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

Bismarck-Mandan Regional ITS Architecture Update

Version 2.0

Final Report

March 2008

Bismarck-Mandan Regional ITS Architecture
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The information contained in this report was obtained through extensive input from various stakeholders in the Bismarck-Mandan region. 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

ACRONYMS

ATAC	Advanced Traffic Analysis Center
AVL	Automated Vehicle Location
Bis	Bismarck
Bis-Man	Bismarck-Mandan
Bismarck FD	Bismarck Fire Department
Bismarck PD	Bismarck Police Department
Bismarck PW	Bismarck Public Works
CAT	Capitol Area Transit
CCTV	Closed Circuit Television
Dist	District
DMS	Dynamic Message Sign
DOT	Department of Transportation
EAS	Emergency Alert System
EOC	Emergency Operations Center
EV	Emergency Vehicle
FHWA	Federal Highway Administration
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
Mandan FD	Mandan Fire Department
Mandan PD	Mandan Police Department
Mandan PW	Mandan Public Works
MCO	Maintenance and Construction Operations
MPO	Metropolitan Planning Organization
NDDOT	North Dakota Department of Transportation
NDHP	North Dakota Highway Patrol
OEM	Office of Emergency Management
RA	Regional Architecture
TOC	Traffic Operations Center

Standards

ASTM	American Society for Testing and Materials
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
NTCIP	National Transportation Communications for ITS Protocol
SAE	Society of Automotive Engineers

Market Packages

APTS	Advanced Public Transportation Systems
ATMS	Advanced Traffic Management Systems
EM	Emergency Management
MCO	Maintenance and Construction Operations

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EXECUTIVE SUMMARY

The Bismarck-Mandan Regional Intelligent Transportation Systems (ITS) Architecture was prepared in March 2005 under the leadership of the Bismarck-Mandan Metropolitan Planning Organization (Bis-Man MPO). The goal of the Bismarck-Mandan regional architecture (RA) is to guide the implementation of ITS in the Bismarck-Mandan region and coordinate funding, deployment, information sharing, and operations of ITS systems in the region. The main ITS goal areas for the Bismarck-Mandan region include enhanced traveler safety; effective traffic and transit management; coordinated incident management; and enhanced traveler information. A 15-year planning horizon was considered in the RA development.

The Bismarck-Mandan area has experienced solid growth in population and increased economic activity. Bismarck is the capitol of North Dakota, so it serves as a government, business, and cultural center. Therefore, an efficient transportation system is crucial for supporting mobility needs of individuals and businesses in the region.

The geographical boundaries identified for purposes of developing the Bismarck-Mandan RA consist of areas included in the Bis-Man MPO metropolitan boundaries. Major jurisdictions with significant roles in the RA include:

1. City of Bismarck
2. City of Mandan
3. Burleigh County
4. Morton County

In addition to these jurisdictions, the RA recognized interfaces with the North Dakota statewide ITS Architecture. The North Dakota Department of Transportation (NDDOT), and the Federal Highway Administration (FHWA) were active participants in the RA development.

The RA development closely followed federal guidelines and was guided by various regional stakeholders who were categorized into three groups:

1. Project Advisory Group: guide overall project in the three MPOs
    a. Two representative from each MPO
    b. FHWA Division Office, Bismarck, North Dakota
    c. NDDOT
2. Technical Steering Committee: provide technical information on existing and planned systems and provide input on the architecture development
    a. City engineering and planning staff
    b. Transit staff
    c. MPO planning staff

    d. County engineering/planning staff
    e. Agency Information Technology technical staff
    f. State DOT district engineering staff
    g. FHWA representative
    h. Law enforcement
    i. Other agencies responsible for system operating/maintenance
3. Local Stakeholders: stakeholders not likely to own/operate ITS systems
    a. Elected official for supporting deployment and funding systems
    b. Event centers
    c. Colleges
    d. Airports
    e. Emergency Medical Services

After the Bis-Man RA stakeholders were identified, a system inventory was conducted to identify 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, and transit management. The inventory identified systems and their functions by agency and jurisdiction.

The Bis-Man MPO completed an ITS Plan in April 2004 which identified several ITS applications to address regional transportation needs. The plan identified high priority ITS user services and an initial set of ITS Market Packages based on the National ITS Architecture. These ITS Market Packages were used extensively in Bis-Man RA 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 16 Market Packages were identified for the Bis-Man area.

The Market Packages were customized based on input from the stakeholders. They were also used to survey roles and responsibilities for each system. System interconnections and relevant information flows were identified for major ITS systems in the region. These systems include: traffic management, transit management, emergency management, and maintenance and construction management.

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. Seven potential agreements were identified for the Bis-Man region and include: Transit Security, Network Surveillance, Traffic Information Dissemination, and Traffic Incident Management.

One of the greatest challenges to successful ITS deployment in the Bis-Man area is funding for ITS infrastructure, especially communications. Therefore, coordination and integration of key system components were cited as critical factors for success. Given the number and diversity of agencies involved, it is important to capitalize on and expand existing partnerships to include new ITS systems. These partnerships can result in cost-effective strategies that meet the demands of each agency and the traveling public in the Bis-Man region.

As part of the RA development, the Bis-Man MPO has been designated with the role of maintaining and updating the Bis-Man Regional ITS Architecture as needed. The Bis-Man MPO will coordinate changes to the RA as more ITS projects have been planned or major changes to the transportation system have taken place. An update cycle of every 2-3 years has also been identified and this report, along with Turbo Architecture database file, serves as the first major update of the Bis-Man RA and has been completed in March 2008.

1.0 INTRODUCTION

This document summarizes the results of the regional Intelligent Transportation architecture development for the Bismarck-Mandan Area. Intelligent Transportation Systems (ITS) refer to integrated applications of sensing, communications, computer processing, and electronics to enhance the transportation systems. The regional architecture (RA) provides a tool to guide future ITS planning, define system requirements, coordinate agency roles and integrate functions across jurisdictional lines.

The Bismarck-Mandan Regional Intelligent Transportation Systems (ITS) Architecture was prepared under the leadership of the Bismarck-Mandan Metropolitan Transportation Organization (Bis-Man MPO). The goal of the Bis-Man regional architecture (RA) is to guide the implementation of ITS systems in the Bis-Man area and coordinate funding, deployment, information sharing, and operations of ITS systems in the region. The main ITS goal areas for the Bis-Man area include enhanced traveler safety; effective traffic and transit management; coordinated incident management; and enhanced 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 Bismarck-Mandan MPO, Fargo-Moorhead Council of Governments, and the Grand Forks-East Grand Forks MPO for supporting the RA development in each region.

1.1 Report Organization

The Bis-Man RA 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 description for each of the remaining sections of this report:

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

2.0 REGION AND SCOPE

This section describes the geographical characteristics of the Bis-Man region. It also discusses the scope of the regional architecture (RA), providing a high-level outline of the range of ITS services and systems used.

2.1 Geographical Boundaries

The geographical boundaries identified for purposes of developing the Bismarck-Mandan RA consist of areas included in the Bis-Man MPO metropolitan boundaries. Major jurisdictions with significant roles in the RA include:

1. City of Bismarck
2. City of Mandan
3. Burleigh County
4. Morton County

In addition to these jurisdictions, the RA recognized interfaces with the North Dakota statewide ITS Architecture. The North Dakota Department of Transportation (NDDOT), and the Federal Highway Administration (FHWA) were active participants in the RA development.

2.2 Scope of the RA

The scope of the Bis-Man RA may be defined using broad ITS user services targeted for deployment within the region. The delineation of relevant ITS user services assisted in identifying relevant stakeholders and corresponding systems to be included in the RA. The range of ITS user services included the following:

1. Travel and Traffic Management
    a. Traffic control
    b. Traveler information
    c. Traffic surveillance
2. Public Transportation Management
    a. Fleet management (real-time information)
    b. Transit security
3. Incident Management
    a. Incident response coordination
4. Information Management
    a. Data archival and analysis services
5. Maintenance and Construction Management
    a. Fleet management
    b. Automated treatment (anti-icing systems)
    c. Winter maintenance

Figure 1 Map of the Bismarck-Mandan Region

3.0 STAKEHOLDERS

Stakeholders participating in the development of the Bis-Man RA included transportation, public works, law enforcement, emergency management, transit, and other related agencies. A regional ITS Core Group consisting of agencies who own/operate ITS elements or will do so in the future has the primary role of guiding the RA development. Table 3.1 lists stakeholders and their representatives who participated in the RA development. Table 3.2 lists stakeholders included in the Bis-Man ITS inventory.

Table 3.1 Bismarck-Mandan Stakeholders

Name		Organization	Work Phone
Sarah	Baehurst	City of Mandan	701-667-3225
Paul	Benning	ND Dept of Transportation	701-328-2217
Mark	Berg	City of Bismarck	701-222-6593
Dennis	Bullinger	City of Mandan, Police Department	701-664-3250
Steve	Busek	FHWA, ND Division	701-250-4395
Glen	Christmann	City of Lincoln	701-258-3145
Mike	Dannenfelzer	Bismarck/Burleigh Combined Comms.	701-222-6727
Matt	Erhardt	Morton County	701-663-5924
Brad	Erickson	Medcenter One Health Systems	701-328-6319
Jim	Fors	National Weather Service	701-223-4582
Jeff	Forster	FHWA, ND Division	701-250-4343
Elroy	Haadem	Burleigh County Extension Service	701-221-6865
Derek	Hanson	St. Alexius Medical Center	701-530-8620
Greg	Haug	Bismarck Municipal Airport	701-222-6502
Pat	Heinert	Burleigh County Sheriff's Department	701-222-6651
Jeff	Heintz	Bismarck Public Works	701-355-1700
Paul	Johnson	Bismarck Public Schools	701-222-3710
Mark	Johnson	FHWA, ND Division	701-250-4343
Karen	Kautzmann	Burleigh/Morton County Schools	701-667-3315
Ken	Lamont	City of Mandan	701-663-8717
Tammy	Lapp-Harris	City of Mandan/Morton County	701-667-3307
Kevin	Levi	ND Dept of Transportation	701-328-6955
Jon	Mill	Burleigh County	701-221-6870
Chuck	Morman	Morton County	701-667-3346
Steve	Nardello	City of Mandan	701-667-3288
Allen	Nass	City of Bismarck, Police Department	701-223-1212

Name		Organization	Work Phone
Todd	Porter	Metro Area Ambulance, Inc	701-255-0812
Norman	Ruud	ND State Highway Patrol	701-328-5590
Ed	Ryen	ND Dept of Transportation	701-328-4274
Steve	Saunders	Bismarck-Mandan MPO	701-222-6449
Kermit	Schaefer	City of Bismarck, Fire Department	701-250-7671
Doug	Schonert	Burleigh County, Commissioner	701-355-1010
Mary	Senger	City of Bismarck/Burleigh County	701-222-6727
Russ	Timmreck	ND Div. of Emergency Management	701-328-8261
John	Warford	City of Bismarck, Mayor	701-222-6570
Robin	Werre	Bis-Man Transit	701-258-6817
Jeff	Wright	City of Mandan, Public Works	701-667-3240

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Table 3.2 Bismarck-Mandan ITS Stakeholders		
Stakeholder	**Description**	**ITS Elements**
Bismarck PD	Bismarck Police Department	Bismarck PD Vehicles
Mandan PD	Mandan Police Department	Mandan PD Dispatch Center
		Mandan PD Vehicles
NDHP	North Dakota Highway Patrol	NDHP Vehicles
NDDOT Bis Dist	NDDOT Bismarck District	NDDOT District Vehicles
		NDDOT District Office
		NDDOT District Field Devices
Mandan PW	Mandan Public Works	Mandan PW Vehicles
		Mandan PW Operations Center
Bismarck PW	Bismarck Public Works	Bismarck PW Vehicles
		Bismarck PW Operations Center
		Bismarck PW Field Devices
Bismarck FD	Bismarck Fire Department	Bismarck FD Vehicles
Mandan FD	Mandan Fire Department	Mandan FD Vehicles
Mandan Engineering	Mandan Engineering Department	Mandan Engineering Field Devices
		Mandan Traffic Engineering
Bismarck Engineering	Bismarck Engineering Department	Bismarck TOC Field Devices
		Bismarck Engineers
		Bismarck TOC
Bis-Man Transit	Bismarck-Mandan Transit	Bis-Man Transit Operator
		Bis-Man Transit Drivers
		Traveler Card
		Bis-Man Transit Vehicles
		Bis-Man Transit Center
Bismarck/Burleigh Emergency Management	Emergency Management for Bismarck and Burleigh County	Bismarck/Burleigh Combined Communications Center
Morton County OEM	Morton County Office of Emergency Management	Morton County Communications
Burleigh County Sheriff	Burleigh County Sheriff Department	Burleigh County Sheriff Vehicles
Morton County Sheriff	Morton County Sheriff department	Morton County Sheriff Vehicles
Metro Area Ambulance	Bismarck-Mandan regional ambulance service	Metro Area Ambulance Vehicles
ND Division of Emergency Management	North Dakota Division of Emergency Management	State Radio

4.0 SYSTEM INVENTORY

This section summarizes the results of the system inventory process for the Bis-Man RA. The information in this section was developed through extensive input from stakeholders in the region. Survey instruments, interviews, and small group meetings were used to obtain and verify the inventory information.

Since the Bismarck-Mandan Metropolitan ITS Plan was completed fairly recently, the majority of the ITS user services identified in the plan were directly applicable for the RA development. However, the inventory had to account for existing ITS systems and those that were deployed after the plan was completed in April 2004.

Based on the National ITS Architecture, four types of Physical Architecture entities were identified for the Bis-Man region, which include:

1. Centers
2. Field Devices
3. Vehicles
4. Communications

These entities are explained in greater details in the following subsections. An Inventory Report generated from Turbo Architecture summarizes ITS elements for each stakeholder is included in section 4.5.

4.1 Bis-Man Centers

Centers in the Physical Architecture represent 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. Each of theses centers communicates with other centers to enable coordination between modes and across jurisdictions. Out of the 10 possible centers, six were found to apply to the Bis-Man area. Figure 2 shows these centers as well as other components of the Physical Architecture.

4.1.1 Traffic Management Center

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.

Traffic management activities within the Bis-Man area are limited. Most of the traffic signals in the area are operated by the City of Bismarck, which maintains several coordinated corridors. Video detection is used at several signalized intersections in Bismarck, however, it is strictly intended to support traffic signal operations and not for incident management or traffic monitoring.

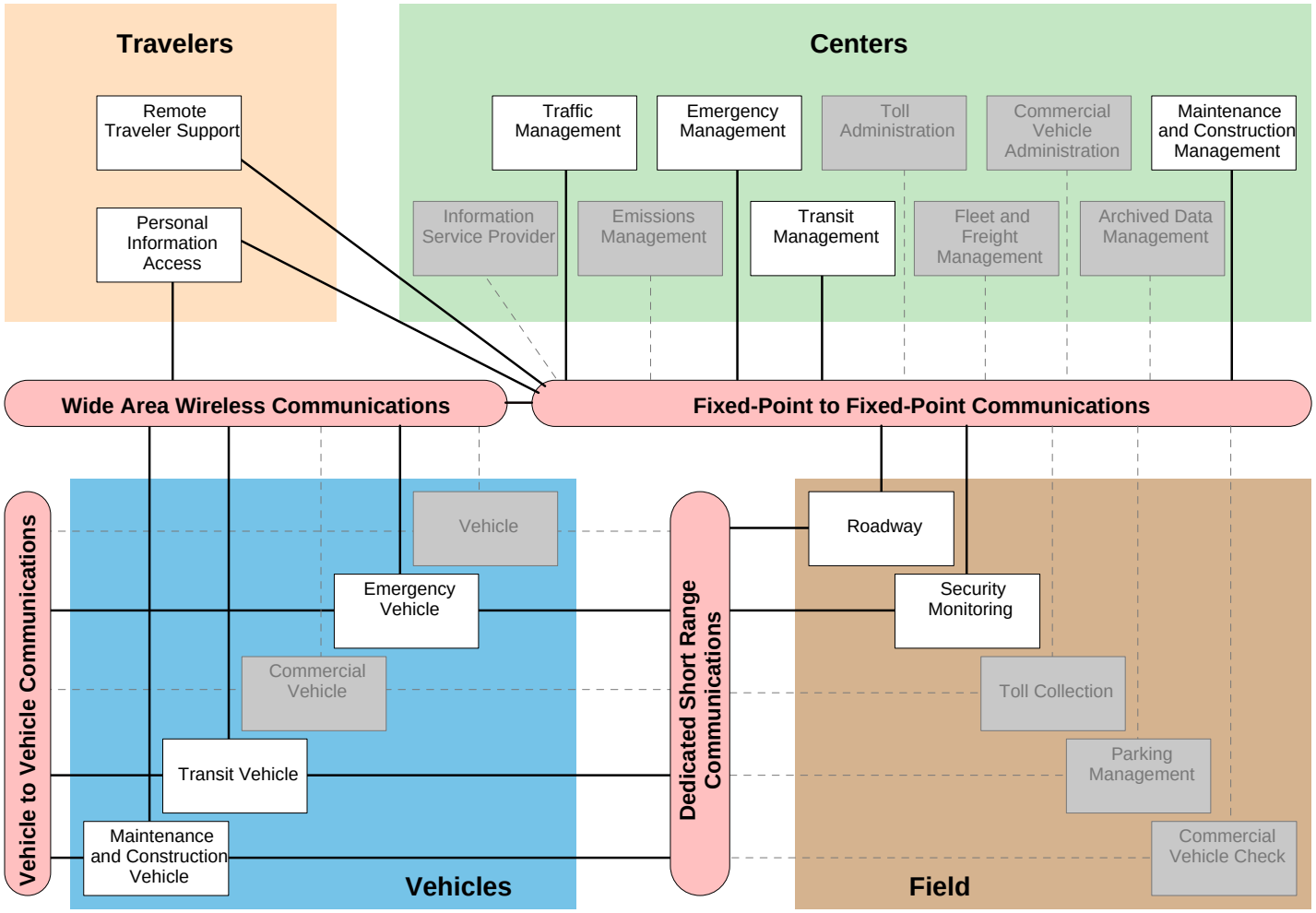

Figure 2 Bismarck-Mandan Physical Architecture

4.1.2 Emergency Management Center

Emergency management is handled by several local, county, and state agencies. The Cities of Bismarck and Burleigh County operate a Combined Communications Center which provides 911 and dispatch service to law enforcement, fire, and ambulance services. The City of Mandan and Morton County each maintain a dispatch center which also handles 911 calls. The NDHP dispatch is handled through State Radio.

In addition, each jurisdiction within the Bis-Man area maintains an Emergency Operations Center (EOC). The EOC brings together law enforcement, fire, emergency management, and public works agencies to coordinate emergencies. These EOCs currently rely on traditional phone line communications for sharing information, i.e., they have little or no ITS.

4.1.3 Maintenance and Construction Management Center

Currently there are three entities which handle Maintenance and Construction Management (MCO) in the Bis-Man area, including: Bismarck Public Works, Mandan Public Works, and NDDOT. County road departments handle rural road maintenance but there are no official interfaces that need to be included in the ITS RA with the metropolitan system.

The NDDOT and the City of Bismarck are planning for an automated anti-icing system to be installed as part of the new Memorial Bridge project in Bismarck.

4.1.4 Information Service Provider

Functions associated with an Information Service Provider (ISP) are currently provided through multiple agencies in the Bis-Man area. Generally, law enforcement agencies are the main point of contact for issuing travel advisories and contacting the media. There currently is no traffic information provided for the metropolitan area. However, the NDDOT maintains a statewide traveler information system which uses 511 and a web page where travelers can obtain a variety of road conditions, weather, and construction information.

4.1.5 Transit Management Center

Bis-Man Transit provides public transportation services for the cities of Bismarck and Mandan as well as surrounding areas. In 2004 a new fixed-route transit service was added in Bismarck, called Capitol Area Transit (CAT).

Buses acquired for CAT are equipped with onboard security surveillance equipment. Additionally, CAT is in the process of installing an electronic fare management system which will allow enhanced fare data functions.

4.1.6 Archived Data Management Center

There currently is no entity which handles ITS data collection in the Bis-Man area. This may in part be due to the small number of ITS devices collecting traffic and other data in the area.

4.2 Bis-Man Field Devices

Field devices in the Physical Architecture refer to hardware installed to support ITS systems. The majority of field devices in the Bis-Man area may be classified under the Roadway Subsystem. Below is a listing of these devices by agency.

1. Sensors
    a. Weather
        i. RWIS and Surface sensors located on I-94 (NDDOT)
    b. Traffic
        i. Video traffic detectors (Bismarck)
        ii. Loop detectors (Bismarck and Mandan)
2. Control devices
    a. Traffic signal controllers (Bismarck and Mandan)
3. Warning/advisory devices
    a. Two portable DMS along I-94 (NDDOT)
    b. Permanent DMS along I-94 (NDDOT)

4.3 Bis-Man Area Vehicles

There are three types of vehicles included in the Bis-Man RA. Only vehicles with existing or planned ITS capabilities are included, i.e., vehicles with advanced communications, navigations, monitoring, and control systems.

1. Emergency Vehicle for Bismarck and Mandan
    a. Fire (planned)
    b. Law enforcement (planned)
    c. Ambulance (planned)
2. Transit Vehicle
    a. CAT buses with electronic fare box (planned)
3. MCO vehicles for NDDOT and Bismarck
    a. Snowplows equipped with AVL (planned)

4.4 Bis-Man Communication Infrastructure

Existing communication infrastructure in the Bis-Man area is limited. Below is a brief summary of available communications:

1. Fiber
    a. Arterial network (Bismarck)
2. Phone drops (dial-up)
    a. Traffic signals (Bismarck)
3. Wireless/cellular
    a. NDDOT DMS

4.5 Summary of Bis-Man ITS Inventory

Entity	ITS Element	Description	Status	Stakeholder
Alerting and Advisory Systems	State Radio	North Dakota State Radio	Existing	ND Division of Emergency Management
Driver	Driver		Existing	
Emergency Management	Bismarck/Burleigh Combined Communications Center	911 and dispatch center for Bismarck and Burleigh County	Existing	Bismarck/Burleigh Emergency Management
Emergency Management	Mandan PD Dispatch Center	Mandan Police Department dispatch	Existing	Mandan PD
Emergency Management	Morton County Communications	Morton County communications department	Existing	Morton County OEM
Emergency Management	State Radio	North Dakota State Radio	Existing	ND Division of Emergency Management
Emergency Telecommunications System	Bismarck/Burleigh Combined Communications Center	911 and dispatch center for Bismarck and Burleigh County	Existing	Bismarck/Burleigh Emergency Management
Emergency Vehicle Subsystem	Bismarck PD Vehicles	Bismarck Police Department vehicles	Existing	Bismarck PD
Emergency Vehicle Subsystem	Bismarck FD Vehicles	Bismarck Fire Department vehicles	Existing	Bismarck FD
Emergency Vehicle Subsystem	Mandan PD Vehicles	Mandan Police Department vehicles	Existing	Mandan PD
Emergency Vehicle Subsystem	Mandan FD Vehicles	Mandan Fire Department vehicles	Existing	Mandan FD
Emergency Vehicle Subsystem	Burleigh County Sheriff Vehicles	Burleigh County Sheriff department vehicles	Existing	Burleigh County Sheriff
Emergency Vehicle Subsystem	Morton County Sheriff Vehicles	Morton County Sheriff department vehicles	Existing	Morton County Sheriff
Emergency Vehicle Subsystem	Metro Area Ambulance Vehicles	Metro Area ambulance service vehicles	Existing	Metro Area Ambulance
Maintenance and Construction Management	Bismarck PW Operations Center	Bismarck Public Works operations	Existing	Bismarck PW
Maintenance and Construction Management	Mandan PW Operations Center	Mandan Public Works operations	Existing	Mandan PW
Maintenance and Construction Management	NDDOT District Office	NDDOT District maintenance and construction	Existing	NDDOT Bis Dist

Maintenance and Construction Vehicle	Mandan PW Vehicles	Mandan public works vehicles	Existing	Mandan PW
Maintenance and Construction Vehicle	Bismarck PW Vehicles	Bismarck public works vehicles	Existing	Bismarck PW
Maintenance and Construction Vehicle	NDDOT District Vehicles	NDDOT District maintenance and construction vehicles	Existing	NDDOT Bis Dist
Media	Media	Terminator	Existing	
Other Roadway	Other Roadway	Terminator	Existing	
Pedestrians	Pedestrians	Terminator	Existing	
Roadway Subsystem	Bismarck TOC Field Devices	Bismarck TOC traffic monitoring and control devices	Existing	Bismarck Engineering
Roadway Subsystem	Bismarck PW Field Devices	Bismarck Public Works filed devices	Planned	Bismarck PW
Roadway Subsystem	NDDOT District Field Devices	NDDOT District field devices	Planned	NDDOT Bis Dist
Roadway Subsystem	Mandan Engineering Field Devices	Mandan traffic field devices	Existing	Mandan Engineering
Traffic	Traffic		Existing	
Traffic Management	Bismarck TOC	Bismarck Traffic Operations Center	Planned	Bismarck Engineering
Traffic Management	Mandan Traffic Engineering	Mandan traffic engineering	Existing	Mandan Engineering
Traffic Operations Personnel	Bismarck Engineers	Bismarck traffic engineering personnel	Existing	Bismarck Engineering
Transit Management	Bis-Man Transit Center	Bismarck Mandan Transit Center	Existing	Bis-Man Transit
Transit System Operators	Bis-Man Transit Operator		Existing	Bis-Man Transit
Transit Traveler	Bis-Man Transit Center	Bismarck Mandan Transit Center	Existing	Bis-Man Transit
Transit Vehicle Operator	Bis-Man Transit Drivers		Existing	Bis-Man Transit
Transit Vehicle Subsystem	Bis-Man Transit Vehicles	Bis-Man Transit buses	Existing	Bis-Man Transit
Traveler Card	Traveler Card	Bis-Man Transit fare cars	Planned	Bis-Man Transit
Emergency Vehicle Subsystem	NDHP Vehicles	NDHP vehicles	Existing	NDHP

5.0 NEEDS AND SERVICES

This section describes the ITS user services selected for the Bis-Man area. These services were identified from previous ITS planning efforts and from stakeholders input during the RA development. It should be noted that due to the recent completion of the Bismarck-Mandan Metropolitan ITS Plan, the set of ITS User Services were readily available for use in the RA development.

5.1 Needs

The Bis-Man area enjoys a well-developed transportation system which operates at a high level of service. The Metropolitan ITS Plan identified possible areas of improvement that involve ITS applications. The broad areas for improvement include: improved peak-hour traffic and special events traffic management; coordinated incident response; and enhanced transit operations. Communication infrastructure was also identified as an overarching issue which not only directly affects ITS deployment, but also the ability of agencies in the Bis-Man area to coordinate their services.

5.2 Services

Bis-Man RA stakeholders assisted in customizing potential ITS User Services and corresponding Market Packages to reflect regional needs. Subsection 5.2.1 provides a summary of the ITS User Services identified for the Bis-Man area while Subsection 5.2.2 outlines the area's Market Packages.

5.2.1 Bis-Man ITS User Services

1. Travel and Traffic Management

    1.1. Pre-trip Travel Information: Assist travelers in making mode choices, travel time estimates, and route decisions prior to trip departure. Pre-trip information can be provided via web, information hot lines (511), etc.

    1.2. En-route Driver Information: Provide information, such as alternative routes to destination, to vehicle drivers while en-route.

    1.3. Route Guidance: Provide travelers with directions to selected destinations.

    1.6. Traffic Control: Provide functions to efficiently manage the movement of traffic on streets and highways.

    1.7. Incident Management: Identify incidents, such as flooded underpasses, icy bridges, special events (4th of July) etc., formulate response actions, and support initiation and ongoing coordination of response actions.

2. Public Transportation Management

    2.1. Public Transportation Management: Provide automatic vehicle tracking and guiding, in-vehicle personnel management, dynamic transit vehicle scheduling.

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

5. Emergency Management

5.2. Emergency Vehicle Management: Include an emergency vehicle management system which provides vehicle location and advanced communications.

8. Maintenance and Construction Management

8.1. Maintenance and Construction Operations: Provide functions to support monitoring, operating, maintaining, improving and managing physical roadway conditions, such as, icy bridges.

5.2.2 Bis-Man Market Packages

The following Market Packages were identified for the Bis-Man region in order to support ITS services. The descriptions are based on information from the National ITS Architecture. The status of each Market Package is also indicated (i.e., existing, planned, or Existing *). The Existing * indicates that portions of the Market Package are deployed in the area but additional portions are planned for deployment. Customized Bis-Man Market Packages and associated information flows are shown in more detail in **Appendix A**.

Network Surveillance (Existing *)

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

Surface Street Control (Existing *)

This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. Traffic signal control systems represented by this market package range from fixed-schedule control systems to fully traffic-responsive systems. General advisory and traffic control information can be provided to the driver while en route. Systems that achieve coordination across jurisdictions by using a common time-base or other strategies that do not require real time coordination would be represented by this package. This market package is consistent with typical urban traffic signal control systems.

Traffic Information Dissemination (Existing)

This market package provides driver information using roadway equipment such as dynamic message signs. 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 (Planned)

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 (Planned)

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.

Roadway Automated Treatment (Planned)

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.

Transit Vehicle Tracking (Planned)

This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. 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 market package performs vehicle routing and scheduling, as well as automatic operator assignment and system monitoring for fixed-route and flexible-route transit services. This service determines current schedule performance using AVL data and provides information displays at the Transit Management Subsystem. Static and real-time transit data is exchanged with Information Service Providers where it is integrated with data from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

Demand responsive Transit Operations (Existing *)

This market package performs vehicle routing and scheduling as well as automatic operator assignment and monitoring for demand responsive 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. 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.

Transit Fare Collection Management (Existing*)

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

Transit Security (Existing *)

This market package provides for the physical security of transit passengers and transit vehicle operators. Onboard equipment (video, audio equipment, and/or event recorder systems) is deployed to perform surveillance and sensor monitoring in order to warn of potentially hazardous situations. Transit user or transit vehicle operator activated alarms are provided onboard. Public areas and non-public transit facilities are also monitored. Onboard alarms, activated by transit users or transit vehicle operators, are transmitted to both the Emergency Management Subsystem and the Transit Management Subsystem.

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.

Emergency Routing (Existing *)

This market package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic and road conditions are provided to enhance emergency vehicle routing. Special priority can be coordinated to improve the safety and time-efficiency of responding vehicles. The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short-range communications for local signal preemption.

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. The alert includes information and instructions for transportation system operators and the traveling public. 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, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to 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.

6.0 OPERATIONAL CONCEPT

This section discusses the roles and responsibilities of stakeholders in the implementation and operation of the regional systems identified in the Bis-Man RA. The operational concept outlines the roles and responsibilities of relevant stakeholders for specific ITS service areas, i.e., emergency management, incident management, maintenance and construction management, surface street management, and transit service. Specific scenarios were used to facilitate documenting stakeholder roles, 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 region 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.

The set of Market Packages for the Bis-Man area was the vehicle 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 RA 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 Bis-Man area. Subsection 6.1 shows implementation roles and responsibilities, arranged by Market Package. Subsection 6.2 summarizes operational roles and responsibilities, organized by stakeholders.

6.1 Implementation Roles

Market Packages	Stakeholders with Implementation Roles
Network Surveillance	NDDOT, Bismarck
Surface Street Control	Bismarck Engineering, Mandan Engineering
Traffic Information Dissemination	NDDOT
Traffic Incident Management System	Bismarck, NDDOT
Maintenance and Construction Vehicle and Equipment Tracking	Bismarck PW, NDDOT
Roadway Automated Treatment	Bismarck PW, NDDOT
Winter Maintenance	Bismarck PW, Mandan PW, NDDOT
Transit Vehicle Tracking	Bis-Man Transit
Transit Fixed-Route Operations	Bis-Man Transit
Demand Response Transit Operations	Bis-Man Transit
Transit Fare Collection Management	Bis-Man Transit
Transit Security	Bis-Man Transit
Emergency Call-Taking and Dispatch	Combined Communications Center, Mandan PD, Morton County Emergency Management
Emergency Routing	Bismarck Engineering, Mandan Engineering
Wide-Area Alert	Bismarck PD, Mandan PD, NDHP

6.2 Operational Roles and Responsibilities

Responsibility Area	Stakeholder	Role
Emergency Management	Bismarck/Burleigh Emergency Management	1. Coordinate response 2. Provide 911 service for Bismarck and Burleigh 3. Provide dispatch service
	Mandan PD	1. Coordinate emergency response 2. Provide 911 service to Mandan 3. Provide dispatch for Mandan PD and FD
	Morton County OEM	1. Coordinate emergency response 2. Provide 911 service for Morton County 3. Provide dispatch for Morton County Sheriff and rural fire
	ND Division of Emergency Management	1. Issue Amber Alerts 2. Provide dispatch for NDHP
Incident Management	Bismarck Engineering	Coordinate with Law Enforcement and Maintenance and Construction agencies
	Bismarck FD	Respond to incidents
	Bismarck PD	Respond to incidents in Bismarck
	Bismarck PW	Provide resources
	Bismarck/Burleigh Emergency Management	Provides dispatch and communications
	Burleigh County Sheriff	Respond to incidents on Burleigh County system
	Mandan FD	Respond to incidents
	Mandan PD	Respond to incidents
	Mandan PW	Provide resources
	Metro Area Ambulance	Respond to incidents
	Morton County OEM	Coordinate response Provides dispatch and communications to Morton County
	Morton County Sheriff	Respond to incidents on Morton County system
	ND Division of Emergency Management	Provide dispatch and communications for NDHP
	NDDOT Bis Dist	Provide resources
	NDHP	Respond to incidents on the state system
Maintenance and Construction	Bismarck PW	1. Perform roadway construction and maintenance activities in Bismarck 2. Perform winter maintenance activities (snow plow operations, sanding, deicing) in Bismarck
	Mandan PW	1. Perform roadway construction and maintenance activities in Mandan 2. Perform winter maintenance activities (snow plow operations, sanding, deicing) in Mandan

	NDDOT Bis Dist	1. Perform roadway construction and maintenance activities on state system 2. Perform winter maintenance activities (snow plow operations, sanding, deicing) on state system
Surface Street Management	Bismarck Engineering	Design, operate, and maintain signal control in Bismarck
	Mandan Engineering	Design, operate, and maintain signal control in Mandan
Transit Services	Bis-Man Transit	1. Provide demand response transit services for the Bismarck Mandan area
		2. Provide transit fixed route services for the Bismarck Mandan area

7.0 AGREEMENTS

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

The table on the following page shows a summary of potential agreements in the Bis-Man area. 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)

Bismarck-Mandan Potential ITS Agreements			
Market Packages	**Purpose**	**Stakeholders**	**Issues**
APTS5-Transit Security	Response to incidents on buses	Bis-Man Transit Bismarck PD	Response protocols Communications
ATMS01-Network Surveillance	Share data	Bismarck Engineering Mandan Engineering NDDOT-Bismarck District	Access to sensors Access to databases Access to networks/servers
ATMS06-Traffic Info Dissemination	Coordinate traveler information	Bismarck Engineering Mandan Engineering NDDOT-Bismarck District	Communications links Notification protocols
ATMS08-Traffic Incident Management	Incident traffic response Sharing data (flow, video)	Bismarck Police Dept Mandan Police Dept Burleigh Co. Sheriff Morton Co. Sheriff ND Highway Patrol	Communications links Response protocols

8.0 FUNCTIONAL REQUIREMENTS

This section discusses detailed functional requirements for the user services and market packages identified for the Bis-Man. 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: systems or portions of systems in the regional architecture
2. Entity persons, places, and things that make up an intelligent transportation system (i.e., subsystem or terminator).
3. Functional Area: type of and description of functional area
4. Requirements: desired functional requirements
5. Status: existing or planned

Below is an example from the Bis-Man Functional Requirements Report. Due to the length of the Functional Requirements Report, it is included in Appendix B. An example of the information presented in the report is provided below

Bismarck-Mandan Regional ITS Architecture (Region)
Element: **Bis-Man Transit Center**
Entity: **Transit Management**
Functional Area: **On-board EV En Route Support**
Monitoring transit vehicle locations via interactions with on-board systems and determining vehicle schedule adherence. Furnish users with real-time transit related information and maintain interface with digital map providers.

Requirement	1	The center shall monitor the location of all transit vehicles within its network.	Planned

Functional Area: **On-board EV En Route Support**
Planning and scheduling associated with fixed and flexible route transit service, automatically updates customer service operator systems, and provide current vehicle schedule adherence and optimum scenarios for schedule adjustment.

Requirement	3	The center shall be able to generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	Planned
Requirement	5	The center shall collect transit operational data for use in the generation of routes and schedules.	Existing

9.0 INTERFACE REQUIREMENTS

This section outlines possible interconnects among various entities in the Bis-Man RA. The following table summarizes interconnects for each market package based on Turbo Architecture's output. Detailed information flows are shown in Appendix A as part of the Market Packages.

Network Surveillance		
Bismarck TOC	Bismarck TOC Field Devices	Existing
Bismarck TOC Field Devices	Other Roadway	Planned
Bismarck TOC Field Devices	Traffic	Existing
Surface Street		
Bismarck TOC	Bismarck TOC Field Devices	Existing
Bismarck TOC Field Devices	Driver	Planned
Bismarck TOC Field Devices	Other Roadway	Planned
Bismarck TOC Field Devices	Pedestrians	Existing
Bismarck TOC Field Devices	Traffic	Existing
Mandan Engineering Field Devices	Mandan Traffic Engineering	Existing
Traffic Information Dissemination		
Bis-Man Transit Center	Bismarck TOC	Planned
Bismarck PW Field Devices	Bismarck TOC Field Devices	Planned
Bismarck PW Field Devices	Driver	Planned
Bismarck PW Field Devices	Other Roadway	Planned
Bismarck PW Operations Center	Bismarck TOC	Planned
Bismarck TOC	Bismarck TOC Field Devices	Existing
Bismarck TOC	Bismarck/Burleigh Combined Communications Center	Planned
Bismarck TOC	Media	Planned
Bismarck TOC Field Devices	Driver	Planned
Bismarck TOC Field Devices	Other Roadway	Planned
Driver	NDDOT District Field Devices	Planned
NDDOT District Field Devices	Other Roadway	Planned
Traffic Incident Management		
Bis-Man Transit Center	Bismarck/Burleigh Combined Communications Center	Existing
Bis-Man Transit Center	Mandan PD Dispatch Center	Existing
Bis-Man Transit Center	Morton County Communications	Existing
Bismarck FD Vehicles	Bismarck/Burleigh Combined Communications Center	Existing
Bismarck PD Vehicles	Bismarck/Burleigh Combined Communications Center	Existing
Bismarck PW Field Devices	Bismarck TOC Field Devices	Planned

Bismarck PW Field Devices	Other Roadway	Planned
Bismarck PW Operations Center	Bismarck TOC	Planned
Bismarck PW Operations Center	Bismarck/Burleigh Combined Communications Center	Existing
Bismarck TOC	Bismarck TOC Field Devices	Existing
Bismarck TOC	Bismarck/Burleigh Combined Communications Center	Planned
Bismarck TOC	Mandan PW Operations Center	Planned
Bismarck TOC	Media	Planned
Bismarck TOC Field Devices	Other Roadway	Planned
Bismarck TOC Field Devices	Traffic	Existing
Bismarck/Burleigh Combined Communications Center	Burleigh County Sheriff Vehicles	Existing
Bismarck/Burleigh Combined Communications Center	Mandan PD Dispatch Center	Existing
Bismarck/Burleigh Combined Communications Center	Media	Existing
Bismarck/Burleigh Combined Communications Center	Metro Area Ambulance Vehicles	Existing
Bismarck/Burleigh Combined Communications Center	Morton County Communications	Existing
Bismarck/Burleigh Combined Communications Center	State Radio	Existing
Mandan FD Vehicles	Mandan PD Dispatch Center	Existing
Mandan PD Dispatch Center	Mandan PD Vehicles	Existing
Mandan PD Dispatch Center	Mandan PW Operations Center	Existing
Mandan PD Dispatch Center	Media	Existing
Mandan PD Dispatch Center	Metro Area Ambulance Vehicles	Existing
Mandan PD Dispatch Center	Morton County Communications	Existing
Mandan PD Dispatch Center	State Radio	Existing
Media	Morton County Communications	Existing
Media	State Radio	Existing
Metro Area Ambulance Vehicles	Morton County Communications	Existing
Morton County Communications	Morton County Sheriff Vehicles	Existing
Morton County Communications	State Radio	Existing
NDDOT District Field Devices	Other Roadway	Planned
NDDOT District Field Devices	Traffic	Planned
NDDOT District Office	State Radio	Existing
NDHP Vehicles	State Radio	Existing
MCO Vehicle Tracking		
Bismarck PW Field Devices	Driver	Planned
Driver	NDDOT District Field Devices	Planned
NDDOT District Field Devices	Traffic	Planned

MCO Vehicle Tracking		
Bismarck PW Operations Center	Bismarck PW Vehicles	Existing
Bismarck PW Operations Center	NDDOT District Vehicles	Planned
Bismarck PW Vehicles	NDDOT District Office	Planned
NDDOT District Office	NDDOT District Vehicles	Existing
Roadway Automated Treatment		
Bismarck PW Field Devices	Bismarck PW Operations Center	Planned
Bismarck PW Field Devices	Bismarck TOC Field Devices	Planned
Bismarck PW Field Devices	Driver	Planned
Bismarck PW Field Devices	Other Roadway	Planned
Bismarck PW Operations Center	Bismarck TOC Field Devices	Planned
Bismarck TOC Field Devices	Driver	Planned
Bismarck TOC Field Devices	Other Roadway	Planned
Driver	NDDOT District Field Devices	Planned
NDDOT District Field Devices	NDDOT District Office	Planned
NDDOT District Field Devices	Other Roadway	Planned
Winter Maintenance		
Bis-Man Transit Center	Bismarck PW Operations Center	Existing
Bis-Man Transit Center	Mandan PW Operations Center	Existing
Bis-Man Transit Center	NDDOT District Office	Existing
Bismarck PW Operations Center	Bismarck PW Vehicles	Existing
Bismarck PW Operations Center	Bismarck TOC	Planned
Bismarck PW Operations Center	Bismarck/Burleigh Combined Communications Center	Existing
Bismarck PW Operations Center	Media	Existing
Bismarck PW Operations Center	NDDOT District Vehicles	Planned
Bismarck PW Vehicles	NDDOT District Office	Planned
Bismarck TOC	Mandan PW Operations Center	Planned
Mandan PD Dispatch Center	Mandan PW Operations Center	Existing
Mandan PW Operations Center	Mandan PW Vehicles	Existing
Media	NDDOT District Office	Existing
NDDOT District Office	NDDOT District Vehicles	Existing
NDDOT District Office	State Radio	Existing
Transit Vehicle Tracking		
Bis-Man Transit Center	Bis-Man Transit Vehicles	Existing
Transit Fixed-Route Operations		
Bis-Man Transit Center	Bis-Man Transit Operator	Existing
Bis-Man Transit Center	Bis-Man Transit Vehicles	Existing
Bis-Man Transit Center	Bismarck PW Operations Center	Existing
Bis-Man Transit Center	Bismarck TOC	Planned
Bis-Man Transit Center	Mandan PW Operations Center	Existing
Bis-Man Transit Center	NDDOT District Office	Existing

Bis-Man Transit Drivers	Bis-Man Transit Vehicles	Planned
Demand Response Transit Operations		
Bis-Man Transit Center	Bis-Man Transit Operator	Existing
Bis-Man Transit Center	Bis-Man Transit Vehicles	Existing
Bis-Man Transit Drivers	Bis-Man Transit Vehicles	Planned
Transit Fare Management		
Bis-Man Transit Center	Bis-Man Transit Operator	Existing
Bis-Man Transit Center	Bis-Man Transit Vehicles	Existing
Bis-Man Transit Vehicles	Traveler Card	Planned
Transit Security		
Bis-Man Transit Center	Bis-Man Transit Operator	Existing
Bis-Man Transit Center	Bis-Man Transit Vehicles	Existing
Bis-Man Transit Center	Bismarck/Burleigh Combined Communications Center	Existing
Bis-Man Transit Center	Mandan PD Dispatch Center	Existing
Bis-Man Transit Center	Morton County Communications	Existing
Bis-Man Transit Drivers	Bis-Man Transit Vehicles	Planned
Bismarck/Burleigh Combined Communications Center	Mandan PD Dispatch Center	Existing
Bismarck/Burleigh Combined Communications Center	Morton County Communications	Existing
Mandan PD Dispatch Center	Morton County Communications	Existing
Emergency Call Taking and Dispatch		
Bis-Man Transit Center	Bismarck/Burleigh Combined Communications Center	Existing
Bis-Man Transit Center	Mandan PD Dispatch Center	Existing
Bis-Man Transit Center	Morton County Communications	Existing
Bismarck FD Vehicles	Bismarck/Burleigh Combined Communications Center	Existing
Bismarck PD Vehicles	Bismarck/Burleigh Combined Communications Center	Existing
Bismarck TOC	Bismarck/Burleigh Combined Communications Center	Planned
Bismarck/Burleigh Combined Communications Center	Burleigh County Sheriff Vehicles	Existing
Bismarck/Burleigh Combined Communications Center	Mandan PD Dispatch Center	Existing
Bismarck/Burleigh Combined Communications Center	Metro Area Ambulance Vehicles	Existing
Bismarck/Burleigh Combined Communications Center	Morton County Communications	Existing
Bismarck/Burleigh Combined Communications Center	State Radio	Existing
Mandan FD Vehicles	Mandan PD Dispatch Center	Existing

Mandan PD Dispatch Center	Mandan PD Vehicles	Existing
Mandan PD Dispatch Center	Metro Area Ambulance Vehicles	Existing
Mandan PD Dispatch Center	Morton County Communications	Existing
Mandan PD Dispatch Center	State Radio	Existing
Metro Area Ambulance Vehicles	Morton County Communications	Existing
Morton County Communications	Morton County Sheriff Vehicles	Existing
Morton County Communications	State Radio	Existing
NDHP Vehicles	State Radio	Existing
Emergency Routing		
Bismarck FD Vehicles	Bismarck TOC Field Devices	Existing
Bismarck FD Vehicles	Mandan Engineering Field Devices	Existing
Bismarck TOC Field Devices	Mandan FD Vehicles	Existing
Bismarck TOC Field Devices	Metro Area Ambulance Vehicles	Existing
Mandan Engineering Field Devices	Mandan FD Vehicles	Existing
Mandan Engineering Field Devices	Metro Area Ambulance Vehicles	Existing
Wide Area Alert		
Bismarck PW Field Devices	Driver	Planned
Bismarck PW Operations Center	Bismarck/Burleigh Combined Communications Center	Existing
Bismarck TOC	Bismarck TOC Field Devices	Existing
Bismarck TOC	Bismarck/Burleigh Combined Communications Center	Planned
Bismarck TOC Field Devices	Driver	Planned
Bismarck/Burleigh Combined Communications Center	Mandan PD Dispatch Center	Existing
Bismarck/Burleigh Combined Communications Center	Morton County Communications	Existing
Bismarck/Burleigh Combined Communications Center	State Radio	Existing
Driver	NDDOT District Field Devices	Planned
Mandan PD Dispatch Center	Morton County Communications	Existing
Mandan PD Dispatch Center	State Radio	Existing
Morton County Communications	State Radio	Existing
NDDOT District Office	State Radio	Existing

10.0 ITS STANDARDS

This section identifies applicable ITS Standards identified for the Bis-Man RA. 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 for the Bis-Man RA.

Standard Name	Document ID
NTCIP Center-to-Center Standards Group	NTCIP 1102 NTCIP 1104 NTCIP 2104 NTCIP 2202 NTCIP 2303 NTCIP 2304 NTCIP 2306
NTCIP Center-to-Field Standards Group	NTCIP 1102 NTCIP 1103 NTCIP 2101 NTCIP 2102 NTCIP 2103 NTCIP 2104 NTCIP 2201 NTCIP 2202 NTCIP 2301 NTCIP 2302
Global Object Definitions	NTCIP 1201
Object Definitions for Actuated Traffic Signal Controller Units	NTCIP 1202
Object Definitions for Dynamic Message Signs	NTCIP 1203
Object Definitions for Environmental Sensor Stations & Roadside Weather Information System	NTCIP 1204
Data Dictionary for CCTV	NTCIP 1205
Object Definitions for Video Switches	NTCIP 1208
Transportation System Sensor Objects	NTCIP 1209
Objects for Signal Systems Master	NTCIP 1210
Objects for Signal Control Priority	NTCIP 1211
Incident Management Standards Group	IEEE 1512 -2006 IEEE 1512.1-2006 IEEE 1512.2-2004 IEEE 1512.3-2006 IEEE P1512.4
TCIP - Passenger Information (PI) Business Area Standard	NTCIP 1403
TCIP - Scheduling/Run-cutting (SCH) Business Area Standard	NTCIP 1404
TCIP - Spatial Representation (SP) Business Area Standard	NTCIP 1405
TCIP - Onboard (OB) Business Area Standard	NTCIP 1406
TCIP - Control Center (CC) Business Area Standard	NTCIP 1407

TCIP - Fare Collection (FC) Business Area Standard	NTCIP 1408
Dedicated Short Range Communication at 915 MHz Standards Group	ASTM E2158-01 ASTM PS 105-99
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) General Use Standards Group	SAE J2266 SAE J2354 SAE J2540 SAE J2540/1 SAE J2540/2 SAE J2540/3
Dedicated Short Range Communication at 5.9 GHz Standards Group	ASTM E2213-03 IEEE 1609.1-2006 IEEE 1609.2-2006 IEEE 1609.4-2006 IEEE P1609.3 IEEE P802.11p

11.0 PROJECTS SEQUENCE

This section briefly outlines possible time frames for deploying selected ITS projects in the Bis-Man area. Project timing is based on the Bismarck-Mandan ITS Plan, which identified ITS projects and their possible deployment timeframe. It should be noted that not all of the planned services for the area have been fully developed into ITS projects yet. Additionally, given the uncertainty of funding for ITS projects in the area, approximate deployment time frames are used in place of firm deployment plans (i.e., none of these project are currently included in the Bis-Man MPO TIP).

In the following table, Market Packages are arranged into short, medium, and long-term deployment categories. Please note that Market Packages are organized in the same order they appear in the National ITS Architecture.

Market Packages	Time Frame
Network Surveillance	Short
Surface Street Control	Short
Traffic Information Dissemination	Medium
Traffic Incident Management System	Medium-Long
Speed Monitoring	Long
Maintenance and Construction Vehicle and Equipment Tracking	Medium-Long
Roadway Automated Treatment	Short
Winter Maintenance	Short
Transit Vehicle Tracking	Medium
Transit Fixed-Route Operations	Short-Medium
Demand Response Transit Operations	Short-Medium
Transit Fare Collection Management	Short
Transit Security	Short
Emergency Call-Taking and Dispatch	Short-Medium
Emergency Routing	Short-Medium
Wide-Area Alert	Short

11.1 RA Architecture Maintenance

It should be pointed out that the Bismarck-Mandan MPO will be responsible for maintaining the Bis-Man Regional ITS Architecture through a partnership with the Advanced Traffic Analysis Center. It is envisioned that updates will be conducted every two years or upon the deployment of a major ITS project in the area. Additionally, the ITS project list will be updated as they are programmed into the TIP.

APPENDIX A BIS-MAN MARKET PACKAGES AND INFORMATION FLOWS

The Market Package Diagrams are available electronically at:

http://www.atacenter.org/regional/bisman/

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

APPENDIX B BIS-MAN FUNCTIONAL REQUIREMENT

Functional Requirements
Bismarck-Mandan RA (Region)

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Bis-Man Transit Center**		
Entity: **Transit Management**		
Functional Area: **Transit Center Vehicle Tracking** Monitoring transit vehicle locations via interactions with on-board systems. Furnish users with real-time transit schedule information and maintain interface with digital map providers.		
Requirement:	1 The center shall monitor the locations of all transit vehicles within its network.	Planned
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.		
Requirement:	3 The center shall be able to generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	Planned
Requirement:	5 The center shall collect transit operational data for use in the generation of routes and schedules.	Existing
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.		
Requirement:	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.	Existing
Requirement:	2 The center shall monitor the operational status of the demand response vehicles including status of passenger pick-up and drop-off.	Planned
Functional Area: **Transit Center Fare Management** Management of fare collection at the center - includes setting and distributing fare information, central processing of fares for transit as well as other ITS services, links to financial institutions and enforcement agencies.		
Requirement:	4 The center shall support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.	Planned
Functional Area: **Transit Center Security** Monitor transit vehicle operator or traveler activated alarms; authenticate transit vehicle operators; remotely disable a transit vehicle; alert operators, travelers, and police to potential incidents identified by these security features.		
Requirement:	1 The center shall monitor transit vehicle operational data to determine if the transit vehicle is off-route and assess whether a security incident is occurring.	Planned
Functional Area: **Transit Data Collection** Collection and storage of transit management data. For use by operations personnel or data archives in the region.		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Bis-Man Transit Center**		
Entity: **Transit Management**		
Functional Area: **Transit Data Collection** Collection and storage of transit management data. For use by operations personnel or data archives in the region.		
Requirement:	1 The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	Planned
Element: **Bis-Man Transit Vehicles**		
Entity: **Transit Vehicle Subsystem**		
Functional Area: **On-board Transit Trip Monitoring** Support fleet management with automatic vehicle location (AVL) and automated mileage and fuel reporting and auditing.		
Requirement:	1 The transit vehicle shall compute the location of the transit vehicle based on inputs from a vehicle location determination function.	Planned
Functional Area: **On-board Paratransit Operations** On-board systems to manage paratransit and flexible-route dispatch requests, including multi-stop runs. Passenger data is collected and provided to the center.		
Requirement:	2 The transit vehicle shall receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.	Existing
Functional Area: **On-board Transit Security** On-board video/audio surveillance systems, threat sensors, and object detection sensors to enhance security and safety on-board a transit vehicles. Also includes silent alarms activated by transit user or vehicle operator, operator authentication, and remote vehicle disabling.		
Requirement:	1 The transit vehicle shall perform video and audio surveillance inside of transit vehicles and output raw video or audio data for either local monitoring (for processing or direct output to the transit vehicle operator), remote monitoring or for local storage (e.g., in an event recorder).	Planned
Element: **Bismarck FD Vehicles**		
Entity: **Emergency Vehicle Subsystem**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing
Element: **Bismarck PW Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Automated Treatment** Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Bismarck PW Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Automated Treatment** Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.		
Requirement:	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.	Planned
Requirement:	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.	Planned
Requirement:	3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	Planned
Requirement:	4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	Planned
Element: **Bismarck PW Operations Center**		
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.		
Requirement:	1 The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Planned
Functional Area: **MCM Automated Treatment System Control** Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.		
Requirement:	1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Planned
Requirement:	3 The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Planned
Requirement:	4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Planned
Requirement:	5 The center shall accept requests for automated roadway treatment system activation from center personnel.	Planned
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.		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Bismarck PW Operations Center**		
Entity: **Maintenance and Construction Management**		
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
Requirement:	8 The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
Requirement:	9 The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing
Element: **Bismarck PW Vehicles**		
Entity: **Maintenance and Construction Vehicle**		
Functional Area: **MCV Vehicle Location Tracking** On-board systems to track vehicle location and reports the position and timestamp information to the dispatch center.		
Requirement:	1 The maintenance and construction vehicle shall compute the location of the vehicle based on inputs from a vehicle location determination function.	Planned
Requirement:	2 The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Planned
Element: **Bismarck TOC**		
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.		
Requirement:	1 The center shall remotely control traffic signal controllers.	Existing
Requirement:	4 The center shall collect traffic signal controller fault data from the field.	Existing
Element: **Bismarck TOC Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Basic Surveillance**		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Bismarck TOC Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Basic Surveillance** Field elements that monitor traffic conditions using loop detectors and CCTV cameras.		
Requirement:	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.	Planned
Requirement:	2 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Planned
Requirement:	4 The field element shall return sensor and CCTV system operational status to the controlling center.	Planned
Requirement:	5 The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Planned
Functional Area: **Roadway Signal Controls** Field elements including traffic signal controllers for use at signalized intersections; also supports pedestrian crossings.		
Requirement:	1 The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.	Existing
Requirement:	6 The field element shall return traffic signal controller operational status to the controlling center.	Existing
Requirement:	7 The field element shall return traffic signal controller fault data to the maintenance center for repair.	Existing
Functional Area: **Roadway Signal Priority** Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.		
Requirement:	1 The field element shall respond to requests for indicator (e.g., signal) preemption requests from emergency vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Functional Area: **Roadway Traffic Information Dissemination** Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).		
Requirement:	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).	Planned
Requirement:	4 The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Planned
Requirement:	5 The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Planned
Functional Area: **Roadway Data Collection** 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.		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Bismarck TOC Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Data Collection** 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.		
Requirement:	1 The field element shall collect traffic, road, and environmental conditions information.	Existing
Element: **Bismarck/Burleigh Combined Communications Center**		
Entity: **Emergency Management**		
Functional Area: **Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.		
Requirement:	1 The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
Requirement:	2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
Requirement:	6 The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
Requirement:	9 The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
Requirement:	10 The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
Requirement:	11 The center shall provide the capability for digitized map data to act as the background to the emergency information presented to the emergency system operator.	Planned
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	1 The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2 The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3 The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	4 The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Bismarck/Burleigh Combined Communications Center**		
Entity: **Emergency Management**		
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	5 The center shall store and maintain the emergency service responses in an action log.	Existing
Requirement:	6 The center shall provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.	Existing
Requirement:	9 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
Functional Area: **Emergency Routing** Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.		
Requirement:	4 The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
Element: **Mandan Engineering Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Signal Controls** Field elements including traffic signal controllers for use at signalized intersections; also supports pedestrian crossings.		
Requirement:	1 The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.	Existing
Requirement:	6 The field element shall return traffic signal controller operational status to the controlling center.	Existing
Requirement:	7 The field element shall return traffic signal controller fault data to the maintenance center for repair.	Existing
Functional Area: **Roadway Signal Priority** Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.		
Requirement:	1 The field element shall respond to requests for indicator (e.g., signal) preemption requests from emergency vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Element: **Mandan FD Vehicles**		
Entity: **Emergency Vehicle Subsystem**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Mandan PD Dispatch Center**		
Entity: **Emergency Management**		
Functional Area: **Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.		
Requirement:	1 The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
Requirement:	2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
Requirement:	6 The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
Requirement:	9 The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
Requirement:	10 The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	1 The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2 The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3 The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	4 The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing
Requirement:	5 The center shall store and maintain the emergency service responses in an action log.	Existing
Requirement:	6 The center shall provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.	Existing
Requirement:	9 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
Functional Area: **Emergency Routing** Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Mandan PD Dispatch Center**		
Entity: **Emergency Management**		
Functional Area: **Emergency Routing** Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.		
Requirement:	4 The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
Element: **Mandan PW Operations Center**		
Entity: **Maintenance and Construction Management**		
Functional Area: **MCM Automated Treatment System Control** Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.		
Requirement:	1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Planned
Requirement:	3 The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Planned
Requirement:	4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Planned
Requirement:	5 The center shall accept requests for automated roadway treatment system activation from center personnel.	Planned
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
Requirement:	8 The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
Requirement:	9 The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Mandan PW Operations Center**		
Entity: **Maintenance and Construction Management**		
Element: **Mandan Traffic Engineering**		
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.		
Requirement:	1 The center shall remotely control traffic signal controllers.	Existing
Requirement:	4 The center shall collect traffic signal controller fault data from the field.	Existing
Element: **Metro Area Ambulance Vehicles**		
Entity: **Emergency Vehicle Subsystem**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing
Element: **Morton County Communications**		
Entity: **Emergency Management**		
Functional Area: **Emergency Call-Taking** Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.		
Requirement:	1 The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
Requirement:	2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
Requirement:	6 The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
Requirement:	9 The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
Requirement:	10 The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **Morton County Communications**		
Entity: **Emergency Management**		
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	1 The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2 The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3 The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	4 The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing
Requirement:	5 The center shall store and maintain the emergency service responses in an action log.	Existing
Requirement:	9 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
Functional Area: **Emergency Routing** Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.		
Requirement:	4 The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
Element: **NDDOT District Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Traffic Information Dissemination** Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).		
Requirement:	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).	Planned
Requirement:	4 The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Planned
Requirement:	5 The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Planned
Functional Area: **Roadway Automated Treatment** Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **NDDOT District Field Devices**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Automated Treatment** Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.		
Requirement:	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.	Planned
Requirement:	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.	Planned
Requirement:	3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	Planned
Requirement:	4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	Planned
Functional Area: **Roadway Speed Monitoring** Vehicle speed sensors that detect excessive vehicle speeds, informing drivers, centers and/or enforcement agencies of speed violations.		
Requirement:	1 The field element shall include sensors to detect vehicle speeds, under traffic or maintenance center control.	Planned
Element: **NDDOT District Office**		
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.		
Requirement:	1 The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Planned
Functional Area: **MCM Automated Treatment System Control** Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.		
Requirement:	1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Planned
Requirement:	3 The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Planned
Requirement:	4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Planned
Requirement:	5 The center shall accept requests for automated roadway treatment system activation from center personnel.	Planned
Functional Area: **MCM Winter Maintenance Management**		

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **NDDOT District Office**		
Entity: **Maintenance and Construction Management**		
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
Requirement:	8 The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
Requirement:	9 The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing
Element: **NDDOT District Vehicles**		
Entity: **Maintenance and Construction Vehicle**		
Functional Area: **MCV Vehicle Location Tracking** On-board systems to track vehicle location and reports the position and timestamp information to the dispatch center.		
Requirement:	1 The maintenance and construction vehicle shall compute the location of the vehicle based on inputs from a vehicle location determination function.	Planned
Requirement:	2 The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Planned
Element: **State Radio**		
Entity: **Emergency Management**		
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	1 The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2 The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3 The center shall relay location and incident details to the responding vehicles.	Existing

Architecture		Status
Bismarck-Mandan RA (Region)		(Region)
Element: **State Radio**		
Entity: **Emergency Management**		
Functional Area: **Emergency Dispatch** Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.		
Requirement:	5 The center shall store and maintain the emergency service responses in an action log.	Existing
Requirement:	9 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
Functional Area: **Emergency Routing** Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.		
Requirement:	4 The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing