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North Dakota Statewide ITS Architecture Version 2.0

Final Report

May 2009

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North Dakota Department of Transportation

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The information contained in this report was obtained through extensive input from various stakeholders in the state of North Dakota. The contents of the report were written by a research team from the Advanced Traffic Analysis Center of the Upper Great Plains Transportation Institute at North Dakota State University which facilitated the development of the Regional Architecture.

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ACRONYMS

ATR	Automated Traffic Recorders
AVL	Automated Vehicle Location
CARS (Mn/DOT)	Condition Acquisition and Reporting System
CARS (NDDOT)	Construction Automated Records System
CCTV	Closed Circuit Television
DES	Department of Emergency Services
DMS	Dynamic Message Sign
DOT	Department of Transportation
EAS	Emergency Alert System
EV	Emergency Vehicle
FHWA	Federal Highway Administration
IRIS (SDDOT)	Integrated Roadway Information System
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
MCO	Maintenance and Construction Operations
Mn/DOT	Minnesota Department of Transportation
MSP	Minnesota State Petrol
MTDOT	Montana Department of Transportation
NDDOT	North Dakota Department of Transportation
NDHP	North Dakota Highway Patrol
RA	Regional Architecture
RCRS	Road Condition Reporting System
RWIS	Road Weather Information System
SDDOT	South Dakota Department of Transportation
SOC	State Operations Center
TMC	Traffic/Transportation Management Center
TOC	Traffic Operations Center
WIM	Weigh In Motion
Standards	
ASTM	American Society for Testing and Materials
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
NTCIP	National Transportation Communications for ITS Protocol
SAE	Society of Automotive Engineers
Market Packages	
AD	Archived Data
APTS	Advanced Public Transportation Systems
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Traffic Management Systems
CVO	Commercial Vehicle Operations
EM	Emergency Management
MCO	Maintenance and Construction Operation
AD	Archived Data

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EXECUTIVE SUMMARY

The North Dakota statewide Intelligent Transportation Systems (ITS) Regional Architecture (RA) was prepared under the leadership of the North Dakota Department of Transportation (NDDOT). The goal of the NDDOT RA is to guide the implementation of ITS in the state and coordinate funding, deployment, information sharing, and operations of ITS in the region. The main ITS goal areas for the state include enhanced traveler safety; coordinated maintenance and construction activities; effective traffic and transit management; coordinated incident management; enhanced commercial vehicle operations and improved traveler information. A 15-year planning horizon was considered in the RA development.

The development of the RA was facilitated by the Advanced Traffic Analysis Center (ATAC) of the Upper Great Plains Transportation Institute at North Dakota State University. A partnership agreement was established between ATAC and the NDDOT for supporting the RA development and maintenance.

The RA development process primarily followed the Federal Highway Administration (FHWA) guidelines, with some modifications to reflect the unique characteristics of the region. The process made use of completed ITS planning efforts in the region and used the output of those efforts as a starting point for identifying regional needs and ITS services.

The NDDOT is continuously performing updates to the state's transportation system to meet federal guidelines and requirements, and provide an efficient transportation system for supporting mobility needs of individuals and businesses in the region. The RA serves as a framework that guides those efforts.

The geographical boundaries used for purposes of developing the statewide RA encompass the whole state. In addition, the ND RA recognized interfaces with metropolitan planning organization (MPO) architectures in Fargo-Moorhead, Grand Forks-East Grand Forks, and Bismarck-Mandan. The North Dakota statewide architecture also interfaces with the neighboring states of Montana, South Dakota, and Minnesota, in addition to the provinces of Manitoba and Saskatchewan where appropriate.

The RA development was guided by various stakeholders who included:

- NDDOT Divisions of:
 - Maintenance and Engineering
 - Transit
 - Information Technology
 - Local Government
- NDDOT Districts
- North Dakota Highway Patrol (NDHP)
- North Dakota Division of Emergency Services

- FHWA Division Office, Bismarck, North Dakota

A system inventory was updated to account for existing and planned ITS systems. The majority of these systems may be classified into the following service areas: traffic and travel management, maintenance and construction management, emergency management, commercial vehicle operations, transit management, and archived data management. The inventory identified systems and their functions by agency and jurisdiction.

The ITS user services for the region were identified from previous ITS plans as well as input from regional stakeholders. The National ITS Architecture was used to map the services and to develop market packages in support of these services. ITS Market Packages were used extensively in architecture development since they provided an easy to use tool for discussions with stakeholders. They also provided an effective entry point for Turbo Architecture. A total of 33 Market Packages were identified for the statewide architecture. The Market Packages were also used to survey roles and responsibilities for each system. System interconnections and relevant information flows were identified for ITS centers and devices in the region.

Based on potential information flows, access sharing, and funding partnerships, potential agency agreements were identified. The format for each agreement includes the purpose, entities included, and items covered. Eight potential agreements were identified for the state, in the areas of network surveillance, traveler information, emergency management, and weather data collection and processing.

The regional ITS architecture (RA) is a living document that requires regular maintenance to reflect the most up-to-date ITS picture in the region and to continue to meet federal requirements. FHWA architecture conformity rule states that: “The agencies and other stakeholders participating in the development of the regional ITS architecture shall develop and implement procedures and responsibilities for maintaining it, as needs evolve in the region.” Through partnership with the NDDOT, ATAC performed the architecture update. Reasons for updating the RA include:

- The planning of major ITS projects
- Changes in the status of major ITS projects
- Changes in the region’s stakeholders
- Changes in the region’s ITS needs
- Changes in the National ITS Architecture

The ND RA specified an update cycle of two years, the original RA development was completed in early 2005. This update (version 2.0) is the first update to the original.

1.0 INTRODUCTION

This report is the product of the North Dakota statewide Intelligent Transportation Systems architecture development. Intelligent Transportation Systems (ITS) refer to integrated applications of sensing, communications, computer processing, and electronics to enhance the transportation system. The statewide architecture provides a tool to guide future ITS planning, define system requirements, coordinate agency roles and integrate functions across jurisdictional lines.

The statewide ITS architecture was prepared under the leadership of the North Dakota Department of Transportation (NDDOT). The main goal of the statewide architecture is to guide the implementation of ITS systems in North Dakota, and coordinate funding, deployment, information sharing, and operations of ITS systems in the region. The main ITS goal areas for NDDOT include: enhanced traveler safety; accurate and widely available traveler information; coordinated incident management; and improved customer service. A 15-year planning horizon was considered in the statewide architecture development. This planning horizon is consistent with statewide ITS planning effort initiated by the NDDOT.

The development of the architecture was facilitated by the Advanced Traffic Analysis Center (ATAC) of the Upper Great Plains Transportation Institute at North Dakota State University. ATAC has been involved with several NDDOT ITS initiatives, including the development of a statewide ITS Plan. The architecture development was guided by a NDDOT ITS Architecture Core Team which included representation from NDDOT's IT, districts, design, operations and maintenance, as well as other relevant agencies.

1.1 Report Organization

The NDDOT Statewide ITS Architecture Report is organized into several main sections to facilitate the report use. In addition, an electronic file has been prepared using Turbo Architecture 4.1 in order to access the architecture and make changes or future updates. A listing of the remaining sections of this report is as follows:

2	Region and Scope	Identifies the geographical and architecture scope
3	Stakeholders	Agencies participating in the architecture
4	System Inventory	Existing and planned ITS systems
5	Needs and ITS Services	ITS user services and market packages
6	Operational Concept	Roles and responsibilities of participating agencies
7	Potential Agreements	Anticipated regional agreements to facilitate integration
8	Functional Requirements	High-level description of what the systems will do
9	Interface Requirements	System interconnections and information flows
10	ITS Standards	Brief discussion of applicable ITS standards
11	Sequence of Projects	Time-frame for ITS projects
	Appendix A	NDDOT Market Packages and Information Flows
	Appendix B	Functional Requirements

2.0 REGION AND SCOPE

This section describes the geographical characteristics of the State of North Dakota, relative to the architecture development. It also discusses the scope of the statewide architecture, providing a high-level outline of the range of ITS services and systems used.

2.1 Geographical Boundaries

The geographical areas included in the NDDOT statewide architecture primarily consisted of areas within the state boundaries, with emphasis on systems of statewide significance. The NDDOT Statewide ITS Plan identified the major corridors in the state, including Interstate Highways 29 and 94, major state highways, and other locations of special interest (Figure 2.1). The North Dakota statewide ITS architecture also addresses interfaces with other states/provinces, as well as metropolitan areas in North Dakota.

2.2 Scope of the Architecture

This section describes the scope of the North Dakota Statewide ITS Architecture. The scope is defined using broad ITS user services as well as pointing out possible interface points with other ITS architectures.

2.2.1 Geographical Scope

The NDDOT currently coordinates or plans to coordinate road closures and traveler information functions with several states and Canadian provinces, which include the following:

1. Minnesota
2. Montana
3. Manitoba, Canada
4. South Dakota
5. Saskatchewan, Canada

The NDDOT, Mn/DOT, MTDOT, and SDDOT are part of the North/West Passage, a coalition of states along the I-90 and I-94 corridors which aims at streamlining and coordinating traveler information. The coalition has produced a number of joint projects including a NDDOT and Mn/DOT installation of an automated anti-icing system on the Red River Bridge on I-94 between Fargo, ND and Moorhead, MN. Another project was a traveler information website that provides a single access point to weather and travel information along the entire North/West Passage corridor from Washington to Wisconsin.

In addition, there are also potential interfaces with regional ITS architectures in the state's metropolitan areas covered under the federal ITS Architecture rule, including:

1. Bismarck-Mandan
2. Fargo-Moorhead
3. Grand Forks-East Grand Forks

These areas are also home to NDDOT District offices which handle freeway management, maintenance and construction, and traveler information for the state system. Therefore, these districts interface with both the statewide and the regional ITS architectures at the respective MPOs.

2.2.2 Range of ITS User Services

The scope of the NDDOT statewide ITS architecture may be defined using broad ITS user services targeted for deployment within the state. The delineation of relevant ITS user services assisted in identifying relevant stakeholders and corresponding systems to be included in the statewide architecture. The range of ITS user services includes the following:

1. Travel and Traffic Management
 - a. Traffic control
 - b. Traveler information
 - c. Traffic surveillance
2. Incident Management
 - a. Incident response coordination
3. Information Management
 - a. Data archival and analysis services
4. Maintenance and Construction Management
 - a. Automated treatment (anti-icing systems)
 - b. Winter maintenance
 - c. Work zone and road closure management
5. Transit Management
 - a. Rural transit operations
6. Commercial Vehicle Operations
 - a. Electronic clearance
 - b. Weigh-in-motion

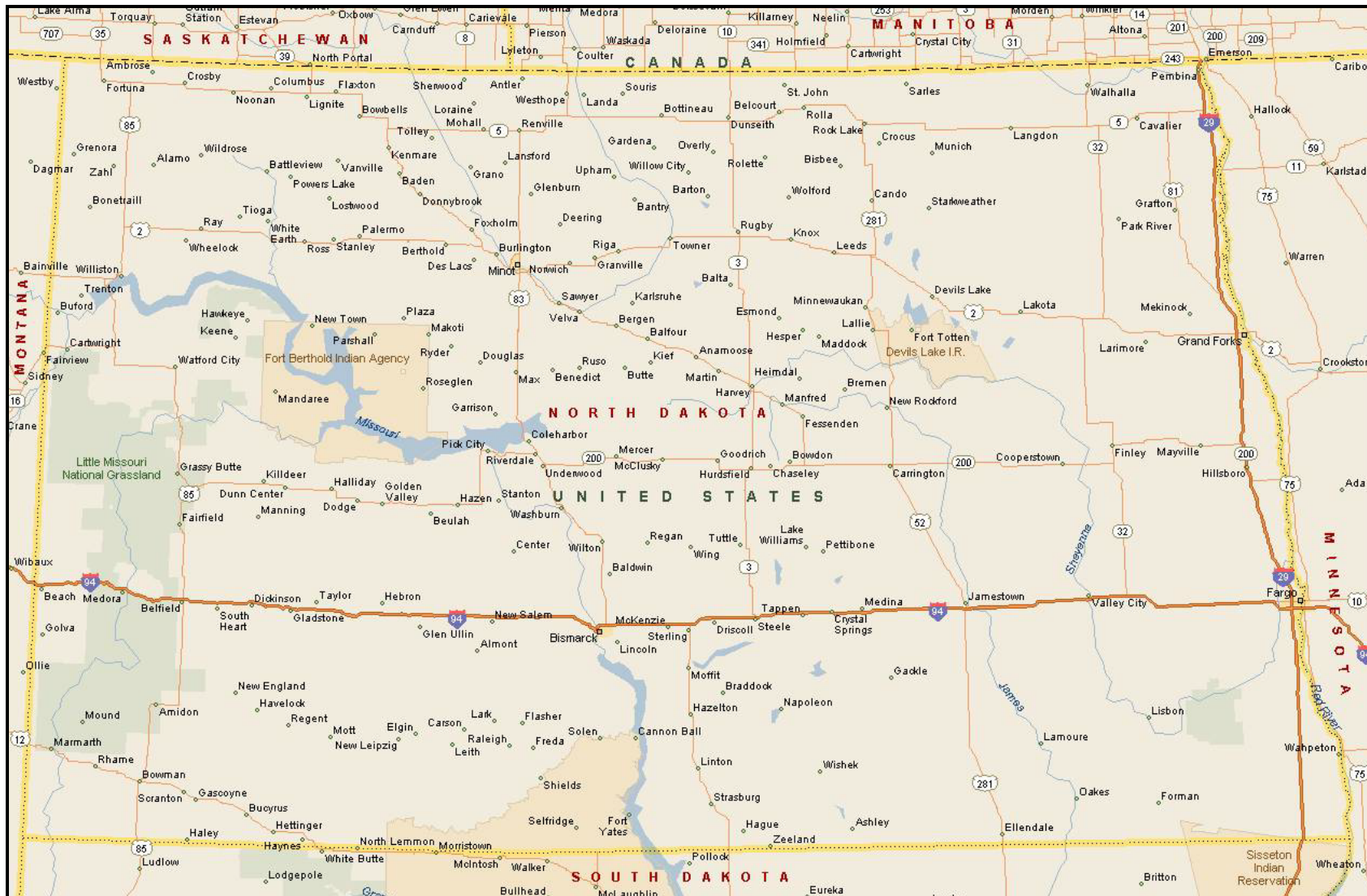


Figure 2.1 Map of the State of North Dakota

3.0 STAKEHOLDERS

This section discusses the stakeholders involved in the North Dakota Statewide ITS Architecture and their respective roles. It should be noted that only stakeholders with a significant role in ITS systems (own, operate, maintain) are included in this discussion.

The NDDOT was the primary stakeholder in the North Dakota Statewide ITS Architecture. Several NDDOT divisions, sections, and districts were involved in the architecture development. In addition, the NDDOT works closely with the North Dakota Highway Patrol, North Dakota Department of Emergency Services, and local governments. A list of primary ITS stakeholders is shown below in Table 3.1.

Table 3.1 North Dakota ITS Stakeholders

Stakeholder	Description	Associated ITS Elements
NDDOT Planning	North Dakota DOT Planning and Programming	NDDOT ATR
		NDDOT Traffic Collection
		NDDOT WIM
NDHP	North Dakota Highway Patrol	NDHP Vehicles
		NDHP Motor Carrier Operations
		NDHP Central Office
NDDOT Maintenance	North Dakota DOT Maintenance	NDDOT Automated Treatment Syst.
		Visitor Centers Kiosks
		NDDOT Maintenance Office
		NDDOT RCRS
		NDDOT Speed Monitoring System
		NDDOT Cameras
		NDDOT DMS
NDDOT RWIS		
Department of Emergency Services	ND Department of Emergency Services	State Radio
		SOC
Meridian	Meridian Environmental Technology Inc	Meridian Forecasting Center
NDDOT Districts	NDDOT Districts	NDDOT District Offices
		NDDOT Maintenance Vehicles
Mn/DOT	Minnesota DOT	Mn/DOT CARS
		Mn/DOT Operations Center
SDDOT	South Dakota DOT	SDDOT IRIS
		SDDOT Operations Center
MTDOT	Montana DOT	MTDOT Operations Center
MSP	Minnesota State Patrol	MSP Central Office
SDHP	South Dakota Highway Patrol	SDHP Central Office
MHP	Montana Highway Patrol	MHP Central Office
NDDOT Construction	North Dakota DOT Construction	NDDOT CARS
NDDOT Transit	NDDOT Transit	NDDOT Transit Center & Vehicles

4.0 SYSTEM INVENTORY

This section summarizes the results of the system inventory process for the NDDOT statewide ITS architecture. The inventory covers systems of statewide significance. Information developed for the inventory was obtained through extensive input from NDDOT ITS stakeholders.

To facilitate the inventory process, the types of systems to be included in the inventory were defined using the National ITS Architecture. More emphasis was placed on the Physical Architecture since it contains most of the ITS hardware. However, additional information about the services provided by various physical ITS entities was also collected. Further, systems were categorized into existing or planned, with planned referring to systems, components, or services which have been identified for future deployment in the region. Using the Physical Architecture, four types of entities were identified for the NDDOT which include: centers, field devices, vehicles, and communications.

These ITS components are explained in greater details in the following subsections. A summary of these components from Turbo Architecture is shown in Section 4.5.

4.1 NDDOT Centers

These are the locations where functions are performed (i.e., process information, issue control commands, and produce output information). Ten centers are possible in the National ITS Architecture that provide management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions. Out of the 10 possible centers, seven were found to apply to the NDDOT statewide ITS architecture. A representation of the NDDOT's Physical Architecture is shown in Figure 4.1.

4.1.1 Traffic Management

The Traffic Management Center (subsystem) monitors and controls traffic and the road network. It communicates with the Roadway Subsystem to monitor and manage traffic flow and monitor the condition of the roadway, surrounding environmental conditions, and field equipment status.

Given the statewide focus of the NDDOT, traffic management activities along major travel corridors in the state are related to traveler information and coordinating incident management. Metropolitan traffic management functions, e.g., traffic control, are covered under regional architectures in the three North Dakota MPOs, including an existing TOC in Fargo and planned TOC's in Bismarck and Grand Forks. However, these functions are included in the statewide architecture to account for traffic control operations in NDDOT districts outside of the three metropolitan areas above.

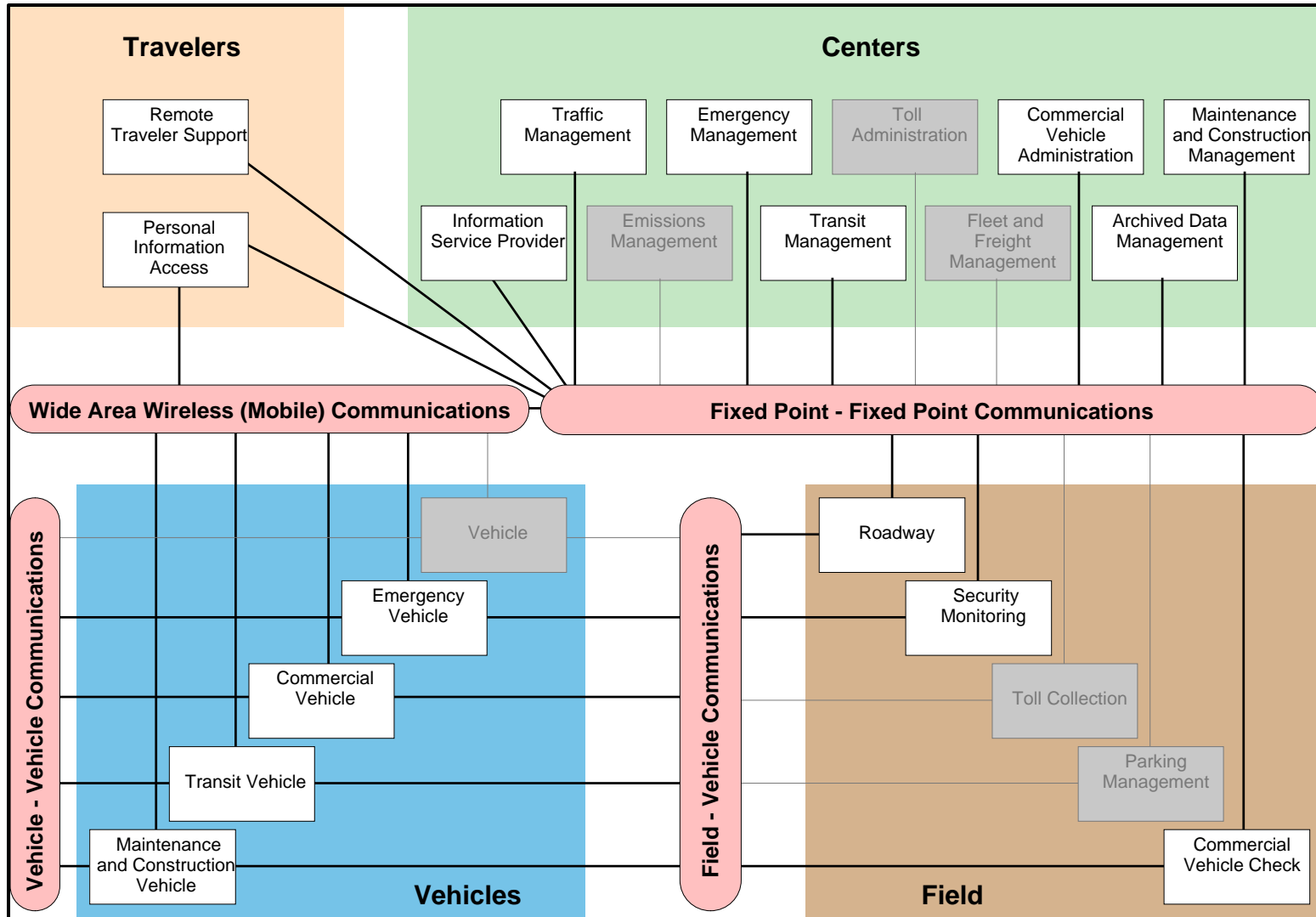


Figure 4.1 NDDOT Physical Architecture

4.1.2 Emergency Management

The North Dakota Department of Emergency Services is the agency in charge of coordinating response to incidents, natural disasters, and homeland security. The division is also responsible for Amber Alert activations in conjunction with the NDHP. It is also in charge of the State Operations Center (SOC) which also includes NDDOT, NDHP, and other agencies. The SOC is activated by the Department of Emergency Services when conditions warrant. The SOC coordinates incident response with local Emergency Operations Centers across the state.

The Department of Emergency Services also encompasses the North Dakota State Radio Communication System as a section within the department. State Radio provides voice radio and mobile data communication capabilities to state agencies (including NDHP) as well as federal, county, and municipal law enforcement and emergency management agencies. It should be noted that larger counties and cities have their own dispatch and communication systems.

4.1.3. Commercial Vehicle Administration

The NDHP Motor Carrier Division is the agency in charge of commercial vehicle operations (CVO) in the state. The division handles permitting and enforcement of load restrictions. The division in partnership with the NDDOT is planning on implementing electronic clearance, and an enhanced commercial vehicle administrative process to include electronic application, processing, fee collection, issuance, and distribution of CVO credentials.

4.1.4 Maintenance and Construction Management

The NDDOT Maintenance Section handles Maintenance and Construction Operations (MCO) for the state and coordinates MCO activities with eight NDDOT Districts. Winter maintenance is a major activity for the NDDOT Maintenance Section. Currently, the fleet of snow plows is not equipped with automated vehicle location (AVL) or other ITS technologies. However, these systems are planned for implementation in the near future. The section also acts as a focal point for road/weather information in the state, including 511 and NDDOT traveler information web page.

4.1.5 Information Service Provider

The NDDOT Maintenance Section handles information service provider (ISP) functions including the collection, processing, and dissemination of transportation information to system operators and the traveling public. The information includes road and weather conditions, incident and response coordination. NDDOT is in the process of developing a new road condition reporting system (RCRS) to facilitate the collection and dissemination of information.

4.1.6 Transit Management

Transit operations at the state level are rural in nature and are handled by the NDDOT Transit Section. The transit section is in the process of implementing a regionalization plan where the state will be covered by eight regional transit centers. Each regional

center will serve as a single point of contact to coordinate route planning, dispatch, and scheduling using AVL.

4.1.7 Archived Data Management

The main data currently collected by the NDDOT relevant to the architecture include weigh-in-motion station data, traffic counting station data, and video surveillance data (limited). Although the NDDOT has access to data from RWIS sensors, the data are processed by a value-added weather information service outside the NDDOT. NDDOT Planning is responsible for storing the majority of traffic data, which are used for transportation planning and road design.

4.2 NDDOT Field Devices

This type of physical entities refers to field devices used to support ITS systems. The majority of NDDOT field devices currently existing or planned may be classified under the Roadway Subsystem. A listing of these devices is as follows:

1. Sensors
 - a. Weather
 - i. RWIS and surface sensors
 - b. Traffic
 - i. ATR
 - ii. WIM
 - c. Surveillance/monitoring
 - i. Video cameras used in conjunction with bridge anti-icing systems
 - ii. Video cameras at RWIS sites
2. Control devices
 - a. Variable speed limit signs
 - b. Fixed automated treatment systems (FAST)
3. Warning/advisory devices
 - a. Portable DMS
 - b. Permanent DMS
 - c. Highway advisory radio (HAR)
 - d. Kiosks at Visitor Centers
 - e. Over-height warning (planned)
 - f. High-wind warning (planned)

4.3 NDDOT Vehicles

Only vehicles with existing or planned ITS capabilities are included, e.g., vehicles with advanced communications, navigation, monitoring, and control systems. Such vehicles include snow plows, emergency vehicles, transit vehicles, and commercial vehicles.

4.4 NDDOT Communication Infrastructure

Given the vast areas covered by the NDDOT architecture, providing effective communication to support ITS devices is a great challenge. The NDDOT has been relying on a mix of wired and wireless communication technologies to support ITS

devices along major rural corridors. Fiber is becoming more available in urban areas of the state and it is increasingly used to support NDDOT Districts and local transportation agencies communication needs. Currently the NDDOT is in the process of updating communications at RWIS sites from analogue to code division multiple access (CDMA) digital modem, the IT division is continuously performing such updates.

4.5 Summary of NDDOT ITS Inventory

Entity	Element	Element Description	Status	Stakeholder
Archived Data Management Subsystem	NDDOT Traffic Collection	NDDOT traffic data collection section	Existing	NDDOT Planning
Commercial Vehicle Administration	NDHP Motor Carrier Operations	North Dakota Highway Patrol oversize/overweight permitting	Existing	NDHP
Commercial Vehicle Check	NDDOT WIM	NDDOT weigh-in-motion stations	Existing	NDDOT Planning
	NDHP CVO Devices	CVO roadside devices for electronic clearance and roadside safety checks	Planned	NDHP
Commercial Vehicle Subsystem	ND Commercial Vehicles	Commercial vehicles traveling in ND	Planned	NDHP
Emergency Management	SOC	State Operations Center	Existing	Department of Emergency Services
	State Radio	North Dakota State Radio	Existing	Department of Emergency Services
Emergency Vehicle Subsystem	NDHP Vehicles	North Dakota Highway Patrol Vehicles	Existing	NDHP
Enforcement Agency	NDHP Central Office	North Dakota Highway Patrol Central Office, Bismarck	Existing	NDHP
Information Service Provider	NDDOT RCRS	North Dakota DOT Road Condition Reporting System	Planned	NDDOT Maintenance
Maintenance and Construction Administrative Systems	NDDOT CARS	NDDOT Construction Automated Records System	Existing	NDDOT Construction
Maintenance and Construction Management	NDDOT Maintenance Office	North Dakota DOT Maintenance Section	Existing	NDDOT Maintenance
	NDDOT District Offices	NDDOT district maintenance and construction centers	Existing	NDDOT Districts
Maintenance and Construction Vehicle	NDDOT Maintenance Vehicles	NDDOT maintenance and construction vehicles	Existing	NDDOT Districts
Media	Media	Radio and television media	Existing	Terminator
Other Emergency Management	MSP Central Office	Minnesota State Patrol Central Office, St Paul	Existing	MSP
	SDHP Central Office	South Dakota Highway Patrol Central Office, Pierre	Existing	SDHP
	MHP Central Office	Montana Highway Patrol Central Office, Helena	Existing	MHP
Other ISP	Mn/DOT CARS	Mn/DOT Condition Acquisition and Reporting System	Existing	Mn/DOT
	SDDOT IRIS	South Dakota DOT Integrated Road Information System	Existing	SDDOT

Entity	Element	Element Description	Status	Stakeholder
Other MCM	MTDOT Operations Center	Montana DOT maintenance and construction operations	Existing	MTDOT
	SDDOT Operations Center	South Dakota DOT maintenance and construction operations	Existing	SDDOT
Other MCM	Mn/DOT Operations Center	Minnesota DOT maintenance and construction operations	Existing	Mn/DOT
Other Roadway	NDDOT DMS	NDDOT statewide DMS system	Existing	NDDOT Maintenance
Personal Information Access	User Personal Computing Devices	Internet enabled personal computing devices	Existing	Terminator
Remote Traveler Support	Visitor Centers Kiosks	North Dakota rest areas kiosks	Existing	NDDOT Maintenance
Roadway Subsystem	NDDOT Automated Treatment Systems	NDDOT statewide automated treatment systems	Existing	NDDOT Districts
	NDDOT ATR	NDDOT automated traffic recorders	Existing	NDDOT Planning
	NDDOT WIM	NDDOT weigh-in-motion stations	Existing	NDDOT Planning
	NDDOT DMS	NDDOT statewide DMS system	Existing	NDDOT Maintenance
	NDDOT RWIS	NDDOT statewide RWIS	Existing	NDDOT Maintenance
	NDDOT Cameras	NDDOT statewide video surveillance system	Planned	NDDOT Maintenance
Security Monitoring Subsystem	NDDOT Cameras	NDDOT statewide video surveillance system	Planned	NDDOT Maintenance
Surface Transportation Weather Service	Meridian Forecasting Center	Meridian Environmental Technologies	Existing	Meridian
Telecommunications System for Traveler Information	ND 511	North Dakota Traveler Information System	Existing	Terminator
Traffic Management	NDDOT Maintenance Office	North Dakota DOT Maintenance Section	Existing	NDDOT Maintenance
	NDDOT District Offices	North Dakota DOT District Maintenance and Traffic Centers	Existing	NDDOT Districts
Transit Management	NDDOT Transit Centers	NDDOT regional transit centers	Existing	NDDOT Transit
Transit Vehicle Subsystem	ND Transit Vehicles	North Dakota transit vehicles	Existing	NDDOT Transit

5.0 NEEDS AND SERVICES

This section describes the ITS user services selected for the NDDOT statewide architecture. These services were largely based on the NDDOT Strategic ITS Plan. NDDOT stakeholders were provided with opportunities to identify additional issues/services throughout the architecture development and update process. To facilitate the discussions with the stakeholders, the results from the inventory were used to identify corresponding ITS user services from the National Architecture. Additional ITS user services were added to address current and future state needs and priorities.

5.1 Needs

The majority of transportation safety and mobility needs for the NDDOT were identified from the NDDOT Strategic ITS Plan, in addition to needs identified through discussion with stakeholders in different service areas. The following is a summary of NDDOT transportation needs relevant to the architecture development:

1. Improve traffic operations and safety
 - a. Incident traffic management
 - b. Work zone and road construction management
 - c. Winter weather impact management
2. Enhance tools for system monitoring and management
 - a. Better system performance data
3. Enhance traveler information and customer service
4. Coordinate emergency and security management
5. Improve rural transit operations
6. Improve commercial vehicle operations

5.2 Services

A set of ITS services was identified by mapping regional transportation needs to the National ITS Architecture. Stakeholders assisted in customizing potential ITS User Services and corresponding market packages to reflect the state needs. Subsection 5.2.1 provides a summary of the ITS User Services while Subsection 5.2.2 outlines NDDOT statewide ITS Market Packages.

5.2.1 NDDOT ITS User Services

1. Travel and Traffic Management
 - a. Pre-trip Travel Information: Includes pre-trip travel information capability to assist travelers in making mode choices, travel time estimates and route decisions prior to trip departure.
 - b. En-route Driver Information: Includes an en route driver information function. It provides vehicle drivers with information, while en route, which will allow alternative routes to be chosen for their destination.

- c. **Traffic Control:** Includes a traffic control function that provides the capability to efficiently manage the movement of traffic on streets and highways.
 - d. **Incident Management:** Includes an incident management function that will identify incidents, formulate response actions and support initiation and ongoing coordination of those response actions.
- 2. **Commercial Vehicle Operations**
 - a. **Commercial Vehicle Electronic Clearance:** Provides commercial vehicle electronic clearance capability.
 - b. **Commercial Vehicle Administrative Processes:** Includes a commercial vehicle administrative process function consisting of electronic purchase of credentials, automated mileage and fuel reporting and auditing, and international border electronic clearance.
 - c. **Hazardous Material Security and Incident Response:** Includes a hazardous materials (HAZMAT) security and incident response service.
- 3. **Emergency Management**
 - a. **Emergency Notification and Personal Security:** Includes an emergency notification and personal security function that provides for faster notification when travelers are involved in an incident.
- 4. **Information Management**
 - a. **Archived Data Function:** Provide an archived data function to control the archiving and distribution of ITS data.
- 5. **Maintenance and Construction Management**
 - a. **Maintenance and Construction Operations:** Provides maintenance and construction operations functions to support monitoring, operating, maintaining, improving and managing the physical condition of roadways, the associated infrastructure equipment and the required resources.
- 6. **Public Transportation Management**
 - a. **Public Transportation Management:** Automates the operations, planning and management functions of public transit systems. It monitors the location of transit vehicles, identifies deviations from the schedule, and offers potential solutions to dispatchers and operators.
 - b. **Public Travel Security:** Creates a secure environment for public transportation patrons, operators, and support staff.

5.2.2 NDDOT Market Packages

The following Market Packages were identified for the NDDOT statewide ITS architecture in support of identified needs and services. The descriptions are based on information from the National ITS Architecture. The status of each Market Package in North Dakota is also indicated (i.e., existing or planned). It should be noted that Market Packages with an Existing followed by an asterisk indicate there are portions of the Market Package already deployed but additional portions are planned for deployment. Customized NDDOT Market Packages and Information Flows are shown in more detail in Appendix A.

Network Surveillance (Existing *)

This market package includes traffic detectors, other surveillance equipment, supporting field equipment, and fixed-point to fixed-point 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.

Surface Street Control (Existing)

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

Traffic Information Dissemination (Existing)

This market package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, emergency alerts and driver advisories. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media, Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time

information on road/bridge closures due to maintenance and construction activities to be disseminated.

Traffic Incident Management System (Existing *)

This market package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. It includes incident detection capabilities through roadside surveillance devices and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as event promoters. This market package supports traffic operations personnel in developing an appropriate response in coordination with other agencies. The response may include traffic control strategy modifications or resource coordination between center subsystems. Incident response also includes presentation of information to affected travelers.

Speed Monitoring (Existing *)

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

Maintenance and Construction Vehicle and Equipment Tracking (Existing *)

This market package will track the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. Activities monitored through this market package include ensuring the correct roads are being plowed and that maintenance work is being performed at the correct locations.

Road Weather Data Collection (Existing)

This market package collects current road and weather conditions using data collected from environmental sensors deployed on the roadway. In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on Maintenance and Construction Vehicles. The collected environmental data is used by the Weather Information Processing and Distribution Market Package to process the information and make decisions on operations.

Weather Information Processing and Distribution (Existing)

This market package processes and distributes the environmental information collected from the Road Weather Data Collection market package. It uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so system operators and decision support systems can make decision on corrective actions to take. The continuing updates of road condition information and current temperatures can be used by system operators

to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers, and aid operators in scheduling work activity.

Roadway Automated Treatment (Existing)

This market package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The market package includes the environmental sensors that detect adverse conditions, and the automated treatment system.

Winter Maintenance (Existing)

This market package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.

Work Zone Management (Existing *)

This market package directs activity in work zones, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity (e.g., traffic management centers) for better coordination management. Work zone speeds and delays are provided to the motorist prior to the work zones.

Maintenance and Construction Activity Coordination (Planned)

This market package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to the Information Service Providers who can provide the information to travelers.

Broadcast Traveler Information (Existing *)

This market package collects traffic conditions, advisories, incident information, roadway maintenance and construction information, and weather information, and broadly disseminates this information through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.

Interactive Traveler Information (Existing *)

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, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. A variety of interactive devices may be used by the traveler to access

information prior to a trip or en route including phone via a 511-like portal, kiosks, and personal computer.

Emergency Call-Taking and Dispatch (Existing)

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

Transportation Infrastructure Protection (Planned)

This market package includes the monitoring of transportation infrastructure for potential threats using sensors and surveillance equipment and barrier and safeguard systems to preclude an incident, control access during and after an incident or mitigate impact of an incident. Threats can result from acts of nature, terrorist attacks or other incidents causing damage to the infrastructure.

Wide-Area Alert (Existing *)

This market package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in certain scenarios. ITS technologies supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information web sites.

Disaster Response and Recovery (Existing *)

This market package enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters and technological and man-made disasters. The market package supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The market package provides enhanced access to the scene for response

personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In addition, this market package tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response.

Evacuation and Reentry Management (Existing *)

This market package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. It addresses evacuations for all types of disasters, natural and man-made. This market package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity.

Disaster Traveler Information (Existing *)

This market package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This market package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems.

ITS Data Warehouse (Planned)

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.

Electronic Clearance (Planned)

This market package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle

Administration subsystem to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and Field-Vehicle Communications to the roadside. Results of roadside clearance activities will be passed on to the Commercial Vehicle Administration. The roadside check facility may be equipped with Automated Vehicle Identification (AVI), weighing sensors, transponder read/write devices and computer workstations.

CV Administrative Process (Planned)

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 roadside check facilities. 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 roadside check facilities at the roadside to support the electronic clearance process.

Commercial Vehicle Administration subsystems can share credential information with other Commercial Vehicle Administration subsystems, so that it is possible for any Commercial Vehicle Administration subsystem to have access to all credentials, credential fees, credentials status and safety status information. In addition, it is possible for one Commercial Vehicle Administration subsystem to collect HAZMAT route restrictions information from other Commercial Vehicle Administration subsystems and then act as a clearinghouse for this route restrictions information for Information Service Providers, Map Update Providers, and Fleet and Freight Management subsystems.

International Border Electronic Clearance (Planned)

This market package provides for automated clearance at international border crossings. It augments the Electronic Clearance market package by allowing interface with border administration and border inspection related functions. This market package processes the entry documentation for vehicle, cargo, and driver, checks compliance with import/export and immigration regulations, handles duty fee processing, and reports the results of the crossing event to manage release of commercial vehicle, cargo, and driver across an international border. It interfaces with administrative systems used by customs and border protection, immigration, carriers, and service providers (e.g., brokers) and inspection systems at international border crossings to generate, process, and store entry documentation.

Weigh-In-Motion (Planned)

This market package provides for high speed weigh-in-motion with or without Automated Vehicle Identification (AVI) capabilities. This market package provides the roadside equipment that could be used as a stand-alone system or to augment the Electronic Clearance (CVO03) market package.

Roadside CVO Safety (Planned)

This market package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at the roadside check locations. The capabilities for performing the safety inspection are shared between this market package and the On-board CVO and Freight Safety & Security (CVO08) 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 off the highway, perhaps as a result of the automated screening process provided by the Electronic Clearance (CVO03) 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 and Freight Safety & Security (CVO08) market package, utilize additional on-board vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

Transit Vehicle Tracking (Planned)

This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update 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.

Demand Response Transit Operations (Planned)

This market package performs automated dispatch and system monitoring for demand responsive transit services. This service performs scheduling activities as well as operator assignment. In addition, this market package performs similar functions to support dynamic features of flexible-route transit services. This package monitors the 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. This service includes the capability for a traveler request for personalized transit services to be made through the Information Service Provider (ISP) Subsystem. The ISP may either be operated by a 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 paratransit service. In the second scenario, a third party service provider determines that the paratransit service is a viable means of satisfying a traveler request and makes a reservation for the traveler.

Transit Fare Collection Management (Planned)

This market package manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device. Readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem.

Transit Security (Planned)

This market package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment is deployed to perform surveillance and sensor monitoring in order to warn of potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems.

Transit Fleet Management (Planned)

This market package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules preventative and corrective maintenance. The market package also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks.

Transit Passenger Counting (Planned)

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

6.0 OPERATIONAL CONCEPT

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

The roles and responsibilities discussion under the operational concept may be categorized into implementation roles and operational roles. Implementation roles include project development, coordination, funding, and future maintenance. Operational roles focus on the technical aspects of how ITS services are performed and explore information sharing amongst the various stakeholders.

Customized NDDOT Market Packages were used for facilitating the operational concept development. Using Market Package graphics, stakeholders were able to identify their roles for given events, current links with other stakeholders, and additional links and/or coordination that could be achieved.

The mechanism for obtaining stakeholders' input relied on using small groups of stakeholders relevant to each Market Package. Once the small group discussions were completed, the results (the customized Market Packages) were presented to all the stakeholders participating in the architecture development.

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

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

6.1 Implementation Roles

Market Package	Stakeholders with Implementation Roles
Network Surveillance	NDDOT Operations & Maintenance
Traffic Information Dissemination	NDDOT Operations & Maintenance
Traffic Incident Management	NDDOT Operations & Maintenance; NDHP, Department of Emergency Services
Speed Monitoring	NDDOT Operations, NDHP
Maintenance and Construction Vehicle and Equipment Tracking	NDDOT Maintenance
Road Weather Data Collection	NDDOT Maintenance
Weather Information Processing and Distribution	NDDOT Maintenance Meridian
Roadway Automated Treatment	NDDOT Maintenance NDDOT Districts
Winter Maintenance	NDDOT Maintenance NDDOT Districts
Work Zone Management	NDDOT Operations and Maintenance NDDOT Districts
Maintenance and Construction Activity Coordination	NDDOT Maintenance
Broadcast Traveler Information	NDDOT Operations and Maintenance
Interactive Traveler Information	NDDOT Operations and Maintenance
Emergency Call-Taking and Dispatch	State Radio
Transportation Infrastructure Protection	NDHP, NDDOT Operations and Maintenance
Wide-Area Alert	Department of Emergency Services State Radio NDHP
Disaster Response and Recovery	Department of Emergency Services NDDOT Operations and Maintenance NDHP
Evacuation and Reentry Management	Department of Emergency Services NDDOT Operations and Maintenance NDHP
Disaster Traveler Information	Department of Emergency Services NDDOT Operations and Maintenance NDHP
Transit Vehicle Tracking	NDDOT Transit
Demand Response Transit Operations	NDDOT Transit
Transit Fare Collection Management	NDDOT Transit
Transit Security	NDDOT Transit

Market Package	Stakeholders with Implementation Roles
Transit Fleet Management	NDDOT Transit
Transit Passenger Counting	NDDOT Transit
Electronic Clearance	NDHP Motor Carrier Operations
Commercial Vehicle Administrative Process	NDHP Motor Carrier Operations
International Border Electronic Clearance	NDHP Motor Carrier Operations
Weigh-In-Motion	NDHP Motor Carrier Operations
Roadside CVO Safety	NDHP Motor Carrier Operations
ITS Data Warehouse	NDDOT Operations and Maintenance

6.2 Operational Roles and Responsibilities

Responsibility Area	Stakeholder	Role
Archived Data Systems	NDDOT Planning	Collect and summarize data from ATR and WIM systems
Commercial Vehicle Operations	NDHP	<ol style="list-style-type: none"> 1. Issue permits 2. Perform enforcement
Emergency Management	Department of Emergency Services	<ol style="list-style-type: none"> 1. Coordinate emergency plans with other federal, state, and local agencies 2. Develop statewide emergency plans 3. Issue Amber Alerts
	NDDOT Maintenance	<ol style="list-style-type: none"> 1. Broadcast emergency alerts on DMS and 511 2. Coordinate emergency plans
	NDHP	Coordinate emergency response with county, local, and other states/provinces law enforcement
Freeway Management	NDDOT Maintenance	Disseminate traffic information
	NDHP	Provide traffic control
Incident Management	Department of Emergency Services	Provide dispatch and communications for NDHP
	MHP	Share incident information
	Mn/DOT	Coordinate response resources
	MSP	Share incident information
	MTDOT	Coordinate response resources
	NDDOT Districts	Coordinate response resources
	NDDOT Maintenance	<ol style="list-style-type: none"> 1. Provide resources 2. Provide road network conditions 3. Provide video surveillance control to NDHP
	NDHP	<ol style="list-style-type: none"> 1. Coordinate incident response with county, local, and other states/provinces law enforcement 2. Respond to incidents
	SDDOT	Coordinate response resources
SDHP	Share incident information	

Responsibility Area	Stakeholder	Role
Maintenance and Construction	Mn/DOT	Share winter maintenance information
	MTDOT	Share winter maintenance information
Maintenance and Constriction	NDDOT Districts	1. Coordinate with city public works departments 2. Perform winter maintenance
	NDDOT Maintenance	1. Control automated treatment systems 2. Coordinate winter maintenance with districts 3. Share winter maintenance information
	SDDOT	Share winter maintenance information
Transit Management	NDDOT Transit	Provide rural transit services
Traveler Information	Department of Emergency Services	Issue emergency alerts
	Meridian	1. Operate ND 511 system 2. Provide weather information
	NDDOT Maintenance NDDOT Maintenance	1. Broadcast traveler information on DMS and 511 2. Provide road conditions to RCRS
	NDHP NDHP	1. Make road closure decisions 2. Relay road conditions to NDDOT

7.0 AGREEMENTS

This section briefly outlines potential agreements needed to support the NDDOT Statewide ITS architecture. The process of identifying needed agreements relied on the Market Packages to identify potential roles and responsibilities, as well as interfaces. Anytime agencies shared operations of a system or shared formal access to system control and data, a potential agreement was flagged. Discussions with stakeholders helped in finalizing the list of agreements, taking into consideration existing agreements with other agencies that they have in place, as well as their own agency requirements. A summary of potential agreements between the NDDOT and other stakeholders in North Dakota is shown in Table 7.1, which provides the following information for each agreement:

1. Market Package: the Market Package where the agreement is needed
2. Purpose: brief statement on what the agreement addresses
3. Stakeholders: list the stakeholders (agencies) which would be included in the agreement
4. Issues: list specific issues to be included in the agreement

Table 7.1. Potential Stakeholders Agreement

Market Packages	Purpose	Stakeholders	Issues
ATMS01-Network Surveillance	Share network data	NDDOT Office of Operations, NDHP	Access to monitoring devices and data
EM06-Wide-Area Alert	Amber Alert	NDDOT Office of Operations ND Highway Patrol State Emergency Management	Use of NDDOT assets Communications links
EM08-Disaster Response and Recovery	Disaster response coordination	NDDOT Office of Operations ND Highway Patrol State Emergency Management	Protocols Communications links
EM09-Evacuation and Reentry Management	Disaster response coordination	NDDOT Office of Operations ND Highway Patrol State Emergency Management	Protocols Communications links
EM10-Disaster Traveler Information	Disaster information coordination	NDDOT Office of Operations ND Highway Patrol NDDOT Public Info Office	Access to data/information Communications links
MC03-Road Weather Data Collection	Access weather data	NDDOT Maintenance Meridian	Security, resource sharing
MC04-Weather Info Processing and Distribution	511	NDDOT Maintenance Meridian, Mn/DOT, SDDOT, MTDOT	Maintain/operate ND 511 Security, resource sharing
MC05-Roadway Automated Treatment	Red River Bridge part of the North/West Passage	NDDOT Maintenance, Mn/DOT	Share operations Share information/data

8.0 FUNCTIONAL REQUIREMENTS

This section discusses detailed functional requirements for the user services and market packages identified for the NDDOT. The requirements were selected from the National ITS Architecture template based on desired functions for each system. Turbo Architecture was used to build the functional requirements and produce a Functional Requirements Report. The organization of the Functional Requirements Report produced by Turbo may be described as follows:

1. Element: Subsystems or Centers in the regional architecture
2. Entity: stakeholders in the statewide architecture
3. Functional Area: ITS Market Package service area
4. Requirements: specific functions to be carried out by the system
5. Status: existing or planned

Due to the length of the Functional Requirements Report, it is included in Appendix B. An example of the information provided in the report is provided in Figure 8.1.

ND Statewide Regional ITS Architecture (Region)		
<i>Element:</i> NDDOT Maintenance Office		
<i>Entity:</i> Maintenance and Construction Management		
<i>Functional Area:</i> MCM Winter Maintenance Management		
		Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.
<i>Requirement:</i>	1 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	Existing
<i>Requirement:</i>	6 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	Existing
<i>Requirement:</i>	11 The center shall assess the current status of all winter maintenance activities, including actual work activities performed, current locations and operational conditions of vehicles, materials and equipment inventories, field equipment status, environmental information, etc.	Existing

Figure 8.1. Example of Functional Requirements

9.0 INTERFACE REQUIREMENTS

This section outlines the possible interconnects in the NDDOT statewide ITS architecture. Potential interfaces were identified initially using Market Packages to reflect existing and planned information flows. The following summary table uses output from Turbo Architecture that shows potential information flows for each Market Package in the NDDOT statewide architecture. For each functional area, the table shows information flows between entities and the status of the flow are provided in Table 9.1.

Table 9.1. Potential ITS Interfaces

Network Surveillance		
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT RCRS	NDDOT Maintenance Office	Planned
Surface Street Control		
NDDOT District Offices	NDDOT District Devices	Existing
Traffic Information Dissemination		
Media	NDDOT Maintenance Office	Existing
NDDOT Automated Treatment Systems	NDDOT DMS	Planned
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	State Radio	Existing
Traffic Incident Management		
MHP Central Office	State Radio	Existing
Mn/DOT Operations Center	NDDOT Maintenance Office	Planned
MSP Central Office	State Radio	Existing
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT RCRS	State Radio	Planned
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
NDHP Vehicles	State Radio	Existing
SDHP Central Office	State Radio	Existing

Speed Monitoring		
NDDOT Maintenance Office	NDDOT Speed Monitoring System	Planned
NDDOT Maintenance Office	NDHP Central Office	Planned
NDDOT Speed Monitoring System	NDHP Central Office	Planned
Electronic Clearance		
NDHP CVO Devices	NDHP Motor Carrier Operations	Planned
ND Commercial Vehicles	NDHP CVO Devices	Planned
ND Commercial Vehicles	NDDOT WIM	Existing
CV Administrative Process		
NDDOT District Offices	NDHP Motor Carrier Operations	Existing
NDDOT Maintenance Office	NDHP Motor Carrier Operations	Existing
NDDOT RCRS	NDHP Motor Carrier Operations	Existing
NDHP Central Office	NDHP Motor Carrier Operations	Existing
International Border Electronic Clearance		
NDHP CVO Devices	NDHP Motor Carrier Operations	Planned
ND Commercial Vehicles	NDHP CVO Devices	Planned
ND Commercial Vehicles	NDDOT WIM	Existing
Weigh-In-Motion		
ND Commercial Vehicles	NDDOT WIM	Existing
ND Commercial Vehicles	NDHP CVO Devices	Planned
Roadside CVO Safety		
ND Commercial Vehicles	NDDOT WIM	Existing
ND Commercial Vehicles	NDHP CVO Devices	Planned
NDHP CVO Devices	NDHP Motor Carrier Operations	Planned
NDHP Central Office	NDHP Motor Carrier Operations	Existing
MCO Vehicle Tracking		
NDDOT District Offices	NDDOT Maintenance Vehicles	Existing
NDDOT Maintenance Office	NDDOT Maintenance Vehicles	Existing
Roadway Weather Collection		
Meridian Forecasting Center	NDDOT Automated Treatment Systems	Existing
Meridian Forecasting Center	NDDOT Maintenance Office	Existing
Meridian Forecasting Center	NDDOT RWIS	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Vehicles	Planned
NDDOT Maintenance Office	NDDOT Maintenance Vehicles	Existing
NDDOT Maintenance Office	NDDOT RWIS	Existing
Weather Information Processing		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing

Meridian Forecasting Center	NDDOT District Offices	Existing
Meridian Forecasting Center	NDDOT RCRS	Planned
Meridian Forecasting Center	NDDOT Maintenance Office	Existing
Meridian Forecasting Center	State Radio	Existing
Mn/DOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
Roadway Automated Treatment		
NDDOT Automated Treatment Systems	NDDOT District Offices	Existing
NDDOT Automated Treatment Systems	NDDOT DMS	Planned
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Cameras	NDDOT District Offices	Planned
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT DMS	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
Winter Maintenance		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing
Meridian Forecasting Center	NDDOT District Offices	Existing
Meridian Forecasting Center	NDDOT Maintenance Office	Existing
Mn/DOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT Maintenance Vehicles	Existing
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	NDDOT Maintenance Vehicles	Existing
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
Work Zone Management		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing
Mn/DOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT Automated Treatment Systems	NDDOT District Offices	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Cameras	NDDOT District Offices	Planned

NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT CARS	NDDOT District Offices	Existing
NDDOT CARS	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT DMS	Existing
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
Maintenance and Construction Activity Coordination		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing
Mn/DOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT CARS	NDDOT District Offices	Existing
NDDOT CARS	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	NDHP Motor Carrier Operations	Existing
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
Broadcast Traveler Information		
Media	NDDOT RCRS	Planned
Meridian Forecasting Center	NDDOT RCRS	Planned
Mn/DOT CARS	NDDOT RCRS	Planned
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT RCRS	SDDOT IRIS	Planned
NDDOT RCRS	State Radio	Planned
NDDOT RCRS	User Personal Computing Devices	Planned
NDDOT RCRS	Visitor Centers Kiosks	Planned
Interactive Traveler Information		
Media	NDDOT RCRS	Planned
Meridian Forecasting Center	NDDOT RCRS	Planned
Mn/DOT CARS	NDDOT RCRS	Planned
ND 511	NDDOT RCRS	Planned
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT RCRS	SDDOT IRIS	Planned
NDDOT RCRS	State Radio	Planned
NDDOT RCRS	User Personal Computing Devices	Planned
NDDOT RCRS	Visitor Centers Kiosks	Planned
Emergency Call Taking and Dispatch		
MHP Central Office	State Radio	Existing
MSP Central Office	State Radio	Existing

NDDOT Maintenance Office	State Radio	Existing
NDHP Vehicles	State Radio	Existing
SDHP Central Office	State Radio	Existing
Infrastructure Protection		
MHP Central Office	State Radio	Existing
MSP Central Office	State Radio	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT Cameras	State Radio	Planned
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	State Radio	Existing
State Radio	Visitor Centers Kiosks	Planned
Wide Area Alert		
MHP Central Office	SOC	Existing
MHP Central Office	State Radio	Existing
MSP Central Office	SOC	Existing
MSP Central Office	State Radio	Existing
ND 511	NDDOT RCRS	Planned
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT District Offices	SOC	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT RCRS	SOC	Planned
NDDOT RCRS	State Radio	Planned
NDDOT RCRS	User Personal Computing Devices	Planned
NDDOT RCRS	Visitor Centers Kiosks	Planned
NDDOT Maintenance Office	SOC	Existing
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	SOC	Existing
SDHP Central Office	State Radio	Existing
SOC	State Radio	Existing
Disaster Response and Recovery		
MHP Central Office	SOC	Existing
MHP Central Office	State Radio	Existing
MSP Central Office	SOC	Existing
MSP Central Office	State Radio	Existing
NDDOT Maintenance Office	SOC	Existing
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	SOC	Existing
SDHP Central Office	State Radio	Existing
SOC	State Radio	Existing

Evacuation and Reentry Management		
MHP Central Office	SOC	Existing
MHP Central Office	State Radio	Existing
MSP Central Office	SOC	Existing
MSP Central Office	State Radio	Existing
NDDOT District Offices	SOC	Existing
NDDOT Maintenance Office	SOC	Existing
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	SOC	Existing
SDHP Central Office	State Radio	Existing
SOC	State Radio	Existing
Disaster Traveler Information		
Media	SOC	Existing
Media	State Radio	Existing
Meridian Forecasting Center	NDDOT RCRS	Planned
ND 511	NDDOT RCRS	Planned
NDDOT RCRS	NDDOT Maintenance Office	Planned
NDDOT RCRS	SOC	Planned
NDDOT RCRS	State Radio	Planned
NDDOT RCRS	User Personal Computing Devices	Planned
NDDOT RCRS	Visitor Centers Kiosks	Planned
Transit Vehicle Tracking		
ND Transit Vehicle	NDDOT Transit Centers	Planned
Demand Response Transit Operations		
ND Transit Vehicle	NDDOT Transit Centers	Planned
Transit Fare Collection Management		
ND Transit Vehicles	NDDOT Transit Centers	Planned
Transit Security		
ND Transit Vehicles	NDDOT Transit Centers	Planned
ND Transit Vehicles	State Radio	Planned
NDDOT Transit Centers	State Radio	Planned
Transit Fleet Management		
ND Transit Vehicles	NDDOT Transit Centers	Planned
Transit Passenger Counting		
ND Transit Vehicles	NDDOT Transit Centers	Planned
ITS Data Warehouse		
NDDOT ATR	NDDOT Traffic Collection	Existing
NDDOT Maintenance Office	NDDOT Traffic Collection	Planned
NDDOT Traffic Collection	NDDOT WIM	Existing

10.0 ITS STANDARDS

This section identifies applicable ITS Standards identified for the NDDOT statewide ITS architecture. It should be noted that the development of ITS Standards is an ongoing process. Therefore, the set of applicable ITS standards should be updated as new standards are approved. The table below shows applicable standards based on Turbo Architecture output are shown in Table 10.1.

Table 10.1. ITS Standards.

Standard Name	Document ID
NTCIP Center-to-Center Standards Group	NTCIP 1102 NTCIP 1104 NTCIP 1105 NTCIP 1106 NTCIP 2104 NTCIP 2202 NTCIP 2303 NTCIP 2304 NTCIP 2305 NTCIP 2501 NTCIP 2502
NTCIP Center-to-Field Standards Group	NTCIP 1101 NTCIP 1102 NTCIP 1103 NTCIP 2101 NTCIP 2102 NTCIP 2103 NTCIP 2104 NTCIP 2201 NTCIP 2202 NTCIP 2301 NTCIP 2302 NTCIP 2303
Global Object Definitions	NTCIP 1201
Global Object Definitions for Dynamic Message Signs	NTCIP 1203
Object Definitions for Environmental Sensor Stations and Roadside Weather Information System	NTCIP 1204
Data Dictionary for Closed Circuit Television (CCTV)	NTCIP 1205
Data Collection and Monitoring Devices	NTCIP 1206
Object Definition for Video Switches	NTCIP 1208
Transportation System Sensor Objects	NTCIP 1209
Incident Management Standards Group	IEEE 1512.1-2003 IEEE 1512.3-2002 IEEE 1512-2000 IEEE P1512.2
Standard for Functional Level Traffic Management Data Dictionary (TMDD)	ITE TM 1.03

Standard Name	Document ID
Message Sets for External TMC Communication (MS/ETMCC)	ITE TM 2.01
Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group	SAE J2266 SAE J2354 SAE J2369 SAE J2529 SAE J2540 SAE J2540-1 SAE J2540-2 SAE J2540-3 SAE J2630
Advanced Traveler Information Systems (ATIS) General Use Standards Group	SAE J2266 SAE J2354 SAE J2529 SAE J2540 SAE J2540-1 SAE J2540-2 SAE J2540-3 SAE J2630
Dedicated Short Range Communication at 5.9 GHz Standards Group	IEEE 1609.1 IEEE 1609.2 IEEE 1609.3 IEEE 1609.4 IEEE 802.11 IEEE 802.2 ISO 21210

11.0 PROJECTS SEQUENCE

This section briefly outlines possible time frame for deployment for selected NDDOT ITS projects. Market Packages are arranged into short, medium, and long-term deployment categories. It should be noted that not all of the planned services have been fully developed into ITS projects yet. Please note that Market Packages are organized in the same order they appear in the National ITS Architecture (Table 11.1).

Table 11.1. Market Package Implementation Time Frame.

Market Package	Time Frame
Network Surveillance	Short-Medium
Traffic Information Dissemination	Short
Traffic Incident Management	Short
Speed Monitoring	Medium-Long
Maintenance and Construction Vehicle and Equipment Tracking	Short
Road Weather Data Collection	Short
Weather Information Processing and Distribution	Short
Roadway Automated Treatment	Short
Winter Maintenance	Short
Work Zone Management	Short-Medium
Maintenance and Construction Activity Coordination	Medium
Broadcast Traveler Information	Short
Interactive Traveler Information	Short-Medium
Emergency Call-Taking and Dispatch	Short
Transportation Infrastructure Protection	Medium-Long
Wide-Area Alert	Short
Disaster Response and Recovery	Medium-Long
Evacuation and Reentry Management	Medium-Long
Disaster Traveler Information	Short-Medium
ITS Data Warehouse	Medium-Long

11.1 Statewide ITS Architecture Maintenance

The NDDOT Maintenance Section is designated with the role of maintaining and updating the NDDOT Statewide ITS Architecture. The maintenance process will follow a two-year cycle, with additional updates when major ITS projects are implemented. The maintenance process will be accomplished through a partnership between the NDDOT and the Advanced Traffic Analysis Center.

APPENDIX-A

NDDOT MARKET PACKAGES AND INFORMATION FLOWS

The Market Package Diagrams are available electronically at:

<http://www.atacenter.org/regional/northdakota/>

Viewing electronically will allow for zooming and panning which is needed for the diagrams readability.

APPENDIX-B
NDDOT FUNCTIONAL REQUIREMENTS

Functional Requirements ND Statewide (Region)



Architecture	Status
ND Statewide (Region)	(Region)
<i>Element: ND Transit Vehicles</i>	
<i>Entity: Transit Vehicle Subsystem</i>	
<i>Functional Area: On-board Passenger Counting</i> On-board systems collect transit vehicle loading data and make it available to the center.	
<i>Requirement:</i>	Planned
1 The transit vehicle shall count passengers boarding and alighting.	
<i>Requirement:</i>	Planned
2 The passenger counts shall be related to location to support association of passenger counts with routes, route segments, or bus stops.	
<i>Requirement:</i>	Planned
3 The passenger counts shall be timestamped so that ridership can be measured by time of day and day of week.	
<i>Requirement:</i>	Planned
4 The transit vehicle shall send the collected passenger count information to the transit center.	
<i>Element: NDDOT ATR</i>	
<i>Entity: Roadway Subsystem</i>	
<i>Functional Area: Roadway Basic Surveillance</i> Field elements that monitor traffic conditions using loop detectors and CCTV cameras.	
<i>Requirement:</i>	Existing
1 The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.	
<i>Functional Area: Roadway Data Collection</i> Field elements to collect traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications. Includes the sensors, supporting roadside infrastructure, and communications equipment.	
<i>Requirement:</i>	Planned
1 The field element shall collect traffic, road, and environmental conditions information.	
<i>Element: NDDOT Cameras</i>	
<i>Entity: Roadway Subsystem</i>	
<i>Functional Area: Roadway Basic Surveillance</i> Field elements that monitor traffic conditions using loop detectors and CCTV cameras.	
<i>Requirement:</i>	Planned
2 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	
<i>Element: NDDOT District Offices</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Functional Area: MCM Vehicle Tracking</i> Remotely tracks the location of maintenance and construction vehicles and other equipment; presented to the center personnel.	
<i>Requirement:</i>	Existing
1 The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element:</i> NDDOT District Offices	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Vehicle Tracking Remotely tracks the location of maintenance and construction vehicles and other equipment; presented to the center personnel.	
<i>Requirement:</i>	Existing
2	The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.
<hr/> <hr/>	
<i>Functional Area:</i> MCM Automated Treatment System Control Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.	
<i>Requirement:</i>	Existing
1	The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.
<i>Requirement:</i>	Existing
2	The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.
<i>Requirement:</i>	Existing
3	The center shall collect automated roadway treatment system and associated environmental sensor operational status.
<i>Requirement:</i>	Existing
4	The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.
<i>Requirement:</i>	Existing
5	The center shall accept requests for automated roadway treatment system activation from center personnel.
<hr/> <hr/>	
<i>Functional Area:</i> MCM Winter Maintenance Management Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.	
<i>Requirement:</i>	Existing
1	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.
<i>Requirement:</i>	Existing
7	The center shall dispatch and route winter maintenance vehicle drivers and support them with route- specific environmental, incident, advisory, threat, alert, and traffic congestion information.
<i>Requirement:</i>	Existing
8	The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.
<i>Requirement:</i>	Existing
9	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.
<hr/> <hr/>	
<i>Element:</i> NDDOT Maintenance Office	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Vehicle Tracking	

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element:</i> NDDOT Maintenance Office	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Vehicle Tracking Remotely tracks the location of maintenance and construction vehicles and other equipment; presented to the center personnel.	
<i>Requirement:</i>	1 The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction. Planned
<i>Requirement:</i>	2 The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment. Planned
<i>Functional Area:</i> MCM Environmental Information Collection Remotely controls environmental sensors and assimilates collected data with environmental probe data and other current and forecast road conditions and surface weather information from weather service providers and transportation operations.	
<i>Requirement:</i>	1 The center shall remotely control environmental sensors that measure road surface temperature, moisture, icing, salinity, and other measures. Planned
<i>Requirement:</i>	2 The center shall remotely control environmental sensors that measure weather conditions including temperature, wind, humidity, precipitation, and visibility. Planned
<i>Requirement:</i>	5 The center shall assimilate current and forecast road conditions and surface weather information using a combination of weather service provider information (such as the National Weather Service and value-added sector specific meteorological services), data from traffic and traveler information providers, and environmental data collected from sensors deployed on and about the roadway as well as the fleet of maintenance and construction vehicles and the broader population of vehicle probes. Existing
<i>Requirement:</i>	8 The center shall collect operational status for the roadside and vehicle-based environmental sensor equipment. Planned
<i>Functional Area:</i> MCM Automated Treatment System Control Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.	
<i>Requirement:</i>	1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc. Existing
<i>Requirement:</i>	2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems. Existing
<i>Requirement:</i>	3 The center shall collect automated roadway treatment system and associated environmental sensor operational status. Existing
<i>Requirement:</i>	4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair. Existing
<i>Requirement:</i>	5 The center shall accept requests for automated roadway treatment system activation from center personnel. Existing
<i>Functional Area:</i> MCM Incident Management	

Architecture

Status

ND Statewide (Region)

(Region)

Element: **NDDOT Maintenance Office**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Incident Management**

Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.

Requirement: 1 The center shall receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System. Existing

Requirement: 4 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations. Existing

Requirement: 5 The center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers. Existing

Requirement: 6 The center shall exchange road network status assessment information with emergency management and traffic management centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery. Existing

Requirement: 7 The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts. Existing

Requirement: 8 The center shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management. Existing

Functional Area: **MCM Winter Maintenance Management**

Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.

Requirement: 1 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance. Existing

Requirement: 6 The center shall collect real-time information on the state of the regional transportation system from other centers including current traffic and road conditions, weather conditions, special event and incident information and use the collected information to support winter maintenance operations. Existing

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element:</i> NDDOT Maintenance Office	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Winter Maintenance Management Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.	
<i>Requirement:</i> 11	The center shall assess the current status of all winter maintenance activities, including actual work activities performed, current locations and operational conditions of vehicles, materials and equipment inventories, field equipment status, environmental information, etc. Existing
<i>Entity:</i> Traffic Management	
<i>Functional Area:</i> TMC Traffic Information Dissemination Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.	
<i>Requirement:</i> 1	The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers. Existing
<i>Requirement:</i> 3	The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.). Existing
<i>Functional Area:</i> TMC Evacuation Support Development, coordination, and execution of special traffic management strategies during evacuation and subsequent reentry of a population in the vicinity of a disaster or major emergency. Interfaces with emergency management and other traffic management centers.	
<i>Requirement:</i> 1	The center shall coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc. Planned
<i>Requirement:</i> 2	The center shall support requests from emergency management centers to preempt the current traffic control strategy, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems to support evacuation traffic control plans. Planned
<i>Requirement:</i> 3	The center shall coordinate information and controls with other traffic management centers. Planned
<i>Requirement:</i> 4	The center shall coordinate execution of evacuation strategies with emergency management centers - including activities such as setting closures and detours, establishing routes, updating areas to be evacuated, timing the process, etc. Planned
<i>Functional Area:</i> Traffic Data Collection Collection and storage of traffic management data. For use by operations personnel or data archives in the region.	
<i>Requirement:</i> 1	The center shall collect traffic management data such as operational data, event logs, etc. Planned

*Element:***NDDOT Maintenance Vehicles**

*Entity:***Maintenance and Construction Vehicle**

Functional Area: **MCV Vehicle Location Tracking**

On-board systems to track vehicle location and reports the position and timestamp information to the dispatch center.

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element:</i> NDDOT Maintenance Vehicles	
<i>Entity:</i> Maintenance and Construction Vehicle	
<i>Functional Area:</i> MCV Vehicle Location Tracking On-board systems to track vehicle location and reports the position and timestamp information to the dispatch center.	
<i>Requirement:</i>	1 The maintenance and construction vehicle shall track its current location. Existing
<i>Requirement:</i>	2 The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center. Existing
<i>Functional Area:</i> MCV Environmental Monitoring On-board systems that collect environmental and road condition data (including road surface or air temperature, wind speed, and road traction information - spatially located and time stamped) from sensors on-board the maintenance vehicle or located at the roadway.	
<i>Requirement:</i>	1 The maintenance and construction vehicle shall collect environmental data from on-board sensors, including air temperature, wind speed, surface temperature, traction conditions, etc. Planned
<i>Requirement:</i>	2 The maintenance and construction vehicle shall transmit environmental sensor data to the center. The sensor data includes location and timestamp information. Planned
<i>Functional Area:</i> MCV Winter Maintenance On-board systems that support snow plow operations and other roadway treatments (e.g., salt spraying and other material applications). Supports information sharing between snow plows.	
<i>Requirement:</i>	1 The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle. Planned
<i>Requirement:</i>	5 The maintenance and construction vehicle shall send operational data to the center including the operational state of the maintenance equipment (e.g., blade up/down, spreader pattern), types and quantities of materials used for construction and maintenance activities, and a record of the actual work performed. Planned
<i>Element:</i> NDDOT RCRS	
<i>Entity:</i> Information Service Provider	
<i>Functional Area:</i> Basic Information Broadcast Broadcast dissemination of traffic, transit, maintenance and construction, event, and weather information to traveler interface systems and vehicles.	
<i>Requirement:</i>	11 [User Defined] The center shall collect, process, store, and disseminate traffic and highway condition information to travelers, including incident information, detours and road closures, and emergency alerts. Planned
<i>Element:</i> NDDOT Speed Monitoring System	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Speed Monitoring Vehicle speed sensors that detect excessive vehicle speeds, informing drivers, centers and/or enforcement agencies of speed violations.	
<i>Requirement:</i>	1 The field element shall include sensors to detect vehicle speeds, under traffic or maintenance center control. Planned

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element:</i> NDDOT Speed Monitoring System	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Speed Monitoring Vehicle speed sensors that detect excessive vehicle speeds, informing drivers, centers and/or enforcement agencies of speed violations.	
<i>Requirement:</i>	Planned
3	If the speed detected by vehicle speed sensors is determined to be excessive, the field element shall provide a safe speed advisory to passing drivers via a driver information system (such as portable messages signs, field to vehicle communications to in-vehicle signing systems, etc.).
<i>Element:</i> NDDOT Transit Centers	
<i>Entity:</i> Transit Management	
<i>Functional Area:</i> Transit Center Vehicle Tracking Monitoring transit vehicle locations via interactions with on-board systems. Furnish users with real-time transit schedule information and maintain interface with digital map providers.	
<i>Requirement:</i>	Planned
1	The center shall monitor the locations of all transit vehicles within its network.
<i>Requirement:</i>	Planned
2	The center shall determine adherence of transit vehicles to their assigned schedule.
<i>Functional Area:</i> Transit Center Paratransit Operations Management of demand response transit services, including paratransit. Planning and scheduling of these services. Supports automated vehicle dispatch and automatically updates customer service operator systems.	
<i>Requirement:</i>	Planned
1	The center shall process trip requests for demand responsive transit services, i.e. paratransit. Sources of the requests may include traveler information service providers.
<i>Element:</i> NDHP Motor Carrier Operations	
<i>Entity:</i> Commercial Vehicle Administration	
<i>Functional Area:</i> Credentials and Taxes Administration Manage electronic filing of credentials, tax filing, and driver licensing for commercial vehicle operators. Provides commercial vehicle (including HAZMAT) route restrictions.	
<i>Requirement:</i>	Planned
1	The center shall manage electronic credentials filing and processing for commercial vehicles.
<i>Requirement:</i>	Planned
2	The center shall manage the filing of appropriate taxes for the operation of commercial vehicles.
<i>Requirement:</i>	Planned
3	The center shall process requests for payments of electronic credentials and tax filing and maintain an interface to a Financial Institution.
<i>Requirement:</i>	Planned
4	The center shall exchange credentials and tax information with other commercial vehicle administration centers - either in other states or the federal government.
<i>Requirement:</i>	Planned
5	The center shall provide route restrictions information, including hazmat restrictions, to other centers and agencies for distribution to commercial vehicle operators. These centers and agencies may include commercial fleet and freight management operators, traveler information centers, digital map update providers, and other commercial vehicle administration centers.

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element:NDHP Vehicles</i>	
<i>Entity:Emergency Vehicle Subsystem</i>	
<i>Functional Area: On-board EV Incident Management Communication</i>	
On-board systems provide communications support to first responders. Incident information is provided to dispatched emergency personnel. Emergency personnel transmit information about the incident and response status.	
<i>Requirement:</i>	1 The emergency vehicle shall receive dispatch instructions sufficient to enable emergency personnel in the field to implement an effective incident response. It includes local traffic, road, and weather conditions, hazardous material information, and the current status of resources that have been allocated to an incident. Existing
<i>Requirement:</i>	2 The emergency vehicle shall provide an interface to the center for emergency personnel to transmit information about the incident site such as the extent of injuries, identification of vehicles and people involved, hazardous material, etc. Existing
<i>Requirement:</i>	3 The emergency vehicle shall provide an interface to the center for emergency personnel to transmit information about the current incident response status such as the identification of the resources on site, site management strategies in effect, and current clearance status. Existing
<i>Element:SOC</i>	
<i>Entity:Emergency Management</i>	
<i>Functional Area: Incident Command</i>	
Tactical decision support, resource coordination, and communications integration among emergency management agencies for Incident Commands that are established by first responders to support local management of an incident.	
<i>Requirement:</i>	1 The center shall provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident. Existing
<i>Requirement:</i>	3 The center shall track and maintain resource information and action plans pertaining to the incident command. Planned
<i>Requirement:</i>	5 The center shall assess the status of responding emergency vehicles as part of an incident command. Planned
<i>Functional Area: Emergency Response Management</i>	
Strategic emergency planning and response capabilities and broad inter-agency interfaces to support large-scale incidents and disasters, commonly associated with Emergency Operations Centers.	
<i>Requirement:</i>	1 The center shall provide strategic emergency response capabilities provided by an Emergency Operations Center for large-scale incidents and disasters. Existing
<i>Requirement:</i>	2 The center shall manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies. Existing

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element: SOC</i>	
<i>Entity: Emergency Management</i>	
<i>Functional Area: Emergency Response Management</i>	
Strategic emergency planning and response capabilities and broad inter-agency interfaces to support large-scale incidents and disasters, commonly associated with Emergency Operations Centers.	
<i>Requirement:</i>	Existing
3	The center shall provide the capability to implement response plans and track progress through the incident by exchanging incident information and response status with allied agencies.
<i>Requirement:</i>	Existing
4	The center shall develop, coordinate with other agencies, and store emergency response plans.
<i>Requirement:</i>	Existing
6	The center shall allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.
<i>Requirement:</i>	Existing
10	The center shall provide the capability to request transit resource availability from transit centers for use during disaster and evacuation operations.
<i>Requirement:</i>	Existing
12	The center shall provide information to the media concerning the status of an emergency response.
<i>Requirement:</i>	Existing
21	[User Defined] The center shall track the availability of resources (including vehicles, roadway cleanup, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
<i>Functional Area: Emergency Evacuation Support</i>	
Evacuation planning and coordination to manage evacuation and reentry of a population in the vicinity of a disaster or other emergency that poses a risk to public safety.	
<i>Requirement:</i>	Existing
1	The center shall manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
<i>Requirement:</i>	Existing
2	The center shall develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.
<i>Requirement:</i>	Existing
4	The center shall coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.
<i>Requirement:</i>	Existing
5	The center shall provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
<i>Requirement:</i>	Existing
6	The center shall request resources from transit agencies as needed to support the evacuation.
<i>Requirement:</i>	Existing
8	The center shall provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.
<i>Element: State Radio</i>	
<i>Entity: Emergency Management</i>	
<i>Functional Area: Emergency Call-Taking</i>	

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element: State Radio</i>	
<i>Entity: Emergency Management</i>	
<i>Functional Area: Emergency Call-Taking</i> Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.	
<i>Requirement:</i>	Existing
1 The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	
<i>Requirement:</i>	Existing
2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	
<i>Requirement:</i>	Existing
5 The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	
<i>Requirement:</i>	Existing
9 The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	
<i>Requirement:</i>	Existing
10 The center shall update the incident information log once the emergency system operator has verified the incident.	
<i>Functional Area: Emergency Dispatch</i> Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.	
<i>Requirement:</i>	Existing
3 The center shall relay location and incident details to the responding vehicles.	
<i>Requirement:</i>	Existing
5 The center shall store and maintain the emergency service responses in an action log.	
<i>Requirement:</i>	Existing
9 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	
<i>Requirement:</i>	Planned
10 [User Defined] The center shall dispatch NDHP vehicles to respond to verified emergencies and provide suggested routing	
<i>Functional Area: Emergency Routing</i> Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.	
<i>Requirement:</i>	Existing
1 The center shall collect current traffic and road condition information for emergency vehicle route calculation.	
<i>Functional Area: Incident Command</i> Tactical decision support, resource coordination, and communications integration among emergency management agencies for Incident Commands that are established by first responders to support local management of an incident.	

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element: State Radio</i>	
<i>Entity: Emergency Management</i>	
<i>Functional Area: Incident Command</i> Tactical decision support, resource coordination, and communications integration among emergency management agencies for Incident Commands that are established by first responders to support local management of an incident.	
<i>Requirement:</i>	Existing
2 The center shall provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.	
<i>Functional Area: Emergency Early Warning System</i> Monitors alerting and advisory systems, information collected by ITS surveillance and sensors, and reports from other agencies in order to identify potential, imminent, or in-progress major incidents or disasters. Notification is provided to other ITS centers to notify the traveling public.	
<i>Requirement:</i>	Existing
3 The center shall broadcast wide-area alerts and advisories to traffic management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.	
<i>Requirement:</i>	Existing
7 The center shall broadcast wide-area alerts and advisories to maintenance centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.	
<i>Requirement:</i>	Existing
8 The center shall broadcast wide-area alerts and advisories to other emergency management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.	
<i>Requirement:</i>	Existing
11 The center shall coordinate the broadcast of wide-area alerts and advisories with other emergency management centers.	
<i>Element: User Personal Computing Devices</i>	
<i>Entity: Personal Information Access</i>	
<i>Functional Area: Personal Basic Information Reception</i> Personal traveler interface that provides formatted traffic advisories, transit, event, and other traveler information, as well as broadcast alerts. Devices include personal computers and personal portable devices such as PDAs and pagers.	
<i>Requirement:</i>	Existing
1 The personal traveler interface shall receive traffic information from a center and present it to the traveler.	
<i>Requirement:</i>	Existing
5 The personal traveler interface shall receive wide-area alerts and present it to the traveler.	
<i>Requirement:</i>	Planned
6 The personal traveler interface shall provide the capability for digitized map data to act as the background to the information presented to the traveler.	
<i>Requirement:</i>	Existing
7 The personal traveler interface shall support traveler input in audio or manual form.	

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element: User Personal Computing Devices</i>	
<i>Entity: Personal Information Access</i>	
<i>Functional Area: Personal Basic Information Reception</i> Personal traveler interface that provides formatted traffic advisories, transit, event, and other traveler information, as well as broadcast alerts. Devices include personal computers and personal portable devices such as PDAs and pagers.	
<i>Requirement:</i>	Existing
8 The personal traveler interface shall present information to the traveler in audible or visual forms, consistent with a personal device.	
<i>Functional Area: Personal Interactive Information Reception</i> Personal traveler interface that provides traffic, transit, yellow pages, event, and trip planning information, and other personalized traveler information services upon request. Devices include personal computers and personal portable devices such as PDAs.	
<i>Requirement:</i>	Existing
1 The personal traveler interface shall receive traffic information from a center and present it to the traveler upon request.	
<i>Requirement:</i>	Existing
5 The personal traveler interface shall receive evacuation information from a center and present it to the traveler.	
<i>Requirement:</i>	Existing
6 The personal traveler interface shall receive wide-area alerts and present it to the traveler.	
<i>Requirement:</i>	Existing
11 The personal traveler interface shall provide digitized map data to act as the background to the information presented to the traveler.	
<i>Requirement:</i>	Existing
12 The personal traveler interface shall support traveler input in audio or manual form.	
<i>Requirement:</i>	Existing
13 The personal traveler interface shall present information to the traveler in audible or visual forms consistent with a personal device, and suitable for travelers with hearing and vision physical disabilities.	
<i>Element: Visitor Centers Kiosks</i>	
<i>Entity: Remote Traveler Support</i>	
<i>Functional Area: Remote Basic Information Reception</i> Public traveler interface, such as a kiosk, that provides formatted traffic advisories, transit, event, and other traveler information, as well as broadcast alerts.	
<i>Requirement:</i>	Existing
1 The public interface for travelers shall receive traffic information from a center and present it to the traveler.	
<i>Requirement:</i>	Existing
4 This public interface for travelers shall receive evacuation information from a center and present it to the traveler.	
<i>Requirement:</i>	Existing
5 The public interface for travelers shall receive wide-area alerts and present it to the traveler.	
<i>Requirement:</i>	Existing
6 The public interface for travelers shall provide the capability for digitized map data to act as the background to the information presented to the traveler.	
<i>Functional Area: Remote Interactive Information Reception</i> Public traveler interface, such as a kiosk, that provides traffic, transit, yellow pages, special event, and other personalized traveler information services upon request.	

Architecture	Status
ND Statewide (Region)	(Region)
<i>Element:</i> Visitor Centers Kiosks	
<i>Entity:</i> Remote Traveler Support	
<i>Functional Area:</i> Remote Interactive Information Reception	
Public traveler interface, such as a kiosk, that provides traffic, transit, yellow pages, special event, and other personalized traveler information services upon request.	
<i>Requirement:</i>	
1 The public interface for travelers shall receive traffic information from a center and present it to the traveler upon request.	Existing
<i>Requirement:</i>	
5 The public interface for travelers shall receive evacuation information from a center and present it to the traveler.	Existing
<i>Requirement:</i>	
6 The public interface for travelers shall receive wide-area alerts and present it to the traveler.	Existing
<i>Requirement:</i>	
11 The public interface for travelers shall provide digitized map data to act as the background to the information presented to the traveler.	Planned