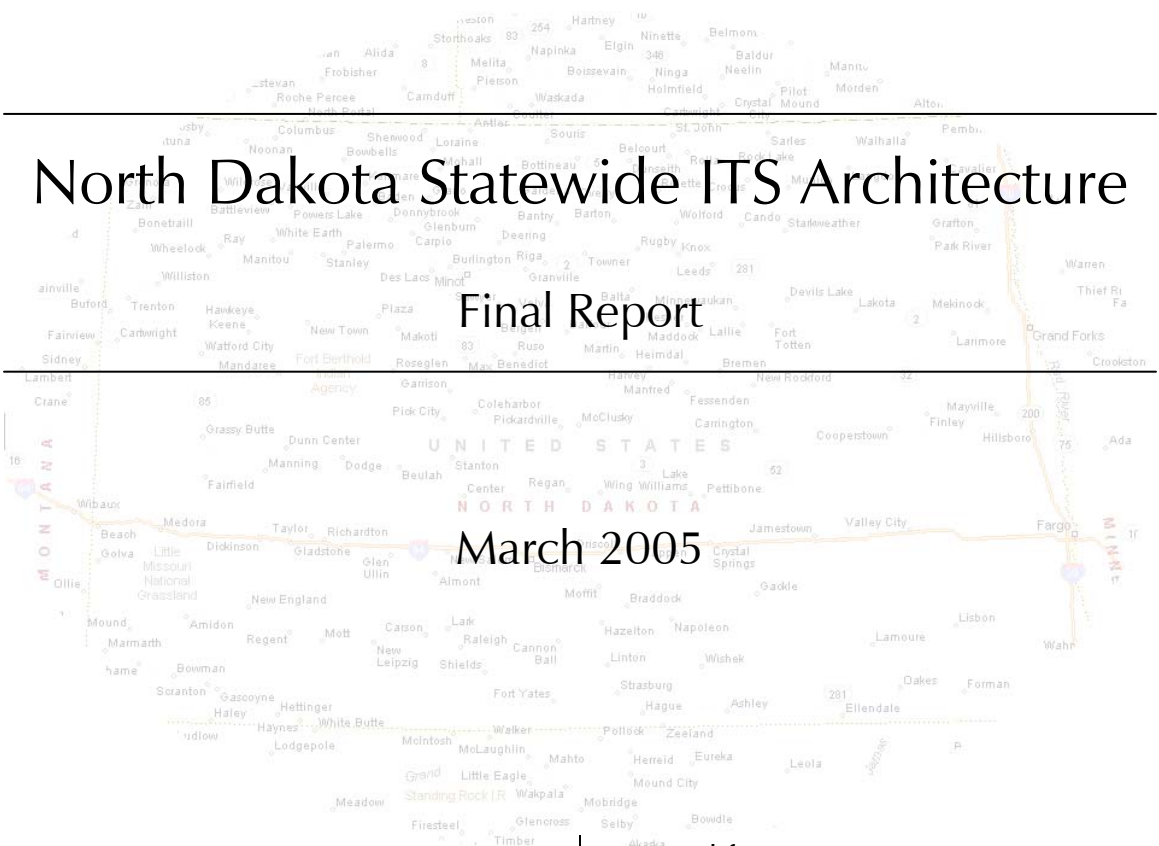




430 IACC Building – Fargo, ND 58105
Tel 701-231-8058 – Fax 701-231-6265
www.atacenter.org - www.ugpti.org



North Dakota Statewide ITS Architecture

Final Report

March 2005

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

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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.

Report Prepared by:

Ayman Smadi
Mohammad Smadi

Advanced Traffic Analysis Center
Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota 58105

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1.0 INTRODUCTION

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

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

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

1.1 Report Organization

The NDDOT Statewide ITS Architecture Report is organized into several main sections to facilitate the report use. In addition, an electronic file has been prepared using Turbo Architecture 3.0 in order to access the architecture and make changes or future updates.

Below is a listing of the remaining sections of this report:

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

2.0 REGION AND SCOPE

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

2.1 Geographical Boundaries

The geographical areas included in the NDDOT statewide architecture primarily consisted of areas within the state boundaries, with emphasis on systems of statewide significance. The NDDOT Statewide ITS Plan identified the major corridors in the state, including Interstate Highways 29 and 94, major state highways, and other locations of special interest. Figure 1 shows a map of the region. 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, including:

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

The NDDOT and MnDOT are part of the North/West Passage, a coalition of states along the I-90 and I94 corridors which aims at streamlining and coordinating traveler information. As a result, the NDDOT and MnDOT are undertaking a joint project in the Fargo-Moorhead area to install automated bridge treatment systems. In conjunction with this installation, the NDDOT and MnDOT will be sharing video monitoring and traveler information functions in border area. Both DOTs will have access to camera controls and the ability to use each others DMS for providing relevant traveler information.

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

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

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

2.2.2 Range of ITS User Services

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

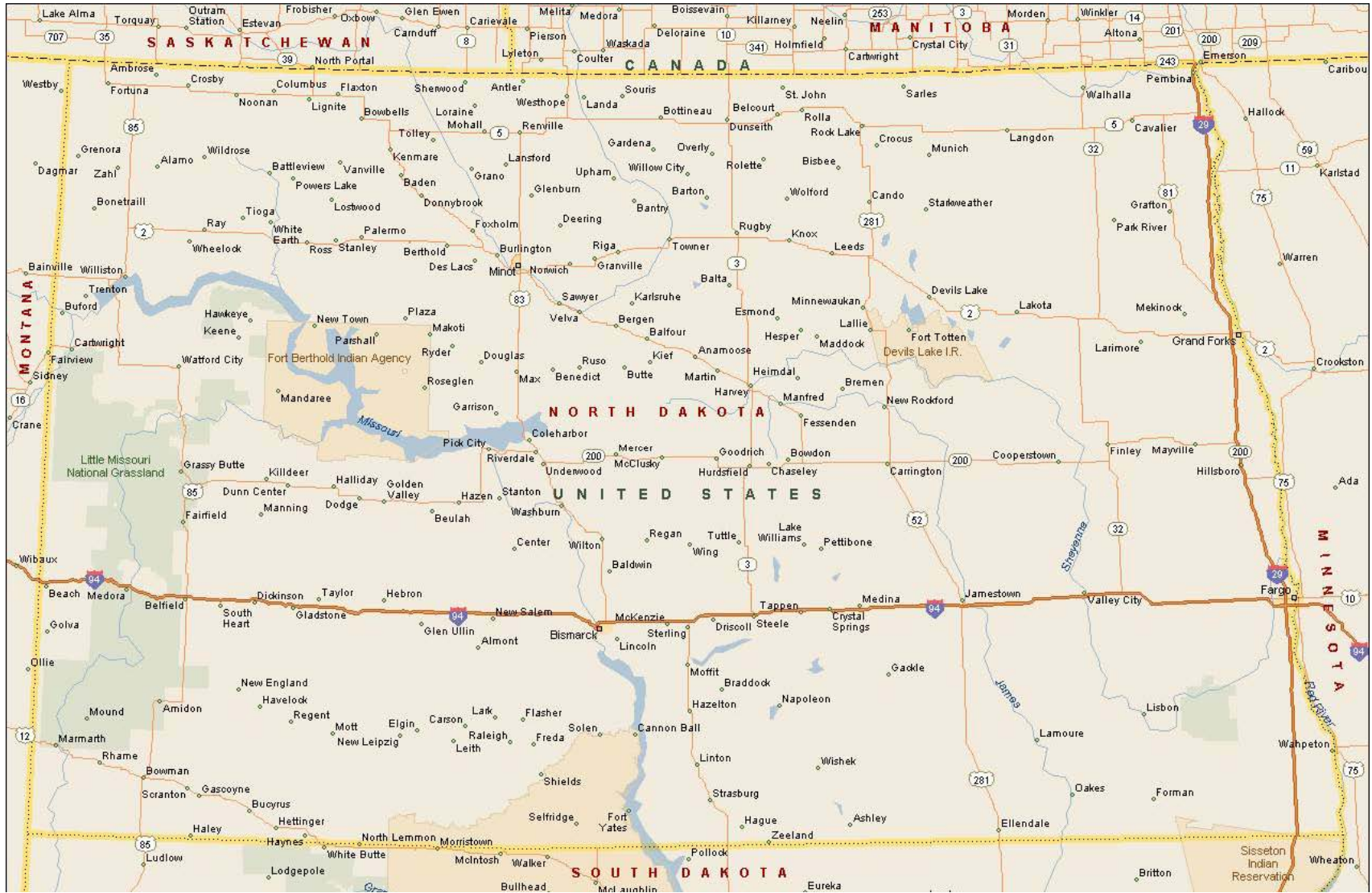


Figure 1 Map of the State of North Dakota

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 significant role in ITS systems (own, operate, maintain) are included in this discussion. Also, it should be noted that this architecture report does not cover the NDDOT ITS/CVO architecture, which is addressed in a separate effort.

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

Table 3.1 North Dakota ITS Stakeholders		
Stakeholder	Description	Associated ITS Elements
NDDOT Planning	North Dakota DOT Planning and Programming	NDDOT ATR
		NDDOT Traffic Collection
		NDDOT WIM
NDHP	North Dakota Highway Patrol	NDHP Vehicles
		NDHP Motor Carrier Section
		NDHP Central Office
NDDOT Maintenance	North Dakota DOT Maintenance	NDDOT Automated Treatment Systems
		Visitor Centers Kiosks
		NDDOT Maintenance Office
		NDDOT IRIS
		NDDOT Speed Monitoring System
		NDDOT Cameras
		NDDOT DMS
NDDOT RWIS		
Division of Emergency Management	North Dakota Division of Emergency Management	State Radio
		SOC
Meridian	Meridian	Meridian Forecasting Center
NDDOT Districts	NDDOT Districts	NDDOT District Offices
		NDDOT Maintenance Vehicles
MnDOT	Minnesota DOT	MnDOT CARS
		MnDOT 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

4.0 SYSTEM INVENTORY

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

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

Using the Physical Architecture, four types of entities were identified for the NDDOT which include:

1. Centers
2. Field Devices
3. Vehicles
4. 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). There are 10 possible centers 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, four were found to apply to the NDDOT statewide ITS architecture. A representation of the NDDOT's Physical Architecture is shown in Figure 2.

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, i.e., traffic control, are covered under regional architectures in the three North Dakota MPOs, including an existing TOC in Fargo and planned TOC in Bismarck and Grand Forks.

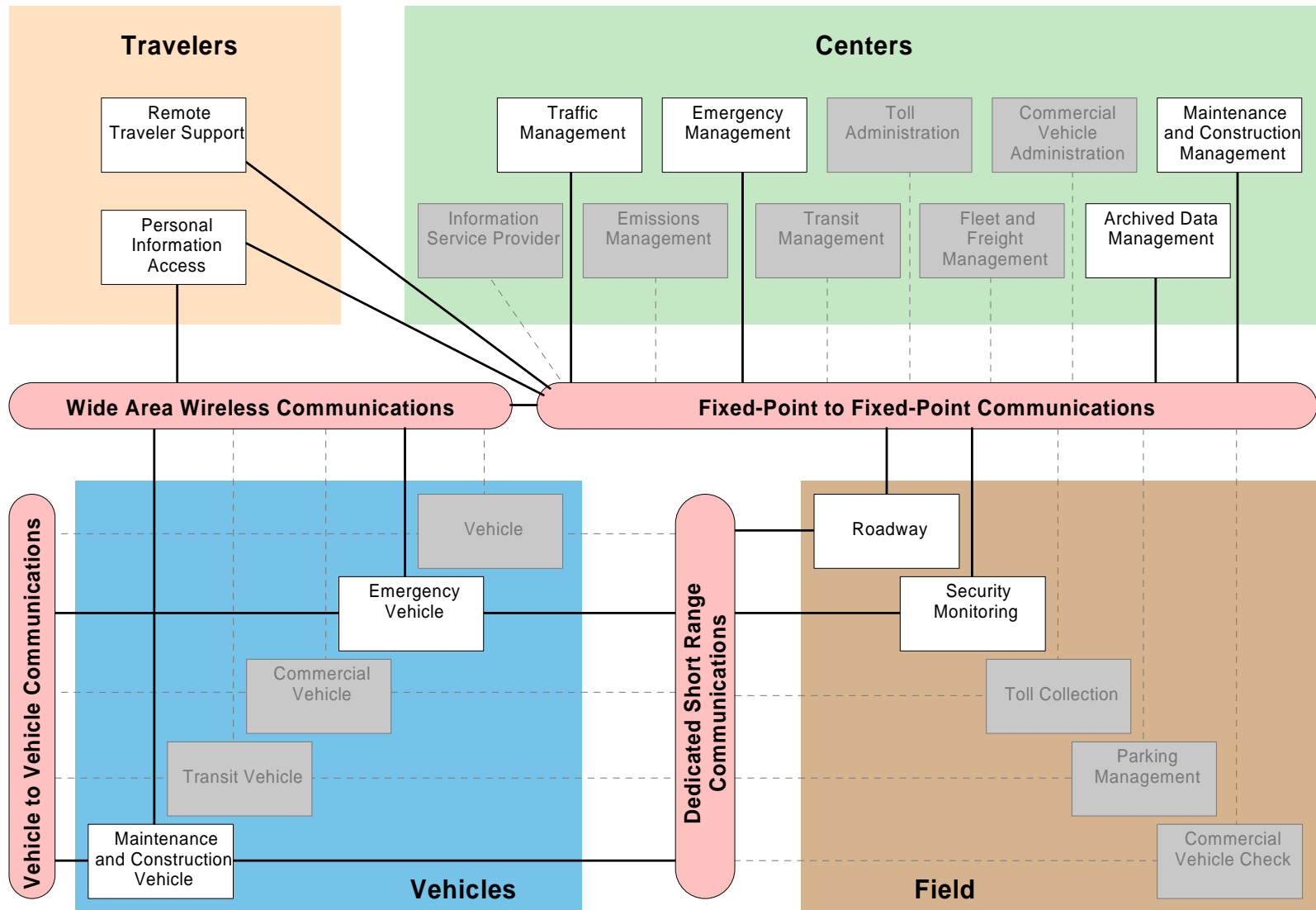


Figure 4.1 NDDOT Physical Architecture

4.1.2 Emergency Management

The North Dakota Division of Emergency Management 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 Operation Center (SOC) which also includes NDDOT, NDHP, and other agencies. The SOC is activated by the Division of Emergency Management when conditions warrant. The SOC coordinates incident response with local Emergency Operation Centers across the state.

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

4.1.3 Maintenance and Construction Management

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

4.1.6 Archived Data Management Center

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

4.2 NDDOT Field Devices

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

1. Sensors
 - a. Weather
 - i. RWIS and Surface sensors
 - b. Traffic
 - i. ATR
 - ii. WIM

- c. Surveillance/monitoring
 - i. Video cameras used in conjunction with bridge anti-icing systems
 - ii. Video cameras at RWIS sites (planned)
 - 2. Control devices
 - a. Variable speed limit signs (planned)
 - b. Automated treatment (anti-icing) systems
 - 3. Warning/advisory devices
 - a. Portable DMS
 - b. Permanent DMS (planned)
 - c. HAR
 - d. Kiosks at Visitor Centers
 - e. Over-height warning (planned)
 - f. High-wind warning (planned)

4.3 NDDOT Vehicles

Only vehicles with existing or planned ITS capabilities are included, i.e., vehicles with advanced communications, navigations, monitoring, and control systems. Therefore, only maintenance and construction vehicles apply to NDDOT architecture. NDDOT snowplows are expected to have AVL capabilities in the future, with additional weather and vehicle monitoring sensors.

4.4 NDDOT Communication Infrastructure

Given the vast areas covered by the NDDOT architecture, providing effective communication to support ITS devices is a great challenge. In the absence of a dedicated statewide network (fiber), the NDDOT has been relying on wireless communication to support ITS devices along major rural corridors. It should be noted that fiber is becoming more available in urban areas of the state and it is increasingly used to support NDDOT District and local transportation agency communication needs. Below is a list of currently used communication by device type.

- 1. Fiber
 - a. Fargo I-29 and I-94 corridors
- 2. Phone drops (dial-up)
 - a. NDDOT –controlled traffic signals in Fargo
 - b. Visitor Centers (DSL currently provided at two centers plus wireless internet service at vicinity of the rest area)
 - c. ATR stations
- 3. Wireless/cellular
 - a. NDDOT portable DMS
 - b. RWIS
 - c. Bridge anti-icing system
 - d. WIM stations

4.5 Summary of NDDOT ITS Inventory

Entity	Element	Element Description	Status	Stakeholder
Emergency Vehicle Subsystem	NDHP Vehicles	North Dakota Highway Patrol Vehicles	Existing	NDHP
Traffic Management	NDDOT Maintenance Office	North Dakota DOT Maintenance Section	Existing	NDDOT Maintenance
Maintenance and Construction Management	NDDOT Maintenance Office	North Dakota DOT Maintenance Section	Existing	NDDOT Maintenance
Maintenance and Construction Vehicle	NDDOT Maintenance Vehicles	NDDOT maintenance and construction vehicles	Existing	NDDOT Districts
Roadway Subsystem	NDDOT Automated Treatment Systems	NDDOT statewide automated treatment systems	Existing	NDDOT Maintenance
Surface Transportation Weather Service	Meridian Forecasting Center	Meridian Environmental Technologies	Existing	Meridian
Telecommunications System for Traveler Information	ND 511	North Dakota Traveler Information System	Existing	Terminator
Personal Information Access	User Personal Computing Devices	Internet enabled personal computing devices	Existing	Terminator
Remote Traveler Support	Visitor Centers Kiosks	North Dakota rest areas kiosks	Existing	NDDOT Maintenance
Emergency Management	SOC	State Operations Center	Existing	Division of Emergency Management
Archived Data Management Subsystem	NDDOT Traffic Collection	NDDOT traffic data collection section	Existing	NDDOT Planning
Emergency Management	State Radio	North Dakota State Radio	Existing	Division of Emergency Management
Information Service Provider	NDDOT IRIS	North Dakota DOT Integrated Road Information System	Planned	NDDOT Maintenance
Media	Media	Radio and television media	Existing	Terminator
Other ISP	MnDOT CARS	MnDOT Condition Acquisition and Reporting System	Existing	MnDOT
	SDDOT IRIS	South Dakota DOT Integrated Road Information System	Existing	SDDOT
Other MCM	MTDOT Operations Center	Montana DOT maintenance and construction operations	Existing	MTDOT
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

Roadway Subsystem	NDDOT ATR	NDDOT Automated Traffic Recorders	Existing	NDDOT Planning
	NDDOT WIM	NDDOT Weigh In Motion stations	Existing	NDDOT Planning
	NDDOT DMS	NDDOT statewide DMS system	Existing	NDDOT Maintenance
Other Roadway	NDDOT DMS	NDDOT statewide DMS system	Existing	NDDOT Maintenance
Roadway Subsystem	NDDOT RWIS	NDDOT statewide RWIS system	Existing	NDDOT Maintenance
Other MCM	SDDOT Operations Center	South Dakota DOT maintenance and construction operations	Existing	SDDOT
Other MCM	MnDOT Operations Center	Minnesota DOT maintenance and construction operations	Existing	MnDOT
Maintenance and Construction Management	NDDOT District Offices	NDDOT district maintenance and construction centers	Existing	NDDOT Districts
Roadway Subsystem	NDDOT Cameras	NDDOT statewide video surveillance system	Planned	NDDOT Maintenance
Security Monitoring Subsystem	NDDOT Cameras	NDDOT statewide video surveillance system	Planned	NDDOT Maintenance
Enforcement Agency	NDHP Central Office	North Dakota Highway Patrol Central Office, Bismarck	Existing	NDHP
Roadway Subsystem	NDDOT Speed Monitoring System	NDDOT work zone speed monitoring sensors	Planned	NDDOT Maintenance
Maintenance and Construction Administrative Systems	NDDOT CARS	NDDOT Construction Administration and Reporting System	Existing	NDDOT Construction
Commercial Vehicle Administration	NDHP Motor Carrier Section	North Dakota Highway Patrol oversize/overweight permitting	Existing	NDHP

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 recently completed NDDOT Strategic ITS Plan. NDDOT stakeholders were provided with opportunities to identify additional issues/services throughout the architecture development. 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. Given that the plan was recently completed, these needs were thought to be valid for developing the ITS architecture.

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

5.2 Services

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

5.2.1 NDDOT ITS User Services

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

- c. **Traffic Control:** Includes a traffic control function that provides the capability to efficiently manage the movement of traffic on streets and highways.
 - d. **Incident Management:** Includes an incident management function that will identify incidents, formulate response actions and support initiation and ongoing coordination of those response actions.
- 2. **Commercial Vehicle Operations (that CVO architecture is developed separately from the statewide ITS Architecture)**
 - 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.

5.2.2 NDDOT Market Packages

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

Network Surveillance (Existing *)

This market package includes traffic detectors, other surveillance equipment, supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally, such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning.

Traffic Information Dissemination (Existing)

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

Traffic Incident Management System (Existing *)

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

Speed Monitoring (Existing *)

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

Maintenance and Construction Vehicle and Equipment Tracking (Planned)

This market package will track the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities.

Activities monitored through this market package include ensuring the correct roads are being plowed and that maintenance work is being performed at the correct locations.

Road Weather Data Collection (Existing)

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

Weather Information Processing and Distribution (Existing *)

This market package processes and distributes the environmental information collected from the Road Weather Data Collection market package. It uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so system operators and decision support systems can make decision on corrective actions to take. The continuing updates of road condition information and current temperatures can be used by system operators to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers, and aid operators in scheduling work activity.

Roadway Automated Treatment (Existing *)

This market package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The market package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated.

Winter Maintenance (Existing)

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

Work Zone Management (Existing *)

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

Maintenance and Construction Activity Coordination (Planned)

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

Broadcast Traveler Information (Existing *)

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

Interactive Traveler Information (Existing *)

This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that 'push' a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal, kiosks, and personal computer.

Emergency Call-Taking and Dispatch (Existing)

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

Transportation Infrastructure Protection (Planned)

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

Wide-Area Alert (Existing *)

This market package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and

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

Disaster Response and Recovery (Existing *)

This market package enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters and technological and man-made disasters. The market package supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The market package provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In addition, this market package tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response.

Evacuation and Reentry Management (Existing *)

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

Disaster Traveler Information (Existing *)

This market package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a

disaster. This market package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems.

ITS Data Warehouse (Planned)

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

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 storm, floods, etc. In addition to providing a snapshot of how things are done for a certain scenario, the operational concept explores additional integration opportunities in the state with particular focus on stakeholder involvement.

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

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

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

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

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

6.1 Implementation Roles

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

6.2 Operational Roles and Responsibilities

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

(Table continued on next page)

Traveler Information	Division of Emergency Management	Issue emergency alerts
	Meridian	<ol style="list-style-type: none"> 1. Operate ND 511 system 2. Provide weather information
	NDDOT Maintenance NDDOT Maintenance	<ol style="list-style-type: none"> 1. Broadcast traveler information on DMS and 511 2. Provide road conditions to IRIS
	NDHP NDHP	<ol style="list-style-type: none"> 1. Make road closure decisions 2. Relay road conditions to NDDOT

7.0 AGREEMENTS

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

The table on the following page shows a summary of potential agreements between the NDDOT and other stakeholders in North Dakota. The table provides the following information for each agreement:

1. Market Package
 - a. The Market Package where the agreement is needed
2. Purpose
 - a. Brief statement on what the agreement addresses
3. Stakeholders
 - a. List the stakeholders (agencies) which would be included in the agreement
4. Issues
 - a. List specific issues to be included in the agreement

(This space was intentionally left blank)

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

8.0 FUNCTIONAL REQUIREMENTS

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

The organization of the Functional Requirements Report produced by Turbo may be described as follows:

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

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

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

9.0 INTERFACE REQUIREMENTS

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

Network Surveillance		
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT IRIS	NDDOT Maintenance Office	Planned
Traffic Information Dissemination		
Media	NDDOT Maintenance Office	Existing
NDDOT Automated Treatment Systems	NDDOT DMS	Planned
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	State Radio	Existing
Traffic Incident Management		
MHP Central Office	State Radio	Existing
MnDOT Operations Center	NDDOT Maintenance Office	Planned
MSP Central Office	State Radio	Existing
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT IRIS	State Radio	Planned
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
NDHP Vehicles	State Radio	Existing
SDHP Central Office	State Radio	Existing

Speed Monitoring		
NDDOT Maintenance Office	NDDOT Speed Monitoring System	Planned
NDDOT Maintenance Office	NDHP Central Office	Planned
NDDOT Speed Monitoring System	NDHP Central Office	Planned
MCO Vehicle Tracking		
NDDOT District Offices	NDDOT Maintenance Vehicles	Existing
NDDOT Maintenance Office	NDDOT Maintenance Vehicles	Existing
Roadway Weather Collection		
Meridian Forecasting Center	NDDOT Automated Treatment Systems	Existing
Meridian Forecasting Center	NDDOT Maintenance Office	Existing
Meridian Forecasting Center	NDDOT RWIS	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Vehicles	Planned
NDDOT Maintenance Office	NDDOT Maintenance Vehicles	Existing
NDDOT Maintenance Office	NDDOT RWIS	Existing
Weather Information Processing		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing
Meridian Forecasting Center	NDDOT District Offices	Existing
Meridian Forecasting Center	NDDOT IRIS	Planned
Meridian Forecasting Center	NDDOT Maintenance Office	Existing
Meridian Forecasting Center	State Radio	Existing
MnDOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
Roadway Automated Treatment		
NDDOT Automated Treatment Systems	NDDOT District Offices	Existing
NDDOT Automated Treatment Systems	NDDOT DMS	Planned
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Cameras	NDDOT District Offices	Planned
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT DMS	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing

Winter Maintenance		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing
Meridian Forecasting Center	NDDOT District Offices	Existing
Meridian Forecasting Center	NDDOT Maintenance Office	Existing
MnDOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT Maintenance Vehicles	Existing
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	NDDOT Maintenance Vehicles	Existing
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
Work Zone Management		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing
MnDOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT Automated Treatment Systems	NDDOT District Offices	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Cameras	NDDOT District Offices	Planned
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT CARS	NDDOT District Offices	Existing
NDDOT CARS	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT DMS	Existing
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing
Maintenance and Construction Activity Coordination		
Media	NDDOT District Offices	Existing
Media	NDDOT Maintenance Office	Existing
MnDOT Operations Center	NDDOT Maintenance Office	Planned
MTDOT Operations Center	NDDOT Maintenance Office	Planned
NDDOT CARS	NDDOT District Offices	Existing
NDDOT CARS	NDDOT Maintenance Office	Existing
NDDOT District Offices	NDDOT Maintenance Office	Existing
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT Maintenance Office	NDHP Motor Carrier Section	Existing
NDDOT Maintenance Office	SDDOT Operations Center	Planned
NDDOT Maintenance Office	State Radio	Existing

Broadcast Traveler Information		
Media	NDDOT IRIS	Planned
Meridian Forecasting Center	NDDOT IRIS	Planned
MnDOT CARS	NDDOT IRIS	Planned
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT IRIS	SDDOT IRIS	Planned
NDDOT IRIS	State Radio	Planned
NDDOT IRIS	User Personal Computing Devices	Planned
NDDOT IRIS	Visitor Centers Kiosks	Planned
Interactive Traveler Information		
Media	NDDOT IRIS	Planned
Meridian Forecasting Center	NDDOT IRIS	Planned
MnDOT CARS	NDDOT IRIS	Planned
ND 511	NDDOT IRIS	Planned
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT IRIS	SDDOT IRIS	Planned
NDDOT IRIS	State Radio	Planned
NDDOT IRIS	User Personal Computing Devices	Planned
NDDOT IRIS	Visitor Centers Kiosks	Planned
Emergency Call Taking and Dispatch		
MHP Central Office	State Radio	Existing
MSP Central Office	State Radio	Existing
NDDOT Maintenance Office	State Radio	Existing
NDHP Vehicles	State Radio	Existing
SDHP Central Office	State Radio	Existing
Infrastructure Protection		
MHP Central Office	State Radio	Existing
MSP Central Office	State Radio	Existing
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing
NDDOT Cameras	NDDOT Maintenance Office	Existing
NDDOT Cameras	State Radio	Planned
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	State Radio	Existing
State Radio	Visitor Centers Kiosks	Planned
Wide Area Alert		
MHP Central Office	SOC	Existing
MHP Central Office	State Radio	Existing
MSP Central Office	SOC	Existing
MSP Central Office	State Radio	Existing
ND 511	NDDOT IRIS	Planned
NDDOT Automated Treatment Systems	NDDOT Maintenance Office	Existing

NDDOT District Offices	SOC	Existing
NDDOT DMS	NDDOT Maintenance Office	Existing
NDDOT IRIS	SOC	Planned
NDDOT IRIS	State Radio	Planned
NDDOT IRIS	User Personal Computing Devices	Planned
NDDOT IRIS	Visitor Centers Kiosks	Planned
NDDOT Maintenance Office	SOC	Existing
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	SOC	Existing
SDHP Central Office	State Radio	Existing
SOC	State Radio	Existing
Disaster Response and Recovery		
MHP Central Office	SOC	Existing
MHP Central Office	State Radio	Existing
MSP Central Office	SOC	Existing
MSP Central Office	State Radio	Existing
NDDOT Maintenance Office	SOC	Existing
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	SOC	Existing
SDHP Central Office	State Radio	Existing
SOC	State Radio	Existing
Evacuation and Reentry Management		
MHP Central Office	SOC	Existing
MHP Central Office	State Radio	Existing
MSP Central Office	SOC	Existing
MSP Central Office	State Radio	Existing
NDDOT District Offices	SOC	Existing
NDDOT Maintenance Office	SOC	Existing
NDDOT Maintenance Office	State Radio	Existing
SDHP Central Office	SOC	Existing
SDHP Central Office	State Radio	Existing
SOC	State Radio	Existing
Disaster Traveler Information		
Media	SOC	Existing
Media	State Radio	Existing
Meridian Forecasting Center	NDDOT IRIS	Planned
ND 511	NDDOT IRIS	Planned
NDDOT IRIS	NDDOT Maintenance Office	Planned
NDDOT IRIS	SOC	Planned
NDDOT IRIS	State Radio	Planned
NDDOT IRIS	User Personal Computing Devices	Planned
NDDOT IRIS	Visitor Centers Kiosks	Planned

ITS Data Warehouse		
NDDOT ATR	NDDOT Traffic Collection	Existing
NDDOT Maintenance Office	NDDOT Traffic Collection	Planned
NDDOT Traffic Collection	NDDOT WIM	Existing

10.0 ITS STANDARDS

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

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

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

11.0 PROJECTS SEQUENCE

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

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

11.1 Statewide ITS Architecture Maintenance

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