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# North Dakota Statewide ITS Architecture Version 3.0

Final Report

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October 2013

Prepared for:  
**North Dakota Department of  
Transportation**

Prepared by:  
Advanced Traffic Analysis Center  
Upper Great Plains Transportation Institute  
North Dakota State University  
Fargo, North Dakota

**NDSU**

UPPER GREAT PLAINS TRANSPORTATION INSTITUTE  
ADVANCED TRAFFIC ANALYSIS CENTER

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Final Report

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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.

Advanced Traffic Analysis Center  
Upper Great Plains Transportation Institute  
North Dakota State University

Dept. 2880 – PO Box 6050  
NDSU – Fargo, ND 58108  
Tel 701-231-8058 – Fax 701-231-6265  
[www.ugpti.org](http://www.ugpti.org) - [www.atacenter.org](http://www.atacenter.org)

# 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 Patrol
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
SEOC	State Emergency Operations Center
TMC	Traffic/Transportation Management Center
TOC	Traffic Operations Center
WIM	Weigh In Motion
<b>Standards</b>	
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
<b>Service packages</b>	
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 state. 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 the 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
  - Engineering
  - Information Technology
  - Planning and Asset Management
  - Local Government – Transit Section
- 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 service packages in support of these services. ITS Service 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 39 Service packages were identified for the statewide architecture. The Service 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 architecture 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 NDDOT ITS Steering Committee specified a RA update cycle, the original RA development was completed in 2005, was updated to version 2.0 in 2009, and this update is version 3.0 which adheres to the National ITS Architecture version 7.0.

# 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 focus 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 7.0 in order to access the architecture and make changes or future updates. The contents of the RA database are available on a website for ease of use and enhanced access. 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 service 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	ITS Standards	Brief discussion of applicable ITS standards
10	Sequence of Projects	Time-frame for ITS projects
	Appendix A	NDDOT Service 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 2013 a proposal was submitted to FHWA's Multistate Corridor Operations and Management program for ITS improvements on I-94 in the Fargo-Moorhead metro area. These improvements are aligned with the ITS goals and service packages identified in the statewide and Fargo-Moorhead regional architectures.

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:

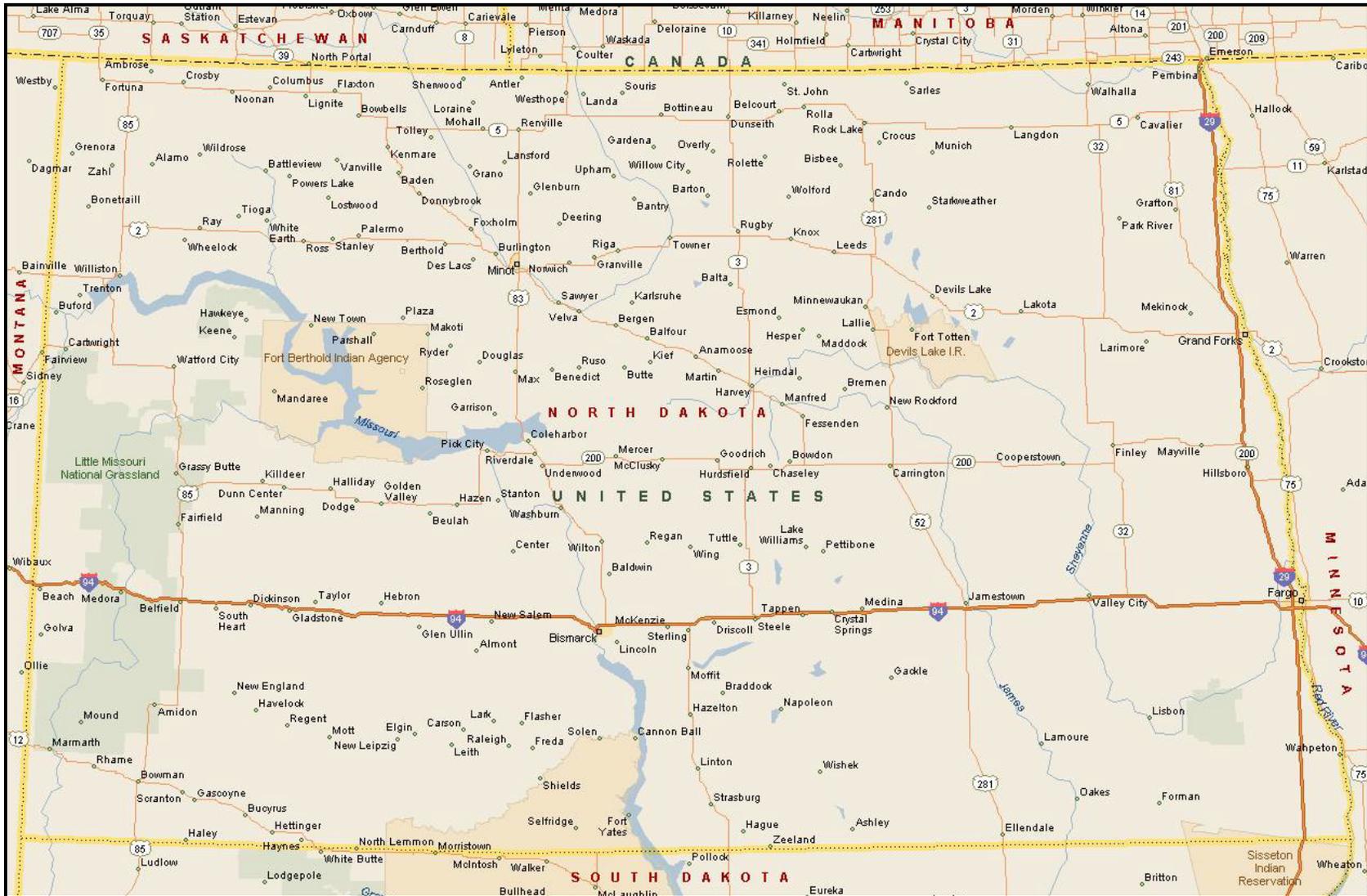
1. Bismarck-Mandan
2. Grand Forks-East Grand Forks
3. Fargo-Moorhead

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
  - b. Fixed-route transit operations in jurisdictions outside ND MPOs
  - c. NDDOT's planned regional transit centers
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 Asset Management	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 (ITS Section)	NDDOT Automated Treatment NDDOT Maintenance Office NDDOT RCRS NDDOT Speed Monitoring NDDOT Cameras NDDOT DMS NDDOT RWIS NDDOT Over-height Detection
Department of Emergency Services	ND Department of Emergency Services	State Radio SEOC
Iteris	Meridian Environmental Technology Inc/Iteris	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 Centers NDDOT Transit Vehicles

Stakeholder	Description	Associated ITS Elements
Local Jurisdictions	Jurisdictions that perform ITS functions outside of MPO boundaries	Local Maintenance Centers Local Maintenance Vehicles Local Traffic Control Centers Local Traffic Control Devices Local Transit Centers Local Transit Vehicle

## 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 identified 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 and other jurisdictions outside of the three metropolitan areas above.

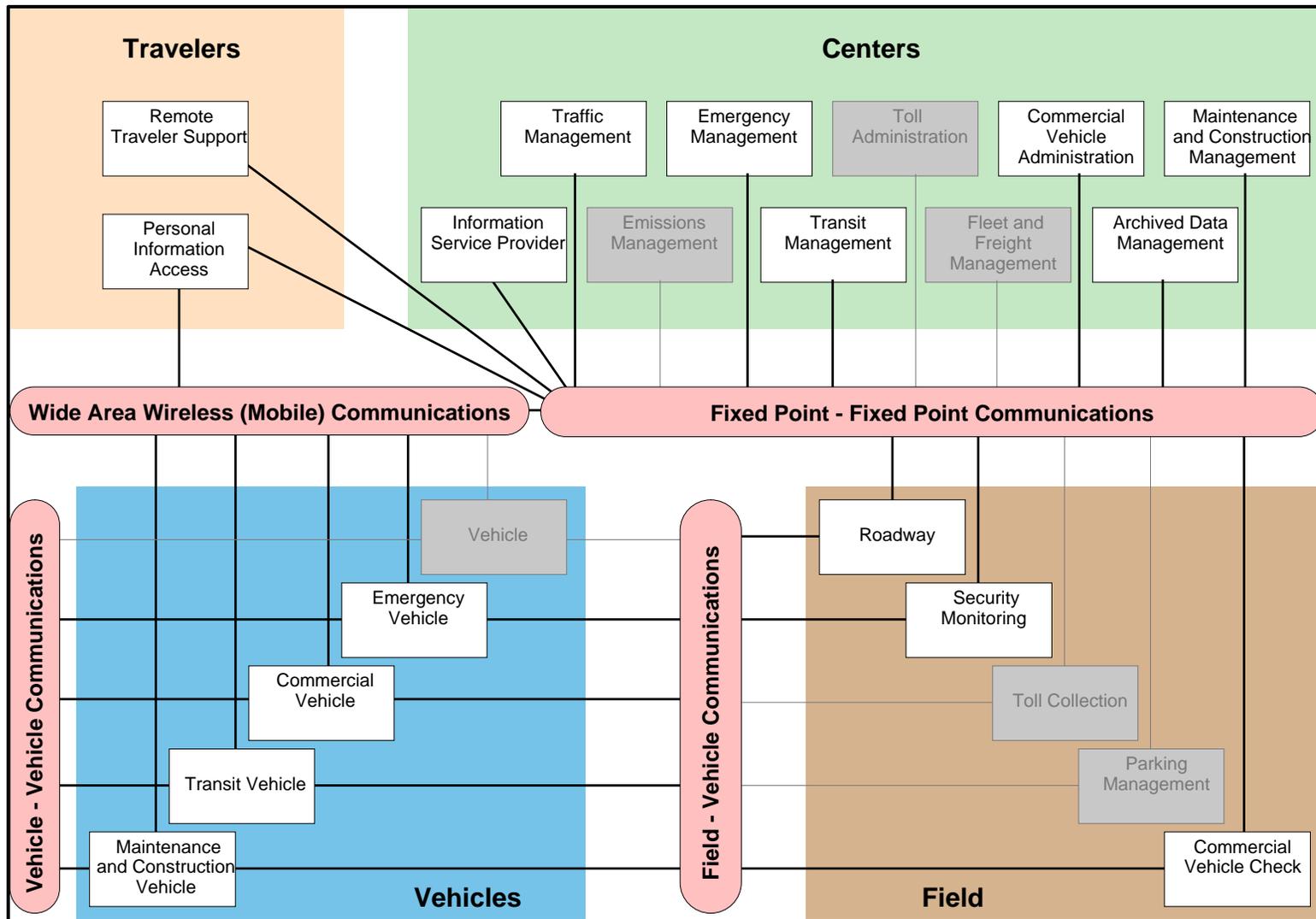


Figure 4.1 NDDOT Physical Architecture

#### **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 Emergency Operations Center (SEOC) which also includes NDDOT, NDHP, and other agencies. The SEOC is activated by the Department of Emergency Services when conditions warrant. The SEOC 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, communication, and public safety answering point (PSAP) capabilities to state agencies (including NDHP) as well as federal, county, and municipal law enforcement and emergency management agencies. It should be noted that some of the 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. In June 2013 the NDHP implemented an electronic permitting system that supports automated routing.

#### **4.1.4 Maintenance and Construction Management**

The NDDOT Maintenance Division 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 being progressively equipped with automated vehicle location (AVL), anti-icing material use monitoring systems, and other ITS technologies. A plan is in place to expand the AVL deployment to 100 vehicles over the next two years. The maintenance division 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 Division 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 reporting, and response coordination. NDDOT has updated their road condition reporting system (RCRS) in 2011 to facilitate the collection and dissemination of information. A new version of the traveler information map was developed that also supports viewing from mobile devices.

#### **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. Local transit service providers outside of the MPO boundaries are also growing their scope of services provided including fixed-route transit operations and the use of AVL and electronic fare box technology.

#### **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. 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 and Asset Management division 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. Standalone cameras for video surveillance
    - ii. Video cameras used in conjunction with bridge anti-icing systems
    - iii. Video cameras at RWIS sites
  - d. Commercial vehicles load restrictions
    - i. Bridge over-height detection
2. Control devices
  - a. Variable speed limit signs
  - b. Traffic signals
  - c. Automated roadway treatment: fixed automated spray technology (FAST)
3. Warning/advisory devices
  - a. Portable DMS
  - b. Permanent DMS
  - c. Highway advisory radio (HAR)
  - d. High-wind warning

### **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 of great importance. 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 updating radio towers for wireless connectivity and stays current with available cell communications from private providers.

## 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 and Asset Management
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 and Asset Management
	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	SEOC	State Emergency 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	Existing	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 Division	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
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
Roadway Subsystem	NDDOT Automated Treatment Systems	NDDOT statewide automated treatment systems	Existing	NDDOT Districts
	NDDOT ATR	NDDOT automated traffic recorders	Existing	NDDOT Planning and Asset Management
	NDDOT WIM	NDDOT weigh-in-motion stations	Existing	NDDOT Planning and Asset Management
	NDDOT DMS	NDDOT statewide DMS system	Existing	NDDOT Maintenance
	NDDOT RWIS	NDDOT statewide RWIS	Existing	NDDOT Maintenance
	NDDOT Cameras	NDDOT statewide video surveillance system	Existing	NDDOT Maintenance
	NDDOT Speed Monitoring System	NDDOT work zone speed monitoring sensors	Existing	NDDOT Maintenance
	NDDOT Over-height Detection	NDDOT over-height detection for low bridge clearance routes	Existing	NDDOT Maintenance
	NDDOT District Devices	District traffic control and surveillance equipment	Existing	NDDOT Districts
	Local Jurisdiction Devices	Traffic control and monitoring equipment in cities outside of ND MPOs	Existing	Local Jurisdictions
Security Monitoring Subsystem	NDDOT Cameras	NDDOT statewide video surveillance system	Planned	NDDOT Maintenance
Surface Transportation Weather Service	Forecasting Center	Meridian Environmental Technologies/Iteris	Existing	Iteris
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
	Local Jurisdiction Transit Centers	Transit centers in cities and counties outside the scope of ND MPOs	Existing	Local Jurisdictions
Transit Vehicle Subsystem	ND Transit Vehicles	North Dakota transit vehicles	Existing	NDDOT Transit
	Local Jurisdictions Transit Vehicles	Transit vehicles in cities and counties outside the scope of ND MPOs	Existing	Local Jurisdictions

## 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 service 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 Service 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 Service Packages

The following Service 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 Service package in North Dakota is also indicated (i.e., existing or planned). It should be noted that Service packages with an Existing followed by an asterisk indicate there are portions of the Service package already deployed but additional portions are planned for deployment. Customized NDDOT Service packages and Information Flows are shown in more detail in Appendix A.

### Network Surveillance (Existing \*)

This service 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 video surveillance system sends data back to the Traffic Management Subsystem). The data generated by this service 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.

### Traffic Signal Control (Existing)

This service package provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service 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.

### Traffic Metering (Planned)

This service package provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp and interchange metering. This package incorporates the instrumentation included in the Network Surveillance service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.).

### Traffic Information Dissemination (Existing)

This service 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 service 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 service 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 Warning and Enforcement (Existing \*)

This service 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. This service can also support notifications to an enforcement agency to enforce the speed limit on a roadway system.

#### Variable Speed Limits (Planned)

This service package sets variable speed limits along a roadway to create more uniform speeds, to promote safer driving during adverse conditions (such as fog, or deteriorated surface conditions due to precipitation). Also known as speed harmonization, this service monitors traffic and environmental conditions along the roadway. Based on the measured data, the system calculates and sets suitable speed limits. Equipment over and along the roadway displays the speed limits and additional information such as basic safety rules and current traffic information. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.

#### Mixed Use Warning Systems (Existing)

This service package supports the sensing and warning systems used to interact with pedestrians, bicyclists, and other vehicles that operate on the main vehicle roadways, or on pathways which intersect the main vehicle roadways. These systems could allow automated warning or active protection for this class of users.

#### Intersection Safety Warning (Planned)

This service package monitors vehicles approaching an intersection and warns drivers when hazardous conditions are detected. The service package detects

potential conflicts between vehicles occupying or approaching the intersection. When a potentially hazardous condition is detected, a warning is communicated to the involved vehicles using signs/signals at the intersection.

#### Maintenance and Construction Vehicle and Equipment Tracking (Existing)

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

#### Maintenance and Construction Vehicle Maintenance (Existing)

This service package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle maintenance.

#### Road Weather Data Collection (Existing)

This service 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 Service package to process the information and make decisions on operations.

#### Weather Information Processing and Distribution (Existing)

This service package processes and distributes the environmental information collected from the Road Weather Data Collection service 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 service package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The service package includes the environmental sensors that detect adverse conditions, and the automated treatment system.

#### Winter Maintenance (Existing)

This service 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 service 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 service 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.

#### Environmental Probe Surveillance (Planned)

This service package collects data from vehicles in the road network that can be used to directly measure or infer current environmental conditions. It leverages vehicle on-board systems that measure temperature, sense current weather conditions (rain and sun sensors) and also can monitor aspects of the vehicle operational status (e.g., use of headlights, wipers, and traction control system) to gather information about local environmental conditions. It includes the on-board vehicle systems that collect and report environmental probe data, the infrastructure equipment that collects the probe data and the centers that aggregate and share the collected probe data.

#### Broadcast Traveler Information (Existing)

This service 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 service package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.

#### Interactive Traveler Information (Existing)

This service 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, and personal computer.

#### Emergency Call-Taking and Dispatch (Existing)

This service 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 service 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 service 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 service 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 service 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 service 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 service 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 service 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 service 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 service 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 service 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 service 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 service package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

#### Electronic Clearance (Planned)

This service 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 (Existing \*)

This service 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 service 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 service package provides for automated clearance at international border crossings. It augments the Electronic Clearance service package by allowing interface with border administration and border inspection related functions. This service 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 (Existing \*)

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

### Roadside CVO Safety (Planned)

This service 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 service package and the On-board CVO and Freight Safety & Security (CVO08) Service package which enables a variety of implementation options. The basic option, directly supported by this service 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) Service 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) service package, utilize additional on-board vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

### Transit Vehicle Tracking (Existing \*)

This service 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.

### Transit Fixed-Route Operations (Existing \*)

This service package performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service determines the transit vehicle trip performance against the schedule using AVL data and provides information displays at the Transit Management Subsystem.

### Demand Response Transit Operations (Existing \*)

This service 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 service 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 (Existing \*)

This service 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 service 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., video surveillance cameras), audio systems and/or event recorder systems.

#### Transit Fleet Management (Planned)

This service 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 service 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 service 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 Service packages were used for facilitating the operational concept development. Using Service 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 service package. Once the small group discussions were completed, the results (the customized service packages) were presented to all the stakeholders participating in the architecture development.

After the service packages were approved by the stakeholders, relevant changes were entered into Turbo Architecture. Turbo was used to generate the operational concept for each service 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 service package. Subsection 6.2 summarizes operational roles and responsibilities, organized by stakeholder.

## 6.1 Implementation Roles

Service package	Stakeholders with Implementation Roles
Network Surveillance	NDDOT Maintenance NDDOT Districts
Traffic Signal Control	NDDOT Districts Local Jurisdictions
Traffic Information Dissemination	NDDOT Maintenance
Traffic Incident Management	NDDOT Maintenance, NDHP, Department of Emergency Services
Speed Warning and Enforcement	NDDOT Districts NDHP
Variable Speed Limits	NDDOT Districts
Mixed Use Warning Systems (over-height detection and warning)	NDDOT Maintenance
Intersection Safety Warning Systems	NDDOT Districts Local Jurisdictions
Maintenance and Construction Vehicle and Equipment Tracking	NDDOT Districts Local Jurisdictions
Maintenance and Construction Vehicle Maintenance	NDDOT Districts Local Jurisdictions
Road Weather Data Collection	NDDOT Maintenance
Weather Information Processing and Distribution	NDDOT Maintenance Iteris
Roadway Automated Treatment	NDDOT Districts
Winter Maintenance	NDDOT Maintenance NDDOT Districts
Work Zone Management	NDDOT Maintenance NDDOT Districts
Maintenance and Construction Activity Coordination	NDDOT Maintenance NDDOT Districts Local Jurisdictions
Environmental Probe Surveillance	NDDOT Maintenance NDDOT Districts
Broadcast Traveler Information	NDDOT Maintenance
Interactive Traveler Information	NDDOT Maintenance
Emergency Call-Taking and Dispatch	Department of Emergency Services
Transportation Infrastructure Protection	NDHP, NDDOT Maintenance
Wide-Area Alert	Department of Emergency Services NDHP NDDOT Maintenance
Disaster Response and Recovery	Department of Emergency Services NDDOT Maintenance NDHP

<b>Service package</b>	<b>Stakeholders with Implementation Roles</b>
Evacuation and Reentry Management	Department of Emergency Services NDDOT Maintenance NDHP
Disaster Traveler Information	Department of Emergency Services NDDOT Maintenance NDHP
Transit Vehicle Tracking	NDDOT Transit Local Jurisdictions
Demand Response Transit Operations	NDDOT Transit Local Jurisdictions
Transit Fare Collection Management	NDDOT Transit Local Jurisdictions
Transit Security	NDDOT Transit Local Jurisdictions
Transit Fleet Management	NDDOT Transit Local Jurisdictions
Transit Passenger Counting	NDDOT Transit Local Jurisdictions
Transit Fleet Management	NDDOT Transit Local Jurisdictions
Transit Passenger Counting	NDDOT Transit Local Jurisdictions
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 Planning and Asset Management

## 6.2 Operational Roles and Responsibilities

<b>Responsibility Area</b>	<b>Stakeholder</b>	<b>Role</b>
Archived Data Systems	NDDOT Planning and Asset Management	<ol style="list-style-type: none"> <li>1. Collect and summarize data from ATR and WIM systems</li> <li>2. Collect and summarize data from other agencies (Maintenance, NDHP, Transit)</li> </ol>
Commercial Vehicle Operations	NDHP	<ol style="list-style-type: none"> <li>1. Issue permits</li> <li>2. Perform enforcement</li> </ol>

<b>Responsibility Area</b>	<b>Stakeholder</b>	<b>Role</b>
Emergency Management	Department of Emergency Services	<ol style="list-style-type: none"> <li>1. Coordinate emergency plans with other federal, state, and local agencies</li> <li>2. Coordinate emergency response</li> <li>3. Develop statewide emergency plans</li> <li>4. Issue Amber Alerts</li> </ol>
	NDDOT Maintenance	<ol style="list-style-type: none"> <li>1. Broadcast emergency alerts on DMS and 511</li> <li>2. Coordinate emergency plans</li> </ol>
	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"> <li>1. Provide resources</li> <li>2. Provide road network conditions</li> <li>3. Provide video surveillance control to NDHP</li> </ol>
	NDHP	<ol style="list-style-type: none"> <li>1. Coordinate incident response with county, local, and other states/provinces law enforcement</li> <li>2. Respond to incidents</li> </ol>
	SDDOT	Coordinate response resources
SDHP	Share incident information	
Maintenance and Construction	Local Jurisdictions	<ol style="list-style-type: none"> <li>1. Coordinate with NDDOT districts</li> <li>2. Perform maintenance operations</li> </ol>
	Mn/DOT	Share winter maintenance information
	MTDOT	Share winter maintenance information
	NDDOT Districts	<ol style="list-style-type: none"> <li>3. Coordinate with city public works departments</li> <li>4. Perform winter maintenance</li> </ol>
	NDDOT Maintenance	<ol style="list-style-type: none"> <li>1. Control automated treatment systems</li> <li>2. Coordinate winter maintenance with districts</li> <li>3. Share winter maintenance information</li> </ol>
	SDDOT	Share winter maintenance information
Transit Management	NDDOT Transit	<ol style="list-style-type: none"> <li>1. Provide rural transit services</li> <li>2. Provide fixed-route transit services via regional transit centers</li> </ol>
	Local Jurisdictions	<ol style="list-style-type: none"> <li>1. Provide rural transit services</li> <li>2. Provide fixed-route transit services</li> </ol>
Traveler Information	Department of Emergency Services	Issue emergency alerts
	Iteris	<ol style="list-style-type: none"> <li>1. Operate ND 511 system</li> <li>2. Provide weather information</li> </ol>

<b>Responsibility Area</b>	<b>Stakeholder</b>	<b>Role</b>
Traveler Information	NDDOT Maintenance	<ol style="list-style-type: none"> <li>1. Broadcast traveler information on DMS and 511</li> <li>2. Provide road conditions to RCRS</li> </ol>
	NDHP	<ol style="list-style-type: none"> <li>1. Make road closure decisions</li> <li>2. Relay road conditions to NDDOT</li> </ol>

## 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 Service 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. Service package: the Service 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**

<b>Service packages</b>	<b>Purpose</b>	<b>Stakeholders</b>	<b>Issues</b>
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 Iteris	Security, resource sharing
MC04-Weather Info Processing and Distribution	511	NDDOT Maintenance Iteris, 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 service 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 Service 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 included in the report is provided in Figure 8.1.

<b>ND Statewide Regional ITS Architecture (Region)</b>		
<i>Element:</i> <b>NDDOT Maintenance Office</b>		
<i>Entity:</i> <b>Maintenance and Construction Management</b>		
<i>Functional Area:</i> <b>MCM Winter Maintenance Management</b>		
		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 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.

**Table 9.1. 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

## 10.0 PROJECTS SEQUENCE

This section briefly outlines possible time frame for deployment for selected NDDOT ITS projects. Service 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 Service packages are organized in the same order they appear in the National ITS Architecture (Table 10.1).

**Table 10.1. Service package Implementation Time Frame.**

Service package	Time Frame
Network Surveillance	Short-Medium
Traffic Information Dissemination	Short
Traffic Incident Management	Short
Speed Monitoring	Medium-Long
Traffic Metering	Log
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
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

### 10.1 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 SERVICE PACKAGES AND INFORMATION FLOWS**

**The Service 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)

*Element:* **Local Jurisdiction Traffic Control Centers**

*Entity:* **Traffic Management**

*Functional Area:* **TMC Signal Control**

Remotely controls traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.

<i>Requirement:</i>	1 The center shall remotely control traffic signal controllers.	Planned
<i>Requirement:</i>	3 The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Planned
<i>Requirement:</i>	4 The center shall collect traffic signal controller fault data from the field.	Planned
<i>Requirement:</i>	5 The center shall manage (define, store and modify) control plans to coordinate signalized intersections, to be engaged at the direction of center personnel or according to a daily schedule.	Planned
<i>Requirement:</i>	6 The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Planned
<i>Requirement:</i>	8 The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Planned

*Element:* **Local Jurisdiction Transit Centers**

*Entity:* **Transit Management**

*Functional Area:* **Transit Center Fixed-Route Operations**

Management of fixed route transit operations. Planning, scheduling, and dispatch associated with fixed and flexible route transit services. Updates customer service operator systems, and provides current vehicle schedule adherence and optimum scenarios for schedule adjustment.

<i>Requirement:</i>	1 The center shall generate transit routes and schedules based on such factors as parameters input by the system operator, road network conditions, incident information, operational data on current routes and schedules, and digitized map data.	Existing
<i>Requirement:</i>	2 The center shall provide the interface to the system operator to control the generation of new routes and schedules (transit services) including the ability to review and update the parameters used by the routes and schedules generation processes and to initiate these processes	Existing
<i>Requirement:</i>	4 The center shall dispatch fixed route or flexible route transit vehicles	Existing
<i>Requirement:</i>	5 The center shall collect transit operational data for use in the generation of routes and schedules.	Existing
<i>Requirement:</i>	11 The center shall provide an interface to the archive data repository to enable the operator to retrieve historical operating data for use in planning transit routes and schedules.	Planned

*Functional Area:* **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.

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element: Local Jurisdiction Transit Centers</i>	
<i>Entity: Transit Management</i>	
<i>Functional Area: Transit Center Paratransit Operations</i> 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>	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. <span style="float: right;">Planned</span>
<i>Requirement:</i>	4 The center shall dispatch demand response (paratransit) transit vehicles. <span style="float: right;">Planned</span>
<i>Requirement:</i>	7 The center shall collect the log of passenger boardings and alightings from the paratransit vehicles. <span style="float: right;">Planned</span>
<i>Element: Local Jurisdiction Transit Vehicles</i>	
<i>Entity: Transit Vehicle</i>	
<i>Functional Area: On-board Transit Fare Management</i> On-board systems provide fare collection using a travelers non-monetary fare medium. Collected fare data are made available to the center.	
<i>Requirement:</i>	1 The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers. <span style="float: right;">Planned</span>
<i>Requirement:</i>	10 The transit vehicle shall provide fare statistics data to the center. <span style="float: right;">Planned</span>
<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>	1 The transit vehicle shall count passengers boarding and alighting. <span style="float: right;">Planned</span>
<i>Requirement:</i>	2 The passenger counts shall be related to location to support association of passenger counts with routes, route segments, or bus stops. <span style="float: right;">Planned</span>
<i>Requirement:</i>	3 The passenger counts shall be timestamped so that ridership can be measured by time of day and day of week. <span style="float: right;">Planned</span>
<i>Requirement:</i>	4 The transit vehicle shall send the collected passenger count information to the transit center. <span style="float: right;">Planned</span>
<i>Element: Local Jurisdictions Maintenance Vehicles</i>	
<i>Entity: Maintenance and Construction Vehicle</i>	
<i>Functional Area: MCV Vehicle Location Tracking</i> 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. <span style="float: right;">Planned</span>
<i>Requirement:</i>	2 The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center. <span style="float: right;">Planned</span>
<i>Element: ND Emergency Management Center</i>	
<i>Entity: Emergency Management</i>	
<i>Functional Area: Incident Command</i>	

**Architecture**

**Status**

**ND Statewide (Region)**

(Region)

*Element:* **ND Emergency Management Center**

*Entity:* **Emergency Management**

*Functional Area:* **Incident Command**

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

*Functional Area:* **Emergency Response Management**

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
<i>Requirement:</i>	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.	Existing
<i>Requirement:</i>	4 The center shall develop, coordinate with other agencies, and store emergency response plans.	Existing
<i>Requirement:</i>	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.	Existing
<i>Requirement:</i>	10 The center shall provide the capability to request transit resource availability from transit centers for use during disaster and evacuation operations.	Existing
<i>Requirement:</i>	12 The center shall provide information to the media concerning the status of an emergency response.	Existing
<i>Requirement:</i>	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.	Existing

*Functional Area:* **Emergency Evacuation Support**

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.

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:ND Emergency Management Center</i>	
<i>Entity:Emergency Management</i>	
<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:ND Transit Vehicles</i>	
<i>Entity:Transit Vehicle</i>	
<i>Functional Area: On-board Transit Fare Management</i> On-board systems provide fare collection using a travelers non-monetary fare medium. Collected fare data are made available to the center.	
<i>Requirement:</i>	Existing
1 The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	
<i>Requirement:</i>	Existing
10 The transit vehicle shall provide fare statistics data to the center.	
<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</i>	
<i>Functional Area: Roadway Basic Surveillance</i> Field elements that monitor traffic conditions using loop detectors and CCTV cameras.	

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT ATR</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Basic Surveillance</b> 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:</i> <b>Roadway Data Collection</b> 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:</i> <b>NDDOT Automated Treatment Systems</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Automated Treatment</b> Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.	
<i>Requirement:</i>	Existing
1 The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Existing
2 The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Existing
3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	
<i>Requirement:</i>	Existing
4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	
<i>Element:</i> <b>NDDOT Cameras</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Basic Surveillance</b> 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>Entity:</i> <b>Security Monitoring</b>	
<i>Functional Area:</i> <b>Field Secure Area Surveillance</b> Security surveillance devices (audio/video) that monitor facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, and transit railways or guideways).	

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT Cameras</b>	
<i>Entity:</i> <b>Security Monitoring</b>	
<i>Functional Area:</i> <b>Field Secure Area Surveillance</b> Security surveillance devices (audio/video) that monitor facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, and transit railways or guideways).	
<i>Requirement:</i>	Existing
1 The field element shall include video and/or audio surveillance of secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways).	
<i>Requirement:</i>	Existing
2 The field element shall be remotely controlled by a center.	
<i>Requirement:</i>	Existing
3 The field element shall provide equipment status and fault indication of surveillance equipment to a center.	
<i>Element:</i> <b>NDDOT District Maintenance</b>	
<i>Entity:</i> <b>Maintenance and Construction Management</b>	
<i>Functional Area:</i> <b>MCM Winter Maintenance Management</b> 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
2 The center shall exchange information with administrative systems to support the planning and scheduling of winter maintenance activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract administration.	
<i>Requirement:</i>	Existing
3 The center shall provide status information about scheduled winter maintenance activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, and the media.	
<i>Element:</i> <b>NDDOT District Traffic</b>	
<i>Entity:</i> <b>Traffic Management</b>	
<i>Functional Area:</i> <b>TMC Variable Speed Limits</b> Remotely monitors and controls variable speed limits systems, including equipment that monitors current traffic and environmental conditions, determines the current speed limits by lane, and displays the speed limits and additional information to drivers.	
<i>Requirement:</i>	Planned
1 The center shall monitor data on traffic and environmental conditions collected from sensors along the roadway.	
<i>Requirement:</i>	Planned
2 Based on the measured data, the center shall calculate and set suitable speed limits by lane.	

Architecture	Status
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ND Statewide (Region)	(Region)
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*Element:***NDDOT District Traffic**

*Entity:***Traffic Management**

*Functional Area:* **TMC Variable Speed Limits**

Remotely monitors and controls variable speed limits systems, including equipment that monitors current traffic and environmental conditions, determines the current speed limits by lane, and displays the speed limits and additional information to drivers.

<i>Requirement:</i>	3 The center shall control field equipment that posts the current speed limits and displays additional information such as basic safety rules and current traffic information to drivers.	Planned
<i>Requirement:</i>	4 The center shall monitor the operational status of the variable speed limit equipment, including fault reports.	Planned
<i>Requirement:</i>	5 The center shall provide center personnel current system status and respond to control data from center personnel regarding variable speed limits and	Planned

*Functional Area:* **TMC Signal Control**

Remotely controls traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.

<i>Requirement:</i>	1 The center shall remotely control traffic signal controllers.	Planned
<i>Requirement:</i>	3 The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Planned
<i>Requirement:</i>	4 The center shall collect traffic signal controller fault data from the field.	Planned
<i>Requirement:</i>	6 The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Planned
<i>Requirement:</i>	8 The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Planned

*Element:***NDDOT DMS**

*Entity:***Roadway**

*Functional Area:* **Roadway Traffic Information Dissemination**

Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).

<i>Requirement:</i>	1 The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
<i>Requirement:</i>	4 The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing
<i>Requirement:</i>	5 The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Existing

*Element:***NDDOT Maintenance Management**

*Entity:***Maintenance and Construction Management**

*Functional Area:* **MCM Vehicle Tracking**

Remotely tracks the location of maintenance and construction vehicles and other equipment; presented to the center personnel.

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT Maintenance Management</b>	
<i>Entity:</i> <b>Maintenance and Construction Management</b>	
<i>Functional Area:</i> <b>MCM Vehicle Tracking</b>	
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. <span style="float: right;">Planned</span>
<i>Requirement:</i>	2 The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment. <span style="float: right;">Planned</span>
<i>Functional Area:</i> <b>MCM Environmental Information Collection</b>	
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. <span style="float: right;">Planned</span>
<i>Requirement:</i>	2 The center shall remotely control environmental sensors that measure weather conditions including temperature, wind, humidity, precipitation, and visibility. <span style="float: right;">Planned</span>
<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. <span style="float: right;">Existing</span>
<i>Requirement:</i>	8 The center shall collect operational status for the roadside and vehicle-based environmental sensor equipment. <span style="float: right;">Planned</span>
<i>Functional Area:</i> <b>MCM Automated Treatment System Control</b>	
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. <span style="float: right;">Existing</span>
<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. <span style="float: right;">Existing</span>
<i>Requirement:</i>	3 The center shall collect automated roadway treatment system and associated environmental sensor operational status. <span style="float: right;">Existing</span>
<i>Requirement:</i>	4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair. <span style="float: right;">Existing</span>
<i>Requirement:</i>	5 The center shall accept requests for automated roadway treatment system activation from center personnel. <span style="float: right;">Existing</span>
<i>Functional Area:</i> <b>MCM Incident Management</b>	

**Architecture**

**Status**

**ND Statewide (Region)**

(Region)

*Element:***NDDOT Maintenance Management**

*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

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT Maintenance Management</b>	
<i>Entity:</i> <b>Maintenance and Construction Management</b>	
<i>Functional Area:</i> <b>MCM Winter Maintenance Management</b> 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
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.	
<hr/> <hr/>	
<i>Entity:</i> <b>Traffic Management</b>	
<i>Functional Area:</i> <b>TMC Traffic Information Dissemination</b> 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>	Existing
1 The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	
<i>Requirement:</i>	Existing
3 The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	
<i>Requirement:</i>	Existing
4 The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	
<i>Requirement:</i>	Existing
7 The center shall distribute traffic data to the media; the capability to provide the information in both data stream and graphical display shall be supported.	
<i>Requirement:</i>	Existing
8 The center shall provide the capability for center personnel to control the nature of the data that is available to non-traffic operations centers and the media.	
<hr/> <hr/>	
<i>Functional Area:</i> <b>TMC Evacuation Support</b> 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>	Planned
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.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
3 The center shall coordinate information and controls with other traffic management centers.	
<i>Requirement:</i>	Planned
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.	
<hr/> <hr/>	
<i>Functional Area:</i> <b>Traffic Data Collection</b> Collection and storage of traffic management data. For use by operations personnel or data archives in the region.	

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT Maintenance Management</b>	
<i>Entity:</i> <b>Traffic Management</b>	
<i>Functional Area:</i> <b>Traffic Data Collection</b> Collection and storage of traffic management data. For use by operations personnel or data archives in the region.	
<i>Requirement:</i>	Planned
1 The center shall collect traffic management data such as operational data, event logs, etc.	
<i>Element:</i> <b>NDDOT Maintenance Vehicles</b>	
<i>Entity:</i> <b>Maintenance and Construction Vehicle</b>	
<i>Functional Area:</i> <b>MCV Vehicle Location Tracking</b> On-board systems to track vehicle location and reports the position and timestamp information to the dispatch center.	
<i>Requirement:</i>	Existing
1 The maintenance and construction vehicle shall track its current location.	
<i>Requirement:</i>	Existing
2 The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	
<i>Functional Area:</i> <b>MCV Environmental Monitoring</b> 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>	Planned
1 The maintenance and construction vehicle shall collect environmental data from on-board sensors, including air temperature, wind speed, surface temperature, traction conditions, etc.	
<i>Requirement:</i>	Planned
2 The maintenance and construction vehicle shall transmit environmental sensor data to the center. The sensor data includes location and timestamp information.	
<i>Functional Area:</i> <b>MCV Winter Maintenance</b> 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>	Planned
1 The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle.	
<i>Requirement:</i>	Planned
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.	
<i>Element:</i> <b>NDDOT Overheight Detection and Warning System</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Safety Warning System</b> Monitors for potential safety hazards including wrong way drivers, debris on the road, and adverse road conditions (e.g., standing water, icy conditions) and warns approaching vehicles of potential hazards.	
<i>Requirement:</i>	Existing
3 The field element shall process the collected data to identify potential hazards.	

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT Overheight Detection and Warning System</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Safety Warning System</b> Monitors for potential safety hazards including wrong way drivers, debris on the road, and adverse road conditions (e.g., standing water, icy conditions) and warns approaching vehicles of potential hazards.	
<i>Requirement:</i>	Existing
5 The field element shall support remote monitoring and control by an authenticated center.	
<i>Requirement:</i>	Existing
6 [User Defined] The field element shall collect height data data from passing vehicles.	
<i>Requirement:</i>	Existing
7 [User Defined] The field element shall provide warnings to passing vehicles using roadside interactive signage.	
<i>Element:</i> <b>NDDOT RCRS</b>	
<i>Entity:</i> <b>Information Service Provider</b>	
<i>Functional Area:</i> <b>Basic Information Broadcast</b> Broadcast dissemination of traffic, transit, maintenance and construction, event, and weather information to traveler interface systems and vehicles.	
<i>Requirement:</i>	Existing
1 The center shall disseminate traffic and highway condition information to travelers, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.	
<i>Requirement:</i>	Existing
2 The center shall disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.	
<i>Requirement:</i>	Existing
6 The center shall disseminate weather information to travelers.	
<i>Requirement:</i>	Existing
9 The center shall provide the capability to support requests from the media for traffic and incident data.	
<i>Requirement:</i>	Existing
10 The center shall provide the capability for a system operator to control the type and update frequency of broadcast traveler information.	
<i>Requirement:</i>	Existing
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	
<i>Element:</i> <b>NDDOT Regional Transit Centers</b>	
<i>Entity:</i> <b>Transit Management</b>	
<i>Functional Area:</i> <b>Transit Center Vehicle Tracking</b> 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> <b>Transit Center Fixed-Route Operations</b>	

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT Regional Transit Centers</b>	
<i>Entity:</i> <b>Transit Management</b>	
<i>Functional Area:</i> <b>Transit Center Fixed-Route Operations</b> Management of fixed route transit operations. Planning, scheduling, and dispatch associated with fixed and flexible route transit services. Updates customer service operator systems, and provides current vehicle schedule adherence and optimum scenarios for schedule adjustment.	
<i>Requirement:</i>	Planned
1 The center shall generate transit routes and schedules based on such factors as parameters input by the system operator, road network conditions, incident information, operational data on current routes and schedules, and digitized map data.	
<i>Requirement:</i>	Planned
2 The center shall provide the interface to the system operator to control the generation of new routes and schedules (transit services) including the ability to review and update the parameters used by the routes and schedules generation processes and to initiate these processes	
<i>Requirement:</i>	Planned
11 The center shall provide an interface to the archive data repository to enable the operator to retrieve historical operating data for use in planning transit routes and schedules.	
<i>Functional Area:</i> <b>Transit Center Paratransit Operations</b> 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>Requirement:</i>	Planned
4 The center shall dispatch demand response (paratransit) transit vehicles.	
<i>Requirement:</i>	Planned
7 The center shall collect the log of passenger boardings and alightings from the paratransit vehicles.	
<i>Element:</i> <b>NDDOT Speed Monitoring System</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Speed Monitoring and Warning</b> Vehicle speed sensors that detect excessive vehicle speeds, optionally based on conditions and vehicle type, informing drivers, centers and/or enforcement agencies of speed violations.	
<i>Requirement:</i>	Planned
1 The field element shall include sensors to detect vehicle speeds, under traffic or maintenance center control.	
<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> <b>NDDOT Traffic Data Collection</b>	
<i>Entity:</i> <b>Archived Data Management</b>	
<i>Functional Area:</i> <b>Traffic and Roadside Data Archival</b> Collects and archives traffic and environmental information directly from the roadside for use in off-line planning, research, and analysis.	

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:</i> <b>NDDOT Traffic Data Collection</b>	
<i>Entity:</i> <b>Archived Data Management</b>	
<i>Functional Area:</i> <b>Traffic and Roadside Data Archival</b> Collects and archives traffic and environmental information directly from the roadside for use in off-line planning, research, and analysis.	
<i>Requirement:</i>	Planned
1 The center shall manage the collection of archive data directly from collection equipment located at the roadside.	
<i>Requirement:</i>	Planned
2 The center shall collect traffic sensor information from roadside devices.	
<i>Requirement:</i>	Planned
8 [User Defined] The center shall collect environmental sensor information from roadside devices.	
<hr/> <i>Element:</i> <b>NDDOT VSL</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Variable Speed Limits</b> Field elements including physical overhead lane signs and associated monitoring, communications, and control electronics that are used to manage and control variable speed limits systems.	
<i>Requirement:</i>	Planned
1 The field element shall monitor traffic and environmental conditions along the roadway.	
<i>Requirement:</i>	Planned
3 The field element shall receive commands from the controlling center that establish speed limits by lane.	
<i>Requirement:</i>	Planned
4 The field element shall display the current speed limits per lane to drivers.	
<i>Requirement:</i>	Planned
6 The field element shall collect operational status of the variable speed limit field equipment and report the operational status to the controlling center.	
<i>Requirement:</i>	Planned
7 The field element shall monitor and report faults to the controlling center.	
<hr/> <i>Element:</i> <b>NDDOT WIM</b>	
<i>Entity:</i> <b>Roadway</b>	
<i>Functional Area:</i> <b>Roadway Basic Surveillance</b> 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.	
<hr/> <i>Functional Area:</i> <b>Roadway Data Collection</b> 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>	Existing
5 [User Defined] The field element shall collect traffic and vehicle weight information	
<hr/> <i>Element:</i> <b>NDHP Motor Carrier Operations</b>	
<i>Entity:</i> <b>Commercial Vehicle Administration</b>	
<i>Functional Area:</i> <b>Credentials and Taxes Administration</b>	

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element:NDHP Motor Carrier Operations</i>	
<i>Entity:Commercial Vehicle Administration</i>	
<i>Functional Area: Credentials and Taxes Administration</i> Manage electronic filing of credentials, tax filing, and driver licensing for commercial vehicle operators. Provides commercial vehicle (including HAZMAT) route restrictions.	
<i>Requirement:</i>	1 The center shall manage electronic credentials filing and processing for commercial vehicles. <span style="float: right;">Planned</span>
<i>Requirement:</i>	2 The center shall manage the filing of appropriate taxes for the operation of commercial vehicles. <span style="float: right;">Planned</span>
<i>Requirement:</i>	3 The center shall process requests for payments of electronic credentials and tax filing and maintain an interface to a Financial Institution. <span style="float: right;">Planned</span>
<i>Requirement:</i>	4 The center shall exchange credentials and tax information with other commercial vehicle administration centers - either in other states or the federal government. <span style="float: right;">Planned</span>
<i>Requirement:</i>	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. <span style="float: right;">Planned</span>

*Element:NDHP Vehicles*

*Entity:Emergency Vehicle*

*Functional Area: On-board EV Incident Management Communication*

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. <span style="float: right;">Existing</span>
<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. <span style="float: right;">Existing</span>
<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. <span style="float: right;">Existing</span>

*Element:User Personal Computing Devices*

*Entity:Personal Information Access*

*Functional Area: Personal Basic Information Reception*

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.

<b>Architecture</b>	<b>Status</b>
<b>ND Statewide (Region)</b>	(Region)
<i>Element: User Personal Computing Devices</i>	
<i>Entity: Personal Information Access</i>	
<i>Functional Area: <b>Personal Basic Information Reception</b></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>	1 The personal traveler interface shall receive traffic information from a center and present it to the traveler. Existing
<i>Requirement:</i>	5 The personal traveler interface shall receive wide-area alerts and present it to the traveler. Existing
<i>Requirement:</i>	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. Planned
<i>Requirement:</i>	7 The personal traveler interface shall support traveler input in audio or manual form. Existing
<i>Requirement:</i>	8 The personal traveler interface shall present information to the traveler in audible or visual forms, consistent with a personal device. Existing
<i>Functional Area: <b>Personal Interactive Information Reception</b></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>	1 The personal traveler interface shall receive traffic information from a center and present it to the traveler upon request. Existing
<i>Requirement:</i>	5 The personal traveler interface shall receive evacuation information from a center and present it to the traveler. Existing
<i>Requirement:</i>	6 The personal traveler interface shall receive wide-area alerts and present it to the traveler. Existing
<i>Requirement:</i>	11 The personal traveler interface shall provide digitized map data to act as the background to the information presented to the traveler. Existing
<i>Requirement:</i>	12 The personal traveler interface shall support traveler input in audio or manual form. Existing
<i>Requirement:</i>	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. Existing