AHS), the Target Level System. AVO service shall include a Partially Automated Highway System (PAHS) as a Transitional System.</td>
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### Information Management

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<tr>
<th>Section</th>
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<tr>
<td>7.1</td>
<td><strong>Archived Data Function:</strong> ITS shall provide an Archived Data Function to control the archiving and distribution of ITS data. The Archived Data User Service provides the Historical Data Archive Repositories and controls the archiving functionality for all ITS data with five major functions: 1) the Operational Data Control function to manage operations data integrity; 2) the Data Import and Verification function to acquire historical data from the Operational Data Control function; 3) the Automatic Data Historical Archive function for permanently archiving the data; 4) the Data Warehouse Distribution function, which integrates the planning, safety, operations, and research communities into ITS and processes data products for these communities; and 5) the ITS Community Interface which provides the ITS common interface to all ITS users for data products specification and retrieval. ADUS helps achieve the ITS information goal of unambiguous interchange and reuse of data and information throughout all functional areas.</td>
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## Table 1397-2. ITS User Services (Continued)

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<thead>
<tr>
<th>Maintenance and Construction Management</th>
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<tr>
<td>Maintenance And Construction Operations: ITS shall provide Maintenance and Construction Operations (MCO) functions to support monitoring, operating, maintaining, improving and managing the physical condition of roadways, the associated infrastructure equipment, and the required resources. MCO shall focus on four major functions: 1) the Maintenance Vehicle Fleet Management function, to monitor and track locations and conditions of fleets of maintenance, construction, and specialized service vehicles; 2) the Roadway Management function, to monitor and forecast conditions and manage treatment of roadways during various travel conditions; 3) the Work Zone Management and Safety function, to support effective and efficient roadway operations during work zone activities; and 4) the Roadway Maintenance Conditions and Work Plan Dissemination function, to coordinate work plans and to communicate conditions. This User Service will utilize ITS systems and processes to support interchange of information among diverse groups of users, to improve efficiency and effectiveness of operational, maintenance, and managerial activities.</td>
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</tbody>
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## Table 1397-3. Regional ITS Architecture in Ohio

<table>
<thead>
<tr>
<th>Region</th>
<th>ITS Architecture</th>
<th>MPO: AMATS (Akron Metropolitan Area Transportation Study)</th>
<th>MPO: SCATS (Stark County Area Transportation Study)</th>
<th>MPO: OKI (Ohio-Kentucky-Indiana Regional Council of Governments)</th>
<th>MPO: NOACA (Northeast Ohio Areawide Coordinating Agency)</th>
<th>MPO: MORPC (Mid Ohio Regional Planning Commission)</th>
</tr>
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<tbody>
<tr>
<td>Akron/Canton</td>
<td><a href="http://www.consystec.com/ohio/akron/akronintro.htm">www.consystec.com/ohio/akron/akronintro.htm</a></td>
<td>MPO Web site: <a href="http://www.ci.akron.oh.us/AMATS">www.ci.akron.oh.us/AMATS</a></td>
<td>MPO Contact: Amy Prater, PE, Transportation Engineer Email: <a href="mailto:prateam@ci.akron.oh.us">prateam@ci.akron.oh.us</a> Phone: (330) 375-2436 Address: 806 Citicenter Building 146 South High St. Akron, Ohio 44308-1423</td>
<td>MPO Web site: <a href="http://www.co.stark.oh.us/internet/HOME.DisplayPage?v_page=rpc">www.co.stark.oh.us/internet/HOME.DisplayPage?v_page=rpc</a> MPO Contact: Jeff Dutton, Technical Director Email: <a href="mailto:jrdutton@co.stark.oh.us">jrdutton@co.stark.oh.us</a> Phone: (330) 451-7498 Address: 201 3rd St. N.E., Suite 201 Canton, Ohio 44702-1231</td>
<td>MPO Web site: <a href="http://www.oki.org">www.oki.org</a> MPO Contact: Andrew J. Reser, AICP, Model Applications Coordinator Email: <a href="mailto:areser@oki.org">areser@oki.org</a> Phone: (513) 621-6300 Address: 720 E Pete Rose Way, Suite 420 Cincinnati, Ohio 45202</td>
<td>MPO Web site: <a href="http://www.morpc.org">www.morpc.org</a> MPO Contact: Kerstin Carr, Senior Planner Email: <a href="mailto:kcarr@morpc.org">kcarr@morpc.org</a> Phone: (614) 233-4163 Address: 111 Liberty Street, Suite 100. Columbus, Ohio 43215</td>
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<td>Cincinnati/Northern Kentucky</td>
<td><a href="http://www.consystec.com/oki/web/_regionhome.htm">http://www.consystec.com/oki/web/_regionhome.htm</a></td>
<td>MPO: OKI (Ohio-Kentucky-Indiana Regional Council of Governments) MPO Web site: <a href="http://www.oki.org">www.oki.org</a> MPO Contact: Andrew J. Reser, AICP, Model Applications Coordinator Email: <a href="mailto:areser@oki.org">areser@oki.org</a> Phone: (513) 621-6300 Address: 720 E Pete Rose Way, Suite 420 Cincinnati, Ohio 45202</td>
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<td>Cleveland</td>
<td><a href="http://www.consystec.com/ohio/cleveland/clevelandintro.htm">www.consystec.com/ohio/cleveland/clevelandintro.htm</a></td>
<td>MPO: NOACA (Northeast Ohio Areawide Coordinating Agency) MPO Web site: <a href="http://www.noaca.org">www.noaca.org</a> MPO Contact: Ron Eckner, Division Director Email: <a href="mailto:reckner@mpo.noaca.org">reckner@mpo.noaca.org</a> Phone: (216) 241-2414 Address: 1299 Superior Ave. Cleveland, Ohio 44114-3204</td>
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<td>Columbus</td>
<td><a href="http://www.morpc.org/transportation/highway/Architecture.asp">http://www.morpc.org/transportation/highway/Architecture.asp</a></td>
<td>MPO: MORPC (Mid Ohio Regional Planning Commission) MPO Web site: <a href="http://www.morpc.org">www.morpc.org</a> MPO Contact: Kerstin Carr, Senior Planner Email: <a href="mailto:kcarr@morpc.org">kcarr@morpc.org</a> Phone: (614) 233-4163 Address: 111 Liberty Street, Suite 100. Columbus, Ohio 43215</td>
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<td>Region</td>
<td>ITS Architecture</td>
<td>MPO: MVRC (Miami Valley Regional Planning Commission)</td>
<td>MPO Web site</td>
<td>MPO Contact</td>
<td>Email</td>
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<tr>
<td>Dayton/Springfield</td>
<td><a href="http://www.mvrpc.org/its/MiamiValleyITSRegionalArchitecture.php">http://www.mvrpc.org/its/MiamiValleyITSRegionalArchitecture.php</a></td>
<td>MVRPC (Miami Valley Regional Planning Commission)</td>
<td><a href="http://www.mvrpc.org">www.mvrpc.org</a></td>
<td>Matthew Lindsay, Manager of Environmental Planning</td>
<td><a href="mailto:mlindsay@mvrpc.org">mlindsay@mvrpc.org</a></td>
<td>(330) 223-6323</td>
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<td>Toledo</td>
<td><a href="http://www.consystec.com/ohio/toledo/toledointro.htm">www.consystec.com/ohio/toledo/toledointro.htm</a></td>
<td>TMACOG (Toledo Metropolitan Area Council of Governments)</td>
<td><a href="http://www.tmacog.org">www.tmacog.org</a></td>
<td>Diane Reamer-Evans, Transportation Project Manager</td>
<td><a href="mailto:evans@tmacog.org">evans@tmacog.org</a></td>
<td>(419)241-9155</td>
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<td>Youngstown</td>
<td><a href="http://www.consystec.com/ohio/youngstown/youngstownintro.htm">www.consystec.com/ohio/youngstown/youngstownintro.htm</a></td>
<td>Eastgate (Eastgate Regional Council of Governments)</td>
<td><a href="http://www.eastgatecog.org">www.eastgatecog.org</a></td>
<td>Ed Davis, Program Manager</td>
<td><a href="mailto:edavis@eastgatecog.org">edavis@eastgatecog.org</a></td>
<td>(330) 779-3800</td>
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Intentionally blank.
As noted in Section 1301-3.1, Figure 1398-1 is a graphical representation of the Minor Project Development Process (PDP).

As noted in Section 1301-3.1, Figure 1398-2 is a graphical representation of the Major Project Development Process (PDP).
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Figure 1398-1. Minor Project Development Process (PDP)