Tippecanoe County Regional Intelligent Transportation System (ITS) Architecture
Version 1.2

Area Plan Commission of Tippecanoe County

Prepared by
Melissa Baldwin, Transportation Planner
and the staff of the
Area Plan Commission of Tippecanoe County

In cooperation with:

Tippecanoe County
City of Lafayette
City of West Lafayette
CityBus
Purdue University
Indiana Department of Transportation
Federal Highway Administration

Area Plan Commission of Tippecanoe County
20 N 3rd St
Lafayette, IN

David R. Williams, President
Sallie Dell Fahey, Executive Director

October 2009

Brian Weber, Transportation Planner, initiated the process that culminated in this report. His death in January 2006 deeply affected all who knew him. The staff of the Area Plan Commission of Tippecanoe County dedicates this report to him and to his memory.

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Planning Documents

Configuration Item	Report Version	Location / Point of Contact	Description of Changes
Tippecanoe County Regional Intelligent Transportation System (ITS) Architecture	Version 1.2 - 10/21/2008	APC of Tippecanoe County MPO – Melissa Baldwin 765-423-9242	• Added Traffic Management Center for the City of Lafayette, West Lafayette (Future) to allow remote control of field devices • Add in Signal Coordination between the City of Lafayette, West Lafayette (future), and INDOT • Include CityBus Transit Fare Collection Management (APTS04) • Update to National Architecture v6.1.0
Tippecanoe County Regional Intelligent Transportation System (ITS) Architecture	Version 1.1 - 06/18/2008	APC of Tippecanoe County MPO – Melissa Baldwin 765-423-9242	• WL School Zone Beacon (ATMS03) • INDOT I-65 DMS equipment (ATMS06) • Conversion to v4.0.12 and National Architecture v6.0.0 (include APTS10)
Tippecanoe County Regional Intelligent Transportation System (ITS) Architecture	Version 1.0 - 12/20/2006	APC of Tippecanoe County MPO – Melissa Baldwin 765-423-9242	

Turbo Architecture Databases

Configuration Item	File Version	Location / Point of Contact	Description of Changes
Tippecanoe County Regional Architecture	Tippecanoe_Regional_ITS_Arch_v1.2.tbo 10/21/2008	APC of Tippecanoe County MPO – Melissa Baldwin 765-423-9242	• Lafayette/West Lafayette Traffic Management Center and Monitoring (ASTM01 ASTM03) • Lafayette/WL/INDOT Signal Coordination (ASTM03) • Add Transit Fare Collection Management (APTS04)
Tippecanoe County Regional Architecture	Tippecanoe_Regional_ITS_Arch_v1.1.tbo 06/18/2008	APC of Tippecanoe County MPO – Melissa Baldwin 765-423-9242	• WL School Zone Beacon (ATMS03) • INDOT I-65 DMS equipment (ATMS06) • Conversion to v4,0.12 and National Architecture v6.0.0 (include APTS10)
Tippecanoe County Regional Architecture	Tippecanoe_Regional_ITS_Arch_v1.0.tbo 12/20/2006	APC of Tippecanoe County MPO – Melissa Baldwin 765-423-9242	

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
APC	Area Plan Commission
APTA	American Public Transportation Organization
APTS	Advanced Public Transportation Systems (Market Package)
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information Systems (Market Package)
ATMS	Advanced Transportation Management Systems (Market Package)
AVL	Automatic Vehicle Location
AVSS	Advanced Vehicle Safety Systems (Market Package)
CAD	Computer Aided Dispatch
CCTV	Closed Circuit Television
CVO	Commercial Vehicle Operations (Market Package)
EAS	Emergency Alert System
EM	Emergency Management (Market Package)
FHWA	Federal Highway Administration
FP2FP	Fixed-Point to Fixed-Point
FTA	Federal Transit Administration
GLPTC	Greater Lafayette Public Transportation Corporation
HAR	Highway Advisory Radio
HAZMAT	Hazardous materials
HRI	Highway-rail intersections
IEEE	Institute of Electrical and Electronics Engineers
INDOT	Indiana Department of Transportation
ISP[1]	Information Service Provider
ISP	Indiana State Police
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
MCM	Maintenance and Construction Management
MCO	Maintenance and Construction Operations
MPO	Metropolitan Planning Organization
NEMA	National Electronic Manufacturers Association
NTCIP	National Transportation Communications for ITS Protocol
PSAP	Public Service Answering Point (9-1-1 call answering center)
RA	Regional Architecture
SAE	Society of Automotive Engineers
TA	Turbo Architecture
TEA-21	Transportation Equity Act for the 21st Century
TEMA	Tippecanoe County Emergency Management Agency
TMC	Traffic Monitoring Center
TO	Traffic Operations

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[1] The acronym for Information Service Provider was used sparingly in this document, however is often referred to in ITS related literature.

GLOSSARY

Regional ITS Architecture

A specific, tailored framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects in a particular region. It functionally defines what pieces of the system are linked to others and what information is exchanged between them.

User Service

User Services represent what the system will do from the perspective of the user. A user might be the public or a system operator.

Logical Architecture

A Logical Architecture identifies the system functions and information flows; it guides development of functional requirements for new systems and improvements. A Logical ITS Architecture is independent of institutions and technology, i.e., it should not define where or by whom functions are performed in the system, nor should it identify how functions are to be implemented.

The Nine Major Processes within the Logical Architecture

Physical Architecture

A Physical Architecture is the physical (versus functional) view of a system. A Physical Architecture provides agencies with a physical representation (though not a detailed design) of how the system should provide the required functionality.
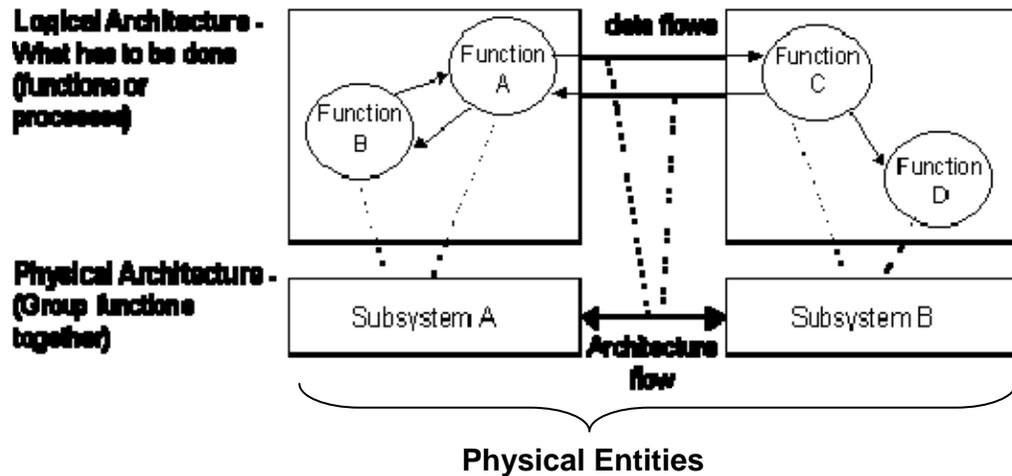
Physical Entities

Physical Entities

Entities are the persons, places, and things that make up an intelligent transportation system. In the Physical Architecture, an entity represents a National ITS Architecture Subsystem or Terminator.

Subsystem

The principle 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 is ITS are grouped into four classes: Centers, Field, Vehicles, and Travelers.

Terminator

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. Terminators define the boundary of architecture.

Market Package

Some of the User Services are too broad in scope to be convenient in planning actual deployments. Additionally, they often don't translate easily into existing institutional environments and don't distinguish between major levels of functionality. In order to address these concerns (in the context of providing a more meaningful evaluation), a finer grained set of deployment-oriented ITS service building blocks were defined from the original user services. These are called *"Market Packages"* in the documentation.

Market Packages are defined by sets of Equipment Packages required to work together (typically across different Subsystems) to deliver a given transportation service and the major architecture flows between them and other important external systems. *In other words, they identify the pieces of the National ITS Architecture required to implement a service.*

Market Package Diagram Example

APTS1 – Transit Vehicle Tracking
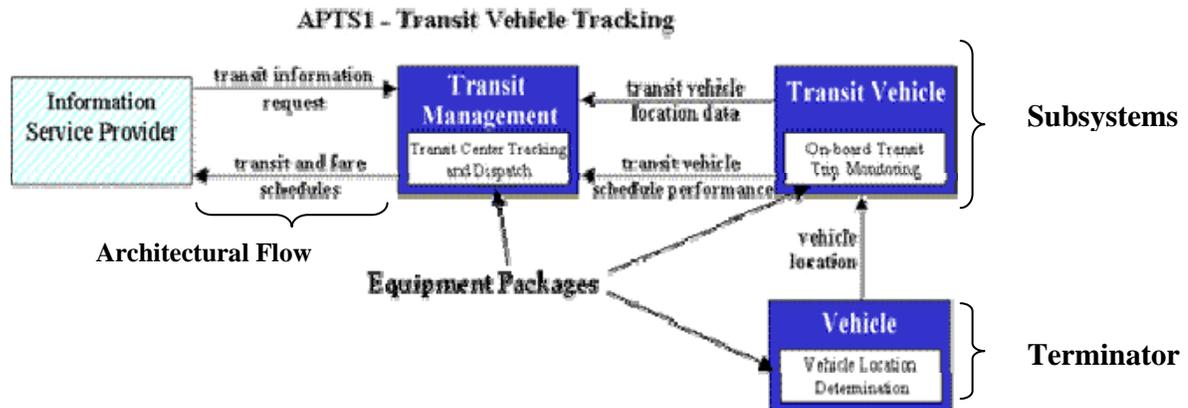
Equipment Package

> The term *"Equipment Package"* is used in the National ITS Architecture development effort to group like functions of a particular subsystem together into an "implementable" package of hardware and software capabilities. The grouping of functions also takes into account the User Services that are needed to accommodate various levels of functionality within them.
>
> The Equipment Packages are closely associated with Market Packages and were used as a basis for estimating deployment costs. The specific set of Equipment Packages defined is merely illustrative and does not represent the only way to combine the functions within a subsystem. The National ITS Architecture has defined 198 equipment packages in total.

Architectural Flows

> Information that is exchanged between Subsystems and Terminators in the Physical Architecture view of the National ITS Architecture. The terms "information flow" and "architecture flow" are used interchangeably.

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EXECUTIVE SUMMARY

In 1997, Congress passed the Transportation Equity Act for the 21st Century (TEA-21) to advance regionally integrated transportation systems. In January 2001 the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) published rules/policies implementing the section of the law relating to Intelligent Transportation Systems (ITS), which is the use of advanced communications technologies, both wire and wireless, to improve transportation safety and mobility. This rule/policy seeks to foster regional integration by requiring that all Intelligent Transportation Systems (ITS) projects, funded from the Highway Trust Fund, be in conformance with the National ITS Architecture and appropriate standards. To meet this rule our community is required to use the National ITS Architecture to develop a Regional ITS Architecture that would be tailored to address our situation and needs. Additionally, the rule requires that all future ITS projects adherence to the Regional ITS Architecture.

The Tippecanoe County Regional ITS Architecture was prepared under the leadership of the Area Plan Commission of Tippecanoe County (APC) in its role as the Metropolitan Planning Organization (MPO). The goal of the Tippecanoe County Regional Architecture (RA) is to guide the implementation of ITS systems in the region and coordinate: funding, deployment, information sharing, and operations of ITS systems in the region. The main ITS goals include: enhanced traveler safety, effective traffic and transit management, coordinated incident management, and enhanced traveler information. A 10-year planning horizon was considered in the Tippecanoe County RA development.

Tippecanoe County continues to experience increased economic and cultural activity, serving as a business and cultural center for a multi county area. Therefore, this report is designed to help insure an efficient transportation system that supports the mobility and safety needs of individuals and businesses in the region.

The geographical area covered by the RA is all of unincorporated Tippecanoe County and the following jurisdictions:
1. City of Lafayette
2. City of West Lafayette
3. Town of Dayton
4. Town of Battleground
5. Town of Clark's Hill

In addition to these jurisdictions, the RA recognized interfaces with the statewide ITS architecture. Therefore, the Indiana Department of Transportation (INDOT), and the Federal Highway Administration (FHWA) participated in the RA development.

The Tippecanoe County RA development process followed the FHWA required procedures, with input to reflect the unique characteristics of the region. As a starting point for identifying the County needs and ITS services, an inventory was conducted of the existing and planned local ITS systems. Examples of existing ITS in the region were identified from transportation plans as well as input from regional stakeholders. This inventory identified systems and their functions by agency and jurisdiction. The majority of these systems were classified into the following service areas: traffic and travel management, transit management, and emergency management.

The National ITS Architecture was also used to help identify these services, as well as to group tasks into FHWA defined "Market Packages" that help support these services, such as transit vehicle tracking, or traffic information dissemination. ITS Market Packages were used extensively in the Tippecanoe County RA development since they provided an easy to use tool for discussions with stakeholders. They also provided an effective entry point for use of the FHWA required software: Turbo Architecture. A total of 21 Market Packages were identified for Tippecanoe County.

The Market Packages were also used to further define the roles and responsibilities of each system, how they interact with each other and how information is shared and flows between them. The systems identified include: traffic management, transit management, emergency management, and maintenance and construction management, data warehousing.

Based on potential information flows, data sharing, and funding partnerships, several potential agency agreements were identified. The outline for each potential agreement includes its purpose, the departments/jurisdictions included, and central issues to be addressed. Several potential agreements were identified for the Tippecanoe County region, including: traffic surveillance and signal coordination, incident management and information dissemination, and data archiving and warehousing.

As part of the Tippecanoe County RA development, the APC of Tippecanoe County (MPO) will maintain and update the Tippecanoe County Regional ITS Architecture as needed. The MPO will coordinate changes to the RA as more ITS projects are planned or major changes to the transportation system take place.

T-09-12
TIPPECANOE COUNTY REGIONAL
INTELLIGENT TRANSPORTATION SYSTEM (ITS)
ARCHITECTURE VERSION 1.2

STAFF REPORT
October 14, 2009

BACKGROUND AND REQUEST
Links to the Tippecanoe County Regional Intelligent Transportation System (ITS) Architecture Version 1.2 can be found on the APC Transportation Planning webpage or at http://www.tippecanoe.in.gov/egov/docs/1210599658182.htm.

The goal of this document, and associated databases, is to guide the implementation of technology systems in the region and coordinate: funding, deployment, information sharing, and operations of ITS systems for the years 2006-2016

The previous version of this ITS Architecture (Version 1.1) was adopted in June of 2008. This version (1.2) includes the following updates:

- The City of Lafayette's Advanced Traffic Management System (ATMS) which creates a traffic management center and interconnects INDOT and Lafayette traffic signals. The future incorporation of West Lafayette traffic signals into the ATMS system was also included to the Architecture.
- New components to the CityBus fare box system will allow on-board creation of traveler cards (e.g., transfer cards with a magnetic strip).

ITS projects in Tippecanoe County that utilize the Federal Highway Trust Fund must be included in the Regional ITS Architecture. Future ITS projects will be incorporated as needed and in conjunction with the Long Range Transportation Plan update.

STAFF RECOMMENDATION
Recommend adoption of the Tippecanoe County Regional Intelligent Transportation System (ITS) Architecture Version 1.2.

RESOLUTION TO AMEND THE TIPPECANOE COUNTY REGIONAL INTELLIGENT TRANSPORTATION SYSTEM ARCHITECTURE, V 1.2

WHEREAS, the Area Plan Commission of Tippecanoe County is designated as the Metropolitan Planning Organization by the Governor and is responsible for transportation planning in Tippecanoe county, and

WHEREAS, Congress has required through the Transportation Efficiency Act for the 21st Century that all MPO's develop and adopt a Regional Intelligent Transportation System (ITS) Architecture that complies with the National and state ITS Architecture, and

WHEREAS, the MPO staff has developed the plan in cooperation with local jurisdictions and their engineering, traffic, street, and public safety departments, as well as CityBus, Purdue, INDOT and the Indiana State Police, and

WHEREAS, the MPO staff has worked with the Citizen Participation, Technical Transportation, and the Administrative Committees to develop and review the draft amended plan, and

WHEREAS, the amended ITS plan was recommended for adoption to the Area Plan Commission by the Technical Transportation Committee on September 16, 2009, Administrative Committee on September 21, 2009, and by the Citizens Participation Committee on September 22, 2009.

NOW THEREFORE BE IT RESOLVED by the Area Plan commission of Tippecanoe County, as the Metropolitan Planning Organization, that the Amended Tippecanoe County Regional Intelligent Transportation System Architecture, V 1.2 is hereby accepted and adopted.

Adopted Wednesday, the 21st of October, 2009.
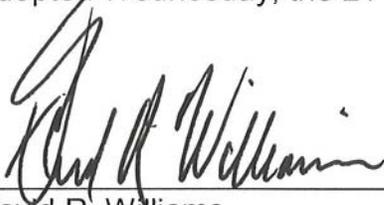
_____
David R. Williams
President, APC

_____
Sallie Dell Fahey
Secretary

Area Plan Commission

of TIPPECANOE COUNTY

20 NORTH 3RD STREET
LAFAYETTE, INDIANA 47901-1209

(765) 423-9242
(765) 423-9154 [FAX]
www.tippecanoe.in.gov/apc

SALLIE DELL FAHEY
EXECUTIVE DIRECTOR

October 22, 2009
Ref. No. 2009-342

Robert F. Tally, Jr.
FHWA
Federal Building, Room 254
575 N. Pennsylvania St
Indianapolis, IN 46204-1575

RE: Tippecanoe County Regional ITS Architecture Version 1.2

Dear Mr. Tally,

The Area Plan Commission of Tippecanoe County, at its October 21 meeting, adopted the amended Tippecanoe County Regional ITS Architecture, as Version 1.2 that includes the documentation and database. In addition to numerous minor changes, Version 1.2 includes the following updates to Version 1.1:

- The City of Lafayette's Advanced Traffic Management System (ATMS) which creates a traffic management center and interconnects INDOT and Lafayette traffic signals. The future incorporation of West Lafayette traffic signals into the ATMS system was also included to the Architecture.
- New components to the CityBus fare box system will allow on-board creation of traveler cards (e.g., transfer cards with a magnetic strip). Market Package APTS04.

Enclosed you will find an electronic copy of the report and the TurboArchitecture database.

Sincerely,
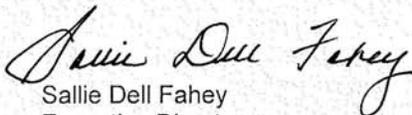
Sallie Dell Fahey

Sallie Dell Fahey
Executive Director

SDF/mb

cc: Karen Stippich, FHWA
        Mike Cline, INDOT, Deputy Commissioner of Traffic Management
        Meggan Simpson, INDOT, Operations Engineer

Planning for Lafayette, West Lafayette, Dayton, Battle Ground, Clarks Hill and Tippecanoe County

1.0 INTRODUCTION

This document summarizes the results of the Regional Intelligent Transportation Systems (ITS) Architecture development for Tippecanoe County. ITS refers to integrated applications of sensing, communications, computer processing, and electronics to enhance the transportation systems. The Regional Architecture (RA) provides a tool to guide future ITS planning, define system requirements, coordinate agency roles and integrate functions across jurisdictional lines.

The Tippecanoe County RA was prepared under the leadership of the Area Plan Commission (APC) of Tippecanoe County which is the Metropolitan Planning Organization (MPO). The goal of the RA is to guide the implementation of ITS in the Tippecanoe County area and coordinate funding, deployment, information sharing, and operations of ITS in the region. The main ITS goals for the county include: enhanced traveler safety; effective traffic and transit management; coordinated incident management; and enhanced traveler information. A 10-year planning horizon was considered in the RA development.

1.1 Report Organization

The Tippecanoe County RA report is organized into sections to facilitate the use of report. In addition, an electronic file has been prepared using Turbo Architecture 4.0.12 in order to access the architecture and make changes or future updates.

Below is a description for each of the sections of this report:

2. Scope and Region — Identifies the geographical and architecture scope
3. Stakeholders — Agencies participating in the architecture
4. System Inventory — Existing and planned ITS systems
5. Needs and ITS Services — ITS User Services and market packages
6. Operational Concept — Roles and responsibilities of participating agencies
7. Potential Agreements — Regional agreements to facilitate integration
8. Functional Requirements — High-level description of what the systems will do
9. Interface Requirements — Shows systems interconnections and information flows
10. ITS Standards — Brief discussion of applicable ITS standards
11. Sequence of Projects — Time-frame for ITS projects
Appendix A Tippecanoe County Regional ITS Architecture Market Packages
Appendix B Tippecanoe County Regional ITS Architecture Functional Requirements
Appendix C Tippecanoe County Relevant ITS Standards By Flow

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2.0 REGION AND SCOPE

This section describes the geographical characteristics of the Tippecanoe County MPO area. It also discusses the Tippecanoe County RA providing a high-level outline of the range of ITS services and systems used.

2.1 Geographical Boundaries

The geographical areas included in the Tippecanoe County RA primarily consisted of the county boundary. Figure 1 shows a map of the county. This includes unincorporated Tippecanoe County, and the major jurisdictions of:
1. City of Lafayette
2. City of West Lafayette
3. Town of Dayton
4. Town of Battleground
5. Town of Clark's Hill

In addition, the Indiana Department of Transportation (INDOT) is responsible for operating and maintaining the state system, including sections of Interstate I-65, US 231, US 52 as well as several other major state highways including State Roads 25, 26, 28, 38, 225, 126, 526, and 43. INDOT is responsible for maintaining all traffic signal operations and equipment on the state system.

2.2 Scope of the Tippecanoe County RA

The scope of the Tippecanoe County RA may be defined using broad ITS services targeted for deployment within the region. The delineation of relevant ITS services assisted in identifying relevant stakeholders and corresponding systems to be included in the Tippecanoe County RA. The range of ITS services included the following:
1. Travel and Traffic Management
    a. Traffic control
    b. Traveler Information
    c. Traffic surveillance
    d. Incident management
    e. Highway-Rail Intersection
2. Public Transportation Management
    a. Fleet management (real-time information)
    b. Public travel security
    c. Pre-trip travel information and guidance
    d. En-route transit information
3. Emergency Management
    a. Incident response coordination (integrated communications)
    b. Emergency Vehicle Management
    c. Disaster Response and Evacuation
4. Information Management
    a. Archived Data

The Area Plan Commission
Of Tippecanoe County

Figure 1. Map of Tippecanoe County
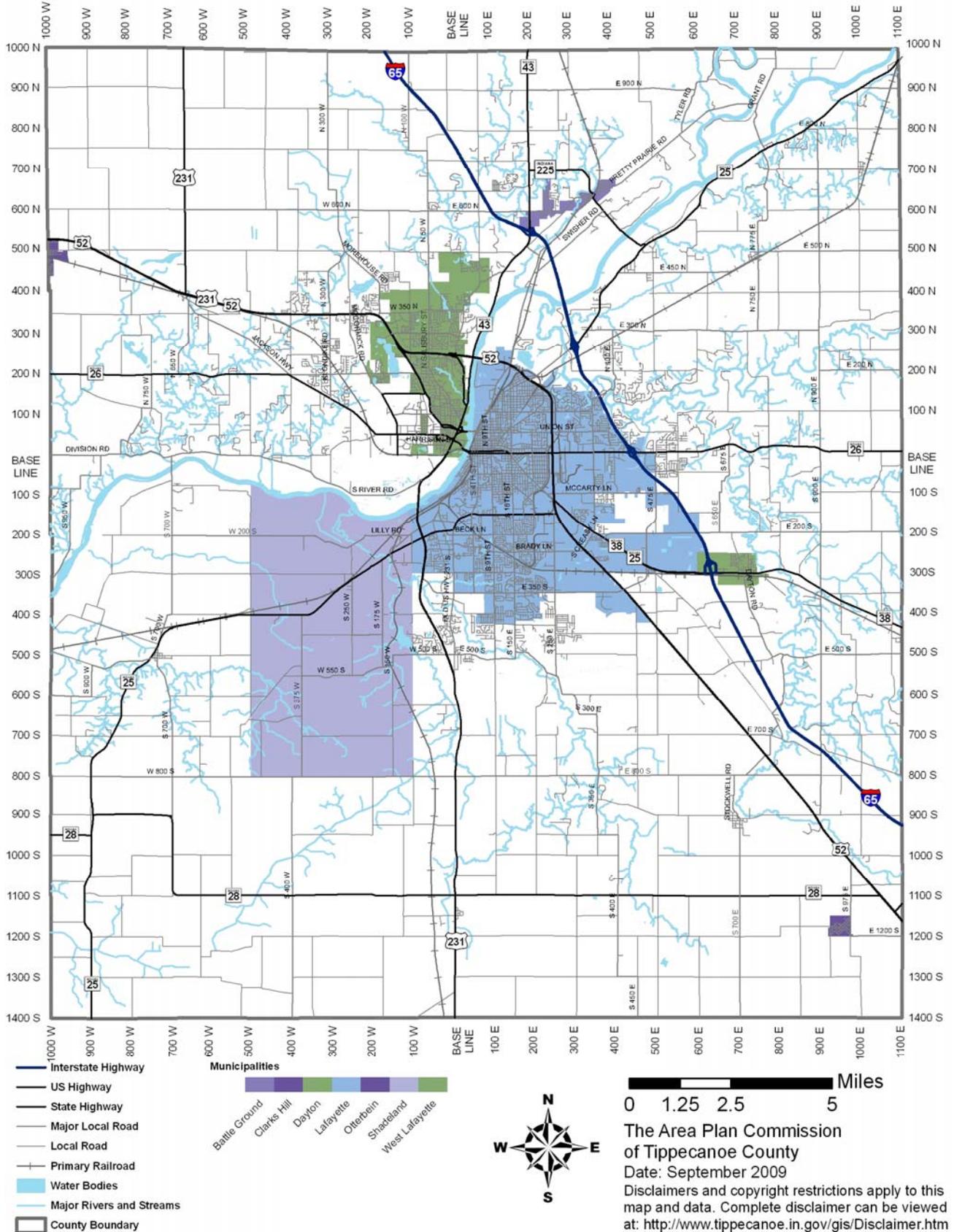
3.0 STAKEHOLDERS

Stakeholders who support the regional ITS architecture developed for Tippecanoe County RA include transportation, public works, law enforcement, emergency management, transit, and other related agencies.

Principal Stakeholders (primary participants)

- CityBus
- City of Lafayette – Engineering, Traffic, Street, Police, Fire, and 911/Dispatch
- City of West Lafayette – Engineering, Street, Police, Fire, 911/Dispatch, and the West Lafayette School Corporation.
- Purdue – Facilities/Grounds, Police, Fire, and 911/Dispatch
- Indiana State Police
- INDOT – Operations Support Div (Indianapolis) and Crawfordsville District Office
- The Area Plan Commission (MPO) of Tippecanoe County
- Tippecanoe County – Highway Dept, Sheriff, Ambulance, TEMA, and 911/Dispatch

Stakeholders who participated in the RA development their corresponding representatives, and their typical roles and activities are shown in Table 1.

3.1 Stakeholder Outreach

3.1.1 Workshops and Training

The kick-off for the Tippecanoe County ITS RA was held on April 4th, 2005. Subsequently, half-day and full-day workshops were held for the stakeholders on May 11th and 12th, 2005. The workshops, taught by a FHWA staff and consultants, incorporated training in the National ITS Architecture and development of the Tippecanoe County RA. Each participant received a packet of supplemental materials and workbooks outlining the systems needed to develop the RA.

3.1.2 Inventory Interviews and Site Visits

Initial surveys were sent out to the key stakeholders asking them to identify existing, planned, and envisioned ITS implementations within Tippecanoe County. These were used to create the initial RA in the Turbo Architecture software. In 2006, in-depth interviews with the stakeholders were conducted where traffic and incident management scenarios were discussed, and ITS inventories were taken.

3.1.3 Reviews

Stakeholders were provided a draft of the Tippecanoe County RA for review in late October 2006. Comments and revisions were incorporated into the document before the documents release for public review. Additional revisions were incorporated up to the time of adoption.

Table 1. Tippecanoe County ITS RA Stakeholders

Organization	Name of Contact	Description	Associated Elements
AMTRAK	NA	Responsible for a fixed-route passenger train service stopping in Lafayette.	AMTRAK Traveler Information
APC of Tippecanoe County	Sallie Fahey, Executive Director Melissa Baldwin, Transportation Planner	The Metropolitan Planning Organization (MPO) serving the Lafayette, West Lafayette, and Tippecanoe County Metropolitan Area.	APC of Tippecanoe County
City of Lafayette			
Street, Traffic, and Engineering Dept.	Jenny Miller, City Engineer and Public Works Director Robert Foley, Assistant Director of Public Works Fred Koning	Responsible for planning, implementation oversight, and maintenance of traffic control equipment	Lafayette - Emergency Vehicles Lafayette - Public Safety and Emergency Management Lafayette - Roadside Equipment Lafayette – TMC and MCM Lafayette - TMC and MCM
Police	Cpt. David Payne, Sgt. Max Smith, and Frank Schmidt, Technician	Responsible for law enforcement within the Lafayette municipal boundary. Responsible for Lafayette 911 call taking and emergency vehicle dispatch.	
Fire	Beth Duell, Lafayette Fire Department	Responsible for fire response, medical assist, and hazardous material response within the Lafayette municipal boundary.	
City of West Lafayette			
Engineering and Street Department	David Buck, City Engineer	Responsible for planning, implementation oversight, and maintenance of traffic control equipment	Lafayette - Emergency Vehicles Lafayette - Public Safety and Emergency Management Lafayette - Roadside Equipment Lafayette – TMC and MCM West Lafayette - TMC and MCM
Police	Cptn. Mike Francis	Responsible for law enforcement within the West Lafayette municipal boundary. Responsible for West Lafayette 911 call taking and emergency vehicle dispatch.	
Fire	Chief Philip Drew	Responsible for fire response and medical assist within the municipal boundary.	

Organization	Name of Contact	Description	Associated Elements
CityBus	John Metzinger	Serves as the public transportation provider in the region. CityBus provides a range of bus services in Lafayette, West Lafayette, Purdue University, and portions of unincorporated Tippecanoe County.	CityBus - Operations Center and Dispatch CityBus - Transit Vehicles CityBus - Transit Information Displays
INDOT			
Planning	Steven Wuertz, INDOT, Operations Support Division, ITS Program Coordinator	The Indiana Department of Transportation (INDOT) is the stakeholder responsible for all state roads, US Routes, and Interstate Routes within Tippecanoe County. This includes all divisions of INDOT that serve Tippecanoe County.	INDOT - Data Services INDOT- TMC, TO, and MCM INDOT - Roadside Equipment INDOT - 511 Traveler Information
Highway Operations	Tim Watson, INDOT Crawfordsville District, Highway Engineer		
Indiana State Police	Sgt. Kim Riley	The Indiana State Police (ISP) Field Enforcement Division oversees enforcement, 24-hour Operations Center and numerous special details. The ISP Records Division gathers, maintain and disseminate criminal history data on individuals arrested within the state e.g., maintaining vehicle crash records and processing criminal background checks.	State Police - Public Safety and Emergency Management State Police - Vehicles State Police - Crash Reports Database
Media	NA	Public Information Dissemination	Radio Stations TV Stations
Purdue University			
Facilities and Grounds	Jim Knapp, Senior Civil Engineer	Responsible for roads in the interior of the campus boundary and portions shared with the city of West Lafayette and the county.	Purdue - Emergency Vehicles Purdue - Public Safety and Emergency Management Purdue - CATS/Civil Engineering Purdue - Facilities and Grounds
Police	NA	Responsible for law enforcement within the Purdue University campus. Responsible for Purdue campus 911 call taking and emergency vehicle dispatch.	

Organization	Name of Contact	Description	Associated Elements
Fire	NA	Responsible for fire response, medical assist, ambulance, and hazardous material response within the campus boundaries.	
Railroads	NA	Responsible for all railway crossing equipment and maintenance	Rail - Wayside Equipment Rail - Operations Control Centers
Regional Hospitals	NA	Provide 24-hour emergency care and treatment	Regional Hospitals
Small Municipality or Township	NA	Responsible for law enforcement and fire response within the municipality or township jurisdiction.	Small Municipality - Emergency Vehicles Small Municipality - Public Safety and Emergency Management
Tippecanoe County			
Highway Dept	Opal Kuhl, Executive Director	Responsible for planning, implementation oversight, and maintenance of traffic control equipment. Responsible for all bridges and county roads in Tippecanoe County	Tippecanoe Co - MCM Tippecanoe Co - Public Safety and Emergency Management Tippecanoe Co - Emergency Vehicles Tippecanoe Co - Security Monitoring Field Equipment Tippecanoe Co - GIS Tippecanoe Co - Roadside Equipment
Emergency Management Agency	Mark Kirby, Director	Responsible for Emergency Management assistance, civil emergency notification, hazardous materials response, and other incident management and response resources.	
E911 and Sheriff's Department	Major Charles Williams	Responsible for law enforcement within the unincorporated Tippecanoe County. Responsible for 911 call taking and emergency vehicle dispatch. Maintains 911 equipment, software, and facilities for all Tippecanoe County call centers.	
Ambulance Service	Jeff Houston, Division Director, Greater Lafayette Health Services	Responsible for ambulance service throughout Tippecanoe County (excluding Purdue University Campus)	
GIS	Mark Ehle, GIS Coordinator	Mapping data creation, maintenance, and warehouse	

Organization	Name of Contact	Description	Associated Elements
Users	NA	Transportation system users	User Personal Computing Devices User Vehicles Traveler Pedestrian Traveler Card
Weather Services	NA	Meteorological data and forecasting services such as the National Weather Service and private companies, e.g., Accuweather and meteorlogix	Weather Services

4.0 SYSTEM INVENTORY

This section summarizes the results of the system inventory process for Tippecanoe County RA. Information developed for the inventory was obtained through extensive input from stakeholders. Survey instruments, interviews, and small group meetings were used to obtain and verify the inventory information.

To facilitate the inventory process, the types of systems to be included in the inventory were defined using the National ITS Architecture. More emphasis was placed on the Physical Architecture[2] since it contains most of the ITS hardware. However, additional information about the services provide by the various ITS services was also collected, e.g., communication standards. Further, systems were categorized into existing or planned, with planned referring to systems, components, or services which have been identified for future development in the region.

Using the Physical Architecture, four categories of Physical Entities are identified within the National ITS Architecture:
1. Centers
2. Field Devices
3. Vehicles
4. Communications

These categories are explained in greater detail in the following subsections. Section 4.5 gives a summary of ITS inventory in Tippecanoe County for each stakeholder.

4.1 ITS Centers

ITS Centers are the locations where functions are preformed, i.e., process information, issue control commands, and produce output information. There are 10 possible centers in the National ITS Architecture that provide management, administrative, and support functions for the transportation system. Center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions.   It is important to note that stakeholders' ITS responsibilities can be represented by several centers.

Out of the 10 possible centers, 6 were found to apply to the Tippecanoe County RA. A representation of the Tippecanoe County Physical Architecture is shown in Figure 2.

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[2] The Physical Architecture forms a high-level structure around the processes in the modeled system. The physical architecture defines the Physical Entities (Subsystems and Terminators) that make up an intelligent transportation system. It defines the Architecture Flows that connect the various Subsystems and Terminators into an integrated system.

Figure 2. Tippecanoe County Physical Architecture
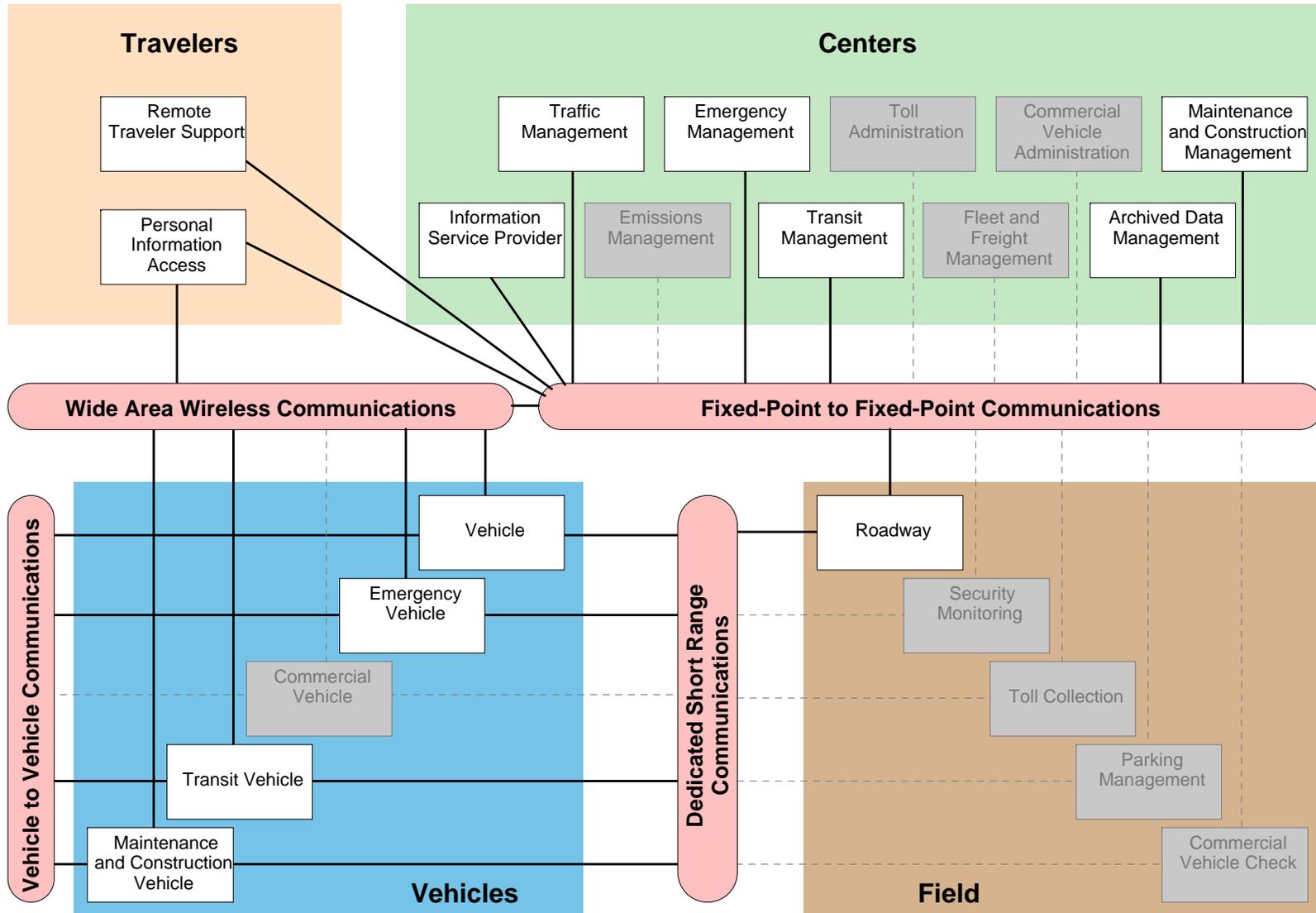
4.1.1 Traffic Management Center

The Traffic Management Center monitors and controls traffic and the road network. It communicates with the Roadway subsystem to monitor and manage traffic flow and monitor the condition of the roadway and field equipment.

Traffic management activities in Tippecanoe County are concentrated into the main corridors in the area including arterial traffic control and managing event traffic. Traffic management systems within Tippecanoe County include INDOT, Lafayette, West Lafayette, Purdue, and Tippecanoe County Highway department. INDOT, Lafayette, and West Lafayette have, or will have the ability to remotely control their traditional traffic signals from a centralized location using Advanced Traffic Control Management software. . Also, West Lafayette has implemented a remotely controlled school zone beacon system.

Tippecanoe County TEMA and Lafayette Police also act as a Traffic Management Centers through the use of their portable Dynamic Message Signs (DMSs) that can be used to direct motorists during evacuations and special events, for example.

4.1.2 Transit Management Center

Greater Lafayette Public Transportation Corporation (GLPTC) commonly referred to as CityBus provides public transportation services for the greater West Lafayette/Lafayette area. CityBus operates fixed transit routes as well as paratransit services. CityBus maintains enhanced management capabilities including passenger analysis, computerized dispatch, and real-time (GPS) transit vehicle tracking. CityBus utilizes a wireless system for communicating with transit vehicles and for downloading all fare-box and vehicle data.

4.1.3 Emergency Management Center

Local Emergency Management

Emergency management 911 and dispatch functions for the cities of Lafayette and West Lafayette, Purdue University, and Tippecanoe County are performed through the Public Service Answering Point (PSAP) locations.   Within the county there are four state-of-the-art PSAP facilities containing secure communications, computer-aided dispatch, and other support systems. The Purdue University, Lafayette, and West Lafayette PSAPs answer all land-line 911 calls made from within their respective jurisdictions. All calls made from the small municipalities or in the unincorporated county are answered by the Tippecanoe County Sheriff's department PSAP. Currently, the county has implemented Phase II E-911[3]. At this time, all wireless phone calls made from within the county (as determined by the cell phone carriers) are answered at the Sheriff's PSAP.

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[3] The wireless E-911 program is divided into two parts - Phase I and Phase II. Phase I requires carriers, upon valid request by a local Public Safety Answering Point (PSAP), to report the telephone number of a wireless 911 caller and the location of the antenna that received the call. Phase II requires wireless carriers to provide far more precise location information, within 50 to 300 meters in most cases.

The PSAP's dispatch function provides radio and data communications to the respective police force, fire department, and county ambulance service. Digital data includes mapping coordinates for the response location, vehicle location (for those with on-board AVL) which can be viewed on a map on the vehicle's on-board computer system.

Currently, Lafayette and Purdue University HAZMAT units are dispatched by their respective jurisdictions. TEMA personnel, vehicles, and equipment are sent to HAZMAT incidents, as requested, from any public service agency within Homeland Security District 4[4].

In addition to local law enforcement, the Indiana State Police (ISP) provides field enforcement, especially on the interstate system traversing Tippecanoe County. The ISP is not a 911 PSAP and it encourages motorists to call 911 for emergencies. Local PSAPs communicate with ISP dispatch to transfer calls falling within their jurisdiction.

Public Transportation Emergency Management

CityBus drivers have the ability to trigger an emergency alarm from within the transit vehicle. The alarm notification is transmitted to CityBus dispatch where the dispatcher can place a 911 call. When a vehicle alarm has been activated, on-vehicle video surveillance is increased and audio surveillance from the vehicle can be monitored in real time at the CityBus operations center. CityBus is not responsible for the surveillance of its transit center or stops. Video surveillance inside the Riehle Plaza Depot is monitored by the Lafayette Police Department. Furthermore, emergency call boxes adjacent to transit stops on the Purdue University campus are answered and maintained by Purdue University Police.

4.1.4 Maintenance and Construction Management Center

Currently, numerous entities handle the Maintenance and Construction Management (MCM) for roads within Tippecanoe County, including: Purdue University Facilities and Grounds, Lafayette Street and Traffic Departments, West Lafayette Street Department, Tippecanoe County Highway Department, and Fowler and Frankfort sub districts of the Crawfordsville District of INDOT. Among the existing ITS technologies deployed are specialized deicing vehicles e.g., West Lafayette brine spraying truck. Communications between MCM dispatch and field vehicles (e.g., between the cities, the county, and INDOT crews during winter weather) are in most instances restricted to two way radios, cell phones, and pagers.

4.1.5 Information Service Provider

The Information Service Provider (ISP) collects, processes, stores, and disseminates transportation information to system operators and the traveling public, e.g., basic advisories, traffic and road conditions, and transit schedule information. The ISP provides a general data warehousing function and information redistribution role. The ISP provides a bridge between the various transportation systems that produce the information and the other ISPs, their subscribers, and the public that use the information.

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[4] Indiana Homeland Security District 4 consists of Benton, Carroll, Cass, Clinton, Fountain, Montgomery, Tippecanoe, Warren, and White Counties.

Functions associated with an Information Service Provider are currently handled through multiple agencies in Tippecanoe County. Street and Engineering Departments all maintain their websites providing road closure and work zone information. INDOT and the Indiana State Police maintain Highway Advisory Radio (HAR) and websites with traffic, work zone, and weather information for the interstate and state highway system. In the future, TrafficWise.com, or other 511 website(s), will provide information and images from interstate cameras installed along Interstate 65 within Tippecanoe County[5].

En-route traveler information can be provided using portable Dynamic Message Signs (DMS) owned by TEMA, Lafayette, and the INDOT Crawfordsville District. The DMS can be used to warn drivers of traffic incidents, weather related conditions, or traffic routes for special events or evacuations. INDOT is tentatively planning to install four DMS on I-65 near the SR 28 and US 231 exits. Neither of these locations falls within the Tippecanoe County boundary.

Amtrak and CityBus maintain websites and customer service phone numbers that provide traveler information. Both websites provides route guidance, trip planning, and other transit information. CityBus also provides a service where transit service updates are provided to list-service subscribers via email or portable computing devices. CityBus manages passenger information displays including arrival/departure displays, and an interactive website.

4.1.6 Archived Data Management

Currently, CityBus and local E911 are the only Tippecanoe County ITS stakeholders collecting, storing and archiving data from ITS sensors. For example, CityBus collects all sensor and surveillance data from its vehicles. E911 stores all data from the PSAP and dispatch including AVL coordinates.

With the implementation of the Advanced Traffic Management System software by the city of Lafayette, data including signal status and traffic volume will be collected and stored. This data will be made available to the APC, Purdue University, and other Engineering firms to develop signal timing patterns and for research.

In the future, INDOT will store ITS data from planned systems, (e.g., speeds sensors and dynamic message boards) using the same systems already in use outside Tippecanoe County.

The Indiana State Police maintains the electronic crash database to which all vehicle crash reports within Tippecanoe County are stored. A secure website provides registered users access to the data and a custom reporting utility.

4.2 Communications Layers

Communications layers are one of the three layers (along with the transportation and institutional layers) defined by the National ITS Architecture. The communications layer includes all of the communications equipment (e.g., wireline and wireless transmitters and receivers) and the information management and transport capabilities necessary to transfer information among entities in the transportation layer. The communication layer's view of ITS is transparent to the

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[5] INDOT is tentatively planning to install CCTV cameras (one per location) approximately every three miles along I-65 in the future.

specific data content or software requirements passing through the layers. The layers support many distributed users, some of them mobile, which require communication services.

Current ITS communications within in Tippecanoe County are agency-specific, except for Emergency Management agencies which are fully integrated.   More integration activities are planned in order to coordinate local and state traffic signals, and to utilize advances in wireless communications and equipment.

4.2.1 Fixed-Point to Fixed-Point Communications

Fixed-point to fixed-point communication (FP2FP) serves as the link between stationary ITS system entities (subsystems and terminators). It is implemented using a variety of public or private communication networks and technologies. It includes, but is not limited to, twisted pair, coaxial cable, fiber optic, microwave relay networks, spread spectrum, etc. Both dedicated and shared communication resources are used for FP2FP.

Existing and planned (where noted) FP2FP communications in Tippecanoe County include:
1. Fiber
   a. Tippecanoe County, Lafayette, West Lafayette, and Purdue University fiber loop
   b. INDOT, and possibly Lafayette and West Lafayette traffic signal connections
2. Wireless/Radio
   a. Lafayette Traffic Signal Connections
   b. INDOT Traffic Signal Connections
   c. West Lafayette Traffic Signal Connection

4.2.2 Wide Area Wireless Communications

Wide area communications provides communications via a wireless device between a user and an infrastructure-based system. Both broadcast (one-way) and interactive (two-way) communication services are grouped into wide-area wireless communications in the National ITS Architecture. These links support a range of services in the National ITS Architecture including real-time traveler information and various forms of fleet communications.

Existing and planned (where noted) wide area communications in Tippecanoe County include:
1. Wireless/Cellular*
   a. CityBus wayside signs
   b. CityBus transit AVL and audio surveillance
   c. Tippecanoe County civil emergency siren system remote control
   d. Lafayette and Purdue University emergency vehicles AVL and data transfer
   e. ISP vehicle data transfer
   f. INDOT portable DMS remote control
   g. Maint. and Constr. personnel communications (County, West Lafayette, Lafayette)
   h. West Lafayette School Zone Flashers
2. Radio
   a. 800 MHz radios
      i. Two way radios used by emergency responders (existing and planned)
      ii. Data channel used by West Lafayette and Tippecanoe County emergency vehicles
      iii. One way radios used at critical facilities e.g., schools
      iv. INDOT Maint. and Constr. personnel communications
   b. Statewide Highway Advisory Radio (HAR)

c. Radio Interconnected signals (INDOT-West Lafayette, Lafayette)

*Several agencies rely on cell phones communications which can provide digital cellular phone, pager, and digital 2-way radio services.

4.2.3 Dedicated Short Range Communications

Dedicated short range communications is a wireless communication channel used for close-proximity communications between transmitters in vehicles and the immediate signal receiving infrastructure. This communications type supports location-specific communications for ITS capabilities such as transit vehicle management, electronic toll collection (automated, free-flow travel toll collection), and automated commercial vehicle operations.

In Tippecanoe County, dedicated short range communication is only utilized by CityBus transit vehicles. Transit and fare-box data, (e.g., passenger data, video and audio surveillance data, and vehicle maintenance data) is downloaded and uploaded to the vehicles via short range wireless communications in the transit barn.

4.2.4 Vehicle to Vehicle Communications

Vehicle to Vehicle communications are dedicated wireless systems handling high data rate, low probability of error, line-of-sight communications between vehicles. Advanced vehicle services may use this link in the future to support advanced collision avoidance implementations, road condition information sharing, and active coordination to advanced control systems.

Currently there are no planned vehicle to vehicle communications systems planned in the Tippecanoe County RA.

4.3 Field Devices

This type of physical entities refers to field devices used to support ITS systems. The majority of field devices in Tippecanoe County are classified as a Roadway Subsystem. Below is a listing of these devices by agency.

4.3.1 City of Lafayette Field Devices
1. Sensors
   a. Traffic loop detectors (induction)
   b. Optical traffic detectors
2. Control devices
   a. Traffic signal controllers
   b. Pedestrian signal control systems
3. Surveillance
   a. Secure area CCTV - controlled and monitored by LPD
4. Warning/advisory devices
   a. Portable DMS (manipulated by control unit)
   b. Speed detection displays
   c. Speed detection display trailers (not used as a traffic sensor) shared with other local agencies

4.3.2 City of West Lafayette Field Devices

1. Sensors
   a. Traffic loop detectors (induction)
2. Control devices
   a. Traffic signal controllers
   b. Pedestrian signal control systems
   c. School zone signal control system
3. Warning/advisory devices
   a. Speed detection display trailers (not used as a traffic sensor) shared with other local agencies

4.3.3 Purdue University Field Devices

At this time Purdue University does not have any field devices. All traffic control and sensor equipment located near or on the Purdue West Lafayette campus is operated by INDOT or the City of West Lafayette.

4.3.4 Tippecanoe County Field Devices

1. Warning/advisory devices
   a. Portable DMS (manipulated by control unit)
   b. Speed detection display trailers (not used as a traffic sensor) shared with other local agencies
2. Sensors
   a. Hazardous material/biological "sniffers" (planned or barrowed from Dept of Homeland Security)

4.3.5 INDOT Field Devices

1. Sensors
   a. Traffic loop detectors (induction)
   b. Video traffic detectors
   c. Speed detectors (planned I-65)
2. Control devices
   a. Traffic signal controllers
   b. Pedestrian signal control systems
3. Surveillance
   a. CCTV (planned I-65)
4. Warning/advisory devices
   a. Portable DMS (manipulated by control unit or remote wireless control)
   b. Fixed DMS (planned on I-65)

4.4 Advanced Vehicles

There are three types of vehicles included in the Tippecanoe County RA. Only vehicles with existing or planned ITS capabilities are included, i.e., vehicles with advanced communications, navigations, monitoring, and control systems.
1. Transit Vehicle
   a. CityBus
      i. Vehicle AVL

ii. Loading sensors
iii. On board audio surveillance (remotely accessible)
iv. On board video surveillance (8 cameras per vehicle)
v. On board fare-box systems
vi. Vehicle data wireless download
vii. Voice annunciating and display for stops and crossing major intersections

2. Emergency Vehicles
   a. Law Enforcement and Emergency Management (ISP, Lafayette, West Lafayette, Purdue, Battle Ground, TEAM, and County Sheriff)
      i. On-board 800MHz radio communications
      ii. Wireless laptop with response location mapping (all but Dayton and Clarks Hill Police Departments. ISP has on-board mapping, but the incident location is not sent electronically from dispatch.)
      iii. Handheld computers with response location mapping (Lafayette)
      iv. AVL (Existing on Lafayette, County Sheriff's, and ISP vehicles, planned for Purdue and West Lafayette)
   b. Ambulance
      i. On-board 800MHz radio communications
   c. Fire and Hazmat
      i. On-board 800MHz radio communications
      ii. AVL – Lafayette Fire Department Car 10 (Asst Chief on Duty)
      iii.

4.5 Summary of Tippecanoe County ITS Inventory

Table 2 provides a summary of the ITS inventory that has been developed in the Turbo Architecture software for the Tippecanoe County RA. The element status types shown in Table 2 are defined as:

Existing: The Stakeholder Element is already in place and meets the description as outlined in the National ITS architecture.

Planned: ITS Stakeholder Element is planned for implementation in the next 10 years.

Table 2. Summary of Tippecanoe County ITS RA Inventory

ITS Subsystem/ Terminator Name	Stakeholder Element Name	Stakeholder Element Description	Element Status
Alerting and Advisory Systems	Weather Services	Weather Services include the National Weather Service as well as private disseminators of weather data.	Existing
Archived Data Management Subsystem	APC of Tippecanoe County	Archive of regional transportation information. Website access to traffic counts, transportation improvement program (TIP) and transportation plans	Planned
	INDOT - Data Services	System for obtaining traffic counts and road conditions. Additionally, the system for obtaining location, design, dimensions etc. about the roadway network.	Existing
	Lafayette – TMC and MCM	Responsible for construction and maintenance of roads and roadside equipment within the City of Lafayette.	Planned

ITS Subsystem/ Terminator Name	Stakeholder Element Name	Stakeholder Element Description	Element Status
	West Lafayette – TMC and MCM	This agency is responsible for maintenance and construction of West Lafayette city streets. The City is also responsible for traffic signals on Purdue campus (those not on the state system) and portions of the roads surrounding the Purdue campus.	Planned
	State Police - Crash Reports Database	Indiana State Police crash records database and web-portal named the Vehicle Crash Records System (VCRS).	Existing
	Purdue - CATS/Civil Engineering	Center for Advancement of Transportation Safety and Civil Engineering Transportation Studies at Purdue University---research and data analysis Safety http://cats.ecn.purdue.edu	Planned
Archived Data User Systems	APC of Tippecanoe County	Archive of regional transportation information. Website access to traffic counts, transportation improvement program (TIP) and transportation plans	Planned
	Purdue - CATS/Civil Engineering	Center for Advancement of Transportation Safety and Civil Engineering Transportation Studies at Purdue University---research and data analysis Safety http://cats.ecn.purdue.edu	Planned
Basic Vehicle	User Vehicles	Traveler Vehicles	Existing
Care Facility	Regional Hospitals	Regional Hospitals and care facilities that support emergency services for travelers and for large scale incidents.	Existing
Driver	Traveler	Travelers	Existing
Emergency Management	Lafayette - Public Safety and Emergency Management	PSAP, Police, Fire, and HAZMAT dispatch and management. Note: LPD monitors security cameras in the Riehle Plaza Terminal	Existing
	State Police - Public Safety and Emergency Management	Indiana State Police dispatch and management	Existing
	West Lafayette - Public Safety and Emergency Management	West Lafayette PSAP, Police, and Fire dispatch and management.	Existing
	Purdue - Public Safety and Emergency Management	Purdue PSAP, Police, Fire, and HAZMAT dispatch and management	Existing
	Tippecanoe Co - Public Safety and Emergency Management	TEMA and Sheriff's Dept Dispatch and PSAP	Existing
	Small Municipality - Public Safety and Emergency Management	EM departments Battle Ground, Clarks Hill, Dayton, and Otterbein. Dispatch handled by the Tippecanoe Sheriff's Department	Planned
Emergency Vehicle Subsystem	Lafayette - Emergency Vehicles	Police, Fire, and HazMat Vehicles	Existing
	West Lafayette - Emergency Vehicles	Police and Fire Vehicles	Planned
	Purdue - Emergency Vehicles	Purdue Police, Fire, HazMat, and ambulance vehicles	Planned
	State Police - Vehicles	Indiana State Police Vehicles	Existing
	Small Municipality - Emergency Vehicles	Battle Ground, Clarks Hill, Dayton, and Otterbein police vehicles.	Planned

ITS Subsystem/ Terminator Name	Stakeholder Element Name	Stakeholder Element Description	Element Status
	Tippecanoe Co - Emergency Vehicles	Sheriff patrol, Ambulances, TEMA vehicles (e.g., command center, off-road , HazMat vehicles)	Existing
Enforcement Agency	State Police - Public Safety and Emergency Management	Indiana State Police dispatch and management	Existing
Information Service Provider	CityBus - Operations Center and Dispatch	This is the local public transportation service provider for the Lafayette-West Lafayette area.	Existing
	INDOT - TMC, TO, and MCM	TO - Crawfordsville District and Subdistricts TMC-Primary Indianapolis, Secondary Borman (Planned implementation in Tippecanoe County).	Existing
	INDOT - 511 Traveler Information	One-stop resource for statewide traveler information, as well as traffic conditions, intermodal information and schedules, work zone information, and weather conditions. The service can be accessed by dialing 511 or viewing a website.	Planned
Maintenance and Construction Management	Lafayette - TMC and MCM	Responsible for construction and maintenance of roads and roadside equipment within the City of Lafayette.	Existing
	West Lafayette - TMC and MCM	This agency is responsible for maintenance and construction of West Lafayette city streets. The City is also responsible for traffic signals on Purdue campus (those not on the state system) and portions of the roads surrounding the Purdue campus.	Existing
	Tippecanoe Co - MCM	This agency is responsible for maintenance and construction of all non-state system bridges and county roads. The County does not have any traffic control signals.	Existing
	INDOT - TMC, TO, and MCM	TO - Crawfordsville District and Subdistricts TMC-Primary Indianapolis, Secondary Borman (Planned implementation in Tippecanoe County).	Existing
	Purdue - Facilities and Grounds	Responsible for all streets and sidewalks not on the West Lafayette or State systems.	Planned
Map Update Provider	Tippecanoe Co - GIS	Mapping data creation and clearinghouse for the county	Existing
Media	TV Stations	Local TV Stations	Existing
	Radio Stations	Local Radio Stations	Existing
Multimodal Transportation Service Provider	AMTRAK Traveler Information	Amtrak Passenger phone and web services	Existing
Other Emergency Management	CityBus - Operations Center and Dispatch	This is the local public transportation service provider for the Lafayette-West Lafayette area.	Existing
Other ISP	AMTRAK Traveler Information	Amtrak Passenger phone and web services	Existing
Pedestrians	Pedestrian	Pedestrians	Existing
Personal Information Access	User Personal Computing Devices	User Personal Computing Devices refers to equipment an individual owns and can personalize with their choices for information about transportation networks. An Internet-connected PC is an example.	Planned
Rail Operations	Rail - Operations Control Centers	Railroad operations centers: Norfolk Southern, CXS, and K.B.&S.	Existing

ITS Subsystem/ Terminator Name	Stakeholder Element Name	Stakeholder Element Description	Element Status
Remote Traveler Support	CityBus - Operations Center and Dispatch	This is the local public transportation service provider for the Lafayette-West Lafayette area.	Existing
	CityBus - Transit Information Displays	Transit information displays without interactive capabilities.	Existing
	Lafayette - Public Safety and Emergency Management	PSAP, Police, Fire, and HAZMAT dispatch and management. Note: LPD monitors security cameras in the Riehle Plaza Terminal	Existing
	Purdue - Public Safety and Emergency Management	Purdue PSAP, Police, Fire, and HAZMAT dispatch and management	Existing
	INDOT - Roadside Equipment	Equipment distributed on and along the state highway and interstate system which monitors and controls traffic. INDOT plans to install CCTV on I-65 in the year 2012. They also plan on installing 0.5 mile markers along the interstate in Tippecanoe County in an undetermined year	Planned
Roadway Subsystem	Lafayette - Roadside Equipment	Equipment distributed on and along the roadway which monitors and controls traffic. Includes Portable DMS	Existing
	West Lafayette - Roadside Equipment	Equipment distributed on and along the roadway which monitors and controls traffic.	Existing
	Rail - Wayside Equipment	In the County all signal controls are controlled and maintained by the railroads. County/Cities have purchased some of the equipment.	Existing
	INDOT - Roadside Equipment	Equipment distributed on and along the state highway and interstate system which monitors and controls traffic. INDOT plans to install CCTV on I-65 in the year 2012. They also plan on installing 0.5 mile markers along the interstate in Tippecanoe County in an undetermined year	Planned
	Tippecanoe Co - Roadside Equipment	Portable Dynamic Message Signs (TEMA)	Existing
Telecommunications System for Traveler Information	INDOT - 511 Traveler Information	One-stop resource for statewide traveler information, as well as traffic conditions, intermodal information and schedules, work zone information, and weather conditions. The service can be accessed by dialing 511 or viewing a website.	Planned
Traffic	Traveler	Travelers	Existing
Traffic Management	Lafayette - TMC and MCM	Responsible for construction and maintenance of roads and roadside equipment within the City of Lafayette.	Existing
	West Lafayette - TMC and MCM	This agency is responsible for maintenance and construction of West Lafayette city streets. The City is also responsible for traffic signals on Purdue campus (those not on the state system) and portions of the roads surrounding the Purdue campus.	Existing
	Lafayette - Public Safety and Emergency Management	PSAP, Police, Fire, and HAZMAT dispatch and management. Note: LPD monitors security cameras in the Riehle Plaza Terminal	Existing

ITS Subsystem/ Terminator Name	Stakeholder Element Name	Stakeholder Element Description	Element Status
	Tippecanoe Co - MCM	This agency is responsible for maintenance and construction of all non-state system bridges and county roads. The County does not have any traffic control signals.	Existing
	State Police - Public Safety and Emergency Management	Indiana State Police dispatch and management	Existing
	Tippecanoe Co - Public Safety and Emergency Management	TEMA and Sheriff's Dept Dispatch and PSAP	Existing
	INDOT - TMC, TO, and MCM	TO - Crawfordsville District and Subdistricts TMC-Primary Indianapolis, Secondary Borman (Planned implementation in Tippecanoe County).	Existing
	Purdue - Facilities and Grounds	Responsible for all streets and sidewalks not on the West Lafayette or State systems.	Planned
Transit Management	CityBus - Operations Center and Dispatch	This is the local public transportation service provider for the Lafayette-West Lafayette area.	Existing
Transit Vehicle Subsystem	CityBus - Transit Vehicles	Transit vehicles include ITS devices that support the safe and efficient movement of passengers. These systems collect, manage, and disseminate transit-related information to the driver, operations and maintenance personnel, and transit system patrons.	Existing
Traveler	Traveler	Travelers	Existing
Traveler Card	Traveler Card	Enables the actual transfer of electronic information from the user of a service (e.g., a CityBus pass) to the provider of the service.	Existing
Vehicle	CityBus - Transit Vehicles	Transit vehicles include ITS devices that support the safe and efficient movement of passengers. These systems collect, manage, and disseminate transit-related information to the driver, operations and maintenance personnel, and transit system patrons.	Existing
	Lafayette - Emergency Vehicles	Police, Fire, and HazMat Vehicles	Existing
	West Lafayette - Emergency Vehicles	Police and Fire Vehicles	Planned
	Purdue - Emergency Vehicles	Purdue Police, Fire, HazMat, and ambulance vehicles	Planned
	State Police - Vehicles	Indiana State Police Vehicles	Existing
	User Vehicles	Traveler Vehicles	Existing
	Small Municipality - Emergency Vehicles	Battle Ground, Clarks Hill, Dayton, and Otterbein police vehicles.	Planned
	Tippecanoe Co - Emergency Vehicles	Sheriff patrol, Ambulances, TEMA vehicles (e.g., command center, off-road , HazMat vehicles)	Existing
Vehicle Characteristics	Traveler	Travelers	Existing
Wayside Equipment	Rail - Wayside Equipment	In the County all signal controls are controlled and maintained by the railroads. County/Cities have purchased some of the equipment.	Existing

5.0 NEEDS AND SERVICES

This section describes the ITS User Services selected for Tippecanoe County. These services were identified from stakeholder input throughout the RA development. To facilitate the discussions with the stakeholders, the results from the systems inventory were used to identify ITS User Services from the National Architecture. Additional ITS User Services were added to address current and future needs and priorities.

5.1 Needs

ITS needs and issues identified by Tippecanoe County ITS stakeholders. The needs relevant to the Tippecanoe County RA development may be classified into the following major areas:
1. Improve traffic operations and safety
   a. Peak-period traffic management, e.g., interconnected signals both on and off the state highway network.
   b. School traffic circulation and safety
   c. Special events traffic management
   d. Work-zone and road construction management
   e. Winter weather impact management
2. Improve incident response times[6], e.g., signal preemption for emergency vehicles.
3. Increase en-route traveler and incident information, e.g., DMS and 5-1-1 call service.
4. Coordinate emergency and security management
5. Long-term coordination among agencies in solving transportation problems, beyond the planning phase

The Tippecanoe County ITS needs fit within those identified in the INDOT ITS Strategic Plan (March 2005). Statewide goals listed in the plan are to increase the transportation system efficiency and capacity, enhance mobility, improve safety, reduce energy consumption and environmental costs, increase economic productivity, and create an environment for ITS market.

5.2 Services

ITS services were initially identified by mapping the area transportation needs to the National ITS Architecture. Stakeholders assisted in customizing potential ITS User Services and corresponding Market Packages to reflect area needs. Subsection 5.2.1 provides a summary of the ITS User Services identified for Tippecanoe County, while Subsection 5.2.2 outlines the area's Market Packages.

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[6] Home and St. Elizabeth's Hospitals have merged and are building a new Hospital and Emergency Room in southeastern Lafayette. At this time, the existing Emergency Room at Elizabeth's Hospital will remain open for the foreseeable future. Ambulance service to the new hospital location will travel through some of the busiest intersections in the county. Signal preemption on the major arterials should be examined as a future ITS project as funds become available.

5.2.1 Tippecanoe County ITS User Services

The descriptions and the numbering assigned to the following ITS User Services are as defined the ITS National Architecture 6.1[7].

1 Travel and Traffic Management:

1.1 Pre-trip Travel Information - This User Service allows travelers access to a complete range of real-time multimodal transportation information. Information on road network conditions, incidents, weather, and transit services, are conveyed through these systems providing travelers with the latest conditions.

1.2 En-route Driver Information - This User Service provides driver advisories to convey information about traffic conditions, incidents, construction, and transit schedules to traveler's vehicles, e.g., state wide Hazard Advisory Radio (HAR) and portable and fixed DMS.

1.6 Traffic Control – This User Service provides for the integration and adaptive control of the freeway and surface street systems to improve the flow of traffic and minimize congestion while maximizing the movement of people and goods. This service gathers data from the transportation system, fuses it into usable information, and uses it to determine the optimum assignment of right-of-way to vehicles and pedestrians.

1.7 Incident Management – This User Service utilizes sensors, data processing, and communications to improve the incident management and response capabilities of transportation and public safety officials, the towing and recovery industry, and others involved in incident response.

1.10 Highway Rail Intersection – This User Service uses ITS technologies to provide improved control of highway and train traffic to avoid or decrease the severity of collisions that occur between trains and vehicles at HRIs.

2 Public Transportation Management:

2.1 Public Transportation Management – This User Service automates the operations, planning and management functions of public transit systems. It provides real-time computer analysis of vehicles and facilities to improve transit operations and maintenance. It monitors the location of transit vehicles, identifies deviations from the schedule, and offers potential solutions to dispatchers and operators. Security of transit personnel will be enhanced through providing access management of transit vehicles.

2.2 En-route Transit Information – This User Service provides information to travelers using public transportation after they begin their trips. Real-time, accurate transit service information will be available on-board the vehicle, at transit stations and bus stops to assist travelers in making informed decisions and itinerary modifications while a trip is underway.

2.3 Personalized Public Transit – This User Service supports flexibly routed transit vehicles. Vehicles provide on-demand routing to pick up passengers who have requested

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[7] National ITS Architecture Version 6.1 http://www.iteris.com/itsarch. December 2008.

service and deliver them to their destinations. Vehicles providing this service can include small buses, taxicabs, or other small, shared-ride vehicles.

2.4 Public Travel Security – This User Service creates a secure environment for public transportation patrons, operators, and support staff. It provides systems that monitor the environment in transit facilities, bus stops, and on-board transit vehicles and generates alarms (manually initiated) when necessary.

5 Emergency Management:

5.1 Emergency Notification and Personal Security – This User Service provides the ability for travelers to notify appropriate emergency response personnel for assistance in emergency or non-emergency situations. The service also provides for monitoring, threat alerts, and automated security system support in secure areas related to travel and transportation. Additionally, the service provides wide area alert to notify the traveling public in emergency situations such as child abductions, severe weather watches and warnings, natural and human-caused disasters, military operations, and civil emergencies.

5.2 Emergency Vehicle Management [8] **–** This User Service reduces the time from when a 911 call was received at the PSAP to the arrival of the emergency vehicles on the scene. This service includes communications between response vehicles and the dispatch center to provide display of emergency vehicle location and automation support to dispatchers to help them dispatch the vehicle that can most quickly reach the incident site.

5.3 Disaster Response and Evacuation – This User Service uses ITS to enhance disaster response by prioritizing, allocating, and tracking personnel and resources responding to disasters. The User Service provides better information about the transportation system in the vicinity of the disaster, and provides more efficient, safer evacuation for the general public if needed.

7 Information Management:

7.1 Archived Data – This User Service provides for the archive and distribution of ITS data; achieving the ITS goal of data/information reuse and unambiguous data interchange throughout all functional areas.

5.2.2 Tippecanoe County Market Packages

ITS Market Packages have been defined within the National ITS Architecture program. They address specific service requirements of various ITS stakeholders and consider the transportation architecture, communication infrastructure and institutional issues. The program is flexible and accommodates a range of possible ITS implementations throughout the nation over a twenty year time frame. Market Packages are designed separately or in combination to solve real world transportation problems and needs. Market Packages are inter-related and are also dependent on external factors such as technology advancement, policy change, and development of

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[8] Although not a planned in Tippecanoe County, this User Services provides traffic signal preemption for emergency vehicle's en-route such that an emergency vehicle is almost always presented with a green signal and cross traffic is stopped for safety.

common interface standards. They provide different benefits, different cost recovery mechanisms, and are subject to different levels of market influence.

In the National ITS Architecture, Market Packages are grouped into the functional areas of:
- Archive Data Management (AD),
- Advanced Public Transportation Systems (APTS),
- Advanced Traffic Management Systems (ATMS),
- Emergency Management (EM),
- Maintenance and Construction Management (MC)
- Advanced Traveler Information Systems (ATIS),
- Commercial Vehicle Operations (CVO), and
- Advanced Vehicle Safety Systems (AVSS).

The selection of Tippecanoe County ITS RA Market Packages was based on whether a signification portion of an ITS technology had, or was planned for implementation with the county based on the Market Package definitions. An additional factor to package selection was the existence of ITS equipment within the county, e.g., portable DMSs, video traffic detectors. Furthermore, if equipment was not a factor, a Market Packages was selected, or not-selected, based on the types of commutations used in the ITS flows. For example, a considerable amount of communications, especially between street/highway departments and other stakeholders, take place over non-ITS communication types, such as land-line phone, cell phone, and pagers. Therefore, Maintenance and Construction Management Market Package group were not chosen as a Tippecanoe County RA Market Package at this time.

Table 3 lists the Market Packages that support the needs and services of the Tippecanoe County RA. The full descriptions and customized diagrams of the Tippecanoe County Market Packages are shown in Appendix A.

Table 3.   Tippecanoe County ITS RA Market Package Implementation Status

Existing Market Packages		Planned Market Packages	
AD1	ITS Data Mart	AD2	ITS Data Warehouse
APTS01	Transit Vehicle Tracking	ATMS01	Network Surveillance
APTS02	Transit Fixed-Route Operations	ATMS08	Traffic Incident Management
APTS03	Demand Response Transit Operations	EM10	Disaster Traveler Information
APTS04	Transit Fare Collection Management	ATIS01	Basic Traveler Information
APTS05	Transit Security		
APTS06	Transit Fleet Management		
APTS08	Transit Traveler Information		
APTS10	Transit Passenger Counting		
ATMS03	Surface Street Control		
ATMS06	Traffic Information Dissemination		
ATMS13	Standard Railroad Grade Crossing		
ATMS19	Speed Monitoring		
EM01	Emergency Call-Taking and Dispatch		
EM06	Wide-Area Alert		
EM07	Early Warning System		

AD1: ITS Data Mart (existing)

Principal Stakeholders:
- Indiana State Police – Statewide Crash Records Information Database (existing)
- Indiana Department of Transportation – Data Services (existing)
- Tippecanoe County – Public Safety and Emergency Management (existing)
- CityBus – Operations Center and Dispatch (existing)
- Lafayette – TMC and MCM (planned)
- West Lafayette – TMC and MCM (planned)

Description: This Market Package provides a focused archive that houses data collected and owned by a <u>single</u> agency, district, private provider, research institution, or other organization.

AD2: ITS Data Warehouse (planned)

Principal Stakeholders:
- INDOT - TMC, TO, and MCM (planned)
- Purdue - CATS/Civil Engineering (planned)
- APC of Tippecanoe County   (planned)

Description: This Market Package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from <u>multiple agencies and data sources</u> spanning across modal and jurisdictional boundaries.

APTS01: Transit Vehicle Tracking (existing)

Principal Stakeholder: CityBus (existing)
Description: This Market Package monitors current transit vehicle location using an Automated Vehicle Location System (AVL). The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.

APTS02: Transit Fixed-Route Operations (existing)

Principal Stakeholder: CityBus (existing)
Description: This Market Package performs vehicle routing and scheduling, current schedule performance using AVL data, as well as automatic operator assignment and system monitoring for fixed-route and flexible-route transit services.

APTS03: Demand Response Transit Operations (existing)

Principal Stakeholder: CityBus (existing)
Description: This Market Package performs vehicle routing and scheduling as well as automatic operator assignment and monitoring for demand responsive transit services. In addition, this Market Package performs similar functions to support dynamic features of flexible-route transit services.

APTS04: Transit Fare Collection Management (existing)

Principal Stakeholder: CityBus (existing)
Description: This market package manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card. Readers located on-board the transit vehicle allows electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem.

APTS05: Transit Security (existing)

Principal Stakeholders:
- CityBus (existing)
- Lafayette Public Safety and Emergency Management (existing)
- Purdue Public Safety and Emergency Management (existing)

Description: This Market Package provides for the physical security of transit passengers and transit vehicle operators. On-board surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms.

APTS06: Transit Fleet Management (existing)

Principal Stakeholder: CityBus (existing)

Description: This Market Package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules preventative and corrective maintenance.

APTS08: Transit Traveler Information (existing)

Principal Stakeholder: CityBus (existing)

Description: This Market Package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.

APTS10: Transit Passenger Counting (existing)

Principal Stakeholder: CityBus (existing)

Description: This market package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.

ATIS01: Broadcast Traveler Information (planned)

Principal Stakeholder: INDOT (TMC TrafficWise, 511) (planned)

Description: This Market Package collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadly disseminates this information through existing infrastructures and low cost user equipment (e.g., FM sub carrier, cellular data broadcast). This package is different from ATMS06 - Traffic Information Dissemination, which provides localized HAR and DMS information capabilities.

ATMS01: Network Surveillance (planned)

Principal Stakeholders:
- INDOT (planned)
- City of Lafayette (planned)
- City of West Lafayette (existing and planned)

Description: This Market Package includes traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The data generated by this Market Package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, and detect faults in indicator operations.

ATMS03: Surface Street Control (existing)

Principal Stakeholders:
- INDOT (existing and planned)
- City of Lafayette (existing and planned)
- City of West Lafayette (existing and planned)

Description: This Market Package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. A range of traffic signal control systems are represented by this Market Package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This Market Package is generally an intra-jurisdictional package that does not rely on real-time communications between separate control systems to achieve area-wide traffic signal coordination. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would be represented by this package. This Market Package is consistent with typical urban traffic signal control systems.

ATMS06: Traffic Information Dissemination (existing)

Principal Stakeholders:
- INDOT (existing and planned)
- Lafayette (existing)
- Tippecanoe County (existing)

Description: This Market Package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, and emergency alerts and driver advisories. This package also covers the equipment and interfaces that provide traffic information to the media.

ATMS08: Traffic Incident Management System (planned)

Principal Stakeholder: INDOT (planned)

Description: This Market Package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The Market Package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters.

ATMS13: Standard Railroad Grade Crossing (existing)

Principal Stakeholders:
- INDOT (existing)
- Railroads (existing)

Description: This Market Package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities, e.g., interconnected signal at the Home Depot entrance on US 52. In Tippecanoe County, all railroad crossing equipment is owned an maintained by the rail companies.

ATMS19: Speed Monitoring (existing)

Principal Stakeholders:
- INDOT (planned)
- Lafayette (existing)

Description: This Market Package monitors the speeds of vehicles traveling through a roadway system. If the speed is determine to be excessive, roadside equipment can suggest a safe driving speed. Environmental conditions may be monitored and factored into the safe speed advisories that are provided to the motorist. This service can also support notifications to an enforcement agency to enforce the speed limit on a roadway system.

EM01: Emergency Call-Taking and Dispatch (existing)

Principal Stakeholders
- Lafayette (existing)
- West Lafayette (existing)
- Purdue University (existing)
- Tippecanoe County (existing)
- Indiana State Police (existing)

Description: This Market Package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Subsystem and an Emergency Vehicle supports dispatch and provision of information to responding personnel.

EM06: Wide-Area Alert (existing)

Principal Stakeholders:
- Tippecanoe County (existing)
- INDOT (existing and planned)
- Indiana State Police (existing)
- Lafayette (existing)

Description: This Market Package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property, e.g., Emergency Alert System (EAS). The ITS systems, in turn, provide the alert information to the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, transit displays, 511 traveler information systems, and traveler information web sites. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios.

EM07: Early Warning System (existing)

Principal Stakeholders
- Indiana State Police (existing)
- National Weather Service (existing)
- Tippecanoe County TEMA/Department of Homeland Security (planned)

Description: This Market Package monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The Market Package monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notifies all agencies of detected emergencies.

EM10: Disaster Traveler Information (planned)

Principal Stakeholder: INDOT (planned)

Description: This Market Package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This Market Package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. This Market Package provides focus on the special requirements for traveler information dissemination in disaster situations.

5.2.3 Market Packages Not Included in the Tippecanoe County RA

Table 4 provides a list of the remaining Market Packages not selected for inclusion in the Tippecanoe County RA. Market Packages were excluded due to either the lack of technology implementation within the county (e.g., toll collection) or on the basis that communication links between elements in the package were not taking place over the accepted ITS communication types, e.g., cell phone communications between snowplow operators.

However based on the current analysis, several Market Packages may be candidates for includes in the future, including:

- EM02   Emergency Routing
- ATIS02   Interactive Traveler Information
- ATIS05   ISP Based Trip Planning and Route Guidance
- APTS07   Multi-modal Coordination
- EM08   Disaster Response and Recovery
- EM09   Evacuation and Reentry Management
- MC06   Winter Maintenance
- MC07   Roadway Maintenance and Construction
- MC10   Maintenance and Construction Activity Coordination

Table 4.   Market Packages Not Included in the Tippecanoe County ITS RA

Not Planned		Not Planned	
AD3	ITS Virtual Data Warehouse	EM02	Emergency Routing
APTS7	Multi-modal Coordination	EM03	Mayday and Alarms Support
ATIS2	Interactive Traveler Information	EM04	Roadway Service Patrols
ATIS3	Autonomous Route Guidance	EM05	Transportation Infrastructure Protection
ATIS4	Dynamic Route Guidance	EM08	Disaster Response and Recovery
ATIS5	ISP Based Trip Planning and Route Guidance	EM09	Evacuation and Reentry Management
ATIS6	Integrated Transportation Management/Route Guidance	MC01	Maintenance and Construction Vehicle and Equipment Tracking
ATIS7	Yellow Pages and Reservation	MC02	Maintenance and Construction Vehicle Maintenance
ATIS8	Dynamic Ridesharing	MC03	Road Weather Data Collection
ATIS9	In Vehicle Signing	MC04	Weather Information Processing and Distribution
ATMS02	Probe Surveillance	MC05	Roadway Automated Treatment
ATMS04	Freeway Control	MC06	Winter Maintenance
ATMS05	HOV Lane Management	MC07	Roadway Maintenance and Construction
ATMS07	Regional Traffic Control	MC08	Work Zone Management
ATMS09	Traffic Forecast and Demand Management	MC09	Work Zone Safety Monitoring
ATMS10	Electronic Toll Collection	MC10	Maintenance and Construction Activity Coordination
ATMS11	Emissions Monitoring and Management	CVO01	Fleet Administration
ATMS12	Virtual TMC and Smart Probe Data	CVO02	Freight Administration
ATMS14	Advance Railroad Grade Crossing	CVO03	Electronic Clearance
ATMS15	Railroad Operations Coordination	CVO04	CV Administrative Processes
ATMS16	Parking Facilities Management	CVO05	International Border Electronic Clearance
ATMS17	Regional Parking Management	CVO06	Weigh-in-Motion
ATMS18	Reversible Lane Management	CVO07	Roadside CVO Safety
ATMS20	Drawbridge Management	CVO08	On-board CVO and Freight Safety & Security
ATMS21	Roadway Closure Management	CVO09	CVO and Fleet Maintenance
AVSS01	Vehicle Safety Monitoring	CVO10	HAZMAT Management
AVSS02	Driver Safety Monitoring	CVO11	Roadside HAZMAT Security Detection and Mitigation
AVSS03	Longitudinal Safety Warning	CVO12	CV Driver Security Authentication
AVSS04	Lateral Safety Warning	CVO13	Freight Assignment Tracking
AVSS05	Intersection Safety Warning	AVSS08	Advanced Vehicle Longitudinal Control
AVSS06	Pre-Crash Restraint Deployment	AVSS09	Advanced Vehicle Lateral Control
AVSS07	Driver Visibility Improvement	AVSS10	Intersection Collision Avoidance
		AVSS11	Automated Highway System

6.0 OPERATIONAL CONCEPT

This section discusses the roles and responsibilities of stakeholders in the implementation and operation of the regional systems identified in the Tippecanoe County RA. The Operational Concept outlines the responsibilities for specific scenarios, e.g., traffic incidents, major winter storms, floods, etc. In addition to providing a snapshot of how things are done for a certain scenario, the operational concept explores additional integration opportunities in the area with particular focus on stakeholder involvement.

ITS stakeholders have either implementation or operational roles and responsibilities. Implementation roles include project development, coordination, funding, and future maintenance. Operational roles focus on technical aspects of how ITS services are preformed and explore information sharing amongst the various stakeholders.

The Market Packages listed in Section 5.2.2 were used to develop the Operational Concept for the Tippecanoe County RA. Using the Market Package diagrams, stakeholders were able to identify their roles and interconnections with other stakeholders.

The mechanism for obtaining stakeholders' input relied on interviews and reviews by stakeholders relevant to each Market Package. Once the data was incorporated into the RA, the resulting customized Market Packages were presented to all stakeholders participating in the RA development.

After the Market Packages were approved by the stakeholders, relevant changes were entered into Turbo Architecture (TA) software[9]. TA was used to generate the Operational Concept for each Market Package based on the National ITS Architecture conventions. The operational concept report generated by TA focuses on roles and responsibilities pertaining to system operations and does not include implementation roles.

The following two subsections outline the roles and responsibilities developed for Tippecanoe County. Subsection 6.1 shows implementation roles and responsibilities, arranged by Market Package. Subsection 6.2 summarizes operational roles and responsibilities, organized by stakeholders.

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[9] Software developed and maintained by Iteris, Inc. Sponsored by the U.S. Department of Transportation, Federal Highway Administration Contract DTFH61-06-D-00030. TA Software v1.012. Database Versions: Physical Architecture v6.0.0, Market Package v6.0.0, and SDOMAP v6.0.0.

6.1 Implementation Roles

Table 5 presents a listing of the Stakeholders primarily responsible for implementing the core functionality of the Market Packages. There are secondary Stakeholders with implementation responsibilities that are contingent or consequential to the core ITS technology, but are not listed.

Table 5. Tippecanoe County ITS RA Implementation Roles

Market Packages	Stakeholder with Implementation Roles
AD1: ITS Data Mart	ISP, INDOT, CityBus, Lafayette, West Lafayette, Purdue University
AD2: ITS Data Warehouse	Purdue, INDOT, APC
APTS1: Transit Vehicle Tracking	CityBus
APTS2: Transit Fixed-Route Operations	CityBus
APTS3: Demand Response Transit Operations	CityBus
APTS5: Transit Security	CityBus, Lafayette
APTS04: Transit Fare Collection Management	CityBus
APTS6: Transit Fleet Management	CityBus
APTS8: Transit Traveler Information	CityBus
APTS10: Transit Passenger Counting	CityBus
ATIS1: Broadcast Traveler Information	INDOT
ATMS01: Network Surveillance	Lafayette, West Lafayette, INDOT
ATMS03: Surface Street Control	Lafayette, West Lafayette, INDOT
ATMS06: Traffic Information Dissemination	INDOT, Lafayette, Tippecanoe County
ATMS08: Traffic Incident Management System	INDOT
ATMS13: Standard Railroad Grade Crossing	INDOT and Railroad Operations
ATMS19: Speed Monitoring	INDOT and Lafayette
EM01: Emergency Call-Taking and Dispatch	Lafayette, West Lafayette, Purdue, Tippecanoe County, Indiana State Police
EM06: Wide-Area Alert	INDOT, ISP, Tippecanoe County, Lafayette
EM07: Early Warning System	Tippecanoe County, ISP, National Weather Service
EM10: Disaster Traveler Information	INDOT, ISP, Tippecanoe County

6.2 Operational Roles and Responsibilities

Each stakeholder's current and future roles and responsibilities in the implementation and operation of the area's transportation systems are identified in Table 6.

The Status types shown in Table 6 are defined as:
Existing: The ITS Stakeholder is already performing the role as outlined in the National ITS architecture.
Planned: The ITS Stakeholder is planning to perform the role in the next 10 years.
Phone/Trad Com: The ITS Stakeholder is performing the role using traditional communication systems, (e.g., phone, cell phone, pager) not traditionally considered an ITS communications type.
Extended Vision: The ITS Stakeholder has no current plans for performing the role. However, in the extended vision of the Tippecanoe County RA, (e.g., > 10 years, upon funding availability, or from safety concerns), the ITS role may be preformed to satisfy the Needs as outlined in Section 5.1.

Table 6.   Tippecanoe County ITS RA Roles and Responsible

Responsibility Area	Stakeholder	Role	Status
Archived Data Systems	APC of Tippecanoe County	Analyze traffic and incident data as needed	Planned
	City of Lafayette	Analyze traffic data as needed	Planned
		Archive video surveillance of Transit Center	Planned
		Collect, archive, and distribute traffic data collected by TMC	Planned
	City of West Lafayette	Analyze traffic data as needed	Planned
		Collect, archive, and distribute traffic data collected by TMC	Planned
	CityBus	Analyze transit data as needed	Planned
		Collect and archive transit data collected by CityBus vehicles	Planned
	INDOT	Analyze traffic data as needed	Existing
		Collect and archive traffic data associated with speeds, volume, and other traffic related items	Existing
		Provide requested traffic data to Universities and other Municipal departments	Existing
	ISP	Archive call and response data	Existing
		Collect and Store Incident Reports	Existing
	Purdue University	Analyze traffic data provided by TMCs, TOs, and MCMs	Existing
		Coordinate research efforts with TMCs, TOs, and MCMs	Existing
		Provide research results to TMCs, TOs, and MCMs	Existing
	Tippecanoe County	Archive 911 CAD and call data	Existing
		Maintain Local NCIC and RMS databases	Existing
		Maintain servers and software licenses for 911 CAD software, equipment and facilities.	Existing
		Analyze traffic and incident data as needed	Planned
Emergency Management	City of Lafayette	Coordinate with other emergency management agencies	Existing
		Provide 911 and dispatch services for Lafayette	Existing
		Respond to emergencies	Existing
		Support evacuation	Existing

Responsibility Area	Stakeholder	Role	Status
	City of West Lafayette	Coordinate with other emergency management agencies	Existing
		Provide 911 and dispatch services for West Lafayette	Existing
		Respond to emergencies	Existing
		Support evacuation	Existing
	CityBus	Monitor voice surveillance feeds during emergencies	Existing
		Retrieve voice and video surveillance from transit vehicles	Existing
		Support evacuation	Existing
	INDOT	Provide clean-up efforts to aid in emergency relief	Existing
		Support evacuation	Existing
	ISP	Coordinate with other emergency management agencies	Existing
		Respond to emergencies	Existing
		Support evacuation	Existing
	Media	Disseminate general emergency warnings	Existing
		Disseminate traffic information	Existing
	Purdue University	Assist those in need of medical attention when called upon by other public safety agencies	Existing
		Coordinate with other emergency management	Existing
		Provide 911 and dispatch services for Purdue University	Existing
		Respond to emergencies	Existing
		Support evacuation	Existing
	Railroads	Coordinate with other emergency management	Existing
		Respond to emergencies	Existing
	Small Municipality or Township	Coordinate with other emergency management agencies	Existing
		Respond to emergencies	Existing
		Support evacuation	Existing
	Tippecanoe County	Assist those in need of medical attention when called upon by other public safety agencies	Existing
		Coordinate with other emergency management	Existing
		Initiate general emergency warnings	Existing
		Maintain 911 system servers, software licenses, and data archives	Existing
		Provide 911 and dispatch services for unincorporated Tippecanoe County and Small Municipalities	Existing
		Provide digital mapping data updates (as needed/requested) for mapping and dispatch computer systems	Existing
		Provide emergency medical services	Existing
		Respond to emergencies	Existing
		Support evacuation	Existing
	Weather Services	Initiate weather emergency warnings	Existing
		Provide current weather data	Existing
		Provide weather forecasts	Existing
Freeway Management	INDOT	Determine travel times for freeways	Planned
		Monitor traffic sensors on freeways	Planned
		Operate traveler information devices such as DMS and HAR	Planned
		Provide traveler information reports	Planned
Incident Management Regional	City of Lafayette	Coordinate incident response with surrounding jurisdictions, State Police, and emergency services	Existing
		Provide dispatch and communications (Police, Fire, HAZMAT)	Existing

Responsibility Area	Stakeholder	Role	Status
Architecture		Provide resources (Police, Fire, HAZMAT, Traffic Dept.)	Existing
		Respond to incidents in the City of Lafayette	Existing
		Notify INDOT TMC of incidents on the interstate or other major roadways that should be posted on information devices (DMS and HAR)	Phone/ Traditional Com
	City of West Lafayette	Coordinate incident response with surrounding jurisdictions, State patrols, and emergency services	Existing
		Provide dispatch and communications (Police, Fire)	Existing
		Provide resources (Police, Fire, Street Dept.)	Existing
		Respond to incidents in the City of West Lafayette	Existing
		Notify INDOT TMC of incidents on the interstate or other major roadways that should be posted on information devices (DMS and HAR)	Phone/ Traditional Com
	INDOT	Provide incident information to travelers via traffic information devices such as HAR	Existing
		Provide resources (portable DMS)	Existing
		Provide incident information to travelers via traffic information devices such as DMS	Planne
	ISP	Coordinate incident response with surrounding jurisdictions, State patrols, and emergency services	Existing
		Notify INDOT TMC of incidents on the interstate or other major roadways that should be posted on information devices (DMS and HAR)	Existing
		Provide dispatch and communications (Police)	Existing
		Provide resources (Police)	Existing
		Respond to incidents on Indiana state system	Existing
	Media	Report incident information including possible evacuation or detour information	Planned
	Purdue University	Coordinate incident response with surrounding jurisdictions, State patrols, and emergency services	Existing
		Provide dispatch and communications (Police, Fire, HAZMAT)	Existing
		Provide resources (Police, Fire, Ambulance, HAZMAT)	Existing
		Respond to incidents on Purdue University Campus	Existing
		Notify INDOT TMC of incidents on the interstate or other major roadways that should be posted on information devices (DMS and HAR)	Phone/ Traditional Com
	Railroads	Coordinate incident response with surrounding jurisdictions, State patrols, and emergency services	Phone/ Traditional Com
	Small Municipality or Township	Coordinate incident response with surrounding jurisdictions, State patrols, and emergency services	Existing
		Provide resources (e.g., Police, Fire, Street Dept.)	Existing
		Respond to incidents within municipal boundary	Existing
	Tippecanoe County	Coordinate incident response with surrounding jurisdictions, State patrols, and emergency services	Existing
		Provide dispatch and communications (Sheriff, TEMA)	Existing
		Provide incident information to travelers via traffic information devices such as DMS	Existing
		Provide resources (Sheriff, Ambulance, TEMA, Hwy Dept)	Existing

Responsibility Area	Stakeholder	Role	Status
		Respond to incidents in unincorporated County or small municipalities	Existing
		Notify INDOT TMC of incidents on the interstate that should be posted on information devices (DMS and HAR)	Phone/ Traditional Com
Surface Street Management	City of Lafayette	Operate traffic signal systems for Lafayette owned roadways	Existing
		Interconnect signal systems with surrounding jurisdictions	Planned
		Provide intersection signal preemption for emergency vehicles	Extended Vision
	City of West Lafayette	Operate traffic signal systems for West Lafayette owned roadways	Existing
		Interconnect signal systems with surrounding jurisdictions	Existing
		Provide intersection signal preemption for emergency vehicles	Extended Vision
	INDOT	Interconnect signal systems with surrounding jurisdictions	Existing
		Operate traffic signal systems for INDOT owned roadways	Existing
		Allow local municipalities to place and maintain signal preemption devices on INDOT owned roadways that connect with non-state owned routes	Extended Vision
Transit Services	AMTRAK	Provide fixed route train services between designated municipalities	Existing
		Provide transit traveler information	Existing
	City of Lafayette	Monitor and archive (short term) video surveillance of Transit facility.	Existing
		Provide resources (Police, Fire, HAZMAT, and Traffic Dept.)	Existing
	CityBus	Analyze transit data as needed	Existing
		Collect and archive transit data collected by CityBus vehicles	Existing
		Disseminate real-time arrival data	Existing
		Monitor voice surveillance feeds during emergencies	Existing
		Provide fixed route bus services for Lafayette-West Lafayette area	Existing
		Provide paratransit service for large Lafayette-West Lafayette area	Existing
		Provide requested transit data to other government offices	Existing
		Provide transit information to the public via website and media	Existing
		Provide transit traveler information	Existing
		Retrieve voice and video surveillance from transit vehicles	Existing
		Support evacuation	Existing
	Purdue University	Answer 9-1-1 calls made from Campus call boxes in the vicinity of transit stops	Planned
Traveler Information	City of Lafayette	Provide traffic and maintenance information to the public via website and media	Existing
	City of West Lafayette	Provide traffic and maintenance information to the public via website and media	Existing
	CityBus	Disseminate real-time arrival data	Existing
		Provide transit information to the public via website and media	Existing
	INDOT	Provide traffic and maintenance information to the public via website and media	Existing
		Provide traffic, incident, and maintenance information to drivers via HAR	Existing

Responsibility Area	Stakeholder	Role	Status
		Provide statewide 511 Traveler Information Service	Planned
		Provide traffic images and speeds to drivers via TrafficWise website	Planned
		Provide traffic, incident, and maintenance information to drivers via DMS	Planned
	Media	Disseminate traffic data	Existing
	Users	Report traffic and incident information to emergency services	Existing
	Weather Services	Provide weather information and alerts	Existing

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7.0 AGREEMENTS

This section briefly outlines potential agreement needs to support the Tippecanoe County RA. To develop the list of needed agreements, Market Packages were used to identify potential roles and responsibilities as well as interfaces. Anytime Agencies shared operations of a system or shared formal access to system control and data, a potential agreement was flagged. Discussions with stakeholders helped to finalize the list of agreements, taking into consideration existing agreements with other agencies, as well as with their own agency requirements.

Table 7 shows a summary of potential agreements in Tippecanoe County. The table provides the following information for each agreement:
- Market Package: The Market Package where the agreement is needed.
- Purpose: Brief statement regarding what the agreement addresses.
- Stakeholders: List of Stakeholders which would be included in the agreement.
- Issues: List of specific issues to be included in the agreement.

Table 7. Tippecanoe County ITS RA Agreements

Market Packages	Purpose	Stakeholders	Issues
AD1: ITS Data Mart and AD2: ITS Data Warehouse	Share Data	INDOT, Lafayette, West Lafayette, CityBus, Purdue Research, Engineering Depts, Law Enforcement, and APC of Tippecanoe County	• Access to live data and databases • Access to archived data and databases
APTS5: Transit Security	Share Data	CityBus and Lafayette	• Access to surveillance data
ATIS1: Broadcast Traveler Information	Share Data	INDOT, ISP, Lafayette, West Lafayette, Purdue, Tippecanoe County, Small Municipalities, CityBus, Railroads	• Communication links • Response protocols • Access to real-time traffic and incident data
ATMS01: Network Surveillance	Share Data	INDOT, Lafayette, West Lafayette	• Access to sensors • Access to networks
ATMS03: Surface Street Control	Corridor Coordination, ATMS software Costs and Maintenance	INDOT, Lafayette, West Lafayette (Purdue-research purposes)	• Plan compatibility • Hardware/software • Communication links • Liability
ATMS06: Traffic Information Dissemination	Support Information Dissimilation	INDOT, Lafayette, Tippecanoe County	• Equipment sharing
ATMS08: Traffic Incident Management System	• Incident Response • Special Event Traffic Response	ISP, INDOT, Lafayette, West Lafayette, Purdue, Tippecanoe County, Small Municipalities, CityBus, Railroads	• Communication links • Response protocols • Access to data (sensor, surveillance, and other data)
EM01: Emergency Call-Tacking and Dispatch	• Response Coordination • Share Data	Lafayette, West Lafayette, Purdue University, Tippecanoe County, ISP	• Communication links • Response protocols • Plans compatibility • Hardware/software
EM06: Wide-Area Alert , EM07: Early Warning System, & EM10: Disaster Traveler Info.	Information Dissemination	Tippecanoe County, National Weather Service, INDOT, ISP, Dept of Homeland Security, West Lafayette, Lafayette	• Communication links • Response protocols • Equipment sharing

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8.0 FUNCTIONAL REQUIREMENTS

This section discusses detailed Functional Requirements for the User Services and Market Packages identified for the Tippecanoe County RA. Functional Requirements were selected from a list of potential requirements for each of the Equipment Package[10] included in the Tippecanoe County RA.

The organization of the Functional Requirements report produced by Turbo Architecture contains the following information:

- Element: The name used by stakeholders to describe a system or piece of a system.

- Entity: Centers or Subsystems as defined in the National ITS Architecture

- Functional Area: Equipment Packages which groups similar processes of a particular subsystem together into an "implementable" package

- Requirements: High-level requirements that support regional integration

- Status: Requirement implementation status

The complete Functional Requirements report is included as Appendix B due to its length. An example of the information provided in Appendix B is provided below.

Tippecanoe County Regional Architecture
Element: **CityBus - Transit Vehicles**
Entity: **Transit Vehicle Subsystem**
Functional Area: **On-board Transit Trip Monitoring**

Requirement:			Status
Requirement:	1	The transit vehicle shall compute the location of the transit vehicle based on inputs from a vehicle location determination function.	Existing
Requirement:	2	The transit vehicle shall support the computation of the location of a transit vehicle using on-board sensors to augment the location determination function. This may include proximity to the transit stops or other known reference points as well as recording trip length.	Existing
Requirement:	3	The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Planned
Requirement:	4	The transit vehicle shall record transit trip monitoring data including operational status information such as doors open/closed, passenger loading, running times, etc.	Existing
Requirement:	5	The transit vehicle shall send the transit vehicle trip monitoring data to center-based trip monitoring functions.	Existing

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[10] Equipment Packages group similar ITS processes of a particular subsystem together into an "implementable" package. Equipment Packages are the most detailed elements of the physical architecture and tied to specific Market Packages. Furthermore, they provide the common link between the interface-oriented architecture definition and the deployment-oriented market packages.

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9.0 INTERFACE REQUIREMENTS

This section outlines the interconnections between ITS stakeholders in the Tippecanoe County RA. Potential interfaces were identified using Market Packages to reflect existing and planned ITS instillations. Table 8 presents output from Turbo Architecture showing the interconnections between stakeholders in the Tippecanoe County RA. For additional information on the flow between the interconnected stakeholders listed in Table 8, refer to Appendix A for Market Package information associated with the Tippecanoe County RA.

Table 8. Tippecanoe County ITS RA Interface Requirements by Market Package

Stakeholder Inventory	Stakeholder Inventory	Status
AD1: ITS Data Mart (existing)		
CityBus - Operations and Dispatch	Lafayette - TMC and MCM	Phone/Trad Com
CityBus - Operations and Dispatch	Purdue - CATS/Civil Engineering	Planned
CityBus - Operations and Dispatch	West Lafayette - TMC and MCM	Phone/Trad Com
INDOT - Data Services	INDOT - Roadside Equipment	Planned
INDOT - Data Services	INDOT - TMC, TO, and MCM	Planned
INDOT - Data Services	Lafayette - TMC and MCM	Planned
INDOT - Data Services	West Lafayette - TMC and MCM	Planned
INDOT - Roadside Equipment	Lafayette - TMC and MCM	Planned
INDOT - Roadside Equipment	Purdue - CATS/Civil Engineering	Planned
INDOT - Roadside Equipment	West Lafayette - TMC and MCM	Planned
INDOT - TMC, TO, and MCM	Lafayette - TMC and MCM	Phone/Trad Com
INDOT - TMC, TO, and MCM	Purdue - CATS/Civil Engineering	Existing
INDOT - TMC, TO, and MCM	West Lafayette - TMC and MCM	Planned
Lafayette – PS and EM	State Police - Crash Reports Database	Existing
Lafayette - Roadside Equipment	Lafayette - TMC and MCM	Existing
Lafayette - Roadside Equipment	Purdue - CATS/Civil Engineering	Planned
Lafayette - Roadside Equipment	West Lafayette - TMC and MCM	Planned
Lafayette - TMC and MCM	Purdue - CATS/Civil Engineering	Planned
Lafayette - TMC and MCM	State Police – PS and EM	Phone/Trad Com
Lafayette - TMC and MCM	Tippecanoe Co - GIS	Existing
Lafayette - TMC and MCM	Tippecanoe Co – PS and EM	Phone/Trad Com
Lafayette - TMC and MCM	West Lafayette - Roadside Equipment	Planned
Lafayette - TMC and MCM	West Lafayette - TMC and MCM	Phone/Trad Com
Purdue - CATS/Civil Engineering	State Police – PS and EM	Planned
Purdue - CATS/Civil Engineering	Tippecanoe Co - GIS	Existing
Purdue - CATS/Civil Engineering	West Lafayette - Roadside Equipment	Planned
Purdue - CATS/Civil Engineering	West Lafayette - TMC and MCM	Planned
Purdue – PS and EM	State Police - Crash Reports Database	Existing
Small Municipality – PS and EM	State Police - Crash Reports Database	Planned
State Police - Crash Reports Database	State Police – PS and EM	Existing
State Police - Crash Reports Database	Tippecanoe Co – PS and EM	Existing
State Police - Crash Reports Database	West Lafayette – PS and EM	Existing
State Police – PS and EM	West Lafayette - TMC and MCM	Phone/Trad Com
Tippecanoe Co - GIS	West Lafayette - TMC and MCM	Existing
Tippecanoe Co – PS and EM	West Lafayette - TMC and MCM	Phone/Trad Com
West Lafayette - Roadside Equipment	West Lafayette - TMC and MCM	Planned
AD2: ITS Data Warehouse (planned)		
APC of Tippecanoe County	CityBus - Operations and Dispatch	Planned
APC of Tippecanoe County	INDOT - TMC, TO, and MCM	Planned
APC of Tippecanoe County	Lafayette - TMC and MCM	Planned

Stakeholder Inventory	Stakeholder Inventory	Status
APC of Tippecanoe County	Purdue - Facilities and Grounds	Planned
APC of Tippecanoe County	State Police - Crash Reports Database	Existing
APC of Tippecanoe County	Tippecanoe Co - GIS	Existing
APC of Tippecanoe County	Tippecanoe Co - MCM	Planned
APC of Tippecanoe County	West Lafayette - TMC and MCM	Planned
CityBus - Operations and Dispatch	Lafayette - TMC and MCM	Phone/Trad Com
CityBus - Operations and Dispatch	Purdue - CATS/Civil Engineering	Planned
CityBus - Operations and Dispatch	West Lafayette - TMC and MCM	Phone/Trad Com
INDOT - 511 Traveler Information	INDOT - Data Services	Planned
INDOT - Data Services	INDOT - TMC, TO, and MCM	Planned
INDOT - Data Services	Lafayette - TMC and MCM	Planned
INDOT - Data Services	Purdue - Facilities and Grounds	Planned
INDOT - Data Services	Tippecanoe Co - MCM	Planned
INDOT - Data Services	West Lafayette - TMC and MCM	Planned
INDOT - TMC, TO, and MCM	Lafayette - TMC and MCM	Phone/Trad Com
INDOT - TMC, TO, and MCM	Purdue - CATS/Civil Engineering	Existing
INDOT - TMC, TO, and MCM	West Lafayette - TMC and MCM	Planned
Lafayette - TMC and MCM	Purdue - CATS/Civil Engineering	Planned
Lafayette - TMC and MCM	Tippecanoe Co - GIS	Existing
Lafayette - TMC and MCM	Tippecanoe Co - MCM	Phone/Trad Com
Lafayette - TMC and MCM	West Lafayette - TMC and MCM	Phone/Trad Com
Purdue - CATS/Civil Engineering	Purdue - Facilities and Grounds	Planned
Purdue - CATS/Civil Engineering	Tippecanoe Co - GIS	Existing
Purdue - CATS/Civil Engineering	Tippecanoe Co - MCM	Planned
Purdue - CATS/Civil Engineering	West Lafayette - TMC and MCM	Planned
Purdue - Facilities and Grounds	West Lafayette - TMC and MCM	Phone/Trad Com
Tippecanoe Co - GIS	West Lafayette - TMC and MCM	Existing
Tippecanoe Co - MCM	West Lafayette - TMC and MCM	Phone/Trad Com
APTS01: Transit Vehicle Tracking (existing)		
CityBus - Transit Vehicles	CityBus - Operations and Dispatch	Existing
CityBus - Operations and Dispatch	Tippecanoe Co - GIS	Existing
APTS02: Transit Fixed-Route Ops (existing)		
CityBus - Operations and Dispatch	CityBus - Transit Vehicles	Existing
CityBus - Operations and Dispatch	INDOT - TMC, TO, and MCM	Phone/Trad Com
CityBus - Operations and Dispatch	Lafayette - Engr and MCO	Phone/Trad Com
CityBus - Operations and Dispatch	Purdue - Facilities and Grounds	Phone/Trad Com
CityBus - Operations and Dispatch	Tippecanoe Co - MCM	Phone/Trad Com
CityBus - Operations and Dispatch	West Lafayette - TMC and MCM	Phone/Trad Com
APTS03: Demand Response Transit Ops (existing)		
CityBus - Operations and Dispatch	CityBus - Transit Vehicles	Existing
CityBus - Operations and Dispatch	INDOT - TMC, TO, and MCM	Phone/Trad Com
CityBus - Operations and Dispatch	Lafayette - Engr and MCO	Phone/Trad Com
CityBus - Operations and Dispatch	Purdue - Facilities and Grounds	Phone/Trad Com
CityBus - Operations and Dispatch	Tippecanoe Co - MCM	Phone/Trad Com
CityBus - Operations and Dispatch	West Lafayette - TMC and MCM	Phone/Trad Com
APTS03: Demand Response Transit Ops (existing)		
CityBus - Operations Center and Dispatch	CityBus - Transit Vehicles	Existing
CityBus - Transit Vehicles	Traveler Card	Existing
APTS04: Transit Fare Collection Management (existing)		
CityBus - Operations and Dispatch	CityBus - Transit Vehicles	Existing
CityBus - Transit Vehicles	Traveler Card	Existing
APTS05: Transit Security (existing)		
CityBus - Operations and Dispatch	CityBus - Transit Vehicles	Existing

Stakeholder Inventory	Stakeholder Inventory	Status
CityBus - Operations and Dispatch	INDOT - TMC, TO, and MCM	Phone/Trad Com
CityBus - Operations and Dispatch	Lafayette - PS and EM	Phone/Trad Com
CityBus - Operations and Dispatch	Purdue - PS and EM	Phone/Trad Com
CityBus - Operations and Dispatch	Radio Stations	Phone/Trad Com
CityBus - Operations and Dispatch	TV Stations	Phone/Trad Com
APTS06: Transit Fleet Maintenance (existing)		
CityBus - Operations and Dispatch	CityBus - Transit Vehicles	Existing
APTS08: Transit Traveler Information (existing)		
CityBus - Operations and Dispatch	CityBus - Transit Vehicles	Existing
CityBus - Operations and Dispatch	CityBus - Transit Information Displays	Existing
CityBus - Operations and Dispatch	Radio Stations	Phone/Trad Com
CityBus - Operations and Dispatch	TV Stations	Phone/Trad Com
CityBus - Operations and Dispatch	User Personal Computing Devices	Existing
APTS10: Transit Passenger Counting (existing)		
CityBus - Operations and Dispatch	CityBus - Transit Vehicles	Existing
ATIS1: Broadcast Traveler Information (planned)		
CityBus - Operations and Dispatch	INDOT - TMC, TO, and MCM	Planned
CityBus - Operations and Dispatch	Lafayette - Engr and MCO	Phone/Trad Com
CityBus - Operations and Dispatch	Lafayette - PS and EM	Existing
CityBus - Operations and Dispatch	Purdue - Facilities and Grounds	Phone/Trad Com
CityBus - Operations and Dispatch	Purdue - PS and EM	Phone/Trad Com
CityBus - Operations and Dispatch	Radio Stations	Phone/Trad Com
CityBus - Operations and Dispatch	Tippecanoe Co - MCM	Phone/Trad Com
CityBus - Operations and Dispatch	Tippecanoe Co - PS and EM	Phone/Trad Com
CityBus - Operations and Dispatch	TV Stations	Phone/Trad Com
CityBus - Operations and Dispatch	West Lafayette - TMC and MCM	Phone/Trad Com
INDOT - 511 Traveler Information	INDOT - TMC, TO, and MCM	Planned
INDOT - 511 Traveler Information	Lafayette - PS and EM	Planned
INDOT - 511 Traveler Information	Purdue - PS and EM	Planned
INDOT - 511 Traveler Information	Radio Stations	Phone/Trad Com
INDOT - 511 Traveler Information	Small Municipality - PS and EM	Planned
INDOT - 511 Traveler Information	State Police - PS and EM	Planned
INDOT - 511 Traveler Information	Tippecanoe Co - PS and EM	Planned
INDOT - 511 Traveler Information	TV Stations	Phone/Trad Com
INDOT - 511 Traveler Information	Weather Services	Planned
INDOT - 511 Traveler Information	West Lafayette - PS and EM	Planned
INDOT- Roadside Equipment	INDOT - TMC, TO, and MCM	Planned
INDOT - TMC, TO, and MCM	Lafayette - Engr and MCO	Phone/Trad Com
INDOT - TMC, TO, and MCM	Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	Purdue - Facilities and Grounds	Phone/Trad Com
INDOT - TMC, TO, and MCM	Purdue - PS and EM	Planned
INDOT - TMC, TO, and MCM	Radio Stations	Phone/Trad Com
INDOT - TMC, TO, and MCM	Small Municipality - PS and EM	Planned
INDOT - TMC, TO, and MCM	State Police - PS and EM	Planned
INDOT - TMC, TO, and MCM	Tippecanoe Co - MCM	Phone/Trad Com
INDOT - TMC, TO, and MCM	Tippecanoe Co - PS and EM	Planned
INDOT - TMC, TO, and MCM	TV Stations	Phone/Trad Com
INDOT - TMC, TO, and MCM	Weather Services	Existing
INDOT - TMC, TO, and MCM	West Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	West Lafayette - TMC and MCM	Phone/Trad Com
ATMS01: Network Surveillance (planned)		
INDOT - 511 Traveler Information	INDOT - TMC, TO, and MCM	Planned
INDOT - Roadside Equipment	INDOT - TMC, TO, and MCM	Existing

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Stakeholder Inventory	Stakeholder Inventory	Status
INDOT - Roadside Equipment	Lafayette - Roadside Equipment	Planned
INDOT - Roadside Equipment	Lafayette - TMC and MCM	Planned
INDOT - Roadside Equipment	Traffic,Traveler,Driver,Vehicle	Planned
INDOT - Roadside Equipment	West Lafayette - Roadside Equipment	Existing
INDOT - Roadside Equipment	West Lafayette - TMC and MCM	Planned
INDOT - TMC, TO, and MCM	Lafayette - TMC and MCM	Phone/Trad Com
INDOT - TMC, TO, and MCM	West Lafayette - TMC and MCM	Planned
Lafayette - Roadside Equipment	Lafayette - TMC and MCM	Existing
Lafayette - Roadside Equipment	Traffic,Traveler,Driver,Vehicle	Planned
Lafayette - Roadside Equipment	West Lafayette - Roadside Equipment	Planned
Lafayette - Roadside Equipment	West Lafayette - TMC and MCM	Planned
Lafayette - TMC and MCM	West Lafayette - Roadside Equipment	Planned
Traffic,Traveler,Driver,Vehicle	West Lafayette - Roadside Equipment	Planned
West Lafayette - Roadside Equipment	West Lafayette - TMC and MCM	Planned
ATMS03: Surface Street Control (existing)		
INDOT - Roadside Equipment	INDOT - TMC, TO, and MCM	Existing
INDOT - Roadside Equipment	Lafayette - Roadside Equipment	Planned
INDOT - Roadside Equipment	Lafayette - TMC and MCM	Planned
INDOT - Roadside Equipment	Pedestrian	Existing
INDOT - Roadside Equipment	Traffic,Traveler,Driver,Vehicle	Planned
INDOT - Roadside Equipment	West Lafayette - Roadside Equipment	Existing
INDOT - Roadside Equipment	West Lafayette - TMC and MCM	Planned
INDOT - TMC, TO, and MCM	Lafayette - TMC and MCM	Phone/Trad Com
INDOT - TMC, TO, and MCM	West Lafayette - TMC and MCM	Planned
Lafayette - Roadside Equipment	Lafayette - TMC and MCM	Existing
Lafayette - Roadside Equipment	Pedestrian	Existing
Lafayette - Roadside Equipment	Traffic,Traveler,Driver,Vehicle	Planned
Lafayette - Roadside Equipment	West Lafayette - Roadside Equipment	Planned
Lafayette - Roadside Equipment	West Lafayette - TMC and MCM	Planned
Lafayette - TMC and MCM	West Lafayette - Roadside Equipment	Planned
Pedestrian	West Lafayette - Roadside Equipment	Existing
Traffic,Traveler,Driver,Vehicle	West Lafayette - Roadside Equipment	Planned
West Lafayette - Roadside Equipment	West Lafayette - TMC and MCM	Planned
ATMS06: Traffic Information Dissemination (existing)		
CityBus - Operations Center and Dispatch	INDOT - TMC, TO, and MCM	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Lafayette - TMC and MCM	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Lafayette - PS and EM	Existing
CityBus - Operations Center and Dispatch	Purdue - Facilities and Grounds	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Tippecanoe Co - MCM	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Tippecanoe Co - PS and EM	Existing
CityBus - Operations Center and Dispatch	West Lafayette - TMC and MCM	Phone/ Trad Com
INDOT - 511 Traveler Information	INDOT - TMC, TO, and MCM	Planned
INDOT - Roadside Equipment	INDOT - TMC, TO, and MCM	Existing
INDOT - TMC, TO, and MCM	Purdue - PS and EM	Planned
INDOT - TMC, TO, and MCM	Radio Stations	Phone/ Trad Com
INDOT - TMC, TO, and MCM	Small Municipality - PS and EM	Existing
INDOT - TMC, TO, and MCM	State Police - PS and EM	Planned
INDOT - TMC, TO, and MCM	Tippecanoe Co - MCM	Phone/ Trad Com
INDOT - TMC, TO, and MCM	Tippecanoe Co - PS and EM	Planned
INDOT - TMC, TO, and MCM	TV Stations	Phone/ Trad Com
INDOT - TMC, TO, and MCM	West Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	West Lafayette - TMC and MCM	Planned
Lafayette - TMC and MCM	Radio Stations	Phone/ Trad Com

Stakeholder Inventory	Stakeholder Inventory	Status
Lafayette - TMC and MCM	State Police - PS and EM	Phone/ Trad Com
Lafayette - TMC and MCM	Tippecanoe Co - MCM	Phone/ Trad Com
Lafayette - TMC and MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Lafayette - TMC and MCM	TV Stations	Phone/ Trad Com
Lafayette - PS and EM	Lafayette - Roadside Equipment	Phone/ Trad Com
Lafayette - PS and EM	Radio Stations	Phone/ Trad Com
Lafayette - PS and EM	Small Municipality - PS and EM	Existing
Lafayette - PS and EM	State Police - PS and EM	Existing
Lafayette - PS and EM	Tippecanoe Co - PS and EM	Existing
Lafayette - PS and EM	TV Stations	Phone/ Trad Com
Lafayette - PS and EM	West Lafayette - PS and EM	Existing
Purdue - Facilities and Grounds	Radio Stations	Phone/ Trad Com
Purdue - Facilities and Grounds	State Police - PS and EM	Phone/ Trad Com
Purdue - Facilities and Grounds	Tippecanoe Co - MCM	Phone/ Trad Com
Purdue - Facilities and Grounds	Tippecanoe Co - PS and EM	Phone/ Trad Com
Purdue - Facilities and Grounds	TV Stations	Phone/ Trad Com
Purdue - Facilities and Grounds	West Lafayette - TMC and MCM	Phone/ Trad Com
Purdue - PS and EM	State Police - PS and EM	Existing
Purdue - PS and EM	Tippecanoe Co - PS and EM	Existing
Radio Stations	State Police - PS and EM	Phone/ Trad Com
Radio Stations	Tippecanoe Co - MCM	Phone/ Trad Com
Radio Stations	Tippecanoe Co - PS and EM	Phone/ Trad Com
Radio Stations	West Lafayette - TMC and MCM	Phone/ Trad Com
Small Municipality - PS and EM	State Police - PS and EM	Existing
Small Municipality - PS and EM	Tippecanoe Co - PS and EM	Existing
State Police - PS and EM	Tippecanoe Co - MCM	Phone/ Trad Com
State Police - PS and EM	Tippecanoe Co - PS and EM	Existing
State Police - PS and EM	TV Stations	Phone/ Trad Com
State Police - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
Tippecanoe Co - MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Tippecanoe Co - MCM	TV Stations	Phone/ Trad Com
Tippecanoe Co - MCM	West Lafayette - TMC and MCM	Phone/ Trad Com
Tippecanoe Co - PS and EM	Tippecanoe Co - Roadside Equipment	Phone/ Trad Com
Tippecanoe Co - PS and EM	TV Stations	Phone/ Trad Com
Tippecanoe Co - PS and EM	West Lafayette - PS and EM	Existing
Tippecanoe Co - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
TV Stations	West Lafayette - TMC and MCM	Phone/ Trad Com
ATMS08: Traffic Incident Management System (planned)		
CityBus - Operations Center and Dispatch	INDOT - TMC, TO, and MCM	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Lafayette - TMC and MCM	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Lafayette - PS and EM	Existing
CityBus - Operations Center and Dispatch	Purdue - Facilities and Grounds	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Purdue - PS and EM	Existing
CityBus - Operations Center and Dispatch	Tippecanoe Co - PS and EM	Existing
CityBus - Operations Center and Dispatch	West Lafayette - TMC and MCM	Phone/ Trad Com
INDOT - 511 Traveler Information	INDOT - TMC, TO, and MCM	Planned
INDOT - Roadside Equipment	INDOT - TMC, TO, and MCM	Existing
INDOT - TMC, TO, and MCM	Lafayette - TMC and MCM	Phone/ Trad Com
INDOT - TMC, TO, and MCM	Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	Purdue - Facilities and Grounds	Phone/ Trad Com
INDOT - TMC, TO, and MCM	Purdue - PS and EM	Planned
INDOT - TMC, TO, and MCM	Radio Stations	Phone/ Trad Com

Stakeholder Inventory	Stakeholder Inventory	Status
INDOT - TMC, TO, and MCM	Small Municipality - PS and EM	Existing
INDOT - TMC, TO, and MCM	State Police - PS and EM	Planned
INDOT - TMC, TO, and MCM	Tippecanoe Co - MCM	Phone/ Trad Com
INDOT - TMC, TO, and MCM	Tippecanoe Co - PS and EM	Planned
INDOT - TMC, TO, and MCM	TV Stations	Phone/ Trad Com
INDOT - TMC, TO, and MCM	West Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	West Lafayette - TMC and MCM	Planned
Lafayette - Emergency Vehicles	Lafayette - PS and EM	Existing
Lafayette - Emergency Vehicles	Purdue - PS and EM	Existing
Lafayette - Emergency Vehicles	Small Municipality - PS and EM	Existing
Lafayette - Emergency Vehicles	State Police - PS and EM	Existing
Lafayette - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Lafayette - Emergency Vehicles	West Lafayette - PS and EM	Existing
Lafayette - TMC and MCM	Radio Stations	Phone/ Trad Com
Lafayette - TMC and MCM	State Police - PS and EM	Phone/ Trad Com
Lafayette - TMC and MCM	Tippecanoe Co - MCM	Phone/ Trad Com
Lafayette - TMC and MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Lafayette - TMC and MCM	TV Stations	Phone/ Trad Com
Lafayette - TMC and MCM	West Lafayette - TMC and MCM	Phone/ Trad Com
Lafayette - PS and EM	Purdue - Emergency Vehicles	Existing
Lafayette - PS and EM	Radio Stations	Phone/ Trad Com
Lafayette - PS and EM	Rail - Operations Control Centers	Existing
Lafayette - PS and EM	Small Municipality - Emergency Vehicles	Existing
Lafayette - PS and EM	Small Municipality - PS and EM	Existing
Lafayette - PS and EM	State Police - PS and EM	Existing
Lafayette - PS and EM	State Police - Vehicles	Existing
Lafayette - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
Lafayette - PS and EM	Tippecanoe Co - PS and EM	Existing
Lafayette - PS and EM	TV Stations	Phone/ Trad Com
Lafayette - PS and EM	West Lafayette - Emergency Vehicles	Existing
Lafayette - PS and EM	West Lafayette - PS and EM	Existing
Purdue - Emergency Vehicles	Purdue - PS and EM	Existing
Purdue - Emergency Vehicles	Small Municipality - PS and EM	Existing
Purdue - Emergency Vehicles	State Police - PS and EM	Existing
Purdue - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Purdue - Emergency Vehicles	West Lafayette - PS and EM	Existing
Purdue - Facilities and Grounds	Radio Stations	Phone/ Trad Com
Purdue - Facilities and Grounds	State Police - PS and EM	Phone/ Trad Com
Purdue - Facilities and Grounds	Tippecanoe Co - MCM	Phone/ Trad Com
Purdue - Facilities and Grounds	Tippecanoe Co - PS and EM	Phone/ Trad Com
Purdue - Facilities and Grounds	TV Stations	Phone/ Trad Com
Purdue - Facilities and Grounds	West Lafayette - TMC and MCM	Phone/ Trad Com
Purdue - PS and EM	Radio Stations	Phone/ Trad Com
Purdue - PS and EM	Rail - Operations Control Centers	Existing
Purdue - PS and EM	Small Municipality - Emergency Vehicles	Existing
Purdue - PS and EM	Small Municipality - PS and EM	Existing
Purdue - PS and EM	State Police - PS and EM	Existing
Purdue - PS and EM	State Police - Vehicles	Existing
Purdue - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
Purdue - PS and EM	Tippecanoe Co - PS and EM	Existing
Purdue - PS and EM	TV Stations	Phone/ Trad Com
Purdue - PS and EM	West Lafayette - Emergency Vehicles	Existing
Purdue - PS and EM	West Lafayette - PS and EM	Existing

Stakeholder Inventory	Stakeholder Inventory	Status
Radio Stations	Small Municipality - PS and EM	Phone/ Trad Com
Radio Stations	State Police - PS and EM	Phone/ Trad Com
Radio Stations	Tippecanoe Co - MCM	Phone/ Trad Com
Radio Stations	Tippecanoe Co - PS and EM	Phone/ Trad Com
Radio Stations	West Lafayette - PS and EM	Phone/ Trad Com
Radio Stations	West Lafayette - TMC and MCM	Phone/ Trad Com
Rail - Operations Control Centers	Small Municipality - PS and EM	Existing
Rail - Operations Control Centers	State Police - PS and EM	Existing
Rail - Operations Control Centers	Tippecanoe Co - PS and EM	Existing
Rail - Operations Control Centers	West Lafayette - PS and EM	Existing
Small Municipality - Emergency Vehicles	Small Municipality - PS and EM	Existing
Small Municipality - Emergency Vehicles	State Police - PS and EM	Existing
Small Municipality - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Small Municipality - Emergency Vehicles	West Lafayette - PS and EM	Existing
Small Municipality - PS and EM	State Police - PS and EM	Existing
Small Municipality - PS and EM	State Police - Vehicles	Existing
Small Municipality - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
Small Municipality - PS and EM	Tippecanoe Co - PS and EM	Existing
Small Municipality - PS and EM	TV Stations	Phone/ Trad Com
Small Municipality - PS and EM	West Lafayette - Emergency Vehicles	Existing
Small Municipality - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	State Police - Vehicles	Existing
State Police - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
State Police - PS and EM	Tippecanoe Co - MCM	Phone/ Trad Com
State Police - PS and EM	Tippecanoe Co - PS and EM	Existing
State Police - PS and EM	TV Stations	Phone/ Trad Com
State Police - PS and EM	West Lafayette - Emergency Vehicles	Existing
State Police - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
State Police - Vehicles	Tippecanoe Co - PS and EM	Existing
State Police - Vehicles	West Lafayette - PS and EM	Existing
Tippecanoe Co - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Tippecanoe Co - Emergency Vehicles	West Lafayette - PS and EM	Existing
Tippecanoe Co - MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Tippecanoe Co - MCM	TV Stations	Phone/ Trad Com
Tippecanoe Co - MCM	West Lafayette - TMC and MCM	Phone/ Trad Com
Tippecanoe Co - PS and EM	TV Stations	Phone/ Trad Com
Tippecanoe Co - PS and EM	West Lafayette - Emergency Vehicles	Existing
Tippecanoe Co - PS and EM	West Lafayette - PS and EM	Existing
Tippecanoe Co - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
TV Stations	West Lafayette - PS and EM	Phone/ Trad Com
TV Stations	West Lafayette - TMC and MCM	Phone/ Trad Com
West Lafayette - Emergency Vehicles	West Lafayette - PS and EM	Existing
ATMS13: Standard Railroad Grade Crossing (existing)		
INDOT - Roadside Equipment	Rail - Wayside Equipment	Existing
ATMS19: Speed Monitoring (existing)		
INDOT - Roadside Equipment	INDOT - TMC, TO, and MCM	Existing
INDOT - Roadside Equipment	Traveler	Planned
Lafayette - Roadside Equipment	Traveler	Existing
EM01: Emergency Call-Taking and Dispatch (existing)		
CityBus - Operations Center and Dispatch	Lafayette - PS and EM	Existing
CityBus - Operations Center and Dispatch	Purdue - PS and EM	Existing
CityBus - Operations Center and Dispatch	Tippecanoe Co - PS and EM	Existing

Stakeholder Inventory	Stakeholder Inventory	Status
INDOT - TMC, TO, and MCM	Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	Purdue - PS and EM	Planned
INDOT - TMC, TO, and MCM	Small Municipality - PS and EM	Existing
INDOT - TMC, TO, and MCM	State Police - PS and EM	Planned
INDOT - TMC, TO, and MCM	Tippecanoe Co - PS and EM	Planned
INDOT - TMC, TO, and MCM	West Lafayette - PS and EM	Planned
Lafayette - Emergency Vehicles	Lafayette - PS and EM	Existing
Lafayette - Emergency Vehicles	Purdue - PS and EM	Existing
Lafayette - Emergency Vehicles	Small Municipality - PS and EM	Existing
Lafayette - Emergency Vehicles	State Police - PS and EM	Existing
Lafayette - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Lafayette - Emergency Vehicles	West Lafayette - PS and EM	Existing
Lafayette - PS and EM	Purdue - Emergency Vehicles	Existing
Lafayette - PS and EM	Small Municipality - Emergency Vehicles	Existing
Lafayette - PS and EM	Small Municipality - PS and EM	Existing
Lafayette - PS and EM	State Police - PS and EM	Existing
Lafayette - PS and EM	State Police - Vehicles	Existing
Lafayette - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
Lafayette - PS and EM	Tippecanoe Co - GIS	Existing
Lafayette - PS and EM	Tippecanoe Co - PS and EM	Existing
Lafayette - PS and EM	West Lafayette - Emergency Vehicles	Existing
Lafayette - PS and EM	West Lafayette - PS and EM	Existing
Purdue - Emergency Vehicles	Purdue - PS and EM	Existing
Purdue - Emergency Vehicles	Small Municipality - PS and EM	Existing
Purdue - Emergency Vehicles	State Police - PS and EM	Existing
Purdue - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Purdue - Emergency Vehicles	West Lafayette - PS and EM	Existing
Purdue - PS and EM	Small Municipality - Emergency Vehicles	Existing
Purdue - PS and EM	Small Municipality - PS and EM	Existing
Purdue - PS and EM	State Police - PS and EM	Existing
Purdue - PS and EM	State Police - Vehicles	Existing
Purdue - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
Purdue - PS and EM	Tippecanoe Co - GIS	Existing
Purdue - PS and EM	Tippecanoe Co - PS and EM	Existing
Purdue - PS and EM	West Lafayette - Emergency Vehicles	Existing
Purdue - PS and EM	West Lafayette - PS and EM	Existing
Small Municipality - Emergency Vehicles	Small Municipality - PS and EM	Existing
Small Municipality - Emergency Vehicles	State Police - PS and EM	Existing
Small Municipality - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Small Municipality - Emergency Vehicles	West Lafayette - PS and EM	Existing
Small Municipality - PS and EM	State Police - PS and EM	Existing
Small Municipality - PS and EM	State Police - Vehicles	Existing
Small Municipality - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
Small Municipality - PS and EM	Tippecanoe Co - PS and EM	Existing
Small Municipality - PS and EM	West Lafayette - Emergency Vehicles	Existing
Small Municipality - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	State Police - Vehicles	Existing
State Police - PS and EM	Tippecanoe Co - Emergency Vehicles	Existing
State Police - PS and EM	Tippecanoe Co - PS and EM	Existing
State Police - PS and EM	West Lafayette - Emergency Vehicles	Existing
State Police - PS and EM	West Lafayette - PS and EM	Existing
State Police - Vehicles	Tippecanoe Co - PS and EM	Existing
State Police - Vehicles	West Lafayette - PS and EM	Existing

Stakeholder Inventory	Stakeholder Inventory	Status
Tippecanoe Co - Emergency Vehicles	Tippecanoe Co - PS and EM	Existing
Tippecanoe Co - Emergency Vehicles	West Lafayette - PS and EM	Existing
Tippecanoe Co - GIS	Tippecanoe Co - PS and EM	Existing
Tippecanoe Co - GIS	West Lafayette - PS and EM	Existing
Tippecanoe Co - PS and EM	West Lafayette - Emergency Vehicles	Existing
Tippecanoe Co - PS and EM	West Lafayette - PS and EM	Existing
West Lafayette - Emergency Vehicles	West Lafayette - PS and EM	Existing
EM06: Wide-Area Alert (existing)		
CityBus - Operations Center and Dispatch	CityBus - Transit Vehicles	Existing
CityBus - Operations Center and Dispatch	INDOT - TMC, TO, and MCM	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Lafayette - PS and EM	Existing
CityBus - Operations Center and Dispatch	Purdue - PS and EM	Existing
CityBus - Operations Center and Dispatch	Tippecanoe Co - PS and EM	Existing
INDOT - 511 Traveler Information	INDOT - TMC, TO, and MCM	Planned
INDOT - Roadside Equipment	INDOT - TMC, TO, and MCM	Existing
INDOT - TMC, TO, and MCM	Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	Purdue - PS and EM	Planned
INDOT - TMC, TO, and MCM	Small Municipality - PS and EM	Existing
INDOT - TMC, TO, and MCM	State Police - PS and EM	Planned
INDOT - TMC, TO, and MCM	Tippecanoe Co - PS and EM	Planned
INDOT - TMC, TO, and MCM	West Lafayette - PS and EM	Planned
Lafayette - TMC and MCM	State Police - PS and EM	Phone/ Trad Com
Lafayette - TMC and MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Lafayette - PS and EM	Lafayette - Roadside Equipment	Phone/ Trad Com
Lafayette - PS and EM	Small Municipality - PS and EM	Existing
Lafayette - PS and EM	State Police - PS and EM	Existing
Lafayette - PS and EM	Tippecanoe Co - PS and EM	Existing
Lafayette - PS and EM	West Lafayette - PS and EM	Existing
Purdue - Facilities and Grounds	State Police - PS and EM	Phone/ Trad Com
Purdue - Facilities and Grounds	Tippecanoe Co - PS and EM	Phone/ Trad Com
Purdue - PS and EM	Small Municipality - PS and EM	Existing
Purdue - PS and EM	State Police - PS and EM	Existing
Purdue - PS and EM	Tippecanoe Co - PS and EM	Existing
Purdue - PS and EM	West Lafayette - PS and EM	Existing
Small Municipality - PS and EM	State Police - PS and EM	Existing
Small Municipality - PS and EM	Tippecanoe Co - PS and EM	Existing
Small Municipality - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	Weather Services	Existing
State Police - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
Tippecanoe Co - MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Tippecanoe Co - PS and EM	Tippecanoe Co - Roadside Equipment	Phone/ Trad Com
Tippecanoe Co - PS and EM	Weather Services	Existing
Tippecanoe Co - PS and EM	West Lafayette - PS and EM	Existing
Tippecanoe Co - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
EM07: Early Warning System (existing)		
CityBus - Operations Center and Dispatch	Lafayette - PS and EM	Existing
CityBus - Operations Center and Dispatch	Purdue - PS and EM	Existing
CityBus - Operations Center and Dispatch	Tippecanoe Co - PS and EM	Existing
INDOT - TMC, TO, and MCM	Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	Purdue - PS and EM	Planned
INDOT - TMC, TO, and MCM	Small Municipality - PS and EM	Existing
INDOT - TMC, TO, and MCM	State Police - PS and EM	Planned

Stakeholder Inventory	Stakeholder Inventory	Status
INDOT - TMC, TO, and MCM	Tippecanoe Co - PS and EM	Planned
INDOT - TMC, TO, and MCM	Weather Services	Existing
INDOT - TMC, TO, and MCM	West Lafayette - PS and EM	Planned
Lafayette - TMC and MCM	State Police - PS and EM	Phone/ Trad Com
Lafayette - TMC and MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Lafayette - PS and EM	Small Municipality - PS and EM	Existing
Lafayette - PS and EM	State Police - PS and EM	Existing
Lafayette - PS and EM	Tippecanoe Co - PS and EM	Existing
Lafayette - PS and EM	West Lafayette - PS and EM	Existing
Purdue - Facilities and Grounds	State Police - PS and EM	Phone/ Trad Com
Purdue - Facilities and Grounds	Tippecanoe Co - PS and EM	Phone/ Trad Com
Purdue - PS and EM	Small Municipality - PS and EM	Existing
Purdue - PS and EM	State Police - PS and EM	Existing
Purdue - PS and EM	Tippecanoe Co - PS and EM	Existing
Purdue - PS and EM	West Lafayette - PS and EM	Existing
Small Municipality - PS and EM	State Police - PS and EM	Existing
Small Municipality - PS and EM	Tippecanoe Co - PS and EM	Existing
Small Municipality - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	Tippecanoe Co - MCM	Phone/ Trad Com
State Police - PS and EM	Tippecanoe Co - PS and EM	Existing
State Police - PS and EM	Weather Services	Existing
State Police - PS and EM	West Lafayette - PS and EM	Existing
State Police - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
Tippecanoe Co - MCM	Tippecanoe Co - PS and EM	Phone/ Trad Com
Tippecanoe Co - PS and EM	Weather Services	Existing
Tippecanoe Co - PS and EM	West Lafayette - PS and EM	Existing
Tippecanoe Co - PS and EM	West Lafayette - TMC and MCM	Phone/ Trad Com
EM10: Disaster Traveler Information (planned)		
CityBus - Operations Center and Dispatch	INDOT - TMC, TO, and MCM	Phone/ Trad Com
CityBus - Operations Center and Dispatch	Lafayette - PS and EM	Existing
CityBus - Operations Center and Dispatch	Purdue - PS and EM	Existing
CityBus - Operations Center and Dispatch	Tippecanoe Co - PS and EM	Existing
INDOT - 511 Traveler Information	INDOT - TMC, TO, and MCM	Planned
INDOT - 511 Traveler Information	Weather Services	Planned
INDOT - TMC, TO, and MCM	Lafayette - PS and EM	Planned
INDOT - TMC, TO, and MCM	Purdue - PS and EM	Planned
INDOT - TMC, TO, and MCM	Regional Hospitals	Phone/ Trad Com
INDOT - TMC, TO, and MCM	Small Municipality - PS and EM	Existing
INDOT - TMC, TO, and MCM	State Police - PS and EM	Planned
INDOT - TMC, TO, and MCM	Tippecanoe Co - PS and EM	Planned
INDOT - TMC, TO, and MCM	Weather Services	Existing
INDOT - TMC, TO, and MCM	West Lafayette - PS and EM	Planned
Lafayette - PS and EM	Radio Stations	Phone/ Trad Com
Lafayette - PS and EM	TV Stations	Phone/ Trad Com
Purdue - PS and EM	Radio Stations	Phone/ Trad Com
Purdue - PS and EM	TV Stations	Phone/ Trad Com
Radio Stations	Small Municipality - PS and EM	Phone/ Trad Com
Radio Stations	State Police - PS and EM	Phone/ Trad Com
Radio Stations	Tippecanoe Co - PS and EM	Phone/ Trad Com
Radio Stations	West Lafayette - PS and EM	Phone/ Trad Com
Small Municipality - PS and EM	TV Stations	Phone/ Trad Com
State Police - PS and EM	TV Stations	Phone/ Trad Com
Tippecanoe Co - PS and EM	TV Stations	Phone/ Trad Com

Stakeholder Inventory	Stakeholder Inventory	Status
TV Stations	West Lafayette - PS and EM	Phone/ Trad Com

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10.0 ITS STANDARDS

ITS Standards are fundamental to the establishment of an open ITS environment, the goal originally envisioned by the DOT. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances and new approaches evolve. The National ITS Architecture is a reference framework that spans all of these ITS Standards activities and provides a means of detecting gaps, overlaps, and inconsistencies between the standards.

The following organizations participate in ITS Standards activities:
- AASHTO (American Association of State Highway and Transportation Officials)
- ANSI (American National Standards Institute)
- APTA (American Public Transportation Organization)
- ASTM (American Society for Testing and Materials)
- IEEE (Institute of Electrical and Electronics Engineers)
- ITE (Institute of Transportation Engineers)
- NEMA (National Electrical Manufacturers Association)
- SAE (Society of Automotive Engineers)

The Table 9 identifies the applicable ITS Standards for the Tippecanoe County RA based on Turbo Architecture v4.0.12 output for 'existing' and 'planned' ITS flows. Appendix C provides the Turbo Architecture "Standards-to-information flow" mapping. It should be noted that the development of ITS Standards is an ongoing process. Therefore, the set of applicable ITS Standards should be updated as new Standards are approved.

Table 9.   Tippecanoe County ITS RA Standards

Standards Development Organization	Standard Name	Document ID
AASHTO/ ITE	**Traffic Management Data Dictionary and Message Sets for External TMC Communication (TMDD and MS/ETMCC)**	**ITE TMDD 2.1**
AASHTO/ ITE/ NEMA	**NTCIP Center-to-Center Standards Group**	
	Octet Encoding Rules (OER) Base Protocol	NTCIP 1102
	Center-to-Center Naming Convention Specification	NTCIP 1104
	Ethernet Sub network Profile	NTCIP 2104
	Internet (TCP/IP and UDP/IP) Transport Profile	NTCIP 2202
	File Transfer Protocol (FTP) Application Profile	NTCIP 2303
	Application Profile for DATEX-ASN (AP-DATEX)	NTCIP 2304
	Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (C2C XML)	NTCIP 2306
	NTCIP Center-to-Field Standards Group	
	Octet Encoding Rules (OER) Base Protocol	NTCIP 1102
	Transportation Management Protocols (TMP)	NTCIP 1103
	Point to Multi-Point Protocol Using RS-232 Sub network Profile	NTCIP 2101

Standards Development Organization	Standard Name	Document ID
	Point to Multi-Point Protocol Using FSK Modem Sub network Profile	NTCIP 2102
	Point-to-Point Protocol Over RS-232 Sub network Profile	NTCIP 2103
	Ethernet Sub network Profile	NTCIP 2104
	Transportation Transport Profile	NTCIP 2201
	Internet (TCP/IP and UDP/IP) Transport Profile	NTCIP 2202
	Simple Transportation Management Framework (STMF) Application Profile	NTCIP 2301
	Trivial File Transfer Protocol (TFTP) Application Profile	NTCIP 2302
	File Transfer Protocol (FTP) Application Profile	NTCIP 2303
	Global Object Definitions	**NTCIP 1201**
	Object Definitions for Actuated Traffic Signal Controller (ASC) Units	**NTCIP 1202**
	Object Definitions for Dynamic Message Signs (DMS)	**NTCIP 1203**
	Object Definitions for Environmental Sensor Stations (ESS)	**NTCIP 1204**
	Object Definitions for Closed Circuit Television (CCTV) Camera Control	**NTCIP 1205**
	Object Definitions for Data Collection and Monitoring (DCM) Devices	**NTCIP 1206**
	Object Definitions for Closed Circuit Television (CCTV) Switching	**NTCIP 1208**
	Data Element Definitions for Transportation Sensor Systems (TSS)	**NTCIP 1209**
	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters	**NTCIP 1210**
	Object Definitions for Signal Control and Prioritization (SCP)	**NTCIP 1211**
APTA	**Standard for Transit Communications Interface Profiles 3.0.0**	**APTA TCIP-S-001 3.0.0**
ASTM	**Standard Practice for Metadata to Support Archived Data Management Systems**	**ASTM E2468-05**
	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data	**ASTM WK7604**
IEEE	**Incident Management Standards Group**	
	Standard for Common Incident Management Message Sets for Use by Emergency Management Centers	IEEE 1512 -2006
	Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers	IEEE 1512.1-2006
	Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers	IEEE 1512.2-2004
	Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers	IEEE 1512.3-2006
	Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers	IEEE P1512.4
	Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection	**IEEE 1570-2002**

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

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11.0 PROJECT SEQUENCE

This section briefly outlines a possible time frame for the deployment of selected ITS projects in Tippecanoe County. Market Packages are arranged into short, medium, and long-term deployment categories.

Table 10.   Tippecanoe County ITS RA Market Package Implementation Schedule

Market Packages	Time Frame*
AD1 ITS Data Mart	Short-Medium-Long
AD2 ITS Data Warehouse	Short-Medium-Long
APTS01 Transit Vehicle Tracking	Short
APTS02 Transit Fixed-Route Operations	Short
APTS03 Demand Response Transit Operations	Short
APTS04 Transit Fare Collection Management	Short
APTS05 Transit Security	Short
APTS06 Transit Fleet Management	Short
APTS08 Transit Traveler Information	Short
APTS10 Transit Passenger Counting	Short
ATIS1 Broadcast Traveler Information	Medium-Long
ATMS01 Network Surveillance	Short-Medium-Long
ATMS03 Surface Street Control	Short-Medium-Long
ATMS06 Traffic Information Dissemination	Short-Medium-Long
ATMS08 Traffic Incident Management	Medium-Long
ATMS13 Standard Railroad Grade Crossing	Short
ATMS19 Speed Monitoring	Short-Medium-Long
EM01 Emergency Call-Taking and Dispatch	Short-Medium-Long
EM06 Wide-Area Alert	Short-Medium-Long
EM07 Early Warning System	Short-Medium
EM10 Disaster Traveler Information	Short-Medium-Long
* Short – Implemented, planned, or highly likely with before 2011 **Medium – Planned or highly likely between 2011 and 2014** **Long – Planned or highly likely between 2015 and 2017**	

In addition to the general planning for ITS listed in Table 10, several ITS projects are currently planned, or are highly likely, to be implemented in Tippecanoe County over the next 10 years. Those projects are listed below:

Stakeholder: Lafayette, Purdue University, West Lafayette (Future), Area Plan Commission (Future)
Project: Advanced Traffic Management System and Traffic Signal Interconnections (Lafayette and with the future incorporation of West Lafayette)
Description: The City of Lafayette plans to interconnect traffic signals (Lafayette and INDOT signals) and manage signal timings through Advanced Traffic Management System software. This new traffic management center and software will allow Purdue University, the City, and the City's contractors the ability to coordinate signal timings on selected traffic corridors and modify signal timing patterns as needed. It is hoped that in the future, West Lafayette signals will be incorporated into the system and the Area Plan Commission will have access to all traffic volume data.

Stakeholder: INDOT
Project: Traffic Signal Interconnections (In General)
Description: INDOT plans further interconnection of traffic signals in Tippecanoe County. Specifically, INDOT plans to add signals on SR 26 and 550E into its interconnected system, and to interconnect with Lafayette signals in downtown Lafayette.

Stakeholder: INDOT
Project: Interstate Surveillance with accompanying TMC control and TrafficWise data Integration
Description: INDOT plans to install CCTV and speed sensor implementation at 12 locations along I-65 in Tippecanoe County around the year 2012. The Indianapolis TMC will be the primary TMC for this surveillance equipment. INDOT also plans to erect DMS boards on I-65 in Tippecanoe County near the northbound and southbound approaches to the exits at SR 38. Outside Tippecanoe County, DMSs will be placed 3 miles before the US 231 Intersection for NB traffic, and 2 miles south of Boone County line for southbound I-65 travelers.

Stakeholder: INDOT
Project: 511 Traveler Information Service
Description: Indiana Department of Transportation officials are studying whether a statewide travel-information system will be established. Besides travel times and weather conditions, information on public transportation, airport delays, tourism events and emergencies could be given. This project will be updated as time frames and locations become clear.

Stakeholders: Purdue, West Lafayette, and Tippecanoe County (including Ambulances)
Project: On-board emergency vehicles systems
Description: Several local emergency responders do not have the on-board computing systems or AVL systems that other county responders currently posses. It is envisioned that within the next 10 years all emergency vehicles will have these systems including, digital messaging with dispatch, incident mapping capabilities, and real-time vehicle tracking.

11.1 Architecture Maintenance

As more ITS projects are deployed or the area needs/services change, the Tippecanoe County RA must be updated to account for these changes. The Area Plan Commission of Tippecanoe County has been assigned the role of maintaining the RA. Updates will be conducted every five years corresponding to the long range plan update or upon the deployment of a major ITS project in the area.

The Technical Transportation Committee for the Greater Lafayette Area Transportation and Development Study is comprised of City and County staff, as well as other ITS Stakeholders. Their monthly meetings are an ideal place to remind agencies of the RA, and for the Committee to discuss updates and processes. Getting input from the Stakeholders guarantees that the Tippecanoe County RA continues to reflect the desires of the Stakeholders.