Northwestern Indiana

Regional Intelligent Transportation Systems (ITS) Architecture

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ITS Services, Market Packages, Interconnects and Information Flows

ADOPTED BY THE

NORTHWESTERN INDIANA REGIONAL PLANNING COMMISSION (NIRPC)

JULY 21, 2005

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NORTHWESTERN INDIANA
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RESOLUTION 05-21

A RESOLUTION OF THE NORTHWESTERN INDIANA REGIONAL PLANNING COMMISSION TO ADOPT THE REGIONAL INTELLIGENT TRANSPORTATION SYSTEMS (ITS) ARCHITECTURE

WHEREAS, the citizens of Northwest Indiana require a safe, efficient and effective regional transportation system that maintains and enhances regional mobility and contributes to improving the quality of life in Northwest Indiana; and

WHEREAS, the Northwestern Indiana Regional Planning Commission, hereafter referred to as the *Commission*, is the designated Metropolitan Planning Organization for Lake, Porter and LaPorte Counties and has carried out a region-wide, continuing, cooperative, and comprehensive transportation planning process; and

WHEREAS, The Northwestern Indiana Regional Planning Commission (NIRPC), in cooperation with the Indiana Department of Transportation (INDOT), initiated the development of the Northwestern Indiana Regional Intelligent Transportation System (ITS) Architecture in 2000; and

WHEREAS, Section 5205(e) of the Transportation Equity Act for the 21st Century (TEA-21) requires that all ITS projects funded through the Highway Trust Fund be in conformance with the National ITS Architecture and applicable standards; and

WHEREAS, Northwestern Indiana is a region that is currently implementing ITS projects and therefore, it must develop a Regional ITS Architecture to guide their deployment by 2005; and

WHEREAS, this Regional ITS Architecture would meet the federal guidelines, help to reduce congestion and improve safety through the use of electronic and communications technology, and to promote the sharing of data and information and minimize project duplication and stand-alone systems; and

NOW, THEREFORE BE IT RESOLVED that the Commission endorses and adopts the Regional Intelligent Transportation Systems (ITS) Architecture.

Duly adopted by the Northwestern Indiana Regional Planning Commission on the twenty-first day of July, 2005.

David F. Shafer, Chairperson

ATTEST:

Daniel M. Klein, Secretary

Northwestern Indiana Regional ITS Architecture Task Force Participants

2000-2005

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Executive Summary

What is "ITS"?

The phrase "Intelligent Transportation Systems (ITS) Regional Architecture" refers to a system (i.e. architecture) of electronic and communications (i.e. intelligent) technologies that is used to help manage and operate the highways and transit systems in the most efficient and safest way possible. This system of technologies gathers real-time information about the movement of people and goods on the existing transportation system and notes when the transportation system is not performing well. The information is then used to give feedback to the travelers and operators of the transportation system so they can be aware of hazardous conditions and available options for alternative routes.

The purpose for using ITS technologies and systems is to help make the highways and transit systems safer and more efficient for people, goods and vehicles. ITS technologies involve the integration of software and electronic hardware and the coordination of a number of agencies. The overhead message boards on expressways that inform drivers of current weather, traffic, accident or construction ahead and available alternative routes is just one familiar example of ITS technologies.

Overview and Timeframe

The Northwestern Indiana Regional Planning Commission (NIRPC), in cooperation with the Indiana Department of Transportation (INDOT), initiated the development of the Northwestern Indiana Regional Intelligent Transportation System (ITS) in 2000. The Northwestern Indiana Regional ITS Architecture effort has a 20-year planning horizon and is built on a strong ITS interest in the region and some signature ITS projects which have brought the need for a Regional ITS Architecture to the forefront.

INDOT is currently implementing the Borman Expressway (I-80/94) Advanced Traffic Management System (ATMS) and it is the region's signature and priority ITS project. This system will provide the capability of operating the Borman Expressway more effectively by using detection and surveillance technologies to enhance safety, reduce congestion and facilitate multi-agency coordination.

The Borman Expressway (I80/94) ATMS is also included in the Gary-Chicago-Milwaukee Corridor (GCMC) ITS Architecture. The GCMC is a National Priority Corridor, as defined by the TEA-21 (National Transportation Act) that traverses through the greater Chicago area that borders Lake Michigan and includes portions of three states, i.e. Indiana, Illinois and Wisconsin.

Goal

The goal of this effort is to develop a Regional ITS Architecture for the Northwestern Indiana Region in accordance with Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) policies. The FHWA Rule and FTA Policy require that a region that is currently implementing ITS projects must develop a Regional ITS Architecture plan to guide their deployment by April 8, 2005. Northwestern Indiana has already implemented ITS projects and thus is required to meet the requirements of this

rule and policy. The National ITS Architecture is used as a resource in developing the regional architecture. A Regional ITS Architecture should be on a scale commensurate with ITS investment in the region.

The Northwestern Indiana Regional ITS Architecture contains the following elements:

- Description of the region
- Participating agencies and stakeholders
- Operational Concept
- Identification of agreements
- High level system functional requirements
- Interface requirements and information exchanges
- Identification of ITS standards
- Sequence of projects

The Northwestern Indiana Regional ITS Architecture was developed to provide the basis for the ongoing planning of ITS integration in the region. A Regional ITS Task Force involving a number of regional stakeholders was created to develop the Northwestern Indiana Regional Architecture. Safety, emergency management, traffic, transit, and safety management agencies are represented on the Regional ITS Task Force.

A series of functional flow tables were developed by the Regional ITS Task Force. The tables are based on the National ITS Architecture and are tailored to illustrate exchange of data and functionality within the region. In addition, an inventory of all ITS-related projects in the region resulted from the committee meetings, indicating the responsible agency and whether the projects are to be completed in the short term (within 3 years) or long term (over 3 years).

Concept of Operations

The Northwestern Indiana Regional ITS Task Force developed a concept of operations that would address the region's requirements for ITS integration and project development. The concept outlines the critical operational or functional needs and provides a narrative and tables explaining how ITS operations in the region will function with respect to data collection, processing, and dissemination.

The Northwestern Indiana ITS Architecture will provide the following user services or functional capabilities:

- Integration with the Gary-Chicago-Milwaukee Corridor ITS Architecture
- Archived Data Management
- Transit Management
- Traveler Information
- Traffic Management
- Commercial Vehicle Administration
- Emergency Management
- Maintenance and Construction Management

As projects identified within the Northwestern Indiana Regional ITS Architecture become ready for implementation, various types of agreements will be required among

stakeholder agencies. These agreements are necessary to establish the roles and responsibilities of each agency for a particular project. Agreements will solidify the substantial efforts that the Northwestern Indiana regional stakeholders have invested towards developing ITS project plans.

Five northern Indiana counties, including the three counties in the Northwestern Indiana Region, i.e. Lake, Porter and LaPorte, recently concluded an agreement to share emergency management services and technology in the event of a regional emergency, including one that relates to a Homeland Security emergency such as terrorism.

Architecture Maintenance

The Northwestern Indiana Regional ITS Architecture and the associated Turbo Architecture files will be maintained on a regular basis, in conjunction with the update to the Regional Transportation Plan. Establishing a maintenance plan allows for critical updates to be made as planned projects progress and new projects and/or stakeholders are added in the process.

Project Sequencing

ITS projects by their very nature depend on and provide information and infrastructure to other ITS projects in any region. Therefore, it is critical that the sequencing of project development is addressed as part of the Northwestern Indiana ITS Architecture effort. Continued coordination among the Northwestern Indiana agencies will ensure a successful regional ITS program.

Turbo Architecture

NIRPC developed the Regional ITS Architecture database, utilizing the Turbo Architecture Version 2.0 software. This software, developed by FHWA to assist regions in developing Regional ITS Architectures, will allow Northwestern Indiana to easily maintain the project in the future and update progress as projects are built.

ITS Standards

ITS Standards are documented to insure the applied technologies of ITS projects in the region are integrated in the most efficient means possible. ITS Standards are guidelines or rules specifying the interconnections among elements and the characteristics of technologies and projects to be used in ITS installations. As standards are continuously being added to the National ITS Architecture, regular updates to the Northwestern Indiana Regional ITS Architecture applicable standards will be required.

Acronym List

AD	Archived Data Management
APC	Automated Passenger Counters
APTS	Advanced Public Transportation System
AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
CAD	Computer Aided Dispatch
CATS	Chicago Area Transportation Study
CCTV	Closed Circuit Television
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Signs
ECPT	East Chicago Public Transit
EDP	Early Deployment Plan
EM	Emergency Management
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GCMC	Gary-Chicago-Milwaukee Corridor
GPTC	Gary Public Transportation Corporation
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HRI	Highway-Rail Intersection
HTS	Hammond Transit System
INDOT	Indiana Department of Transportation
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
MCO	Maintenance and Construction Operations
MDC	Mobile Data Communication
MPO	Metropolitan Planning Organization
NEMA	National Electrical Manufacturers Association
NICA, Inc	Northwestern Indiana Community Action Corp
NICTD	Northern Indiana Commuter Transportation District
NIRPC	Northwestern Indiana Regional Planning Commission
NTCIP	National Transportation Communications for ITS Protocol
PSAP	Public Service Answering Point
TEA-21	Transportation Equity Act for the 21st Century
USDOT	United States Department of Transportation

1.0 Introduction

The Northwestern Indiana Regional Planning Commission (NIRPC), in cooperation with the Indiana Department of Transportation (INDOT), initiated the development of the Northwestern Indiana Regional Intelligent Transportation System (ITS) Architecture in 2000. The Northwestern Indiana Regional ITS Architecture effort is built on a strong ITS interest in the region and some recent major local ITS projects which have brought the need for a Regional ITS Architecture to the forefront. This Architecture would meet the federal guidelines, help to reduce congestion and improve safety through the use of electronic and communications technology, and to promote the sharing of data and information and minimize project duplication and stand-alone systems

1.1 Goal

The goal of this effort is to develop a Regional ITS Architecture for the Northwestern Indiana Region in accordance with Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) policies.

Section 5205(e) of the Transportation Equity Act for the 21st Century (TEA-21) requires that all ITS projects funded through the Highway Trust Fund be in conformance with the National ITS Architecture and applicable standards. The National ITS Architecture is a common framework for ITS interoperability based on a set of user services and defines functions and information exchanges. The National ITS Architecture is maintained by USDOT. Section 2 provides an overview of the National ITS Architecture and describes the background and framework for the Northwestern Indiana Regional ITS Architecture.

On January 8, 2001, the FHWA issued an ITS Architecture and Standards regulation and the FTA issued a parallel policy and they became effective on April 8, 2001. The policy and rule states: “ITS projects shall conform to the National ITS Architecture and standards in accordance with the requirements contained in the rule. Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a Regional ITS Architecture.”

The FHWA Rule and FTA Policy together require that a region that is currently implementing ITS projects must develop a Regional ITS Architecture to guide their deployment by April 8, 2005. The National ITS Architecture is used as a resource in developing the regional architecture. A Regional ITS Architecture should be on a scale commensurate with ITS investment in the region.

Based on this guidance, the Northwestern Indiana Regional ITS Architecture contains:

- Description of the Region
- Identification of the participating agencies and stakeholders
- An operational concept that identifies goals and objectives of the system and the roles and responsibilities of stakeholders
- Any agreements required for operations
- System functional requirement (high level) to address the needs of the region
- Interface requirements and information exchanges with planned and existing systems and subsystems

The Northwestern Indiana Regional ITS Architecture provides the basis for the ongoing planning of ITS integration in the region.

1.2 Approach

A regional ITS Task Force of stakeholders from the region was formed in 2000 to develop the regional ITS Architecture. The planning horizon for this architecture is 20 years. A detailed listing of participating stakeholders can be found in Section 3.

The task force met a number of times over two years to select the ITS elements to be deployed in the region and to develop information flow tables to illustrate the exchange of data and functionality. The functional flow concepts are explained in Section 5 and the functional flow tables are found in the Appendix to this report.

NIRPC developed the Regional ITS Architecture database, utilizing the Turbo Architecture Version 2.0 software, from the functional flow tables created by the regional stakeholders. The regional ITS data from the Turbo Architecture was submitted to the Indiana Division of the Federal Highway Administration (FHWA).

2.0 National ITS Architecture Overview

TEA-21 requires that ITS projects using Federal funds conform to Regional ITS Architectures developed from the National ITS Architecture. The National ITS Architecture is a tool to help identify and plan for system functionality, information sharing and component interoperability. A Regional ITS Architecture guides stakeholders in integrating various project systems and components. This section explains the essential terminology and concepts needed to understand the National ITS Architecture and illustrates how regional ITS Architectures fit into the National ITS Architecture framework. In order for ITS projects in Northwestern Indiana to move forward in the programming process, a Regional ITS Architecture must be developed. The following concepts and terms are explained in this section:

- User Services and User Service Requirements
- Logical Architecture
- Physical Architecture

2.1 User Services and User Service Requirements

User services define what the benefits of ITS should be from the user's perspective. The concept of user services captures the problems, issues, objectives and needs to be addressed by deploying ITS. An example would be the region's desire to coordinate information among agencies during freeway incidents. In many ways, the stakeholder input obtained for the Borman Expressway (I-80/94) ATMS project capture what the National ITS Architecture would call user services or needs to be addressed by the system.

Currently, there are 33 user services defined by the National ITS Architecture. These user services were logically grouped into eight bundles: Travel and Traffic Management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle Safety Systems, Information Management and Maintenance and Construction Management. Each user service contains a series of user service requirements. User service requirements are specific functional statements of what must be done to support the ITS User Services.

2.2 Logical Architecture

A logical architecture is a technology-independent view of the final architecture. It shows the data and information processing that is required to satisfy all of the user services and highlights the data flows that should be supported between processes to ensure that the whole system works as a single unit.

The logical architecture, although not directly used in developing the Regional ITS Architecture, is the foundation upon which all the more concrete or physical aspects of the National ITS Architecture are based. The Logical Architecture specifies the most efficient grouping of processes. This assists in organizing the functional processes and data flows of a system and is a valuable step towards the definition of a physical architecture.

The logical architecture helps to identify the system functions and information flows and guide development of functional requirements to meet specific user service requirements. The logical architecture is independent of institutions and technology, but can provide an excellent starting point for the definition and description of optimum institutional/organizational arrangements to support the technical aspects of the ITS.

The logical architecture of the National ITS Architecture defines a set of processes and data flows that respond to the user services. Processes and data flows are grouped to form particular transportation management functions, which break down into several levels of detail. At the lowest level of detail are the process specifications. These process specifications can be thought of as the elemental functions to be performed in order to satisfy the user service requirements.

2.3 Physical Architecture

The physical architecture builds on the logical architecture by adding real world systems and operations. The physical architecture identifies the desired communications and interactions (interfaces) between different transportation management organizations, i.e. between the planned Borman ATMS and the regional Public Service Answering Points (PSAP) centers. This provides agencies with a physical representation (though not a detailed design) of how the system should provide the required functionality (processes) identified in the logical architecture. This is the level at which the Northwestern Indiana Regional ITS Architecture is developed. Using the National ITS Architecture physical architecture framework as a guide, the Task Force mapped out the connections that are current and planned for the region.

The Physical architecture of the National ITS Architecture is defined with architecture entities (subsystems and terminators), functional flow tables, equipment packages, architecture flows and data flows.

- Architecture Entities

  These are the subsystems and terminators of the National ITS Architecture. The subsystems are the principle structural element of the physical architecture, which correspond to existing things in the physical world, such as traffic operations centers, automobiles and roadside signal controllers.

  Examples of subsystems in the Northwestern Indiana Regional ITS Architecture include: the Borman ATMS, PSAP centers, local traffic control systems, and INDOT District systems.

  The terminators define the boundary of the National ITS Architecture, or of the regional or project architecture. The terminators represent the people, systems and general environment that interface with ITS, but no functional requirements are allocated to terminators as no design control is assumed.

- Functional Flow Tables

  Functional flow tables identify the system components required for the delivery of user services. They are groupings of technologies that when implemented perform a measurable service or tangible benefit.

  An example of a functional flow table for the Northwestern Indiana ITS Architecture is how the region would use surveillance on the freeways for enhanced traffic and incident management. The functional flow tables also define the information flows between the different subsystems and terminators. These information flows are a collection of data flows and are referred to as architecture flows.

- Equipment Packages

  Equipment packages are the basic elements of functional flow tables. Examples of an equipment package for the Northwestern Indiana Regional ITS Architecture include the roadway equipment to be deployed by INDOT such as CCTV and DMS. Equipment Packages could be considered the building blocks of the ITS architecture from an engineering perspective as they support the definition of projects and the detailed design of the implementations required to deploy the entire architecture.

- Architecture Flows/Data Flows

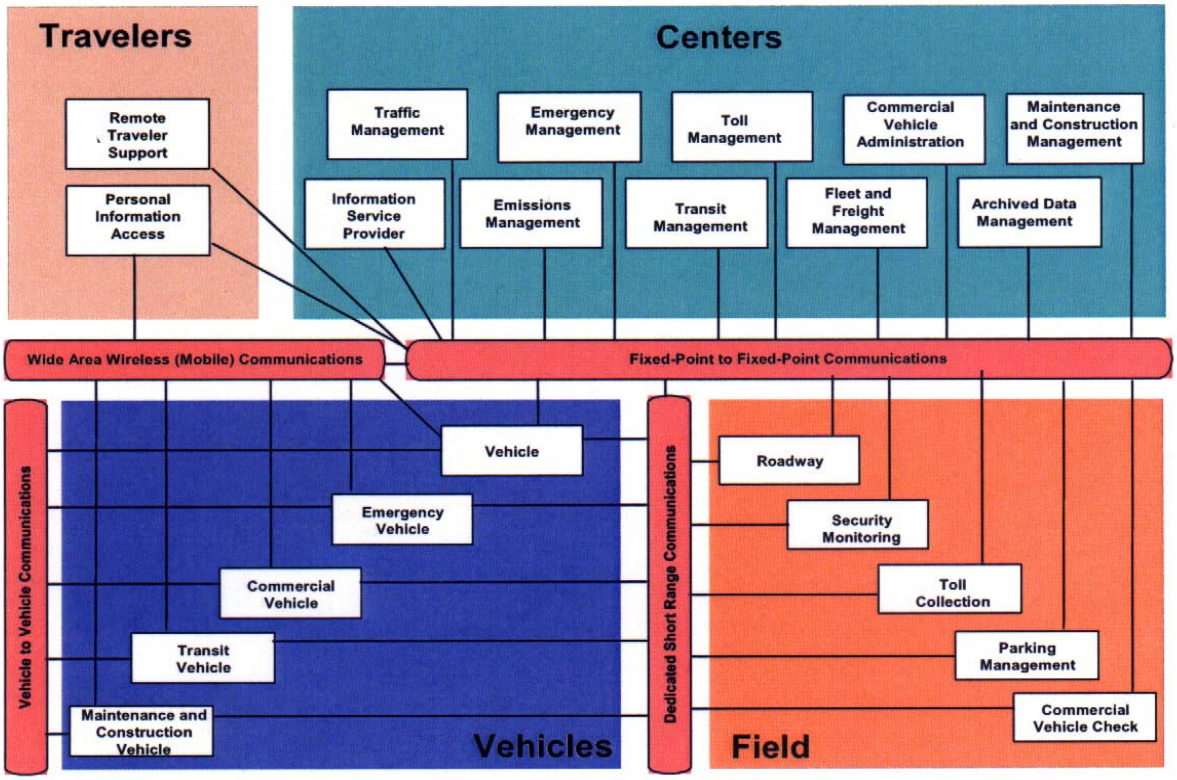
  The data flows between the logical processes (from the logical architecture) that originate at one subsystem and end at another are grouped together into physical architecture flows. In other words, one architecture flow may contain a number of more detailed data flows. These architecture flows and their communication requirements define the interfaces required between subsystems. The flows mapped at this level provide a non-systems reader with an easier understanding of the types of interactions possible among regional agencies.

In addition, the National ITS Architecture allows for each agency's field equipment (detectors of Dynamic Message Signs (DMS)) to be classified under the roadway subsystem entity. However, the National ITS Architecture does not consider architecture flows between traffic management subsystems that fail to consider jurisdiction boundaries within a region. Tackling these jurisdictional boundaries that translate into institutional boundaries is critical in ensuring any system operates efficiently.

2.4 Interconnect Table

In this section, the interactions discussed generically in the previous narrative begin to take shape in the context of the region. **Figure 2.1** illustrates the National ITS Architecture macro view of all the possible interactions between ITS elements. Note that the National ITS Architecture contains four possible entities for information connection: travelers, centers, vehicles and field elements. Boxes within these four centers are called subsystems. The rounded rectangles in the middle represent communications between the elements.

Figure 2.1 National ITS Architecture Summary



3.0 Description of the Region

The Northwestern Indiana Regional Architecture includes ITS projects developed by various traffic, transit, and safety agencies within the counties of Lake, Porter and LaPorte. The area is served by a metropolitan planning organization operating with the three-county region, namely, the Northwestern Indiana Regional Planning Commission (NIRPC).

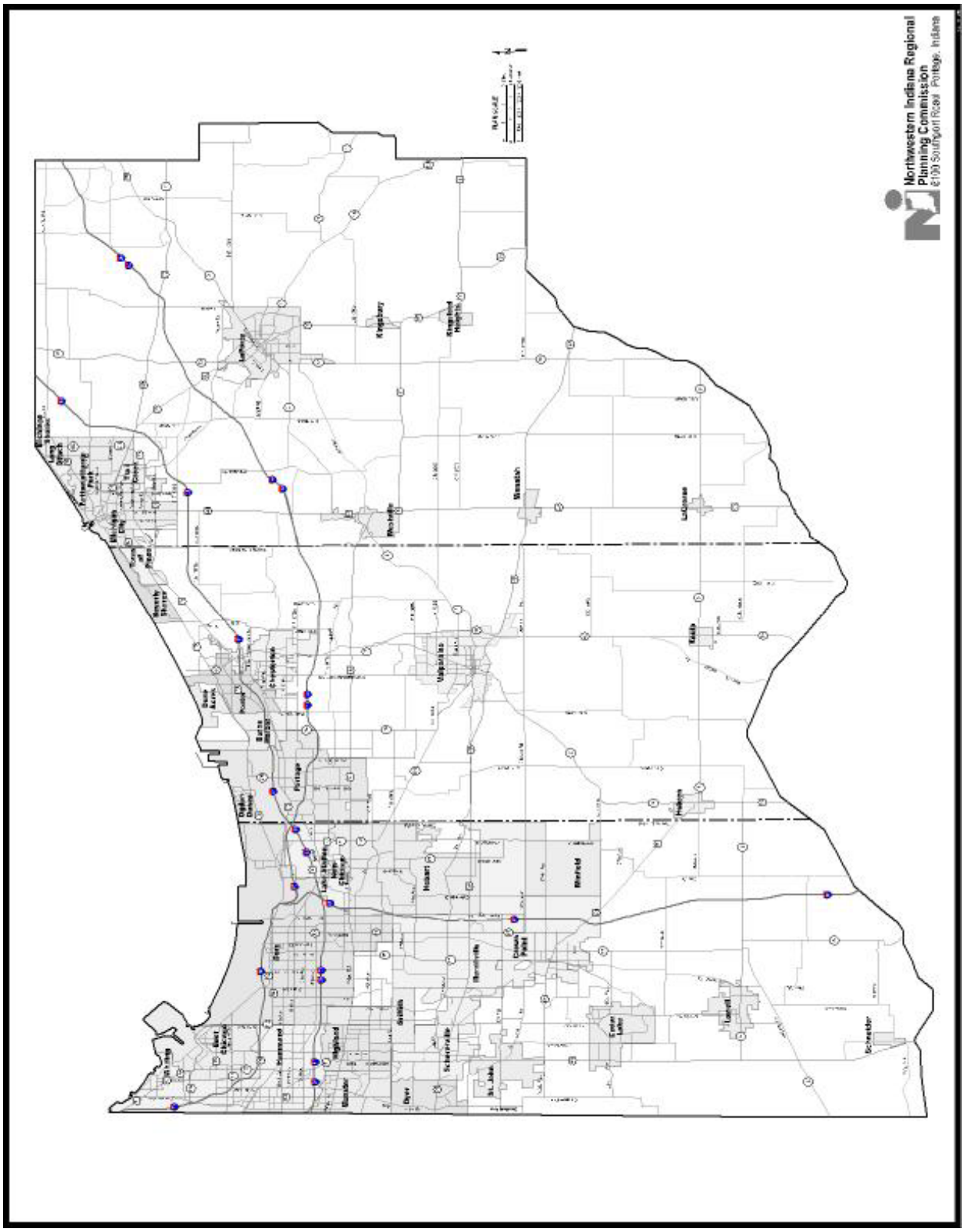
The region is served by the interstates I-65, I-90, I-94, I-80/90, I-80/94 (Borman Expressway); the United States highways US 6, US 12, US 20, US 30, US 35, US 41, US 231, US 421; and State Roads SR 2, SR 4, SR 8, SR 39, SR 49, SR 51, SR 53, SR 55, SR 104, SR 130, SR 149, SR 152, SR 212, SR 241, SR 249, SR 312, and SR 912.

The public transportation needs of the region are served by an electronic commuter rail system, the Northern Indiana Commuter Transportation District (NICTD), several city transit systems including the East Chicago Public Transit (ECPT), Gary Public Transportation System (GPTC), Hammond Transit System (HTS), Michigan City (Municipal Coach), and LaPorte (TransPorte). One regional demand-response system serves the region, i.e. Northwest Indiana Community Action Corp (NICA) (formerly LCEOC, Inc.). Details of the highway and transit ITS projects operating and proposed are outlined in the remainder of the report.

The region is also served by the Gary/Chicago Regional Airport, which has Federal Aviation Agency (FAA) approval for expansion, and by the Portage/Burns Harbor International Port on Lake Michigan. The International Port handles bulk cargo only.

Figure 3.1 shows a map of the Northwestern Indiana region. More information about NIRPC and the Northwestern Indiana Region can be found on the NIRPC website at www.NIRPC.org.

Figure 3.1 Map of Northwestern Indiana
Includes Lake, Porter, and LaPorte Counties in Indiana



3.1 Participating Agencies and Stakeholders

Representatives from the following agencies participated in the stakeholder meetings and workshops. The group consists of stakeholders from traffic, transit and emergency agencies operating within the boundaries of the region, including the Federal Highway Administration - Indiana Division, Indiana Department of Transportation, Gary Public Transportation Corporation, Hammond Transit System, Northwest Indiana Community Action Corp (NICA), City of Crown Point, City of Gary, City of Hammond, and City of Hobart.

The Northwestern Indiana regional ITS architecture is coordinated with the Gary-Chicago-Milwaukee (GCM) Corridor ITS architecture. A more detailed description of the GCM Corridor ITS architecture is available at www.GCMTravel.com.

Table 3.1 includes the stake-holders that have been identified, with respect to the regional ITS, with the associated ITS elements.

Table 3.1 Northwestern Indiana Regional ITS Architecture Stakeholders

Stakeholder	Associated ITS Elements
Academic/Research Organizations	
AMTRAK	
Gary/Chicago Airport Authority	
Gary-Chicago-Milwaukee Corridor Coalition	Gateway Central (information hub for the G-C-M Corridor) Gateway Website G-C-M Archive
IN Area Media Outlets	
IN Bureau of Motor Vehicles	
IN Dept of Environmental Management	Indiana Emissions Management
IN Dept of Revenue	
IN Dept of Transportation	Archived Data Administrator Archived Data Management System Archived Data User Systems Government Reporting Systems Indiana Gateway (information hub for the regional ITS) Northwestern Indiana Archive
IN Dept of Transportation - LaPorte District	Borman Hoosier Helpers Borman Traffic Management Center Borman Traffic Management Center - Personnel Borman Traffic Management Center - Roadside Equipment INDOT Arterial Traffic Management Center INDOT Arterial Traffic Management Center - Kiosks INDOT Arterial Traffic Management Center - Personnel INDOT Arterial Traffic Management Center - Roadside Equipment
IN Dept of Transportation - Toll Road Division	Indiana Toll Road *11 Dispatch Center Indiana Toll Road Operations Center

	Indiana Toll Road Operations Center - Kiosks Indiana Toll Road Operations Center - Personnel Indiana Toll Road Operations Center - Roadside Equipment Indiana Toll Road Operator
IN East Chicago Transit	East Chicago Transit (transit management system) East Chicago Transit - Personnel East Chicago Transit - Transit Vehicles
IN Emergency Management Agency	
IN Gary Public Transportation Corporation	Gary Public Transportation Corporation (transit management system) Gary Public Transportation Corporation - Kiosks Gary Public Transportation Corporation - Personnel Gary Public Transportation Corporation- -Transit Vehicles
IN Hammond Transit System	Hammond Transit System (transit management system) Hammond Transit System - Kiosks Hammond Transit System - Personnel Hammond Transit System - Transit Vehicles
IN NICA	NICA (transit management system) NICA - Personnel NICA - Transit Vehicles
IN Local Governments	Emergency Personnel Emergency Telecommunications System Emergency Vehicles Local Emergency Services Local Emergency Services - Personnel Local Traffic Management Center Local Traffic Management Center - Inspection Facility Local Traffic Management Center - Kiosks Local Traffic Management Center - Personnel Local Traffic Management Center - Roadside Equipment Multimodal Crossings Parking Management System
IN NICTD	NICTD (transit management system) NICTD - Kiosks NICTD - Personnel NICTD - Transit Vehicles
IN Private Construction and Maintenance Companies	Construction and Maintenance
IN Private Information Service Providers	Personal Information Access Private Information Service Providers
IN Private Towing Companies	Private Towing Companies
IN State Police District 13	Indiana State Police District 13 Indiana State Police Weigh Station
IN State Police – Commercial Vehicle Enforcement Division	CVO Information Requestor CVO Inspector
Indiana Port Commission	Port of Indiana at Burns Harbor
National Park Service	Indiana Dunes National Lakeshore

4.0 Concept of Operations and Functional Requirements

The Northwestern Indiana Intelligent Transportation System includes an integrated set of information and communication processes that will make information and transportation-related services available to a wide variety of users.

To the users, the ITS will be evident in the roadside equipment, transit vehicles, kiosks, and the availability of timely transportation information and services through websites and private information services. To transportation and emergency agencies, the ITS will be evident in the sharing of information in a distributed computer network.

The information and electronic services will be tied together through a central hub called the Indiana Gateway. Through the Indiana Gateway, real-time traffic and transit service information will be shared among transportation agencies and with transportation system users. Private information service providers will have the ability to tap into the information and tailor the information, add value and provide their customers with specific information and services that will fill individual needs. Payment for transportation services, such as transit fares, tolls and parking fees will be possible through the ITS.

The operational concept identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture. The operational concept is expressed in terms of the user services to be provided, and the market packages that facilitate the provision of the services.

The Northwestern Indiana Regional Intelligent Transportation System will provide services to a wide range of transportation system users, including transit users, commercial vehicle operators, drivers and pedestrians. These user services are defined in the National Intelligent Transportation System Architecture.

Operational elements anticipated to be key components of the Regional ITS Architecture include: Integration with the Gary-Chicago-Milwaukee ITS Corridor, Data Management, Transit Management, Traveler Information, Traffic Management, Commercial Vehicle Administration, and Emergency Operations These elements, as summarized below, define the concept of operations for the region.

4.1 Integration of the Regional ITS Architecture with the Gary-Chicago-Milwaukee (GCM) Corridor

Lake, Porter and LaPorte Counties are included in the Gary-Chicago-Milwaukee Intelligent Transportation System Corridor. This corridor was established as one of four National Priority Corridors to serve as a platform for coordinated interagency and interstate integration of ITS equipment and procedures.

The GCM Gateway information system provides the mechanism for sharing and coordinating transportation system information across the entire corridor. Three state Gateways will serve the primary coordination function within each of the three states, in concert with the other states through the Gateway Central. Through this system,

incident management, efficiency and traveler conveniences are all enhanced across the broad multi-state region.

Current Chicago-area and Northwestern Indiana traffic information and construction information is found at the Gary-Chicago-Milwaukee Corridor web site www.GCMTravel.com and at www.trafficwise.org.

The categories of elements of the Regional ITS Architecture follows with a brief explanation.

4.2 Data Management

Archived Data Function controls the archiving and distribution of ITS data. The Indiana Gateway is the central hub for the storage and dissemination of this data. The data keeps all the other elements in the Regional ITS Architecture functional.

4.3 Transit Management

Public Transportation service providers are preparing to use intelligent transportation system technology to monitor vehicle location and coordinate services. The system will enhance the efficiency of vehicle maintenance programs and make timely information available to the transit travelers. The Northern Indiana Commuter Transportation District is reconstructing and rehabilitating the electrical and communication system to improve system reliability.

Public Transportation Management will assist transit systems to operate vehicles and facilities.

Personalized Public Transit will allow an individual rider to request a trip by specifying the trip origin and destination, time and date. This service applies to demand-responsive transit and fixed route transit with deviations.

Multi-modal coordination will allow pre-trip travel information to assist travelers with travel time estimates for making mode choices and route decisions prior to trip departure. Information is integrated from various transportation modes and presented to the user for decision making.

En-Route Transit Information provides transit travelers with real-time transit and high-occupancy vehicle information allowing travel alternatives to be chosen once the traveler is en-route

4.4 Traveler Information Operations

En-route driver information provides vehicle drivers with information while en-route, which will allow alternative routes to be chosen for their destination. The potential decrease in traffic may also provide benefits in highway safety, reduced air pollution, and

decreased congestion. Route Guidance will provide travelers with directions to selected destinations.

4.5 Traffic Management

Traffic Management provides the capability to efficiently manage the movement of traffic on streets and highways, using surveillance and signal control to optimize flow. This will also include control of network signal systems with eventual integration of freeway control.

INDOT is implementing the Borman (I-80/94) Expressway Advanced Traffic Management System (ATMS) and it is the region's priority ITS project. This system will provide the capability of operating the I-80/94 Corridor in Northwestern Indiana more effectively by employing detection and surveillance technologies to enhance safety, reduce congestion and facilitate multi-agency coordination. This technology also exists on I-65 from US 30 to I-80/94.

The Borman ATMS project includes the construction of a freeway management facility, installation of traffic monitoring sensors, video cameras, variable message signs (VMS), and upgrading the highway advisory radio (HAR). The project integrates the Hoosier Helper motorist assistance program, with the capability to activate VMS and HAR resources and coordinate incident management from within the Hoosier Helper vehicles.

Incident Management will identify incidents, formulate response actions, and support initiation and ongoing coordination of those response actions. Incident management will include scheduled planned incidents and the ability to predict hazardous conditions.

The Highway-Rail Intersection (HRI) function will control highway and rail traffic in at-grade HRIs. Two sub-services are supported: Standard Speed Rail Sub-service which is applicable to light rail transit, commuter rail and heavy rail trains with operational speeds up to 79 miles per hour (MPH); and High Speed Rail Sub-service which is applicable to all passenger and freight trains with operational speeds from 80 to 125 MPH.

Electronic Payment Services allows travelers to pay for transportation services by electronic means. Electronic payment can support electronic toll collection, electronic transit fare collection, and electronic parking payment.

Emissions Management, such as testing and mitigation, will provide state government with the capability to enhance their air quality control strategies to mitigate pollution and may be provided to enforcement agencies to compel offenders to comply with standards.

4.6 Commercial Vehicle Administration

Commercial vehicle safety and efficiency are also improved with the ITS infrastructure. Commercial Fleet Management includes the capability for users to provide commercial drivers and dispatchers with real-time routing information in response to congestion or incidents.

Electronic pre-clearance at truck weigh stations and on-board safety equipment will help to reduce incidents and delay for interstate commerce. The Indiana Gateway information hub will carry the credential information that allows pre-clearance capability and aid in responding to incidents involving hazardous material cargo. Commercial Vehicle Electronic Clearance will allow pre-cleared commercial vehicles to bypass weigh station facilities. Commercial Vehicle Administrative Processes include electronic purchase of credentials, automated mileage and fuel reporting and auditing.

4.7 Emergency Management

The Indiana Toll Road operates the Toll Road "*11" Emergency Call number through the Toll Road's Emergency Dispatch Center. The Toll Road will soon implement incident management and traffic management systems and could implement electronic payment services in the future.

Local governments have begun to install traffic signal preemption devices to allow emergency vehicles to safely get through congested intersections. A centralized traffic signal integration system is in place in the cities of Hammond, East Chicago, and Highland and some roads in Gary and Munster have coordinated signals.

Public Travel Security will create an environment of safety in public transportation.

Hazardous Materials Incident Response provides enforcement and HAZMAT response teams with timely and accurate information on cargo contents when a commercial vehicle is involved in an incident.

Automated Roadside Safety Inspection will improve the ability to perform safety inspection through the use of automation.

Emergency Notification and Personal Security provides for the faster notification of travelers involved in an incident.

Emergency Vehicle Fleet Management System will maintain the availability status of relevant emergency vehicles, determine the emergency response vehicles best suited to respond to an incident and dispatch the appropriate emergency response vehicles to the incident.

4.8 Maintenance and Construction Management

Road Weather Data Collection will assist travelers to assess weather and road construction conditions when making travel plans.

5.0 Regional ITS Architecture Interface Requirements

Section 4 included a brief explanation of the seven categories of ITS elements that were selected for the Regional ITS Architecture, i.e. Data Management, Transit Management, Traveler Information, Traffic Management, Commercial Fleet Administration, Emergency Operations, and Maintenance and Construction Management.

This section includes a brief description of each of the market packages associated with the ITS National Architecture. The 85 National ITS Architecture market packages are listed in **Table 5.1** (ITS codes are in parentheses). Market Packages represent slices of the Physical Architecture that address specific services like surface street control. A market package collects together several different subsystems, equipment packages, terminators, and architecture flows that provide the desired service. The 42 ITS market packages that were selected for the Regional ITS Architecture are shown in bold font. These identify the various system components the regional architecture will utilize.

Table 5.1 National ITS Architecture Market Packages

Currently listed on the ITS Architecture Website www.iteris.com/itsarch

Archived Data Management

(AD1) ITS Data Mart
(AD2) ITS Data Warehouse
(AD3) ITS Virtual Data Warehouse

Public Transportation

(APTS1) Transit Vehicle Tracking
(APTS1) Transit Fixed-Route Operations
(APTS3) Demand Response Transit Operations
(APTS4) Transit Passenger and Fare Management
(APTS5) Transit Security
(APTS6) Transit Maintenance
(APTS7) Multi-modal Coordination
(APTS8) Transit Traveler Information

Traveler Information

(ATIS1) Broadcast Traveler Information
(ATIS2) Interactive Traveler Information
(ATIS3) Autonomous Route Guidance
(ATIS4) Dynamic Route Guidance
(ATIS5) ISP Based Trip Planning and Route Guidance
(ATIS6) Integrated Transportation Management/Route Guidance
(ATIS7) Yellow Pages and Reservation
(ATIS8) Dynamic Ridesharing
(ATIS9) In-Vehicle Signing

Traffic Management

(ATMS01) Network Surveillance
(ATMS02) Probe Surveillance
(ATMS03) Surface Street Control
(ATMS04) Freeway Control
(ATMS05) HOV Lane Management
(ATMS06) Traffic Information Dissemination
(ATMS07) Regional Traffic Control
(ATMS08) Traffic Incident Management System
(ATMS09) Traffic Forecast and Demand Management
(ATMS10) Electronic Toll Collection
(ATMS11) Emissions Monitoring and Management
(ATMS12) Virtual TMC and Smart Probe Data
(ATMS13) Standard Railroad Grade Crossing
(ATMS14) Advanced Railroad Grade Crossing
(ATMS15) Railroad Operations Coordination
(ATMS16) Parking Facility Management
(ATMS17) Regional Parking Management
(ATMS18) Reversible Lane Management
(ATMS19) Speed Monitoring

(ATMS20) Drawbridge Management
(ATMS21) Roadway Closure Management

Vehicle Safety

(AVSS01) Vehicle Safety Monitoring
(AVSS02) Driver Safety Monitoring
(AVSS03) Longitudinal Safety Warning
(AVSS04) Lateral Safety Warning
(AVSS05) Intersection Safety Warning
(AVSS06) Pre-Crash Restraint Deployment
(AVSS07) Driver Visibility Improvement
(AVSS08) Advanced Vehicle Longitudinal Control
(AVSS09) Advanced Vehicle Lateral Control
(AVSS10) Intersection Collision Avoidance
(AVSS11) Automated Highway System

Fleet Administration

(CVO01) Fleet Administration
(CVO02) Freight Administration
(CVO03) Electronic Clearance
(CVO04) CV Administrative Processes
(CVO05) International Border Electronic Clearance
(CVO06) Weigh-In-Motion
(CVO07) Roadside CVO Safety
(CVO08) On-Board CVO Safety and Freight Safety & Security
(CVO09) CVO Fleet Maintenance
(CVO10) HAZMAT Management
(CVO11) Roadside HAZMAT Security Detection and Mitigation
(CVO12) CV Driver Security Authentication
(CVO13) Freight Assignment Tracking

Emergency Operations

(EM01) Emergency Call-Taking and Dispatch
(EM02) Emergency Routing
(EM03) Mayday and Alarms Support
(EM04) Roadway Service Patrols
(EM05) Transportation Infrastructure Protection
(EM06) Wide Area Alert
(EM07) Early Warning System
(EM08) Disaster Response and Recovery
(EM09) Evacuation and Reentry Management
(EM10) Disaster Traveler Information

Maintenance and Construction Management

(MC01) Maintenance & Construction Vehicle and Equipment Tracking
(MC02) Maintenance & Construction Vehicle Maintenance
(MC03) Road Weather Data Collection
(MC04) Weather Information Processing & Distribution
(MC05) Roadway Automated Treatment
(MC06) Winter Maintenance
(MC07) Roadway Maintenance & Construction
(MC08) Work Zone Management
(MC09) Work Zone Safety Monitoring
(MC10) Maintenance & Construction Activity Coordination

Functional and informational flow tables associated with each selected ITS market package were developed by the ITS Management Committee for the Northwestern Indiana ITS Architecture to provide a detailed look at the communications and data flows among regional stakeholders. These information tables are presented in the Appendix. As the regional ITS infrastructure develops, these functional flow tables can be modified and additional functional flow tables can be incorporated. The functional flow tables describe the system-wide approach to ITS for the entire Northwestern Indiana Region.

All of the interfaces outlined here were used to develop and document the architecture for further update in Turbo Architecture. A description of the selected ITS elements and activities are presented in this section.

5.1 (AD1) ITS Data Mart

This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.

The associated information flow tables, i.e. Tables 5.1.1 to 5.1.22 are in the Appendix.

5.2 (AD2) ITS Data Warehouse

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 multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this market package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

The associated information flow tables, i.e. Tables 5.2.1 to 5.2.29 are in the Appendix.

5.3 (AD3) ITS Virtual Data Warehouse

This market package provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse Market Package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse Market Package are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

The associated information flow tables, i.e. Tables 5.3.1 to 5.3.7 are in the Appendix.

5.4 (APTS1) Transit Vehicle Tracking

This market package provides for an Automated Vehicle Locator System to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position

determination and facilitate communications with each vehicle at fixed intervals. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider Subsystem via a wireline link.

This system also provides mobile data communication (MDC) in order to update manifests and schedules on a real-time computer console.

The associated information flow tables, i.e. Tables 5.4.1 to 5.4.8 are in the Appendix.

5.5 (APTS2) Transit Fixed-Route Operations

This market package performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services. This service uses the existing AVL database as a source for current schedule performance data, and is implemented through data processing and information display at the transit management subsystem. This data is exchanged using the existing wireline link to the information service provider where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

The associated information flow tables, i.e. Tables 5.5.1 to 5.5.13 are in the Appendix.

5.6 (APTS3) Demand Response Transit Operations

This market package performs automatic driver assignment and monitoring as well as vehicle routing and scheduling for demand response transit services. This package uses the existing AVL database to monitor current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions.

The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. The Information Service Provider Subsystem may be either be operated by transit management center or be independently owned and operated by a separate service provider. In the first scenario, the traveler makes a direct request to a specific transit operator. In the second scenario, a third party service provider determines which transit operator is a viable means of satisfying a traveler request and uses wireline communications to make a reservation for the traveler.

The associated information flow tables, i.e. Tables 5.6.1 to 5.6.13 are in the Appendix.

5.7 (APTS4) Transit Passenger and Fare Management

This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means. The payment instrument may be either a stored value or credit card.

This package is implemented with sensors mounted on the vehicle to permit the driver and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle to allow fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem using existing wireless infrastructure.

The associated information flow tables, i.e. Tables 5.7.1 to 5.7.21are in the Appendix.

5.8 (APTS5) Transit Security

This market package provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Public areas (e.g. stops, park and ride lots, stations) are also monitored.

Information is communicated to the Transit Management Subsystem using the existing or emerging wireless (vehicle to center) or wireline (area to center) infrastructure. Security related information is also transmitted to the Emergency Management Subsystem when an emergency is identified that requires an external response. Incident information is communicated to the Information Service Provider.

The associated information flow tables, i.e. Tables 5.8.1 to 5.8.15 are in the Appendix.

5.9 (APTS6) Transit Maintenance

This market package supports automatic maintenance scheduling and monitoring. On-board condition sensors monitor critical system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes these data and schedules maintenance activities.

The associated information flow tables, i.e. Tables 5.9.1 to 5.9.6 are in the Appendix.

5.10 (APTS7) Multi-modal Coordination

This market package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Intermodal coordination between transit agencies can increase traveler convenience at transfer points and also improve operating efficiency.

Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. More limited local coordination between the transit vehicle and the individual intersection for signal priority is also supported by this package.

The associated information flow tables, i.e. Tables 5.10.1 to 5.10.9 are in the Appendix.

5.11 (APTS8) Transit Traveler Information

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.

5.12 (ATIS1) Broadcast Traveler Information

This market package provides the user with a basic set of ATIS services; its objective is early acceptance. It involves the collection of traffic conditions, advisories, general public transportation, toll and parking information, incident information, air quality and weather information, and the near real time dissemination of this information over a wide area through existing infrastructures and low cost user equipment (e.g., FM sub-carrier, cellular data broadcast).

ATIS1 is different from the market package ATMS6--Traffic Information Dissemination--which provides the more basic HAR and DMS information capabilities. ATIS1 provides the more sophisticated digital broadcast service. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.

The associated information flow tables, i.e. Tables 5.12.1 to 5.11.18 are in the Appendix.

5.13 (ATIS2) Interactive Traveler Information

This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported.

The traveler can obtain current information regarding traffic conditions, transit services, rideshare/ride match, parking management, and pricing information. A range of two-way wide-area wireless and wireline communications systems may be used to support the required digital communications between traveler and the information service provider. A variety of interactive devices may be used by the traveler to access information prior to a trip or en-route to include phone, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices.

Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles or other means.

The associated information flow tables, i.e. Tables 5.13.1 to 5.13.41 are in the Appendix.

5.14 (ATIS3) Autonomous Route Guidance

This market package relies on in-vehicle sensory, location determination, computational, map database, and interactive driver interface equipment to enable route planning and detailed route guidance based on static, stored information. No communication with the infrastructure is assumed or required. Identical capabilities are available to the traveler outside the vehicle by integrating a similar suite of equipment into portable devices.

The associated information flow tables, i.e. Tables 5.14.1 to 5.15.8 are in the Appendix.

5.15 (ATIS9) In Vehicle Signing

This market package supports distribution of traffic and travel advisory information to drivers through in-vehicle devices. It includes short range communications between roadside equipment and the vehicle and wireline connections to the Traffic Management Subsystem for coordination and control. This market package also informs the driver of both highway-highway and highway-rail intersection status.

The associated information flow tables, i.e. Tables 5.15.1 to 5.15.4 are in the Appendix.

5.16 (ATMS01) Network Surveillance

This market package includes traffic detectors, other surveillance equipment, the supporting field equipment, and wireline communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends 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, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem. This market package would be implemented by the Indiana Department of Transportation and to a limited extent by local governments.

The associated information flow tables, i.e. Tables 5.16.1 to 5.16.14 are in the Appendix.

5.17 (ATMS03) Surface Street Control

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 static pre-timed control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. Additionally, general advisory and traffic control information can be provided to the driver while en-route.

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. This market package would be implemented by the Indiana Department of Transportation and by local governments.

The associated information flow tables, i.e. Tables 5.17.1 to 5.17.15 are in the Appendix.

5.18 (ATMS04) Freeway Control

This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways. Coordination and integration of ramp meters are included as part of this market package.

This package is consistent with typical urban traffic freeway control systems. This package incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option.

This market package also includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a traffic management center; however, developments might allow for point detection with roadway equipment.

For example, a CCTV might include the capability to detect an incident based upon image changes. Additionally, this market package allows general advisory and traffic control information to be provided to the driver while en-route. This market package is being implemented by the Indiana Department of Transportation.

The associated information flow tables, i.e. Tables 5.18.1 to 5.18.12 are in the Appendix.

5.19 (ATMS06) Traffic Information Dissemination

This market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio. This package provides a tool that can be used to notify drivers of incidents; careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information.

This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), transit management center, emergency management center, and information service provider. This market package is being implemented by the Indiana Department of Transportation.

The associated information flow tables, i.e. Tables 5.19.1 to 5.19.13 are in the Appendix.

5.20 (ATMS07) Regional Traffic Control

This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated Inter-jurisdictional traffic control. This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and wireline communications capabilities to implement traffic management strategies which are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers. This market package will be implemented by the Indiana Department of Transportation and local governments.

The associated information flow tables, i.e. Tables 5.20.1 to 5.20.9 are in the Appendix.

5.21 (ATMS08) Traffic Incident Management System

This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized. Requisite incident detection capabilities are included in the freeway control market package and through the regional coordination with other traffic management and emergency management centers, weather service entities, and event promoters supported by this market package. Information from these diverse sources are collected and correlated by this market package to detect and verify incidents and implement an appropriate response.

This market package provides Traffic Management Subsystem equipment that supports traffic operations personnel in developing an appropriate response in coordination with emergency management and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications and presentation of information to affected travelers using the Traffic Information Dissemination market package.

The same equipment assists the operator by monitoring incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other field service personnel. This market package is being implemented by the Indiana Department of Transportation. Local governments will also implement this market package.

The associated information flow tables, i.e. Tables 5.21.1 to 5.21.35 are in the Appendix.

5.22 (ATMS09) Traffic Forecast and Demand Management

This market package includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation, real-time assessment, and forecast of the roadway network performance. This includes the prediction of travel demand patterns to support better link travel time forecasts.

The source data would come from the Traffic Management Subsystem itself as well as other traffic management centers and forecasted traffic loads derived from route plans supplied by the Information Service Provider Subsystem. In addition to short term forecasts, this market package provides longer range forecasts that can be used in transportation planning.

This market package provides data that supports the implementation of TDM programs, and policies managing both traffic and the environment. Information on vehicle pollution levels, parking availability, usage levels, and vehicle occupancy are collected by monitoring sensors to support these functions. Demand management requests can also be made to Toll Administration, Transit Management, and Parking Management Subsystems.

The associated information flow tables, i.e. Tables 5.22.1 to 5.22.13 are in the Appendix.

5.23 (ATMS10) Electronic Toll Collection

This market package provides toll operators with the ability to collect tolls electronically and detect and process violators. Variations in the fees that are collected enables implementation of demand management strategies

Dedicated short range communication between the roadway equipment and the vehicle is required as well as wireline interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. Vehicle tags of toll violators are read and electronically posted to vehicle owners. Standards, inter-agency coordination, and financial clearinghouse capabilities enable regional and ultimately national interoperability for these services.

The population of toll tags and roadside readers that these systems utilize can also be used to collect road use statistics for highway authorities. This data can be collected as a natural by-product of the toll collection process or collected by separate readers that are dedicated to probe data collection.

The associated information flow tables, i.e. Tables 5.23.1 to 5.23.22 are in the Appendix.

5.24 (ATMS11) Emissions Monitoring and Management

This market package monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the emissions management subsystem for processing.

Both individual detection and identification of vehicles that exceed emissions standards and general area-wide monitoring of air quality are supported by this market package.

For area wide monitoring, this market package measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. For point emissions monitoring, this market package measures tail pipe emissions and identifies vehicles that exceed emissions standards. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations.

The associated information flow tables, i.e. Tables 5.24.1 to 5.24.13 are in the Appendix.

5.25 (ATMS13) Standard Railroad Grade Crossing

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 cross-buck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the roadway subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train.

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. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem. Similar interfaces and services are provided for other types of multimodal crossings (e.g., draw bridges).

The associated information flow tables, i.e. Tables 5.25.1 to 5.25.11 are in the Appendix.

5.26 (ATMS14) Advanced Railroad Grade Crossing

This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This market package includes all capabilities from the Standard Railroad Grade Crossing Market Package and augments these with additional safety features to mitigate the risks associated with higher rail speeds.

The active warning systems supported by this market package include positive barrier systems which preclude entrance into the intersection when the barriers are activated. Like the Standard Package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train.

In this market package, additional information about the arriving train is also provided by the wayside interface equipment so that the train's direction of travel, its estimated time of arrival, and the estimated duration of closure may be derived. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation.

This market package also includes additional detection capabilities which enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.

The associated information flow tables, i.e. Tables 5.26.1 to 5.26.11 are in the Appendix.

5.27 (ATMS15) Railroad Operations Coordination

This market package provides an additional level of strategic coordination between rail operations and traffic management centers. Rail operations provide train schedules, maintenance schedules, and any other forecast events which will result in highway-rail intersection (HRI) closures. This information is used to develop forecast HRI closure times and durations which may be used in advanced traffic control strategies or to enhance the quality of traveler information.

The associated information flow tables, i.e. Tables 5.27.1 to 5.27.7 are in the Appendix.

5.28 (ATMS16) Parking Facility Management

This market package provides enhanced monitoring and management of parking facilities. The included equipment assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees. This is performed by sensing and collecting current parking facilities status, sharing the data with information service providers and traffic operations, and automatic fee collection using short range communications with the same in-vehicle equipment utilized for electronic toll collection.

The associated information flow tables, i.e. Tables 5.28.1 to 5.28.20 are in the Appendix.

5.29 (ATMS17) Regional Parking Management

This market package supports coordination between parking facilities to enable regional parking management strategies.

The associated information flow tables, i.e. Tables 5.29.1 to 5.29.4 are in the Appendix.

5.30 (CVO1) Fleet Administration

This market package keeps track of vehicle location, itineraries, and fuel usage at the Fleet and Freight Management Subsystem using a cell based or satellite data link and

the pre-existing wireless infrastructure. The vehicle has a processor to interface to its sensor (e.g., fuel gauge) and to the cellular data link.

The Fleet and Freight Management Subsystem can provide the vehicle with dispatch instructions, and can process and respond to requests for assistance and general information from the vehicle via the cellular data link. The market package also provides the Fleet Manager with connectivity to intermodal transportation providers using the existing wireline infrastructure.

The associated information flow tables, i.e. Tables 5.30.1 to 5.30.10 are in the Appendix.

5.31 (CVO2) Freight Administration

This market package tracks cargo and the cargo condition. This information is communicated with the Fleet and Freight Management Subsystem via the existing wireless infrastructure. Interconnections are provided to intermodal shippers and intermodal freight depots for tracking the cargo from source to destination.

The associated information flow tables, i.e. Tables 5.31.1 to 5.31.4 are in the Appendix.

5.32 (CVO3) Electronic Clearance

This market package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration subsystem over wireline to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles.

This package allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and dedicated short range communications to the roadside. The roadside check facility may be equipped with AVI, weighing sensors, transponder read/write devices, computer workstation processing hardware, software, and databases.

The associated information flow tables, i.e. Tables 5.32.1 to 5.32.17 are in the Appendix.

5.33 (CVO4) CV Administrative Processes

This market package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles may be enrolled in the electronic clearance program provided by a separate market package which allows commercial vehicles to be screened at mainline speeds at commercial vehicle check points. Through this enrollment process, current profile databases are maintained in the Commercial Vehicle Administration Subsystem and snapshots of this database are made available to the commercial vehicle check facilities at the roadside to support the electronic clearance process.

The associated information flow tables, i.e. Tables 5.33.1 to 5.33.17 are in the Appendix.

5.34 (CVO6) Weigh-In-Motion

This market package provides for high speed weigh-in-motion with or without AVI attachment. Primarily this market package provides the roadside with additional equipment, either fixed or removable. If the equipment is fixed, then it is thought to be an addition to the electronic clearance and would work in conjunction with the AVI and AVC equipment in place.

The associated information flow tables, i.e. Tables 5.34.1 to 5.34.5 are in the Appendix.

5.35 (CVO7) Roadside CVO Safety

This market package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at the Commercial Vehicle Check roadside element. The capabilities for performing the safety inspection are shared between this market package and the On-Board CVO Safety Market Package which enables a variety of implementation options.

The basic option, directly supported by this market package, facilitates safety inspection of vehicles that have been pulled in, perhaps as a result of the automated screening process provided by the Electronic Clearance Market Package. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure which is used to support the safety inspection, and may also inform the pull-in decision if system- timing requirements can be met.

More advanced implementations, supported by the On-Board CVO Safety market package, utilize additional vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

The associated information flow tables, i.e. Tables 5.35.1 to 5.35.14 are in the Appendix.

5.36 (CVO8) On-Board CVO Safety and Freight Safety and Security

This market package provides for on-board commercial vehicle safety monitoring and reporting. It is an enhancement of the Roadside CVO Safety Market Package and includes roadside support for reading on-board safety data via tags.

This market package uses the same communication links as the Roadside CVO Safety Market Package, and provides the commercial vehicle with a wireless link (data and possibly voice) to the Fleet and Freight Management and the Emergency Management Subsystems. Safety warnings are provided to the driver as a priority with secondary requirements to notify the Fleet and Freight Management and Commercial Vehicle Check roadside elements.

The associated information flow tables, i.e. Tables 5.36.1 to 5.36.12 are in the Appendix.

5.37 (CVO9) CVO Fleet Maintenance

This market package supports maintenance of CVO fleet vehicles through close interface with on-board monitoring equipment and AVLS capabilities with in the Fleet and Freight Management Subsystem. Records of vehicle mileage, repairs, and safety violations are maintained to assure safe vehicles on the highway.

The associated information flow table, i.e. Table 5.37.1 is in the Appendix.

5.38 (CVO10) HAZMAT Management

This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Subsystem. The Emergency Management subsystem is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Subsystem. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

The associated information flow tables, i.e. Tables 5.38.1 to 5.38.9 are in the Appendix.

5.39 (EM1) Emergency Call-Taking and Dispatch

This market package provides the computer-aided dispatch systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency.

Coordination between Emergency Management Subsystems supports emergency notification and coordinated response between agencies. Existing wide area wireless communications would be utilized between the Emergency Management Subsystem and an Emergency Vehicle to enable an incident command system to be established and supported at the emergency location. The Emergency Management Subsystem would include hardware and software for tracking the emergency vehicles. Public safety, traffic management, and many other allied agencies may each participate in the coordinated response managed by this package.

The associated information flow tables, i.e. Tables 5.39.1 to 5.39.21 are in the Appendix.

5.40 (EM2) Emergency Routing

This market package supports dynamic routing of emergency vehicles and coordination with the Traffic Management Subsystem for special priority on the selected route(s). The Information Service Provider Subsystem supports routing for the emergency fleet based on real-time traffic conditions and the emergency routes assigned to other responding vehicles. In this market package, the Information Service Provider Subsystem would typically be integrated with the Emergency Management Subsystem in a public safety communications center. The Emergency Vehicle would also optionally be equipped with dedicated short range communications for local signal preemption.

The associated information flow tables, i.e. Tables 5.40.1 to 5.40.15 are in the Appendix.

5.41 (EM3) Mayday and Alarms Support

This package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user and determine the appropriate response. The Emergency Management Subsystem may be operated by the public sector or by a private sector provider. The request from the traveler needing assistance may be manually initiated or automated and linked to vehicle sensors. The data is sent to the Emergency Management subsystem using wide area wireless communications with voice as an option. Providing user location implies either a location technology within the user device or location determination within the communications infrastructure.

The associated information flow tables, i.e. Tables 5.41.1 to 5.41.11 are in the Appendix.

5.42 (MC04) Weather Information Processing and Distribution

This market package monitors current and forecast road and weather conditions using a combination of weather service information and data collected from environmental sensors deployed on and about the roadway. The collected road weather information is monitored and analyzed to detect and forecast environmental hazards such as icy road conditions, dense fog, and approaching severe weather fronts.

This information can be used to more effectively deploy road maintenance resources, issue general traveler advisories, and support location specific warnings to drivers using the Traffic Information Dissemination Market Package.

The associated information flow tables, i.e. Tables 5.42.1 to 5.42.11 are in the Appendix.

6.0 Agreements

As projects identified within the Northwestern Indiana Regional IS Architecture proceed toward implementation, various types of agreements will be required among stakeholder agencies. These agreements are necessary to establish the roles and responsibilities of each agency for a particular project.

At a minimum, agreements affecting ITS project interoperability will need to be identified and drafted. Agreements will solidify the substantial efforts that the Northwestern Indiana regional stakeholders have invested towards developing ITS project plans.

6.1 Agreements for Implementation

Table 6.1 identifies the projects where agreements will be required among the participating stakeholders. As the Regional ITS Architecture evolves, agreements may be added or modified. The stakeholders listed in bold are anticipated to take the lead in initiating the agreements.

Table 6.1 Agreements for Implementation

Agreement	**Stakeholders**
Transit Trip Planning Website	NICTD, ECPT, HTS, GPTC, NICA
Borman (I-80/94) ATMS Information Sharing	INDOT GCMC County Agencies Municipal Agencies Emergency Management Agencies Transit Agencies Media
Safety Mutual Aid	INDOT County Sheriffs County Emergency Management Agency Municipal Police and Fire
Archived Data Structure	NIRPC INDOT GCMC County Agencies Municipal Agencies Transit Agencies Emergency Management Agencies

6.2 Regional Mutual Aid Agreement

In October 2002, the Emergency Management Directors of Jasper, Lake, LaPorte, Newton, and Porter, in the State of Indiana entered into an agreement whereby mutual emergency management services assistance may be provided by various county and local governments for the benefit of each. The five counties agreed to assist one

another in the event that the emergency response assets of any of the five counties are insufficient to respond to a natural or manmade emergency or disaster.

On the next page is a copy of the NIRPC resolution to assist in the negotiation of the reciprocal mutual aid agreement. To review the entire five-county Mutual Aid Agreement, contact the NIRPC staff consultant for Homeland Security, Mr. Jody Melton, by phone at (219) 763-6060, extension 115, or by e-mail at jmelton@nirpc.org.

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MUTUAL AID AGREEMENT RESOLUTION

WHEREAS, the statutes of the State of Indiana authorize local governments through their local Emergency Management Agencies to enter into mutual aid agreements with other local and county agencies, and

WHEREAS, the Emergency Management Directors of Jasper, Lake, LaPorte, Newton, and Porter, in the State of Indiana are desirous of entering into agreements whereby mutual emergency management services assistance may be provided by various county and local governments for the benefit of each, and

WHEREAS, agreements can be prepared which will provide for mutual aid protection assistance among county and local governments in Jasper, Lake, LaPorte, Newton, and Porter.

NOW, THEREFORE, BE IT RESOLVED by the directors of the Emergency Managements Agencies of Jasper, Lake, LaPorte, Newton, and Porter Counties that those county directors wish to make available to one another their resources to assist one another in the event that the emergency response assets of any of the 5 counties are insufficient to respond to a natural or manmade emergency or disaster.

BE IT FURTHER RESOLVED THAT the Indiana General Assembly in IC 10-4-1-9 authorized and provided for the director of each local organization for emergency management and disaster to assist in negotiation of reciprocal mutual aid agreements with and between other public and private agencies for reciprocal emergency management aid and assistance and that the 5 county directors urge the executive of each of the 5 counties and each local jurisdiction to approve the Mutual Aid Agreement.

Adopted 10th of October, 2002.

Lois L Dowell
Lois Dowell, Jasper County

Jeff Miller
Jeff Miller, Lake County

Paul A. Young
Paul Young, LaPorte County

Ray A Chambers
Ray Chambers, Newton County

Phil Griffith
Phil Griffith, Porter County

7.0 ITS Standards

ITS Standards are documented guidelines or rules specifying the interconnections among elements and the characteristics of technologies and products to be used in ITS installations. Standards describe in detail what types of interfaces should exist between ITS components and how the components will exchange information and work together to deliver certain user services. Standards define, for example, data elements and message sets used by devices and systems, or certain characteristics of a particular device.

Communication protocols are collections of rules for moving data elements and messages between devices and systems within the context or framework established by the National ITS Architecture. Section 520.6(e) of TEA-21 explicitly requires that all ITS projects funded through the Highway Trust Fund "conform to the national architecture, applicable standards or provisional standards, and protocols."

ITS standards are being developed by several working groups composed of public and private sector stakeholders. The process is partially supported by the USDOT. There are seven Standards Development Organizations (SDOs) actively participating in ITS standards development activities:

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

There are several categories of standards including the following:

- Hardware and Software Standards – define the standards for physical devices, such as fare boxes and CAD/AVL systems as well as the standards for the software that control those physical devices.

- Human Factors Standards – define how to design ITS systems safely for humans and provide consistent operating characteristics and control/interface design, such as driver warning systems. SAE has developed a series of standards for in-vehicle systems.

- Communications Standards – allow different systems to "speak" with each other in a common language, using common data elements, well-defined data structures or "messages", and well-understood protocols or rules for data exchange and sharing. Communication protocols define sets of rules for moving data and associated messages.

As standards are continuously being added to the National ITS Architecture, regular updates to the Northwestern Indiana Regional ITS Architecture applicable standards will be required. Regional stakeholders will continue to evaluate standards applicable to their appropriate ITS program plans as projects are deployed and integrated with other regional ITS efforts.

8.0 Maintenance of the Regional ITS Architecture

The Northwestern Indiana Regional ITS Architecture was developed with a 20 year planning horizon and will need to be maintained on a regular basis. The maintenance will allow for updates to be made as progress is made on planned projects as well as to add new projects and/or stakeholders in the process. NIRPC will be responsible for updating the Northwestern Indiana Regional Architecture. It is planned that updates to the Turbo Architecture database and the architecture itself will be made in conjunction with updates to the Regional Transportation Plan.

9.0 Sequencing of Projects

ITS projects by their very nature, depend on and provide information and infrastructure to other ITS projects in any region. Therefore, it is critical that the sequencing of project development is addressed as part of the Northwestern Indiana effort.

Section 3 outlined the key regional ITS projects that came out of the ITS architecture development exercise. The projects are presented below with an estimated timeline associated with each project. (Short Term is within three years, Long Term is beyond three years). The projects shown in bold currently exist.

Table 9.1 Northwestern Indiana Regional ITS Project Sequencing

Stakeholder / Project(s)	Timeline
Gary-Chicago-Milwaukee Corridor Coalition	
➢ **Gateway Website**	➢ **Existing**
➢ **Gateway Central** (G-C-M Corridor info hub)	➢ **Existing**
➢ G-C-M Archive	➢ Short Term
Indiana Department of Environmental Management (IDEM)	
➢ **Indiana Emissions Management**	➢ **Existing**
Indiana Department of Transportation (INDOT) and INDOT - LaPorte District	
➢ **Indiana Gateway (info hub for the regional ITS)**	➢ **Existing**
➢ **Borman Hoosier Helpers**	➢ **Existing**
➢ **Borman Traffic Management Center (TMC)**	➢ **Existing**
➢ **Borman TMC - Roadside Equipment**	➢ **Existing**
➢ **Interactive Traveler System** www.trafficwise.org	➢ **Existing**
➢ **Network Surveillance** (Borman TMC)	➢ **Existing**
➢ **Surface Street Control**	➢ **Existing**
➢ **Freeway Control** (similar to Network Surveillance but is not ramp metering in this instance)	➢ **Existing**
➢ **Traffic Information Dissemination** (DMSs and HARs)	➢ **Existing**
➢ **Regional Traffic Control** (between the Borman TMC and the IN Toll Road)	➢ **Existing**
➢ **Traffic Incident Management System**	➢ **Existing**
➢ **Roadway Service Patrols** (Hoosier Helper Freeway	➢ **Existing**

Service Patrol) ➢ **Transportation Infrastructure Protection** (Critical infrastructure, i.e., I-80/94, I 654 and Borman TMC, are monitored via Closed Circuit TV (CCTV) cameras.)	➢ **Existing**
➢ **Wide Area Alert** (e.g. "Amber" & Weather Alerts)	➢ **Existing**
➢ **Roadway Weather Data Collection** (3 RWIS stations in Lake County)	➢ **Existing**
➢ **Winter Maintenance** (monitors weather forecasts & conditions and subscribes to a transportation-oriented weather forecasting service during winter months)	➢ **Existing**
➢ **Work Zone Management** (Portable DMSs are deployed in work zones and approaching work zones with work zone information. Traffic information is also provided with these portable DMSs and with Permanent Overhead DMSs.)	➢ **Existing**
➢ Interactive Traveler System 511 (Radio Alert)	➢ Short Term
➢ Traffic Forecast and Demand Management (algorithms to support travel time information)	➢ Short Term
➢ Weather Information Processing & Distribution (information will be made available to the public via the internet)	➢ Short Term
➢ Archived Data Administrator	➢ Long Term
➢ Archived Data Management System	➢ Long Term
➢ Archived Data User Systems	➢ Long Term
➢ Government Reporting Systems	➢ Long Term
➢ Northwestern Indiana Archive	➢ Long Term
Indiana State Police	
➢ CVO Information Requestor	➢ Long Term
➢ CVO Inspector	➢ Long Term
Gary Public Transportation Corporation (GPTC)	
➢ **Signal Preemption 11th Ave**	➢ **Existing**
➢ Signal Preemption 35th Ave	➢ Short Term
➢ AVL	➢ Short Term
➢ Smart Card (Fare Box)	➢ Long Term
➢ Traveler Information System (Kiosks)	➢ Long Term
East Chicago Public Transit (ECPT)	
➢ **AVL**	➢ **Existing**
➢ Transit Management System (TMS)	➢ Long Term

Hammond Transit System (HTS)	
➢ Transit Management System (TMS)	➢ Long Term
Northwest Indiana Community Action Corp (NICA)	
➢ AVL	➢ Short Term
➢ Transit Management System (TMS)	➢ Long Term
Local Police Departments	
➢ **Signal Preemption Hi Priority**	➢ **Existing**
County Emergency Management Systems (EMSs)	
➢ **AVL**	➢ **Existing**
➢ **Signal Preemption Hi Priority**	➢ **Existing**
Munster-Highland	
➢ **Traffic Signal Coordination (Local)**	➢ **Existing**

It is important to note that some of these projects depend on others being conducted first. For example, the Borman (I-80-94) final design will be closely linked with the widening of the Borman over the next few years. Ensuring the proper conduit and pull-boxes are part of the reconstruction's design is a critical cost saving step. In addition, as local municipalities continue to install fiber on arterials, the ATMS could leverage that infrastructure as well to save on overall cost of the system.

Finally, transit's key role in creating ITS data in the region makes them a critical partner as INDOT and the region begin to form regional ATIS initiatives after the Borman ATMS comes online. Continued coordination among the Northwestern Indiana agencies will ensure a successful regional ITS program.