Bismarck-Mandan MPO

221 N 5th St. Bismarck, ND 58506
(701) 355-1300
Bismarck-Mandan Metropolitan Planning Organization

Bismarck- Mandan Regional ITS Architecture Update

Version 5.0

Final Report

December 2025

Principal Investigator
Sharijad Hasan, Ph.D.
Associate Research Fellow
Upper Great Plains Transportation Institute

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

Bismarck- Mandan
Regional ITS Architecture
Version 5.0

Final Report

December 2025

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.

The preparation of this document was funded in part by the United States Department of Transportation with funding administered through the North Dakota Department of Transportation, the Federal Highway Administration, and the Federal Transit Administration. Additional funding was provided through local contributions from the governments of Bismarck, Mandan, Lincoln, Burleigh County, and Morton County. The United States Government and the State North Dakota assume no liability for the contents or use thereof.

The document does not constitute a standard specification, or regulation. The United States Government, the State North Dakota, and the Metropolitan Planning Organization do not endorse products or manufacturers. Trade or manufacturers' names appear herein only because they are considered essential to the objective of the document.

The contents of the document reflect the authors, who are responsible for facts and accuracy of data presented herein. Contents do not necessarily reflect polices of the States and Federal Department of Transportation.

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

Dept. 2880 – PO Box 6050
NDSU – Fargo, ND 58108
Tel 701-231-8085
www.ugpti.org - www.atacenter.org

ACRONYMS

ACS	Advanced System Controller
ADA	Americans with Disabilities Act
ATAC	Advanced Traffic Analysis Center
ATC	Advanced Transportation Controller
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
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
CAD	Computer Aided Dispatch
CCTV	Closed Circuit Television
CenCom	Central Dakota Communications Center
Constr	Construction
Dist	District
DMS	Dynamic Message Sign
DOT	Department of Transportation
EAS	Emergency Alert System
ESS	Environmental Sensor Station
EV	Emergency Vehicle
FHWA	Federal Highway Administration
IPAWS	Integration Public Alert and Warning System
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
ITSRA	Intelligent Transportation Systems Regional Architecture
LOS	Level of Service
Mandan FD	Mandan Fire Department
Mandan PD	Mandan Police Department
Mandan PW	Mandan Public Works
Maint	Maintenance
MCO	Maintenance and Construction Operations
MPO	Metropolitan Planning Organization
NDDOT	North Dakota Department of Transportation
NDHP	North Dakota Highway Patrol
NTD	National Transit Database
OEM	Office of Emergency Management
PSAP	Public Safety Answering Point
PTZ	Pan-Tilt-Zoom
RAD-IT	Regional Architecture Development for Intelligent Transportation
SDO	Standard Development Organization
SP	Service Package
TDP	Transit Development Plan

Standards

ASTM	American Society for Testing and Materials
FIPS	Federal Information Processing Standards
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
NEMA	National Electrical Manufacturers Association
NIST	National Institute of Standards and Technology
NTCIP	National Transportation Communications for ITS Protocol
SAE	Society of Automotive Engineers

Service Packages

DM	Data Management
MC	Maintenance and Construction
PS	Public Safety
PT	Public Transportation
TM	Traffic Management

Table of Contents

List of Figures ..... **i**
List of Tables ..... **i**
Executive Summary ..... **ii**
1.0 Introduction **1**
1.1 Report Organization 2
2.0 Region and Scope **3**
2.1 Geographical Boundaries 3
2.2 Scope of the ITSRA 3
3.0 Stakeholders **5**
4.0 System Inventory **7**
4.1 Bis-Man Centers 7
4.1.1 Traffic Management Center 7
4.1.2 Transit Management Center 10
4.1.3 Emergency Management Center 10
4.1.4 Maintenance and Construction Management Center 11
4.1.5 Information Service Provider 11
4.1.6 Archived Data Management Center 11
4.2 Bis-Man Field Devices 12
4.2.1 NDDOT Field Devices 12
4.2.2 City of Mandan Field Devices 12
4.2.3 City of Bismarck Field Devices 12
4.3 Bis-Man Vehicles 14
4.3.1 Emergency Vehicle for Bis-Man area 14
4.3.2 MCO vehicles for City of Bismarck and Mandan 15
4.3.3 Transit Vehicle for Bis-Man area 17
4.4 Bis-Man Communication Infrastructure 17
4.5 Summary of Bis-Man Inventory 18
5.0 Service Packages **22**
6.0 Operational Concept **36**
6.1 Operational Roles and Responsibilities 36
7.0 Agreements **42**
8.0 Functional Requirements **45**
9.0 ITS Standards **46**
10.0 Planning Aspects **50**
10.1 Planning and the Regional ITS Architecture 50
10.3 Regional ITS Architecture Maintenance 54
11.0 Project Architecture **55**
11.1 Signal controller on Bismarck intersections 55
11.2 Signal controller on Mandan intersections 55
12.0 Conclusive Remark **56**
Appendix-A **57**
Bismarck-Mandan Service Packages And Information Flows **57**
Appendix-B **85**
Functional Requirements **85**

LIST OF FIGURES

Figure 1 Bismarck-Mandan Boundary Map 4
Figure 2 Bis-Man Physical Architecture 8
Figure 3 Mandan City Hall (Engineering Department) 9
Figure 4 Bis-Man Transit Facility 10
Figure 5 Typical Signal Controller Cabinet 12
Figure 6 Video and Optical Detector for Preemption 13
Figure 7 Black Cat Radar 13
Figure 8 DMS (Public Work Department) 13
Figure 9 Burleigh County Sheriff Vehicle 14
Figure 10 Bismarck Fire Department Engine 14
Figure 11 Metro Area Ambulance 15
Figure 12 Truck unit with a road temperature sensor (Bismarck PW) 15
Figure 13 Snow blower attachments for loader (Mandan PW) 16
Figure 14 Sander Control 16
Figure 15 Transit Bus 17

LIST OF TABLES

Table 1: List of Stakeholders 5
Table 2: Stakeholder Group Members 6
Table 3: List of Inventory 18
Table 4: List of Roles and Responsibilities 36
Table 5: List of Potential Agreements 43
Table 6: Sample of Functional Requirements 45
Table 7: List of Standards 46

EXECUTIVE SUMMARY

The Bismarck-Mandan Regional Intelligent Transportation Systems (ITS) Architecture was developed under the guidance of the Bismarck-Mandan Metropolitan Planning Organization (Bis-Man MPO). Initially created in 2005, this architecture has undergone four updates in 2008, 2013, 2021, and 2025. Its primary purpose is to guide the implementation of ITS systems across the Bismarck-Mandan region while coordinating funding, deployment, information sharing, and overall operations related to these technologies. The key goals for ITS in this area are enhancing traveler safety, improving traffic and transit management, coordinating incident response, and providing better traveler information. A 5-year planning horizon was considered during the development of this regional architecture.

The development of the ITS Regional Architecture (ITSRA) was facilitated by the Advanced Traffic Analysis Center (ATAC) of the Upper Great Plains Transportation Institute (UGPTI) at North Dakota State University (NDSU). A partnership agreement was established between ATAC and the Bis-Man MPO to support ITSRA development and maintenance.

This version of the ITSRA is the fifth iteration in a maintenance process that aims to keep the architecture up to date in accordance with FHWA guidelines and to continue to reflect the most current ITS picture in the region. This version of the ITSRA is based on the national Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT 9.3).

Bismarck, the capital of North Dakota, is currently experiencing significant population growth and increased economic and cultural activity. Consequently, the development of an efficient transportation system is vital to address the mobility requirements of both individuals and businesses in this area.
The geographical boundaries of the Bis-Man Regional Architecture align with the metropolitan boundaries defined by the Bis-Man MPO, encompassing approximately 394 square miles. The principal jurisdictions within this region include:

1. The City of Bismarck.
2. The City of Mandan.
3. The City of Lincoln.
4. Portions of Burleigh County.
5. Portions of Morton County.

In addition to the jurisdictions mentioned, the ITSRA acknowledges the importance of integrating with North Dakota's statewide transportation frameworks. As a result, the North

Dakota Department of Transportation (NDDOT) played an active role in developing the ITSRA, contributing its insights and expertise to ensure a cohesive, effective transportation system.

The ITSRA development was guided by various regional stakeholders who owned and operated ITS in the Bis-Man region and included:

- MPO planning staff
- City engineering and maintenance staff
- Transit staff
- State DOT district engineering and maintenance staff
- FHWA representative
- Law enforcement and emergency responders
- County maintenance staff
- Agency information technology technical staff
- Other agencies responsible for system operations and maintenance

An inventory of systems has been systematically updated to encompass both existing and anticipated ITS implementations. These systems have been broadly categorized into the following service areas: traffic and travel management, maintenance and construction management, emergency management, transit management, and advanced data management. The inventory delineates the various systems and their functions by agency and jurisdiction.

The ITS user services pertinent to the region were initially identified through previous ITS planning initiatives, in consultation with regional stakeholders. The National ITS Architecture served as a framework for mapping these services and formulating service packages that support them. In total, 26 service packages were recognized, categorized into existing, planned, and future initiatives specific to the Bis-Man area.

Service packages comprise the necessary agencies, devices, and information flows required for the delivery of each ITS service. These packages were also employed to assess roles and responsibilities associated with each system. The interconnections and relevant information exchanges were detailed for the principal ITS systems within the region, including traffic management, transit management, emergency management, and maintenance and construction management.

Based on an analysis of information flows, access sharing, and funding partnerships, prospective agency agreements were identified. Each agreement outlines its purpose, the participating entities, and the covered components. Eight potential agreements were

recognized for the Bis-Man region, addressing transit security, network surveillance, traffic information dissemination, incident management, data archival, and regional transportation management.

One of the main challenges for deploying ITS in the Bis-Man area is securing funding, especially for communications infrastructure. Successful deployment relies on effective coordination among various agencies, which can be achieved through expanding existing partnerships. However, new network security protocols from the State IT Department have complicated inter-agency information sharing, slowing down coordination and service delivery. To address this, a cross-agency policy task force is proposed to review the current protocols, identify issues, and recommend solutions that balance security with efficient collaboration. The aim is to maintain transparency and improve service delivery while ensuring the IT infrastructure effectively serves the public.

1.0 INTRODUCTION

This document provides a comprehensive overview of the development of a regional Intelligent Transportation Systems (ITS) architecture specifically tailored for the Bismarck-Mandan area. Intelligent Transportation Systems encompass a wide range of integrated applications utilizing advanced technologies in sensing, communications, computer processing, and electronics, all aimed at significantly improving the efficiency and safety of transportation networks.

The Bismarck-Mandan Regional ITS Architecture (ITSRA) serves as a crucial framework for guiding future ITS planning and development. It outlines necessary system requirements, clarifies the roles of various coordinating agencies, and facilitates the integration of transportation functions across different jurisdictions. This collaborative approach is vital in creating a cohesive, efficient transportation ecosystem.

Led by the Bismarck-Mandan Metropolitan Planning Organization (Bis-Man MPO), the development of the ITSRA is focused on several key objectives. The primary aim is to enhance the implementation of ITS systems throughout the Bis-Man area, while also ensuring effective coordination of funding, deployment strategies, information sharing, and operational management of these systems within the region. The architecture highlights four principal goal areas:

- Enhancing traveler safety,
- Streamlining traffic and transit management,
- Ensuring the smooth operation of maintenance services,
- Coordinating incident response efforts effectively, and
- Providing improved traveler information services.

A five-year planning horizon was carefully considered during the architecture's development to ensure alignment with future transportation needs.

The current update of the ITS architecture has been expertly facilitated by the Advanced Traffic Analysis Center (ATAC), which is part of the Upper Great Plains Transportation Institute (UGPTI) at North Dakota State University (NDSU). ATAC has a strong track record in this area, having previously led updates of the ITS architecture in 2008, 2013, and 2021, ensuring that the framework remains relevant and effective in addressing the evolving challenges of transportation in the region.

1.1 Report Organization

The Bis-Man ITSRA Report is structured into several key sections, making it easy for users to navigate and understand. To enhance accessibility and facilitate future modifications, an electronic file has been created utilizing the Federal Highway Administration's regional architecture development for intelligent transportation (RAD-IT) software. This digital resource allows users to easily access the architecture and implement any necessary changes or updates in the future.
Below is a description of 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 Service Packages	ITS user services and service packages
6 Operational Concept	Roles and responsibilities of participating agencies
7 Potential Agreements	Regional agreements to facilitate integration
8 Functional Requirements	High-level descriptions of what the systems will do
9 ITS Standards	Brief discussion of applicable ITS standards
10 Planning Aspects	Relating planning goals to the ITSRA
11 Project Architecture	Identifies existing ITS projects within ITSRA
Appendix-A	Detailed Service Packages/Information Flow Diagrams
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, providing a high-level overview of the range of ITS services and systems.

2.1 Geographical Boundaries

The geographical areas included in the Bis-Man ITSRA primarily consisted of the Bis-Man MPO's metropolitan boundaries. Major jurisdictions within the region includes:

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

In addition, the ITSRA 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 ITSRA development.

2.2 Scope of the ITSRA

The scope of the Bis-Man ITSRA can be defined by the broad ITS user services intended for deployment within the region. Identifying these relevant ITS user services has helped in pinpointing the stakeholders and corresponding systems that should be included in the ITSRA. The range of ITS user services consists of 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. Automated Passenger and Fare Management
    c. Transit Security
3. Incident Management
    a. Incident response coordination (integrated communications)
4. Information Management
    a. Data archival and analysis services
5. Maintenance and Construction Management
    a. Winter maintenance
    b. Fleet management

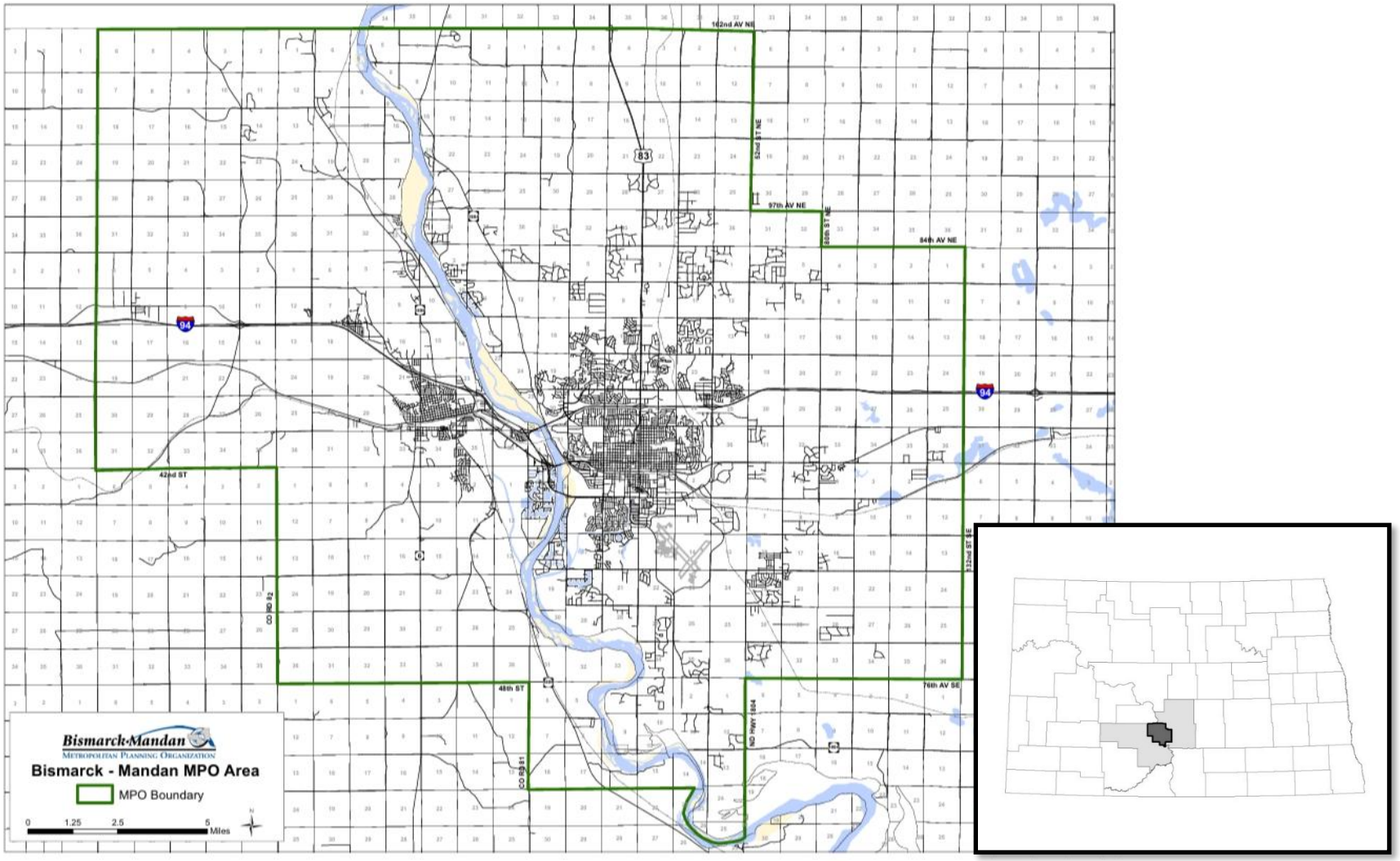


Figure 1 Bismarck-Mandan Boundary Map

3.0 STAKEHOLDERS

Stakeholders in the Bis-Man ITSRA include transportation, public works, law enforcement, emergency management, transit, and other related agencies.

Table 1: List of Stakeholders

Stakeholder Name	Stakeholder Description
ATAC	Advanced Traffic Analysis Center - Upper Great Plains Transportation Institute - North Dakota State University
Bis-Man Emergency Management Agencies	A stakeholder group comprising law enforcement agencies, fire departments, and emergency managers in the Bis-Man area.
Bis-Man MPO	Bismarck-Mandan Metropolitan Planning Organization
Bis-Man Transit	Bismarck-Mandan Transit
Bismarck Emergency Management	Emergency Management Division for City of Bismarck
Bismarck Engineering	City of Bismarck Engineering Department
Bismarck FD	City of Bismarck Fire Department
Bismarck IT	City of Bismarck Information and Technology Division
Bismarck PD	City of Bismarck Police Department
Bismarck PW	City of Bismarck Public Works
BRFD	Bismarck Rural Fire Department
Burleigh County Engineering	Burleigh County Highway Department
Burleigh County OEM	Burleigh County Office of Emergency Management
Burleigh County Sheriff	Burleigh County Sheriff Department
CenCom	Central Dakota Communications Center
Lincoln PD	City of Lincoln Police Department
Lincoln PW	City of Lincoln Public Works Department
Mandan Engineering	City of Mandan Engineering Department
Mandan FD	City of Mandan Fire Department
Mandan PD	City of Mandan Police Department
Mandan PW	City of Mandan Public Works
Metro Area Ambulance	Bismarck-Mandan regional ambulance service
Morton County Highway Department	Morton County Highway Department

Stakeholder Name	Stakeholder Description
Morton County OEM	Morton County Office of Emergency Management
Morton County Sheriff	Morton County Sheriff department
ND DES	North Dakota Division of Emergency Services
NDDOT Bis Dist	NDDOT Bismarck District Engineering and Maintenance
NDHP Bismarck	North Dakota Highway Patrol - Bismarck District

Additionally, ITSRA stakeholder groups were used to simplify services when multiple agencies from the same area of specialty collaborated to perform a service. One stakeholder group was created in the emergency management area.

Table 2: Stakeholder Group Members

Stakeholder Name	Group Members
Bis-Man Emergency Management Agencies	Bismarck Emergency Management
	Bismarck FD
	Bismarck PD
	BRFD
	Burleigh County OEM
	Burleigh County Sheriff
	CenCom
	Lincoln PD
	Mandan FD
	Mandan PD
	Metro Area Ambulance
	Morton County OEM
	Morton County Sheriff
	NDHP Bismarck

4.0 SYSTEM INVENTORY

This section provides an overview of the results from the system inventory process conducted for the Bis-Man ITSRA. The information gathered for this inventory was obtained through extensive stakeholder engagement. A combination of surveys, interviews, and small-group discussions was used to collect and validate the inventory data. Additionally, follow-up interviews were held to identify changes needed for the update.

To streamline the inventory process, we defined the types of systems to be included using the National ITS Architecture. We placed greater emphasis on the Physical Architecture, as it encompasses most of the ITS hardware. Additionally, we gathered information about the services offered by various physical ITS entities. In this region, the majority of systems can be categorized as existing. Those systems, components, or services identified for future deployment are labeled as planned.

Using the Physical Architecture, four types of entities were identified for the Bis-Man region:

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

These entities are explained in greater detail in the following subsections. Section 4.5 shows a summary of the ITS inventory in the Bis-Man region for each stakeholder.

4.1 Bis-Man Centers

Centers are the locations where functions are performed (i.e., processing information, issuing control commands, and producing output information). This document identifies relevant centers in the National ITS Architecture that manage and support the transportation system, as shown in the Bis-Man area Physical Architecture in Figure 2.

4.1.1 Traffic Management Center

The Traffic Management Center monitors and controls traffic and the road network. It works with the Roadway Subsystem to manage traffic flow and monitor road conditions, the surrounding environment, and the status of field equipment. This traffic management system covers many transportation facilities in coordination with the NDDOT's Bismarck district office. Specific traffic management systems in the Bis-Man area is discussed in the next section.

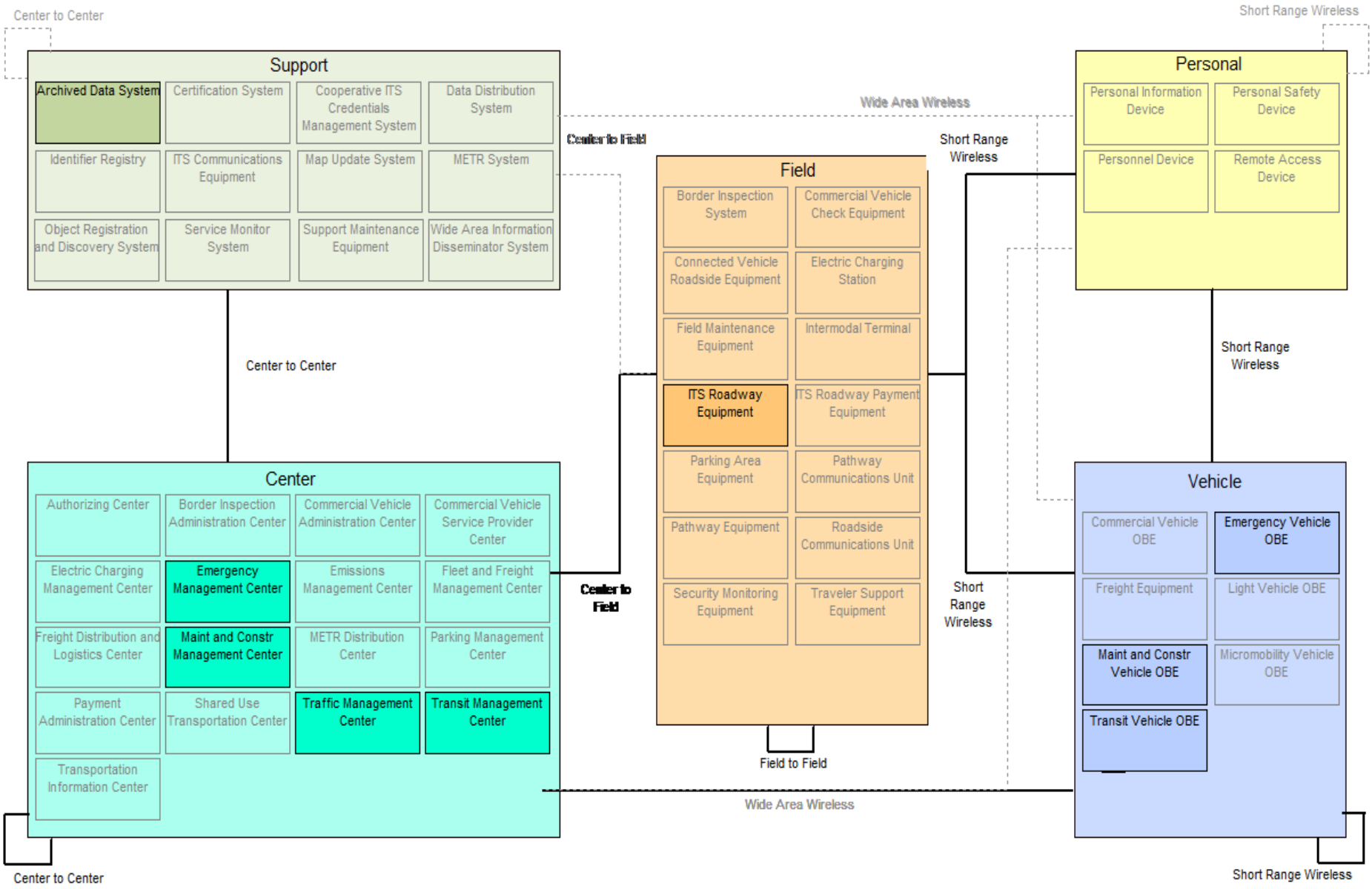


Figure 2 Bis-Man Physical Architecture

City of Bismarck Traffic Engineering Department

The City of Bismarck's traffic engineering department oversees a traffic signal system covering 109 intersections. Five of these intersections are on the state road system, of which NDDOT maintains four: State St & I-94 North Ramps, State St & I-94 South Ramps, US 83 & ND 1804 / 71st Ave N, and Bismarck Expwy / Centennial Rd & I-94 Ramps. The majority of the traffic signal controllers are Econolite Cobalt (ATC) models, although there are a few McCains controllers. Approximately half of these intersections have remote communication capabilities. For control and management, the city utilizes Centracs mobility software. Most intersections in Bismarck, particularly along the expressway corridor, are equipped with video detection and are planned to connect to a central system via fiber and wireless communications, facilitating remote monitoring and the collection of detailed traffic data.

City of Mandan Engineering

In the city of Mandan, every one of the nine traffic intersections is equipped with advanced video detection technology and is integrated into the state highway system. The engineering department of Mandan works in close collaboration with NDDOT to manage the operation and effectiveness of traffic signals in the area. While the city's public works department handles the maintenance and upkeep of most signals, the NDDOT District office is specifically responsible for four intersections in Mandan: those at Sunset Drive and the north and south I-94 ramps, the Memorial Highway and ND 810/ 194 northbound off-ramp, and the Memorial Highway and 3rd Street Southeast. This partnership between local and state agencies is essential for ensuring traffic flow and maintaining safety for all road users.

Figure 3 Mandan City Hall (Engineering Department)

4.1.2 Transit Management Center

Bis-Man Transit offers public transportation services encompassing Bismarck and Mandan, covering an area of 56 square miles. Their offerings include both fixed-route and demand-response services, as well as Paratransit demand-response coverage for the city of Lincoln. Currently, there is no coordination with other transit agencies, but Bis-Man Transit is open to collaborating with external transit services to enhance their facilities and support passengers. Transit operates a comprehensive management system that encompasses functions such as dispatching, routing, and fare management, and also conducts revenue and passenger data analysis. Each transit vehicle is equipped with onboard security surveillance and Automated Vehicle Location (AVL) technology, enabling real-time tracking. Additionally, all vehicles are fully compliant with the Americans with Disabilities Act (ADA) and feature automated audible and visual announcements at each stop.

Figure 4 Bis-Man Transit Facility

4.1.3 Emergency Management Center

The Emergency Management Center includes functions across the whole array, from notifying of an emergency to supporting incident management and evacuation. Emergency management is handled by several local, county, and state agencies. The Central Dakota Communications Center (CenCom) serves as the dispatch center of the city of Bismarck, Mandan, Lincoln, and Burleigh County. It includes the Police and

Fire department of both Bismarck and Mandan, the Burleigh County Sheriff's department, the Bismarck Rural Fire department, and the Metro area ambulance. It is also connected with Morton County Communication Center's dispatch communication and the NDHP dispatch over the State radio.

4.1.4 Maintenance and Construction Management Center

Currently, three entities are responsible for Maintenance and Construction Operations (MCO) in the Bis-Man area: Bismarck Public Works, Mandan Public Works, and the NDDOT Bismarck District. These agencies are gradually implementing fleet management capabilities and utilizing AVL technologies. All centers utilize GIS capabilities to track and display vehicle progress during maintenance work. The Department of Transportation has the added capacity to present current road conditions to the public in collaboration with the city's GIS department mapping service. County highway departments are tasked with rural road maintenance; however, these counties have limited ITS capabilities, leading to traditional phone calls being the primary means of communication between rural and metropolitan systems.

4.1.5 Information Service Provider

Functions associated with an Information Service Provider (ISP) are currently handled through multiple agencies in the Bis-Man region. Generally, law enforcement agencies are the main point of contact for issuing travel advisories and contacting the media. Public Service announcements can be made by the respective department at City Hall. Both traffic and public works departments extensively use portable message signs to provide road users with detour information during special events or in the event of an incident. However, the NDDOT maintains a statewide traveler information system that uses 511 and a web page where travelers can obtain a variety of road conditions, weather, and construction information.

4.1.6 Archived Data Management Center

The City of Bismarck's CenCom and IT departments can gather data from their respective ITS sensors, though their archiving capacity is limited to specific timeframes. The Advanced Traffic Analysis Center (ATAC) utilizes the Bismarck IT infrastructure to access the Bismarck engineering Centracs server. This access enables ATAC to generate and provide critical traffic analysis data, thereby supporting the Bismarck engineering team in facilitating efficient traffic movement.

The transit center is the Data Archive Center for regional transit management, gathering and analyzing data for reports to the State and Federal Transit Administration (FTA) via the National Transit Database (NTD). However, as more ITS devices are deployed, it is expected that archival data functions will be coordinated region-wide.

4.2 Bis-Man Field Devices

This type of physical entity refers to field devices used to support ITS systems. The majority of field devices in the Bis-Man area are part of the Roadway Subsystem. Below is a listing of these devices by the agency.

4.2.1 NDDOT Field Devices

1. Sensors
    a. Cameras
        i. PTZ cameras along I-94 through Bismarck-Mandan
    b. Weather
        i. RWIS and Environmental Sensor Stations located on I-94
2. Warning/advisory devices
    a. DMS along I-94 (5 Permanent and 3 trailer-mounted)

4.2.2 City of Mandan Field Devices

1. Control devices
    a. Traffic signal controllers
2. Sensors
    a. Video traffic detectors

4.2.3 City of Bismarck Field Devices

1. Control devices
    a. Traffic signal controllers

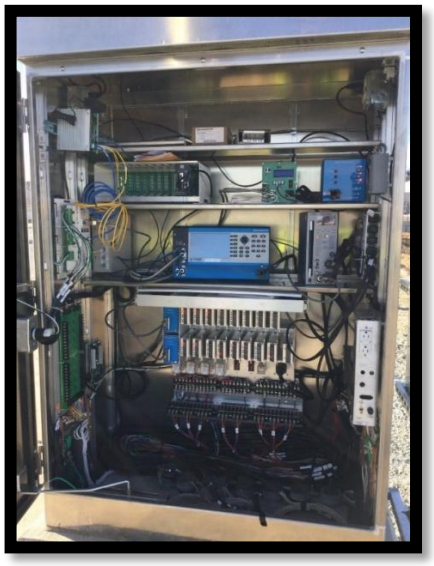


Figure 5 Typical Signal Controller Cabinet

2. Sensors
    a. Video traffic detectors

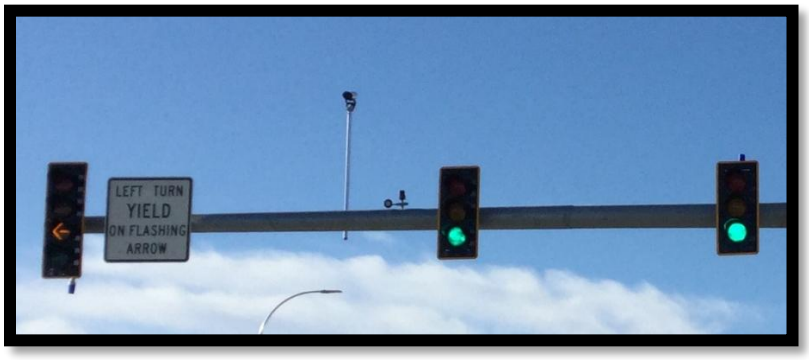


Figure 6 Video and Optical Detector for Preemption

i.Speed Radar

Figure 7 Black Cat Radar

3. Warning/advisory devices
    a. Portable DMS (Temporary)

Figure 8 DMS (Public Work Department)

4.3 Bis-Man Vehicles

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

4.3.1 Emergency Vehicle for Bis-Man area

1. Law enforcement vehicles equipped with mobile data computer, two-way radio, Computer Aided Dispatch (CAD) integration, mobile command post installation system, etc.

Figure 9 Burleigh County Sheriff Vehicle

2. Fire vehicles equipped with two-way radio, CAD equipment, Opticom Traffic Signal Preemption (TSP) system, etc.

Figure 10 Bismarck Fire Department Engine

3. Ambulance equipped with two-way radio, CAD equipment, Opticom Traffic Signal Preemption (TSP) system, mobile communication platform (Pulsara)), etc.

Figure 11 Metro Area Ambulance

4.3.2 MCO vehicles for City of Bismarck and Mandan

1. Maintenance trucks with an atmospheric sensor

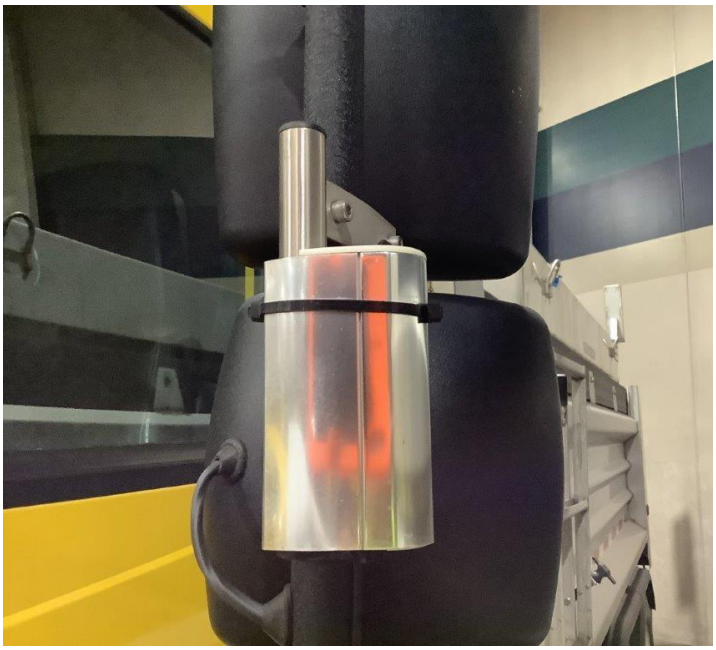


Figure 12 Truck unit with a road temperature sensor (Bismarck PW)

2. Snowplows equipped with AVL

Figure 13 Snow blower attachments for loader (Mandan PW)

3. Advanced Sander control

Figure 14 Sander Control

4.3.3 Transit Vehicle for Bis-Man area

1. Transit buses with electronic fare box, security camera, and ADA compliance.

Figure 15 Transit Bus

4.4 Bis-Man Communication Infrastructure

Below is a brief description of the existing and planned communication infrastructure in the Bis-Man area. It should be noted that this infrastructure has been agency-specific to date, with limited integration. However, more integration activities are expected as the Bis-Man ITSRA is implemented.

1. Fiber Optic Cable
    a. Arterial network (Bismarck)
    b. External Service provider (Bismarck and Mandan)
2. Cell Modem
    a. A couple of traffic signals in the City of Bismarck
3. Wireless/cellular
    a. Most of the emergency vehicles
    b. DMS
    c. Public work vehicles

4.5 Summary of Bis-Man Inventory

Table 3: List of Inventory

Element Name	Element Description	Associated Physical Objects	Stakeholder
Bis-Man Emergency Vehicles	Fire, police, ambulance, and other emergency vehicles in the Bis-Man area.	Emergency Vehicle OBE	Bis-Man Emergency Management Agencies
Bis-Man Traffic Data Archival	Data archives are integral to the traffic and emergency departments focused on transportation. These systems encompass various components such as databases, models, analytical tools, and user interface devices that facilitate the acquisition of data and the analysis of results derived from these archives.	Archived Data System, Archived Data User System	ATAC, Bismarck Engineering, Bismarck IT
Bis-Man Transit Center	Bismarck Mandan Transit Center	Archived Data User System, Transit Management Center	Bis-Man Transit
Bis-Man Transit Drivers	Person that receives and provides additional information that is specific to operating the ITS functions in all types of transit vehicles	Transit Vehicle Operator	Bis-Man Transit
Bis-Man Transit Operator	Personnel for fleet management, maintenance operations, and scheduling activities	Transit Operations Personnel	Bis-Man Transit
Bis-Man Transit Vehicles	Bis-Man Transit vehicles are now equipped with portable vehicle tracking devices like Tablet which integrates with the current Transit Management software.	Transit Vehicle OBE	Bis-Man Transit
Bismarck Centracs Server	Bismarck Traffic Operations Center	Archived Data System, Archived Data User System, Traffic Management Center	Bismarck Engineering

Element Name	Element Description	Associated Physical Objects	Stakeholder
Bismarck Engineering Field Devices	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic. This can include equipment for tolling or Black Cat radar for speed detection and reporting.	ITS Roadway Equipment	Bismarck Engineering
Bismarck Engineers	Bismarck traffic engineering personnel	Traffic Operations Personnel	Bismarck Engineering
Bismarck PW Field Devices	MCO Field Devices include sensors, displays, and cameras for operational purposes of maintenance and construction.	ITS Roadway Equipment	Bismarck PW
Bismarck PW Operations Center	Bismarck-Mandan Maintenance and Construction Operations Center	Maint and Constr Management Center	Bismarck PW
Bismarck PW Vehicles	Bismarck public works vehicles	Maint and Constr Vehicle OBE	Bismarck PW
Burleigh County PW	Public Works Department of Burleigh County	Maint and Constr Management Center	Burleigh County Engineering
Burleigh County PW Vehicles	Public Works Vehicles of Burleigh County	Maint and Constr Vehicle OBE	Burleigh County Engineering
Central Dakota Communications Center	911 and dispatch center for City of Bismarck, Mandan, and Burleigh County	Emergency Management Center, Emergency Telecommunications System	CenCom
Driver		Driver	

Element Name	Element Description	Associated Physical Objects	Stakeholder
Government Reporting Systems	'Government Reporting Systems' represents the system and associated personnel that prepare the inputs to support the various local, state, and federal government transportation data reporting requirements (e.g. Highway Performance Monitoring System, Fatality Analysis Reporting System) using data collected by ITS systems. It represents a system interface that provides access to the archived data relevant to these reports. In most cases, this system will combine data collected from ITS archives with data from non-ITS sources to assemble the required information.	Government Reporting Systems	
Lincoln PW	Lincoln Public Works Department	Maint and Constr Management Center	Lincoln PW
Lincoln PW Vehicles	Lincoln public works vehicles	Maint and Constr Vehicle OBE	Lincoln PW
Mandan Engineering Field Devices	Mandan traffic field devices	ITS Roadway Equipment	Mandan Engineering
Mandan PW Operations Center	Mandan public works operations	Maint and Constr Management Center	Mandan PW
Mandan PW Vehicles	Mandan public works vehicles and handheld devices within the vehicle	Maint and Constr Vehicle OBE	Mandan PW
Mandan Traffic Engineering	Mandan traffic engineering	Archived Data User System, Traffic Management Center	Mandan Engineering
Media	Represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media	Media	

Element Name	Element Description	Associated Physical Objects	Stakeholder
Morton County Communications	Morton County communications department	Emergency Management Center	Morton County OEM, Morton County Sheriff
Morton County PW	Public Works Department of Morton County	Maint and Constr Management Center	Morton County Highway Department
Morton County PW vehicles	Morton County Public Works Vehicles	Maint and Constr Vehicle OBE	Morton County Highway Department
Morton County Sheriff Vehicles	Morton County Sheriff department vehicles	Emergency Vehicle OBE	Morton County Sheriff
NDDOT District Field Devices	NDDOT District ITS field devices includes surveillance cameras at interchanges, Environmental Sensor Station, and DMS Boards	ITS Roadway Equipment	NDDOT Bis Dist
NDDOT District Office	NDDOT District maintenance and construction	Maint and Constr Management Center	NDDOT Bis Dist
NDDOT District Vehicles	NDDOT District maintenance and construction vehicles	Maint and Constr Vehicle OBE	NDDOT Bis Dist
NDHP Vehicles	NDHP vehicles	Emergency Vehicle OBE	NDHP Bismarck
Pedestrians		MMV User, Pedestrian	
State Radio	North Dakota State Radio	Alerting and Advisory System, Emergency Management Center	ND DES
Transit Fare Card	Bis-Man Transit fare card	Payment Device, Traveler Card	Bis-Man Transit

5.0 SERVICE PACKAGES

This section describes the ITS services selected for the Bis-Man area. These services were identified from previous ITS planning efforts, stakeholders' input throughout the ITSRA development, and possible coordination with the statewide architecture update.

Utilizing service packages is the method for representing ITS services in the regional architecture. Service packages are slices of the architecture that address a specific service (e.g., traffic signal control); they are a collection of several different physical objects (systems and devices) along with the information flows needed to provide the desired service.

The following service packages were identified for the Bis-Man region. The descriptions are from the National ITS Architecture and have been augmented with the narrative about the service in Bis-Man. The status of each service package is also indicated (i.e., existing, planned, or future). Customized Bis-Man service packages and their information flow diagrams are shown in Appendix A.

DM01: ITS Data Warehouse (Existing)

National architecture description: This service package provides access to transportation data to support transportation planning, condition and performance monitoring, safety analysis, and research. Configurations range from focused repositories that house data collected and owned by a single agency, district, private sector provider, or research institution to broad repositories that contain multimodal, multidimensional data from varied data sources covering a broader region. Both central repositories and physical distributed ITS data repositories are supported. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse service package may be parsed by the local repository and dynamically translated to requests to other repositories that relay the data necessary to satisfy the request. The repositories could include a data registry capability that allows registration of data identifiers or data definitions for interoperable use throughout a region.

- Bis-Man: Data collection and archiving are key roles of agencies like the City of Bismarck and CenCom. The Bismarck Engineering Department shares traffic data with ATAC for archiving, to support engineering representations for government reporting, and to help identify additional performance measures. Bismarck's public works departments can contribute to this effort, as no other regional entity handles data warehousing. The transit center serves as the Data Archive Center for regional transit management, collecting and analyzing data for reporting.

DM02: Performance Monitoring (Existing)

National architecture description: The Performance Monitoring service package uses information collected from detectors and sensors, connected vehicles, and operational data feeds from centers to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g., environmental data and infrastructure conditions monitoring data. Additional data are collected including accident data, road condition data, road closures and other operational decisions to provide context for measured transportation performance and additional safety and mobility–related measures. More complex performance measures may be derived from the collected data.

- Bis-Man: The data collected and stored in DM01 is utilized by government agencies to enhance operational functions, particularly in areas like asset management. Each user service area possesses its own dedicated data archival component and system. Currently, however, there is no centralized monitoring system that covers the entire region.

MC01: Maintenance and Construction Vehicle and Equipment Tracking (Existing)

National architecture description: This service package tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. Checks can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

- Bis-Man: AVL technologies for vehicle tracking are utilized on the maintenance fleet of several area agencies, including the City of Bismarck, City of Mandan Public Works, and NDDOT. City and county utilizes a tracking system on their blades and plows that provides insights into what areas have been plowed and bladed. This system is powered by a Verizon wireless tracker, enhancing their operational efficiency. The DOT currently has AVL technology installed on all of its snowplow fleet and plans to implement AVL across its entire fleet in the near future.

MC02: Maintenance and Construction Vehicle Maintenance (Existing)

National architecture description: This service package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on–board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the

systems that collect this diagnostic information and use it to schedule and manage vehicle and equipment maintenance.

- Bis-Man: The City of Bismarck's public works department (Vaster) and DOT district office utilize an asset management software system to schedule and perform preventive maintenance on their fleet vehicles. In contrast, other cities and counties rely on their own maintenance staff and manual tracking methods.

MC04: Winter Maintenance (Existing)

National architecture description: This service package supports winter road maintenance including snowplow 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.

- Bis-Man: In the region, all maintenance agencies are actively engaged in winter road maintenance. The NDDOT employs state-wide Maintenance Decision Support Systems (MDSS) to evaluate and determine the most effective solutions based on prevailing weather conditions. Other Public Works agencies use their own specialized mixtures of roadway treatments, which typically include salt, sand, and bottom ash, along with vehicular environment sensors to assess snow and ice control responses and establish winter maintenance schedules. These agencies also depend on GIS services to monitor the roadway network, enabling them to identify areas that have received maintenance and those that still require attention.

MC05: Roadway Maintenance and Construction (Existing)

National architecture description: This service package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right–of–way. Maintenance services include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non–ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.

- Bis-Man: All maintenance agencies in the region leverage GIS to determine the need for roadway maintenance and construction. The DOT District offices use pavement profilers to assess pavement condition, which informs their scheduling decisions for maintenance and construction activities.

MC06: Work Zone Management (Existing)

National architecture description: This service package manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., TIC, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This service package provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck–mounted devices supporting both stationary and mobile work zones.

- Bis-Man: All maintenance agencies in the region make public service announcements through various city departments, agencies, television, radio, and social media. Bismarck public works have portable message signs for the road users to guide in the work zone.

PS01: Emergency Call-Taking and Dispatch (Existing)

National architecture description: This service package provides basic public safety call–taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel. This service package also provides information to support dynamic routing of emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle routing. The Emergency Management Center provides routing information based on real–time conditions and has the option to request an ingress/egress route from the Traffic Management Center.

- Bis-Man: Cencom manages inbound calls via the Vesta 911 system, which accurately locates cellular callers by interfacing with their CAD system to initiate the call process. For rural agencies, the fast-forward system takes priority to send critical info before the call is officially paged, speeding up processing. Cencom also tracks response units with AVL technology, but has not fully adopted closest unit dispatching, still prioritizing traditional response areas for critical incidents.

PS02: Emergency Response (Existing)

National architecture description: This service package supports emergency/ incident response by personnel in the field. It includes emergency vehicle equipment used to

provide response status as well as video or images from either the vehicle or from emergency personnel in the field. Wide area wireless communications between the Emergency Management Center, Emergency Personnel and Emergency Vehicles supports a sharing of emergency response information. The service package also includes tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders at or near the incident scene to support local management of an incident, including the functions and interfaces commonly supported by a mobile command center.

- Bis-Man: This service is performed by all emergency responders in the region. Among the notable examples, the Bismarck Police Department is recognized for its drone program, which can upload video footage. Furthermore, this program allows video transmission to other computers and tablets, enhancing communication and data sharing. The Metro area ambulance has started utilizing Pulsara to relay critical patient information to the CAD. This shift to the Fast Forward system speeds up communication by favoring cell phones over traditional paging technology. However, this SP is more applicable towards the coordination with statewide architecture.

PS03: Emergency Vehicle Preemption (Existing)

National architecture description: This service package provides signal preemption for public safety first responder vehicles. Both traditional signal preemption systems and new systems based on connected vehicle technology are covered. In more advanced systems, movement of public safety vehicles through the intersection can be facilitated by clearing queues and holding conflicting phases. In addition, this SP also covers the transition back to normal traffic signal operations after providing emergency vehicle preemption.

- Bis-Man: In Bismarck, traffic signal preemption technology is somewhat limited, with only a few intersections utilizing GPS capabilities. Most intersections in Bismarck and Mandan use the traditional Opticom system, which helps emergency vehicles, particularly those from the Fire Department and Ambulance Services, respond more quickly to incidents. When an emergency vehicle approaches, the Opticom emitter transmits a coded infrared or GPS signal, which is then received by intersection receivers and relayed to the traffic controller.

PS10: Wide-Area Alert (Existing)

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

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

- Bis-Man: This service is performed by all emergency responders using the IPAWS system, which can utilize the Environmental Sensor Station managed by the Department of Transportation.

PS12: Disaster Response and Recovery (Future)

National architecture description: This service package enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man–made disasters (hazardous materials incidents, nuclear power plant accidents, and national security emergencies such as nuclear, chemical, biological, and radiological weapons attacks).

The service package supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The service package provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In addition, this service package tracks and coordinates the transportation resources – the transportation professionals, equipment, and materials – that constitute a portion of the disaster response.

The service package identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this service package, the Emergency Management Center represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Center and the other centers provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control

strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this service package supports transition back to normal transportation system operation, recovering resources, managing on–going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities.

This service package builds on the basic traffic incident response service that is provided by TM08, the Traffic Incident Management service package. This service package addresses the additional complexities and coordination requirements that are associated with the most severe incidents that warrant an extraordinary response from outside the local jurisdictions and require special measures such as the activation of one or more emergency operations centers. Many users of ARC–IT will want to consider both TM08 and this service package since every region is concerned with both day–to–day management of traffic–related incidents and occasional management of disasters that require extraordinary response.

- Bis-Man: This SP is reserved as a future package for coordination with the statewide architecture.

PS13: Evacuation and Reentry Management (Future)

National architecture description: This service package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The service package addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning.

This service package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role

in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times.

Evacuations are also supported by PS14, the "Disaster Traveler Information" service package, which keeps the public informed during evacuations. See that service package for more information.

- Bis-Man: This SP is reserved as a future package for coordination with the statewide architecture.

PT01: Transit Vehicle Tracking (Existing)

National architecture description: This service package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real–time.

- Bis-Man: Location tracking is facilitated by GPS technology integrated into the tablet used for transit operations. The fixed route service, known as ‘Passio’, is a paid offering managed by the operations contractor ‘WeDriveU’. They provide a portal that oversees all fixed-route transit activities, enabling the generation of schedule-adherence reports. The only manual task required from drivers is selecting their route assignment on the tablet at the start of each day. The tablet is designed to identify geofenced areas and the corresponding timestamp requirements for these locations.

PT02: Transit Fixed-Route Operations (Existing)

National architecture description: This service package performs automated dispatch and system monitoring for fixed–route and flexible–route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service monitors the transit vehicle trip performance against the schedule and provides information displays at the Transit Management Center.

- Bis-Man: Since the major route revision in 2021, there are a total of six fixed routes. The entire fixed route system is managed through Passio, which allows for in-house changes such as detours or changes made via customer service. This system includes route maps and geo-fenced timing points. Driver and vehicle assignments

are handled manually. For traveler information, Passio provides push notifications for customers who opt into this feature, and social media updates are also available.

PT03: Dynamic Transit Operations (Existing)

National architecture description: The Dynamic Transit Operations service package allows travelers to request trips and obtain itineraries using a personal device such as a smart phone, tablet, or personal computer. The trips and itineraries cover multiple transportation services (public transportation modes, private transportation services, shared–ride, walking and biking). This service package builds on existing technology systems such as computer–aided dispatch/ automated vehicle location (CAD/AVL) systems and automated scheduling software, providing a coordination function within and between transit providers that would dynamically schedule and dispatch or modify the route of an in–service vehicle by matching compatible trips together. TI06 covers other shared use transportation options.

- Bis-Man: Ecolane's demand response services software optimizes routing based on user requests, with dispatchers manually inputting information and connecting drivers to requesters via radio. If drivers can't find a passenger, they notify the dispatcher for further instructions. On-time performance is tracked hourly without geolocation. Currently, the agency handles trip requests through phone, text, and email

PT04: Transit Fare Collection Management (Existing)

National architecture description: This service package manages transit fare collection on–board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device such as a smart phone. Readers located either in the infrastructure or on–board the transit vehicles enable electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Center.

- Bis-Man: The agency uses a payment tracker and a record keeper for past trips and short-term vehicle tracking that is accessible to the customers through a service provider app. Payment options include account charges and Token transit for fixed routes, while paratransit users can pay with cash, tickets, or account charges. Buses are equipped with Genfare Fareboxes for on-the-spot cash or card payments, and fare data is updated weekly.

PT05: Transit Security (Existing)

National architecture description: This service package provides for the physical security of transit passengers and transit vehicle operators. On–board equipment performs surveillance and sensor monitoring in order to identify potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or

event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on–board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this service package provides surveillance and sensor monitoring of non–public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring).

Most of the surveillance and sensor data that is collected by this service package may be monitored by either the Emergency Management Center or the Transit Management Center, providing two possible approaches to implementing this service package. This service package also supports remote transit vehicle disabling and transit vehicle operator authentication by the Transit Management Center.

- Bis-Man: Transit agency implements video and audio surveillance across its fleet of vehicles to enhance incident resolution. These recordings can be downloaded either locally or wirelessly from the transit facility. In addition to this monitoring system, vehicles are equipped with a one-click emergency notification option that allows drivers to alert dispatch quickly if needed. Furthermore, drivers can change the head sign on fixed-route buses, enabling them to signal for assistance from passersby.

PT06: Transit Fleet Management (Existing)

National architecture description: This service package supports automatic transit maintenance scheduling and monitoring. On–board condition sensors monitor system status and transmit critical status information to the Transit Management Center. The Transit Management Center processes this data and schedules preventative and corrective maintenance. The service package also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks and the assignment of transit vehicle operators to runs.

- Bis-Man: External contractors use Zonear for pre-trip inspections, allowing them to report vehicle issues, like burnt-out headlights, along with the starting mileage. For internal maintenance, a new software called Maximal tracks preventive

maintenance is used, which can be accessed from the transit center. Facility repairs are recorded through Black Cat in the state system.

- Bis-Man: The central software for the fixed-route system can report the passenger count data. Although the bus has the automatic passenger counting capability, this service is still completed manually by the driver.

PT08: Transit Traveler Information (Existing)

National architecture description: This service package provides transit users at transit stops and on–board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real–time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.

- Bis-Man: Transit vehicles now offer both a web platform and the Passio Go App for real-time bus tracking, significantly improving the passenger experience. These tools allow customers to monitor bus arrivals and capacity, ensuring they receive timely information. By enabling location services on the app, users can easily discover the nearest bus routes and estimated arrival times. Additionally, the app features a detailed list of stops, simplifying journey planning for passengers.

TM01: Infrastructure-Based Traffic Surveillance (Existing)

National architecture description: This service package includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. 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 Center). The data generated by this service package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.

- Bis-Man: The traffic signals in the Bismarck and Mandan areas are equipped with advanced video detection systems, enhancing their ability to monitor vehicle movement. These signals are connected through a network of fiber-optic, cellular, and coaxial cables, enabling efficient communication and data exchange. Additionally, NDDOT has installed PTZ cameras along the I-94 corridor that runs through Bismarck and Mandan. These cameras provide real-time surveillance, and

the captured images are accessible to the public via NDDOT's travel map website, offering useful information for travelers navigating the region.

TM03: Traffic Signal Control (Existing)

National architecture description: This service package provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service package ranging from fixed–schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This service package is generally an intra–jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real–time communications is covered in the TM07–Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.

- Bis-Man: The City of Bismarck is implementing initiatives to improve communication and coordination of traffic signals through an expanding fiber optic network. Two distinct instances are proposed under this service package for the City of Bismarck and the City of Mandan, reflecting the different coordination and communication requirements.

TM06: Traffic Information Dissemination (Existing)

National architecture description: This service package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.

- Bis-Man: The engineering departments are proactive in communicating with the public by issuing announcements through multiple channels, including city

departments, press releases, television, radio, and social media. To enhance traveler awareness, the DOT district installs temporary DMS boards near bridges or during bridge closures to relay essential traffic information. Additionally, the ND Roads GIS system provides updates on active or upcoming maintenance activities, ensuring that road users remain informed about any changes that may affect their journeys.

TM08: Traffic Incident Management System (Existing)

National architecture description: This service package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The service package includes incident detection capabilities through roadside surveillance devices (e.g., CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this service package to detect and verify incidents and implement an appropriate response. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination service package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information service packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel. This service package is closely related with the Public Safety service packages, which focus on services that support first responders. In particular, local management of the incident using an incident command system is covered by PS02.

- Bis-Man: Both Bismarck and Mandan rely on the CenCom to report and manage any incidents occurring on collector roads and higher classifications. For situations arising on local roads, it is the responsibility of emergency responders within the region to initiate the appropriate incident response protocols. Additionally, the DOT district actively deploys portable DMS boards as necessary to provide real-time updates and assistance regarding traffic incidents, thereby enhancing awareness and safety for all road users.

TM13: Standard Railroad Grade Crossing (Existing)

National architecture description: This service package manages highway traffic at highway–rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the ITS Roadway Equipment and the Driver in the physical view.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification of an approaching train by interfaced wayside equipment. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway–rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the Traffic Management Center.

- Bis-Man: In Bismarck, six at-grade rail crossings are equipped with advanced wayside detection systems. These systems activate gates and warning signals to alert drivers to approaching trains and help manage traffic at nearby signalized intersections. The use of this technology contributes to safety and supports a more efficient flow of traffic in the area.

TM17: Speed Warning and Enforcement (Existing)

National architecture description: This service package monitors vehicle speeds and supports warning drivers when their speed is excessive. Also the service includes notifications to an enforcement agency to enforce the speed limit of the roadway. Speed monitoring can be made via spot speed or average speed measurements. Roadside equipment can display the speed of passing vehicles and/or suggest a safe driving speed. Environmental conditions and vehicle characteristics may be monitored and factored into the safe speed advisories that are provided to the motorist. For example, warnings can be generated recognizing the limitations of a given vehicle for the geometry of the roadway such as rollover risk for tall vehicles.

This service focuses on monitoring of vehicle speeds and enforcement of the speed limit while the variable speed limits service (covered in TM20-Variable Speed Limits service package) focuses on varying the posted speed limits to create more uniform speeds along a roadway, to promote safer driving during adverse conditions (such as fog) and/or to reduce air pollution.

- Bis-Man: The traffic engineering department in Bismarck utilizes a black cat radar system to monitor speed, which assesses adherence to speed limits in areas identified as prone to accidents. Additionally, the DOT district office utilizes four portable speed trailers to alert drivers and enforce speed limits.

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 ITSRA. The operational concept outlines the roles and responsibilities of relevant stakeholders for specific ITS service areas, i.e., emergency and incident management, maintenance and construction management, traffic management, and transit service. In addition to providing a snapshot of how things are done for a specific scenario, the operational concept explores additional integration opportunities in the region with a particular focus on stakeholder involvement.

The discussion of roles and responsibilities 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 delivered and on information sharing among the various stakeholders.

The set of service packages for the Bis-Man area was the deciding factor in facilitating the development of the operational concept. From the Service Package graphics, stakeholders were able to identify their roles and responsibilities for the given events, current links with other stakeholders, and additional links or coordination that could be established. The mechanism for obtaining stakeholders' input relied on using small groups of stakeholders relevant to each service package. Once the small group discussions were completed, the results (i.e., customized service packages) were presented to all the stakeholders participating in the ITSRA development.

The following section outlines the roles and responsibilities of stakeholders in the Bis-Man ITSRA.

6.1 Operational Roles and Responsibilities

Table 4: List of Roles and Responsibilities

RR Area Name	Stakeholder	Roles and Responsibilities Description
Data Management for Bismarck-Mandan RA	Bis-Man Transit	Provide better route planning based on the passenger usage analysis.
	Bis-Man Transit	Collect transit data.
Data Management for Bismarck-Mandan RA	Bismarck Engineering	Operate and maintain a coordinated centracs system with all intersections.

RR Area Name	Stakeholder	Roles and Responsibilities Description
Data Management for Bismarck-Mandan RA	CenCom	Provide a disaster recovery data backup.
	CenCom	Coordinate with other departments to archive CAD and other dispatch records.
Data Management for Bismarck-Mandan RA	NDDOT Bis Dist	Setting up the traffic signal system on Mandan area using the fiber optic network.
Emergency and Incident Management for Bismarck-Mandan	Bis-Man Emergency Management Agencies	Coordinate with other emergency management agencies.
	Bis-Man Emergency Management Agencies	Respond to incidents.
Emergency and Incident Management for Bismarck-Mandan	Bismarck Emergency Management	Coordinate with other city of Bismarck emergency management agencies.
Emergency and Incident Management for Bismarck-Mandan	Bismarck Engineering	Coordinate with emergency management, maintenance and construction agencies in the city of Bismarck.
Emergency and Incident Management for Bismarck-Mandan	Bismarck FD	Coordinate with other emergency management agencies in the region.
	Bismarck FD	Respond to incidents in the city of Bismarck.
Emergency and Incident Management for Bismarck-Mandan	Bismarck PD	Coordinate with other emergency management agencies in the region.
	Bismarck PD	Respond to incidents in the city of Bismarck.
	Bismarck PD	Provide 911 service to city of Bismarck.

RR Area Name	Stakeholder	Roles and Responsibilities Description
Emergency and Incident Management for Bismarck-Mandan	BRFD	Respond to incidents in the city of Lincoln and other Rural Fire Protection District.
Emergency and Incident Management for Bismarck-Mandan	Burleigh County OEM	Issue and Broadcast Emergency Alerts (Amber, Silver, Blue, etc.)
	Burleigh County OEM	Coordinate emergency response.
Emergency and Incident Management for Bismarck-Mandan	Burleigh County Sheriff	Coordinate with other emergency management agencies in the region
	Burleigh County Sheriff	Provide 911 service to Burleigh county.
	Burleigh County Sheriff	Respond to incidents in the Burleigh County system.
Emergency and Incident Management for Bismarck-Mandan	CenCom	Coordinate dispatch communication with the public works department during winter.
	CenCom	Receives Morton County's dispatch communication over state radio.
	CenCom	Provide PSAP 9-1-1 and dispatch services in the city of Bismarck, Mandan, Lincoln, and Burleigh county.
	CenCom	Broadcast Emergency Alerts (Amber, Silver, Blue, etc.)
Emergency and Incident Management for Bismarck-Mandan	Lincoln PD	Respond to incidents in the city of Lincoln.
	Lincoln PD	Provide 911 service to the city of Lincoln.
	Lincoln PD	Coordinate with other emergency management agencies in the region.
Emergency and Incident Management for Bismarck-Mandan	Mandan Engineering	Coordinate with emergency management, maintenance and construction agencies in the city of Mandan.

RR Area Name	Stakeholder	Roles and Responsibilities Description
Emergency and Incident Management for Bismarck-Mandan	Mandan FD	Coordinate with other emergency management agencies in the region.
	Mandan FD	Respond to incidents in the city of Mandan.
Emergency and Incident Management for Bismarck-Mandan	Mandan PD	Respond to incidents in the city of Mandan.
	Mandan PD	Provide 911 service to the city of Mandan.
	Mandan PD	Coordinate with other emergency management agencies in the region.
Emergency and Incident Management for Bismarck-Mandan	Metro Area Ambulance	Coordinate with other emergency management agencies.
	Metro Area Ambulance	Coordinate with other emergency management agencies in the region.
Emergency and Incident Management for Bismarck-Mandan	Morton County OEM	Issue and Broadcast Emergency Alerts (Amber, Silver, Blue, etc.)
	Morton County OEM	Coordinate emergency response.
Emergency and Incident Management for Bismarck-Mandan	Morton County Sheriff	Coordinate with other emergency management agencies in the region.
	Morton County Sheriff	Provide 911 services to Morton county.
	Morton County Sheriff	Respond to incidents on Morton County system.
Emergency and Incident Management for Bismarck-Mandan	ND DES	Issue Amber Alerts.
	ND DES	Provide dispatch for Morton county and NDHP.
Emergency and Incident Management for Bismarck-Mandan	NDDOT Bis Dist	Provide resources
Emergency and Incident Management for Bismarck-Mandan	NDHP Bismarck	Respond to incidents on the ND state system

RR Area Name	Stakeholder	Roles and Responsibilities Description
Maintenance and Construction for Bismarck-Mandan RA	Bismarck PW	Maintenance of street lights and traffic signals in the city of Bismarck.
	Bismarck PW	Bismarck city system roadway maintenance (cleaning, repair) activities.
	Bismarck PW	Perform winter maintenance activities (snow plow operations, sanding, anti-icing) in the city of Bismarck.
Maintenance and Construction for Bismarck-Mandan RA	Burleigh County Engineering	Perform winter maintenance activities (snow plow operations, sanding, anti-icing) in Burleigh county.
	Burleigh County Engineering	Roadway construction and maintenance (cleaning, repair) activities in Burleigh county.
Maintenance and Construction for Bismarck-Mandan RA	Lincoln PW	Maintenance of street lights and traffic signals in the city of Lincoln.
	Lincoln PW	Perform winter maintenance activities in the city of Lincoln.
	Lincoln PW	Lincoln city system roadway maintenance activities.
Maintenance and Construction for Bismarck-Mandan RA	Mandan PW	Maintenance of street lights and traffic signals in the city of Mandan.
	Mandan PW	Mandan city system roadway maintenance activities.
	Mandan PW	Perform winter maintenance activities (snow plow operations, sanding, anti-icing) in the city of Mandan.
Maintenance and Construction for Bismarck-Mandan RA	Morton County Highway Department	Perform winter maintenance activities (snow plow operations, sanding, anti-icing) in Morton county.
	Morton County Highway Department	Roadway construction and maintenance (cleaning, repair) activities in Morton county.

RR Area Name	Stakeholder	Roles and Responsibilities Description
Maintenance and Construction for Bismarck-Mandan RA	NDDOT Bis Dist	Perform winter maintenance activities (snow plow operations, sanding, anti-icing) in the ND state system.
	NDDOT Bis Dist	ND state system roadway construction and maintenance activities.
Traffic Management for Bismarck-Mandan RA	Bismarck Engineering	Design, operate, and maintain signal control in the city of Bismarck.
	Bismarck Engineering	Coordinate with NDDOT Bis District.
Traffic Management for Bismarck-Mandan RA	Mandan Engineering	Maintain signal control in the city of Mandan.
	Mandan Engineering	Coordinate with NDDOT Bis District.
Traffic Management for Bismarck-Mandan RA	NDDOT Bis Dist	Install and maintain traffic signal system on the State Road system within the jurisdiction.
	NDDOT Bis Dist	Coordinate with City of Bismarck and City of Mandan engineering department.
Transit Services for Bismarck-Mandan RA	Bis-Man Transit	Retrieve data from a stationed vehicle at the facility based on an incident or lodged complaint.
	Bis-Man Transit	Provide real time tracking on arrival and capacity of a vehicle to the users.
	Bis-Man Transit	Ensure driver compliance by random checking on vehicle and driver camera.
	Bis-Man Transit	Provide dynamic transit (demand response) services in the Bismarck Mandan area.
	Bis-Man Transit	Provide transit fixed route operations for the Bismarck Mandan area.

7.0 AGREEMENTS

This section provides an overview of the agreements required and identified to facilitate ITS implementation in the region. The identification of these essential agreements was guided by the Service Packages, which outline the specific roles, responsibilities, and interaction points among agencies involved. Whenever multiple agencies collaborate on system operations or share authorized access to control and data, these arrangements highlight the need for formal agreements.

Engaging with key stakeholders was crucial to refining the list of required agreements. This process ensured that the unique needs of each agency were considered, as well as any existing agreements they have established with other organizations. By considering both current partnerships and agency-specific requirements, we aimed to create a comprehensive framework that supports effective collaboration and operational efficiency.

The table on the following page summarizes potential agreements in the Bis-Man area. The table provides the following information for each agreement:

1. Area
    a. The service area where the agreement is needed
2. Purpose
    a. A brief statement regarding what the agreement addresses
3. Stakeholders
    a. List of stakeholders (agencies) which would be included in the agreement
4. Issues
    a. List of specific issues to be included in the agreement

Table 5: List of Potential Agreements

Area	Purpose	Stakeholders	Issues
ITS Data Warehouse	Archival of ITS data from various agencies for the purpose of measuring and improving performance.	Bis-Man Emergency Management Agencies Bis-Man Transit Bismarck Engineering Bismarck PW Lincoln PW Mandan Engineering Mandan PW ND DES NDDOT Bis Dist	Information sharing for data archival
Traffic Incident Management System	Incident traffic response Sharing data (flow, video)	Bismarck PD Burleigh County Sheriff CenCom Lincoln PD Mandan PD Morton County Sheriff NDHP Bismarck	Communication links Response protocols
Traffic Information Dissemination	Coordinate traveler information	Bismarck Engineering CenCom Mandan Engineering NDDOT Bis Dist	Notification protocols Communication links
Transit Security	Response to incidents on buses	Bis-Man Transit Bismarck PD Mandan PD	Response protocols Communication links

Area	Purpose	Stakeholders	Issues
State Road Maintenance	Own and maintain concurrently	NDDOT Bismarck District Bismarck Engineering Bismarck PW Mandan Engineering Mandan PW	
ATAC Work Plan	Setting up connection to Centracs server	Bismarck Engineering ATAC	Connection to VPN

8.0 FUNCTIONAL REQUIREMENTS

This part outlines the specific functional requirements for the user services and service packages identified for the Bis-Man region. The requirements were selected from the National ITS Architecture template based on the preferred functions for each system. RAD-IT software was utilized to develop the functional requirements and generate a Functional Requirements Report.

A sample of the functional requirements is listed in the table below. The table contains the following columns with the headings described as follows:

1. Element Name: Element from Bis-Man inventory (section 4.5)
2. Functional Object: Element mapping to the national ITS architecture
3. Requirement number (Req#)
4. Requirement
5. Status: Existing or planned.

Due to the length of the Functional Requirements table, it is included in Appendix B. A sample table is provided below.

Table 6: Sample of Functional Requirements

Element Name	Functional Object	Req #	Requirement	Status
Bis-Man Data Archival	Archive Data Repository	1	The center shall collect data from centers.	Existing
		3	The center shall store collected data in an information repository.	Existing
		6	The center shall include capabilities for archive-to-archive coordination.	Existing
		7	The center shall provide the capability to execute methods on the incoming data such as cleansing, summarizations, aggregations, or transformations applied to the data before it is stored in the archive.	Existing
		8	The center shall collect data from data distribution systems and other data sources.	Existing
		11	The center shall respond to requests for archive data from archive data users (centers, field devices).	Existing

9.0 ITS STANDARDS

This section frames the relevant ITS Standards for the Bis-Man ITSRA. It is important to recognize that creating ITS Standards is a continuous process. As a result, the collection of applicable ITS standards should be revised as new standards receive approval. The table below presents the relevant standards for the Bis-Man ITSRA as determined by the RAD-IT output. The details in the table are organized into the following columns:

- SDO: Standard development organization
- Standard Number: Name and ID number of the document containing the standard
- Standard Title: Title provided by the development organization
- Element: Relevant Bis-Man architecture element

Table 7: List of Standards

SDO	Standard Number	Standard Title	Element Name
Advanced Traffic Controller Joint Committee	ITE ATC 5201	Advanced Transportation Controller	Bismarck Engineering Field Devices, Bismarck PW Field Devices, Mandan Engineering Field Devices, NDDOT District Field Devices
Advanced Traffic Controller Joint Committee	ITE ATC 5301	Intelligent Transportation System Standard Specification for Roadside Cabinets	Bismarck Engineering Field Devices, Bismarck PW Field Devices, Mandan Engineering Field Devices, NDDOT District Field Devices
Advanced Traffic Controller Joint Committee	ITE ATC 5401	Application Programming Interface Standard for the Advanced Transportation Controller	Bismarck Engineering Field Devices, Bismarck PW Field Devices, Mandan Engineering Field Devices, NDDOT District Field Devices

SDO	Standard Number	Standard Title	Element Name
International Organization for Standardization	ISO 21217	Intelligent transport systems -- Communications access for land mobiles (CALM) -- Architecture	Bis-Man Emergency Vehicles, Bis-Man Traffic Data Archival, Bis-Man Transit Center, Bis-Man Transit Vehicles, Bismarck Centracs Server, Bismarck Engineering Field Devices, Bismarck FD Vehicles, Bismarck PD Vehicles, Bismarck PW Field Devices, Bismarck PW Operations Center, Bismarck PW Vehicles, Burleigh County Sheriff Vehicles, Central Dakota Communications Center, Lincoln PW, Lincoln PW Vehicles, Mandan Engineering Field Devices, Mandan FD Vehicles, Mandan PD Vehicles, Mandan PW Operations Center, Mandan PW Vehicles, Mandan Traffic Engineering, Metro Area Ambulance Vehicles, Morton County Communications, Morton County PW, Morton County PW vehicles, Morton County Sheriff Vehicles, NDDOT District Field Devices, NDDOT District Office, NDDOT District Vehicles, NDHP Vehicles, State Radio
National Electrical Manufacturers Association	NEMA TS 5	Portable Traffic Signal Systems (PTSS) Standard	Bismarck Engineering Field Devices, Bismarck PW Field Devices, Mandan Engineering Field Devices, NDDOT District Field Devices

SDO	Standard Number	Standard Title	Element Name
National Electrical Manufacturers Association	NEMA TS 8	Cyber and Physical Security for Intelligent Transportation Systems	Bis-Man Traffic Data Archival, Bismarck Centracs Server, Bismarck Engineering Field Devices, Bismarck PW Field Devices, Bismarck PW Operations Center, Central Dakota Communications Center, Lincoln PW, Mandan Engineering Field Devices, Mandan PW Operations Center, Mandan Traffic Engineering, Morton County Communications, Morton County PW, NDDOT District Field Devices, NDDOT District Office, State Radio
National Electrical Manufacturers Association	NEMA TS2	Traffic Controller Assemblies with NTCIP Requirements	Bismarck Engineering Field Devices, Bismarck PW Field Devices, Mandan Engineering Field Devices, NDDOT District Field Devices
National Electrical Manufacturers Association	NEMA TS4	Hardware Standards for Dynamic Message Signs (DMS) With NTCIP Requirements	Bismarck Engineering Field Devices, Bismarck PW Field Devices, Mandan Engineering Field Devices, NDDOT District Field Devices

SDO	Standard Number	Standard Title	Element Name
National Institute for Standards and Technology	NIST FIPS PUB 140-2	Security Requirements for Cryptographic Modules	Bis-Man Emergency Vehicles, Bis-Man Traffic Data Archival, Bis-Man Transit Center, Bis-Man Transit Vehicles, Bismarck Centracs Server, Bismarck Engineering Field Devices, Bismarck FD Vehicles, Bismarck PD Vehicles, Bismarck PW Field Devices, Bismarck PW Operations Center, Bismarck PW Vehicles, Burleigh County Sheriff Vehicles, Central Dakota Communications Center, Lincoln PW, Lincoln PW Vehicles, Mandan Engineering Field Devices, Mandan FD Vehicles, Mandan PD Vehicles, Mandan PW Operations Center, Mandan PW Vehicles, Mandan Traffic Engineering, Metro Area Ambulance Vehicles, Morton County Communications, Morton County PW, Morton County PW vehicles, Morton County Sheriff Vehicles, NDDOT District Field Devices, NDDOT District Office, NDDOT District Vehicles, NDHP Vehicles, State Radio

10.0 PLANNING ASPECTS

The regional ITS architecture plays a critical role in shaping a region's transportation planning process, underscoring the need for close alignment between the two to achieve effective integration and coordination. By developing clear objectives and strategic initiatives that link land use and transportation, stakeholders can establish a cohesive framework that not only enhances the efficiency of transportation systems but also supports overall urban development. The ITSRA has identified several key services that align with the operational goals and objectives outlined in the Metropolitan Transportation Planning document, ARRIVE 2050. This alignment is vital, as it lays the foundation for the successful implementation of transportation initiatives that meet community needs while promoting sustainable growth.

10.1 Planning and the Regional ITS Architecture

Safety

Goal Statement:

Reduce the risk of traffic crashes and harm to all transportation system users, regardless of travel mode.

Objective 1.1- Reduce crash frequency and severity for all modes:

Based on crash history and future crash prediction, work to reduce the incidence of all motor vehicle and non-motor vehicle (pedestrian and cyclist) crashes, with an emphasis on serious injury and fatal crashes. Consider the context of each transportation corridor and safety needs by existing and potential modes of travel using the corridor.

Performance Measure:

- Safety and Security

Associated Service Package

PT01: Transit Vehicle Tracking
PT05: Transit Security
TM01: Infrastructure-Based Traffic Surveillance
TM03: Traffic Signal Control
TM13: Standard Railroad Grade Crossing

Resilient

Goal Statement:

Providing a transportation system that is secure from man-made disasters and adaptable to severe weather, major economic changes, and other shocks. Impacts on the built and natural environment are avoided, minimized, and mitigated to the greatest extent possible.

Objective 3.3- System Security:

Enhance transportation security and resiliency by developing strategies to address critical transportation assets that will facilitate the rapid movement of first responders and support incident management during times of emergency.

Performance Measure:

- Safety and Security

Associated Service Package

PT05: Transit Security

Objective 3.4- Reduce and/or Mitigate Vehicle Miles Traveled (VMT):

Implement strategies and projects that reduce the rate of VMT growth to lessen transportation emissions and the associated environmental and air quality impacts. Implementing strategies that reduce VMT growth have broad benefits, such as the opportunity for shorter trips, more transportation connections, reduced transportation costs, and using modes other than automobile travel.

Performance Measure:

- Alternative transportation modes to automobile travel
- Congestion reduction

Associated Service Package

PT01: Transit Vehicle Tracking
TM03: Traffic Signal Control
TM13: Standard Railroad Grade Crossing

Efficient and Reliability

Goal Statement:

Providing for the efficient, reliable movement of people along with connecting people and where they live to goods, services, and jobs with multiple options and a focus on predictable travel times. This goal also places an emphasis on improving the efficiency in how transportation projects are delivered.

Objective 4.1- Promote Reliable Vehicle Travel:

Implement strategies and projects that increase transportation system reliability by reducing unexpected or non-recurring incidents and bottlenecks to make travel time more predictable.

Performance Measure:

- Safety and Security
- System reliability for freight movement and economic vitality

Associated Service Package

MC01: Maintenance and Construction Vehicle and Equipment Tracking
MC02: Maintenance and Construction Vehicle Maintenance
PT01: Transit Vehicle Tracking
PT05: Transit Security

PT08: Transit Traveler Information
TM01: Infrastructure-Based Traffic Surveillance
TM03: Traffic Signal Control

Forward thinking

Goal Statement:

Incorporating emerging trends and technologies into the transportation system. This includes deploying innovative infrastructure (such as for electric vehicles [EVs] or autonomous travel), using innovative mobility options, and utilizing innovative data sources to make more informed decisions.

Objective 5.1- ITS Maintenance and Planning:

Maintain and enhance ITS already in use locally and their evolution, such as dynamic signal phasing, driver information systems, and vehicle detection systems.

Performance Measure:

- Infrastructure Condition
- Safety and Security
- System reliability for freight movement and economic vitality

Associated Service Package

MC02: Maintenance and Construction Vehicle Maintenance
MC04: Winter Maintenance
MC05: Roadway Maintenance and Construction
PT06: Transit Fleet Management

Objective 5.2- Manage the System Through Technology:

Consider the application of ITS to help mitigate the need for capital-intensive projects and associated impacts.

Performance Measure:

- Congestion reduction
- Infrastructure Condition
- Safety and Security

Associated Service Package

MC01: Maintenance and Construction Vehicle and Equipment Tracking
MC04: Winter Maintenance
MC05: Roadway Maintenance and Construction
MC06: Work Zone Management
PS01: Emergency Call-Taking and Dispatch
PS02: Emergency Response
PS03: Emergency Vehicle Preemption
PS10: Wide-Area Alert
PT01: Transit Vehicle Tracking
PT02: Transit Fixed-Route Operations
PT03: Dynamic Transit Operations
PT04: Transit Fare Collection Management

PT05: Transit Security
PT06: Transit Fleet Management
TM01: Infrastructure-Based Traffic Surveillance
TM03: Traffic Signal Control
TM08: Traffic Incident Management System
TM13: Standard Railroad Grade Crossing
TM17: Speed Warning and Enforcement

Objective 5.5- Leverage Data for Decision-Making:

Apply well-vetted and appropriate datasets available to help support more intelligent local decision-making regarding transportation planning, design, and investments.

Performance Measure:

- Reduced project delivery time
- Congestion reduction
- Infrastructure Condition
- System reliability for freight movement and economic vitality

Associated Service Package

DM01: ITS Data Warehouse
DM02: Performance Monitoring

Active Transportation and Equity
Goal Statement:

Providing enhanced infrastructure and connections for pedestrians, bicyclists, and other modes of active transportation; transit is integral to transportation in the MPO area and complements both active transportation and passenger auto transportation.

Objective 6.1- Transit Coordination:

Coordinate planning and project development with transit agencies to improve transit route efficiency, safety, system productivity, and community awareness by implementing transportation investments that support the transit system.

Performance Measure:

- Alternative transportation modes to automobile travel

Associated Service Package

PT08: Transit Traveler Information

Objective 6.3- Transit Security:

Provide a safe, secure environment for transit system riders.

Performance Measure:

- Safety and Security

Associated Service Package

PT05: Transit Security

Objective 6.8- Implement Complete Streets:

Implement transportation projects that accommodate active transportation and transit where feasible. Overall, streets in the MPO area will become more accommodating for active transportation and transit.

Performance Measure:

- Congestion reduction

Associated Service Package

TM 03: Traffic Signal Control

Equity

Goal Statement:

Improving transportation infrastructure so that people from all walks of life have access to affordable, reliable transportation options, including consideration of how transportation benefits and impacts all members of the community.

Objective 7.1- Connect Disadvantaged Neighborhoods:

Plan projects and programs that safely connect disadvantaged populations to the surrounding transportation system, with a focus on all modes of transportation. Also, provide projects in or adjacent to disadvantaged populations that respond to each community's desired multimodal mobility and accessibility, and safely connect disadvantaged populations to needed services.

Performance Measure:

- Alternative transportation modes to automobile travel
- Congestion reduction

Associated Service Package

PT02: Transit Fixed-Route Operations
PT03: Dynamic Transit Operations

Performance Measures

Performance measurement is a crosscutting activity throughout all the goals above to set measures designed to serve as a benchmark to evaluate and quantify progress. Performance measures can be supported by these service packages:

DM01: ITS Data Warehouse
DM02: Performance Monitoring

10.3 Regional ITS Architecture Maintenance

The Bismarck-Mandan MPO is responsible for maintaining and updating the Bis-Man Regional ITS Architecture. It is envisioned that the updates will be conducted every five years or as needed upon the deployment of major ITS projects in the area. The updates will account for any changes to existing systems, as well as changes to regional needs and priorities, and changes in the National ITS Architecture.

11.0 PROJECT ARCHITECTURE

A well-maintained regional architecture is essential for pinpointing necessary projects within the area. Complementing this, a project architecture helps to identify the institutional agreements and technical integrations needed for ITS projects. Essentially, this framework is a customized version of the broader ITS architecture, integrating components specific to individual projects while ensuring they align with the overall regional architecture.

Creating a distinct project architecture, rather than simply integrating project items into the regional architecture, facilitates a focused review of project components. This allows stakeholders to evaluate and finalize the project details before they are incorporated into the regional framework. Moreover, having a dedicated project architecture streamlines the identification of essential items, such as requirements and standards, necessary for effective implementation throughout the project's lifecycle.

The following existing project architectures are associated with the ITSRA:

11.1 Signal controller on Bismarck intersections

New signal controller systems along 7th and 9th streets at the intersections of Front Avenue, Main Avenue, Boulevard Avenue, Thayer Avenue, Rosser Avenue, and Avenue C. The systems would include video detection and an interconnect fiber optic cable. The City of Bismarck (Bismarck Engineers) plans to connect this fiber to the City Engineering building during this project. The City of Bismarck may extend this system per its master plan for fiber optic interconnect throughout the city.

11.2 Signal controller on Mandan intersections

An interconnected fiber-optic cable will run along the roadway network of Memorial Highway, from 40th Ave SE to 46th Ave SE. The City of Mandan plans to connect this fiber to the traffic signal systems along the corridor during this project and to City Hall in the future to leverage the video detection at the intersections.

12.0 CONCLUSIVE REMARK

An ITS architecture from an enterprise perspective provides an opportunity to identify integration opportunities related to policies, funding incentives, working arrangements, and jurisdictional structures. The functional viewpoint enables analysis of abstract functional elements and their logical interactions, facilitating the identification of opportunities for new services. The communication perspective establishes a framework for determining the protocols needed to enable information flow among existing components.

During the development of this architecture, a key area requiring further attention was identified: inter-agency data exchange. The challenge concerns new network security protocols mandated by the State IT Department to enhance cybersecurity across agencies. The implementation of these protocols has introduced substantial procedural overhead for cross-agency data flows.

In practice, this situation results in the current technology being capable of holding data but restricting information flow. Information sharing between agencies now necessitates multiple layers of approval, firewall exceptions, and compliance checks. While these measures are essential for security, they have led to increased latency and friction in coordination workflows.

The ITS update does not recommend rolling back these protocols. Instead, there is an opportunity to collaborate with the State IT Department to explore technical solutions—such as secure APIs or federated access models—that can maintain security while facilitating smoother interoperability.

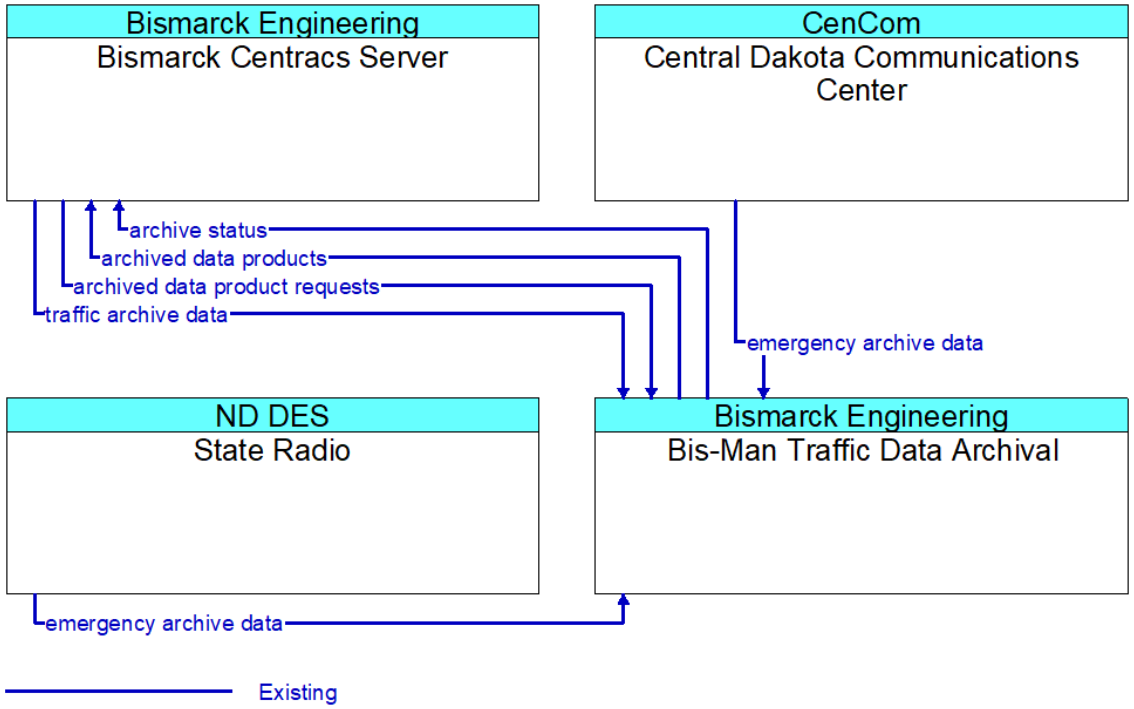
Although this issue falls outside the scope of the architecture update, it was identified during the project. A proposal is made to establish a technical working group comprising representatives from the relevant agencies and the State IT team. This group can identify specific bottlenecks, suggest architectural adjustments, and develop a roadmap for secure, scalable data exchange.

APPENDIX-A

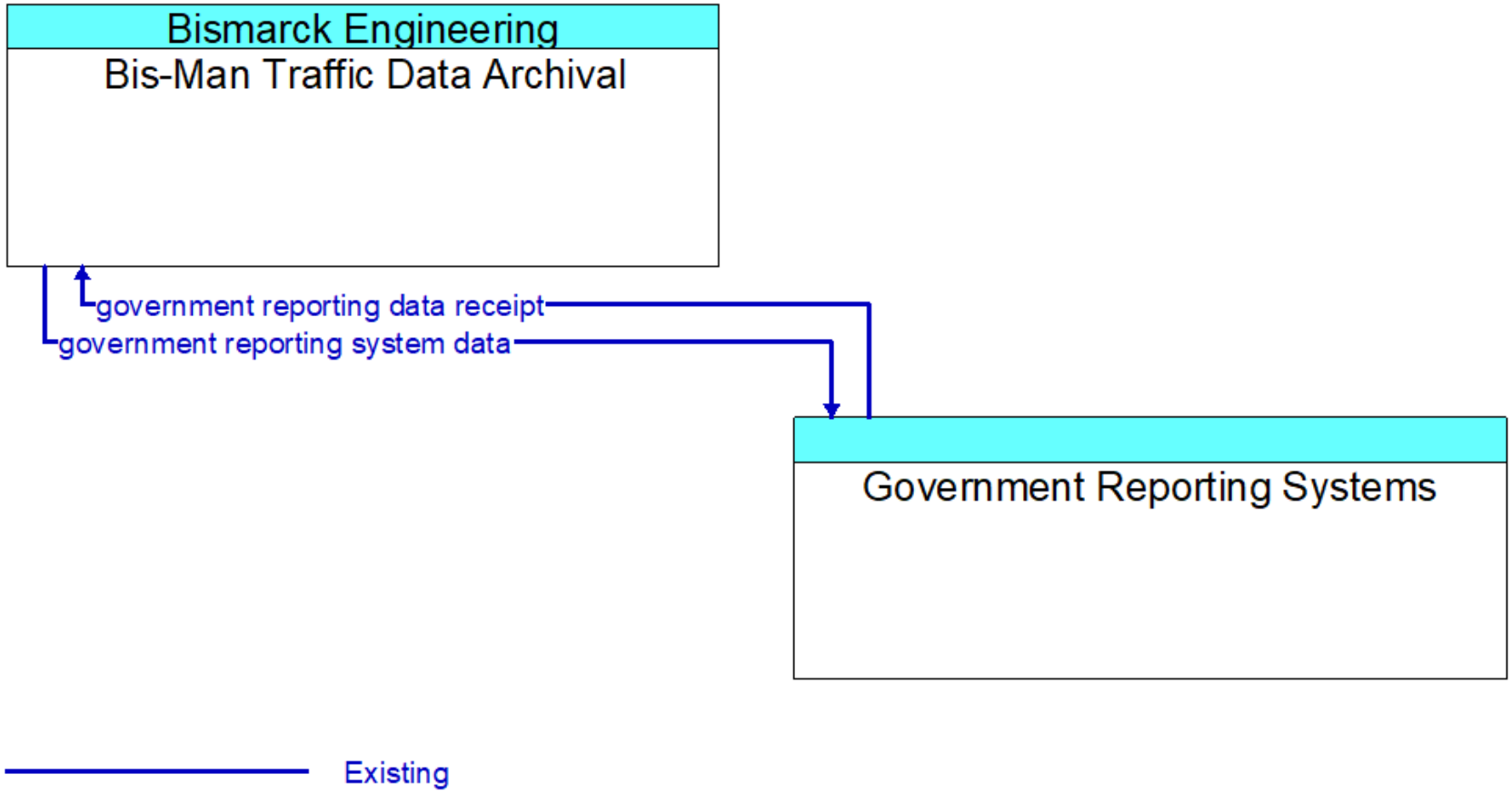
BISMARCK-MANDAN SERVICE PACKAGES AND INFORMATION FLOWS

The Service Package Diagrams are available electronically at: https://regional.atacenter.org/bisman/
Viewing electronically will allow for zooming and panning, which is required for the diagram's readability.

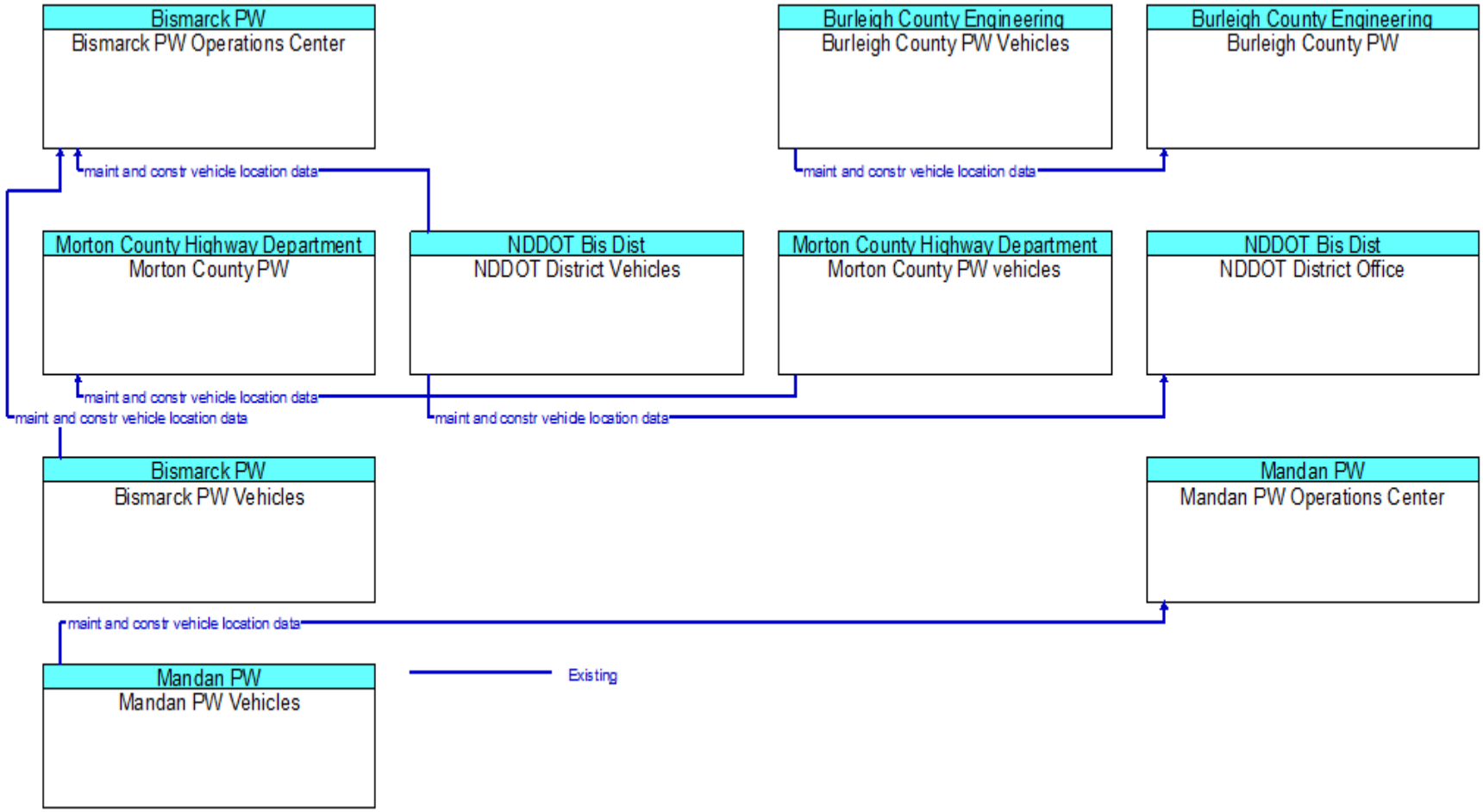
DM01 ITS Data Warehouse



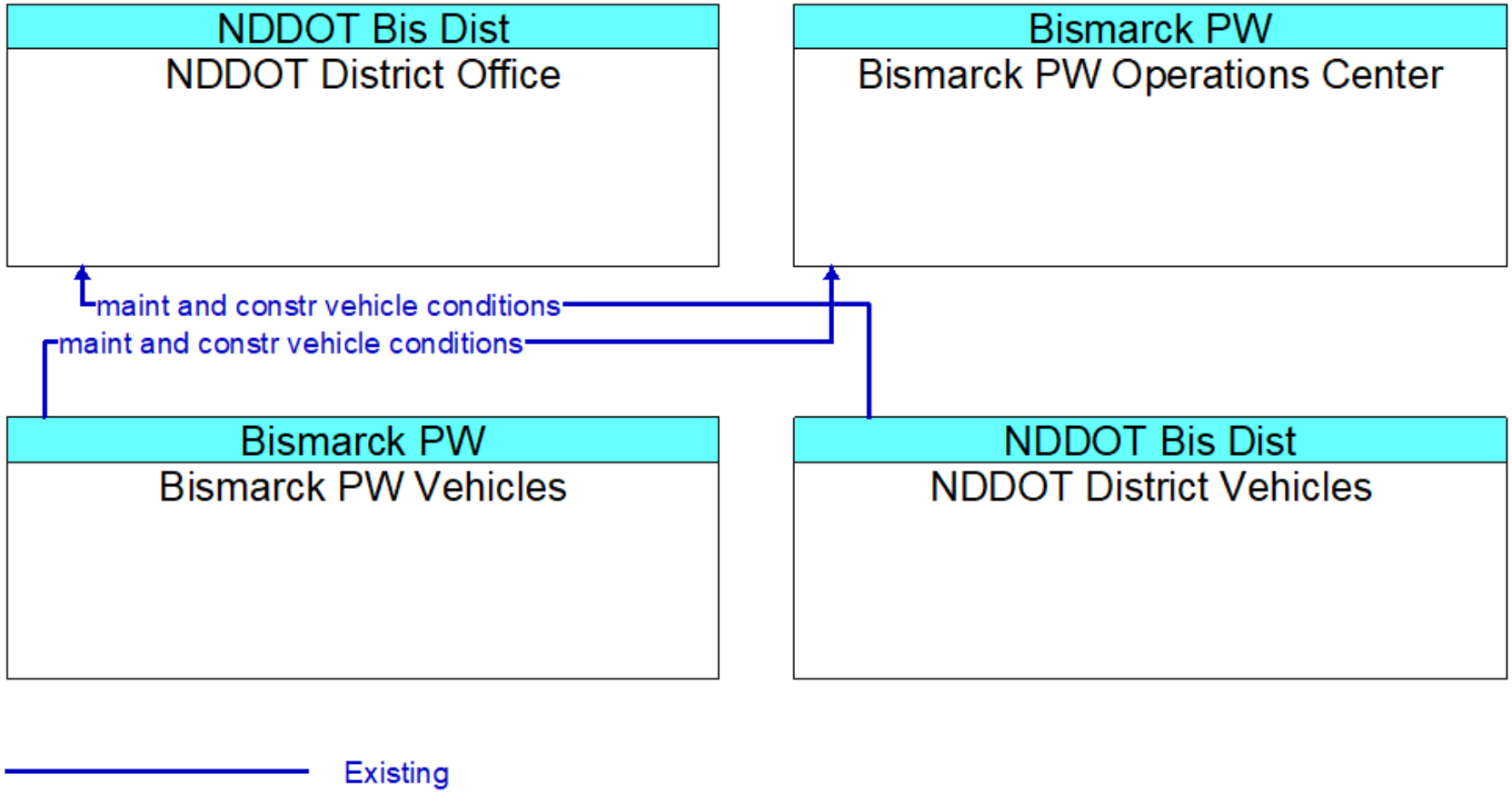
DM02 Performance Monitoring



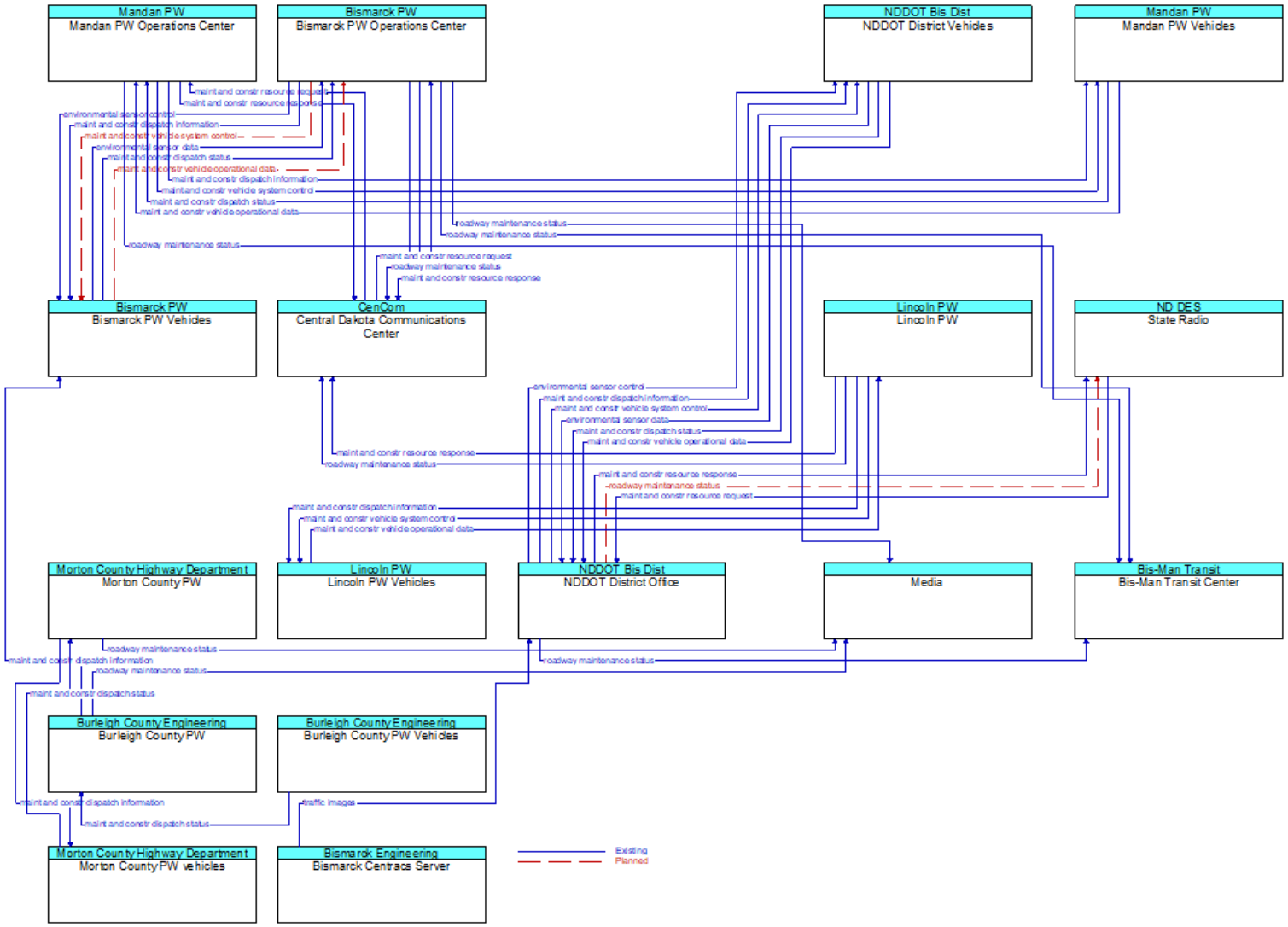
MC01 Maintenance and Construction Vehicle and Equipment Tracking



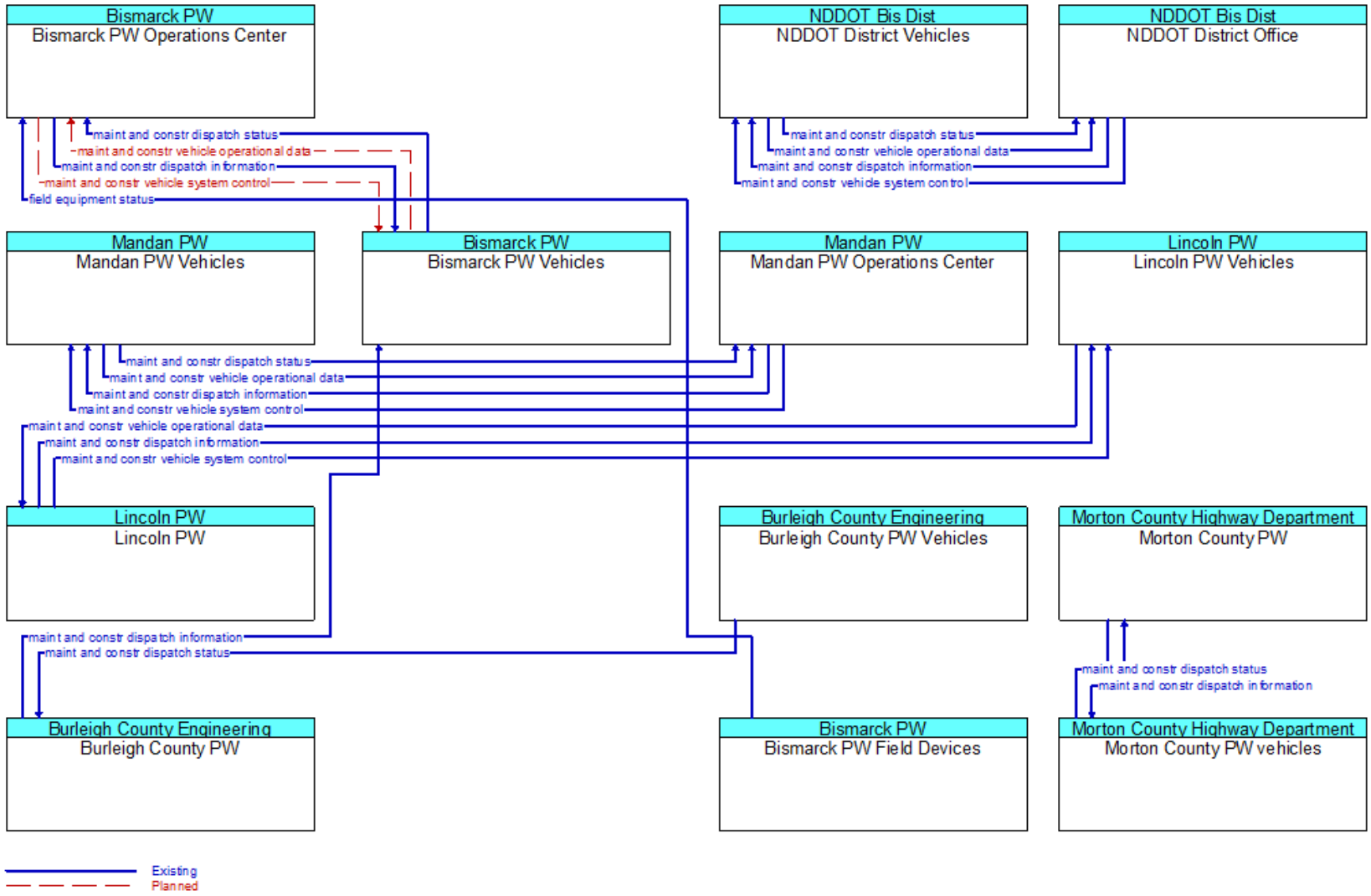
MC02 Maintenance and Construction Vehicle Maintenance



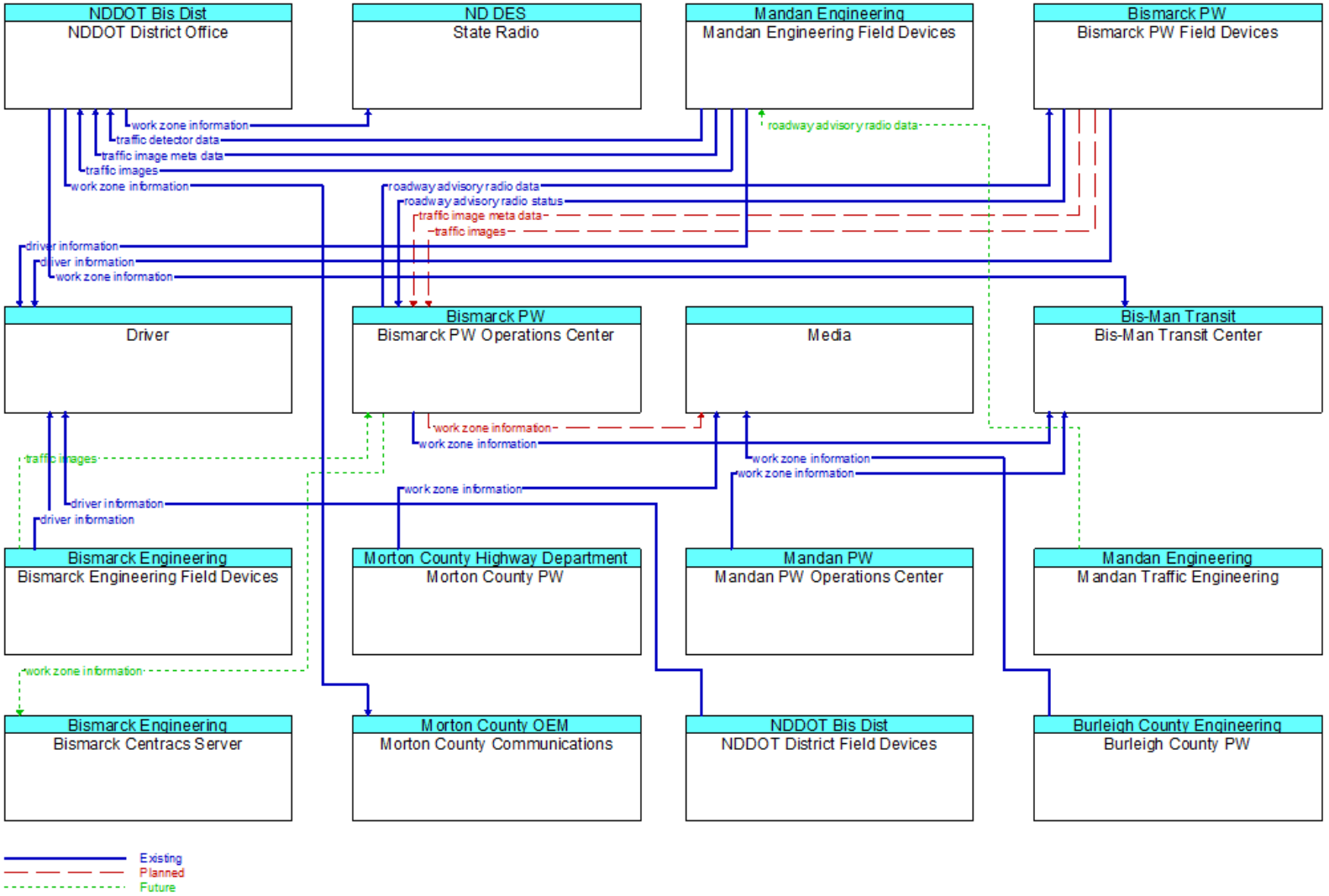
MC04 Winter Maintenance



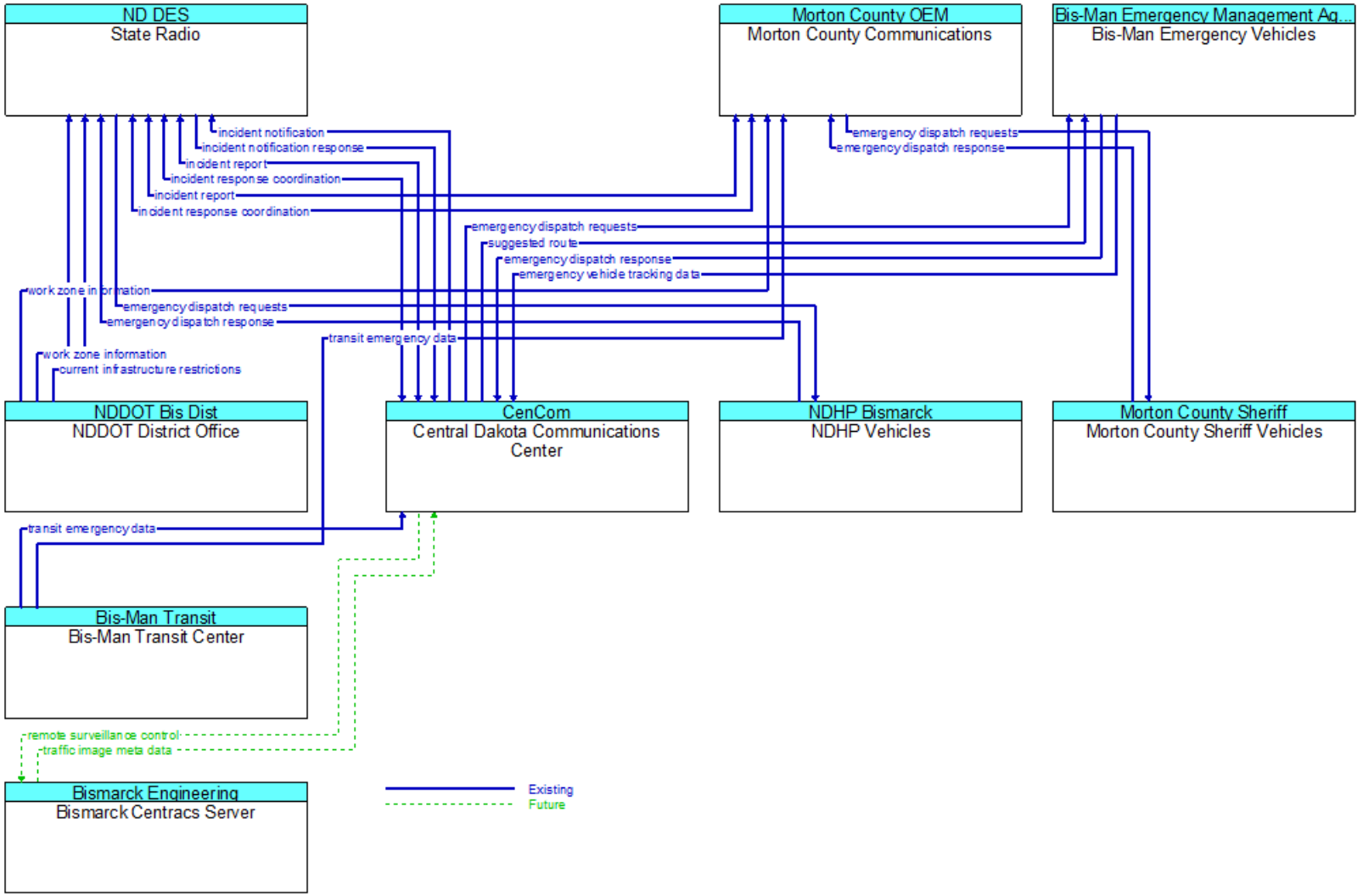
MC05 Roadway Maintenance and Construction



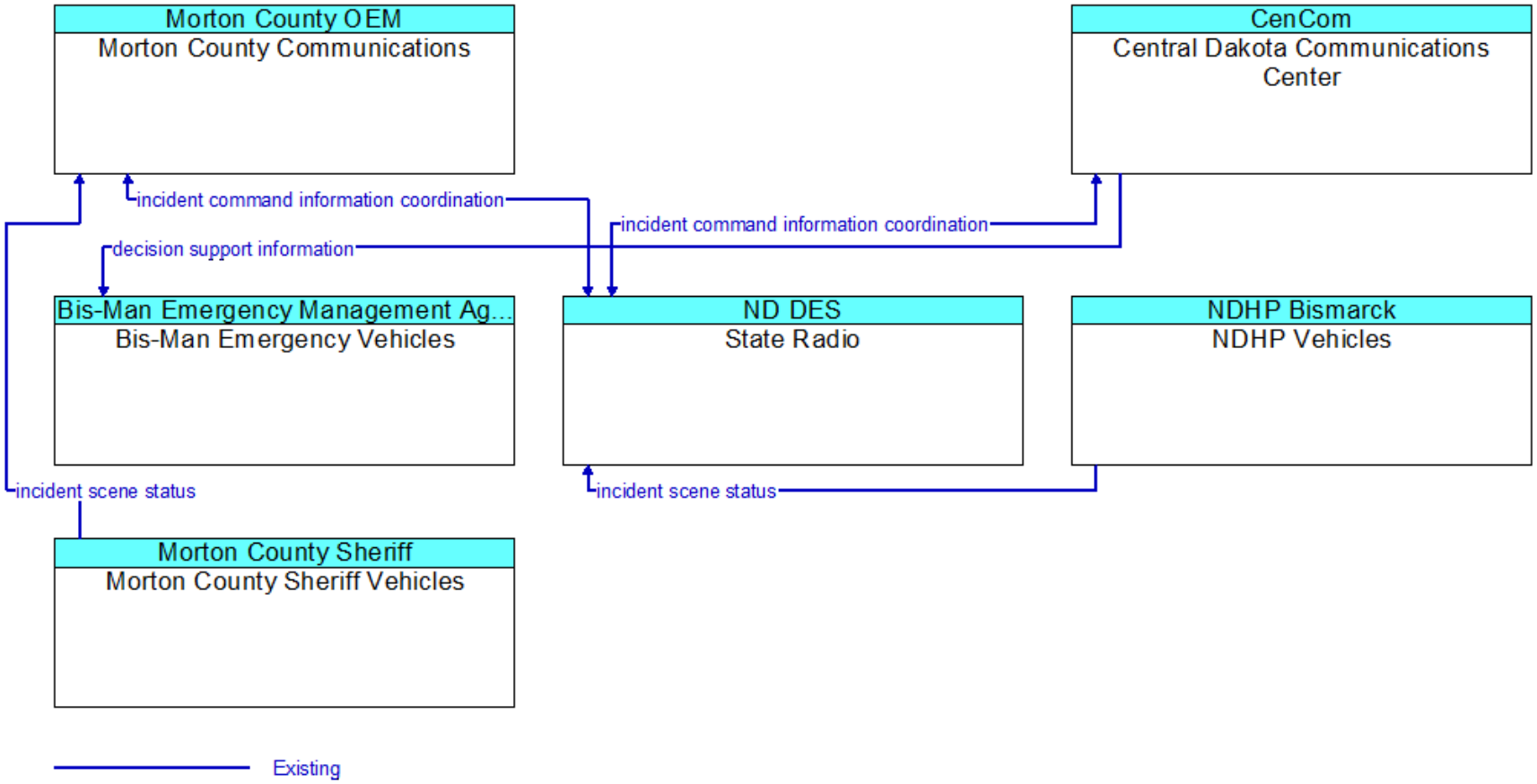
MC06 Work Zone Management



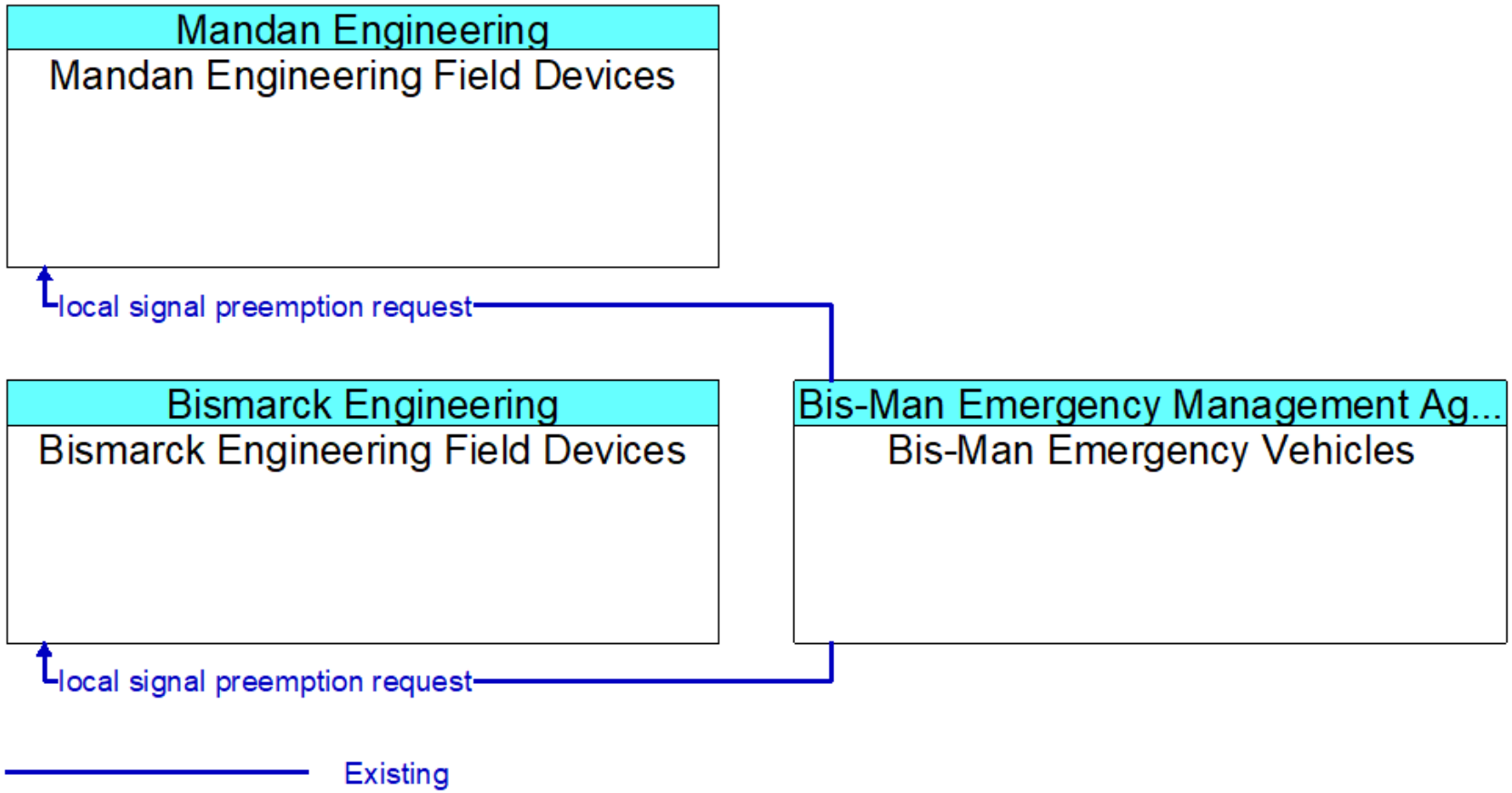
PS01 Emergency Call-Taking and Dispatch



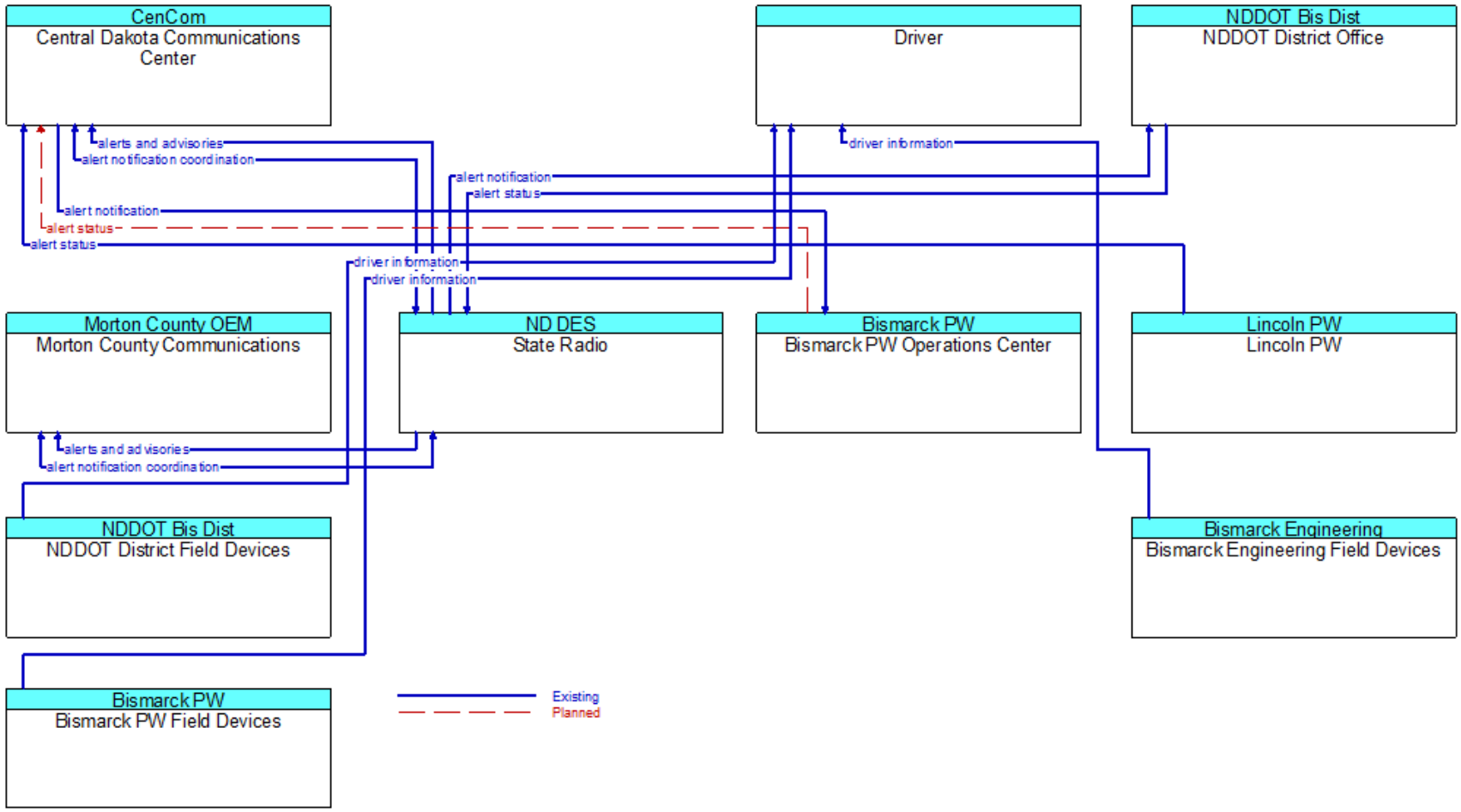
PS02 Emergency Response



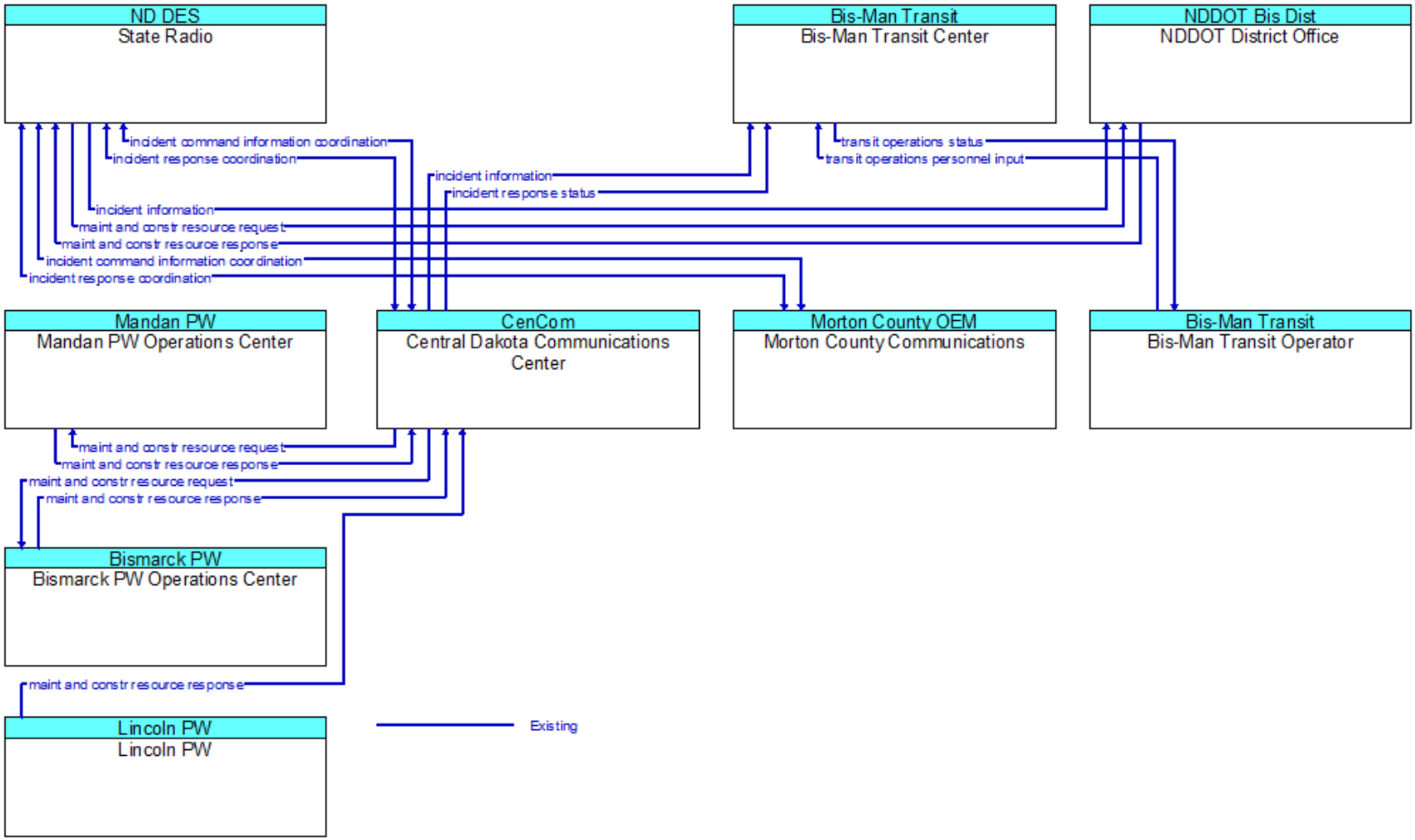
PS03 Emergency Vehicle Preemption



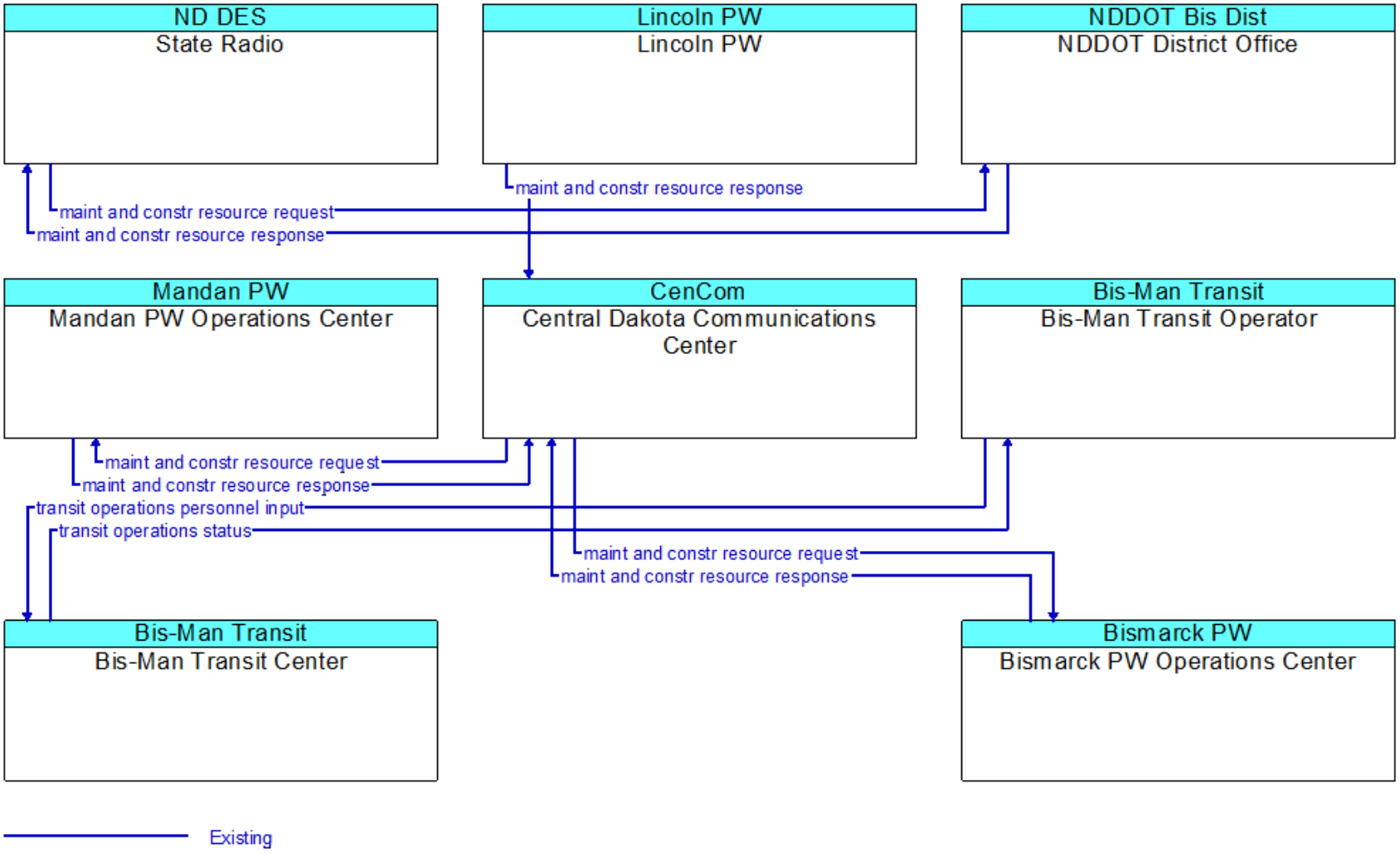
PS10 Wide-Area Alert



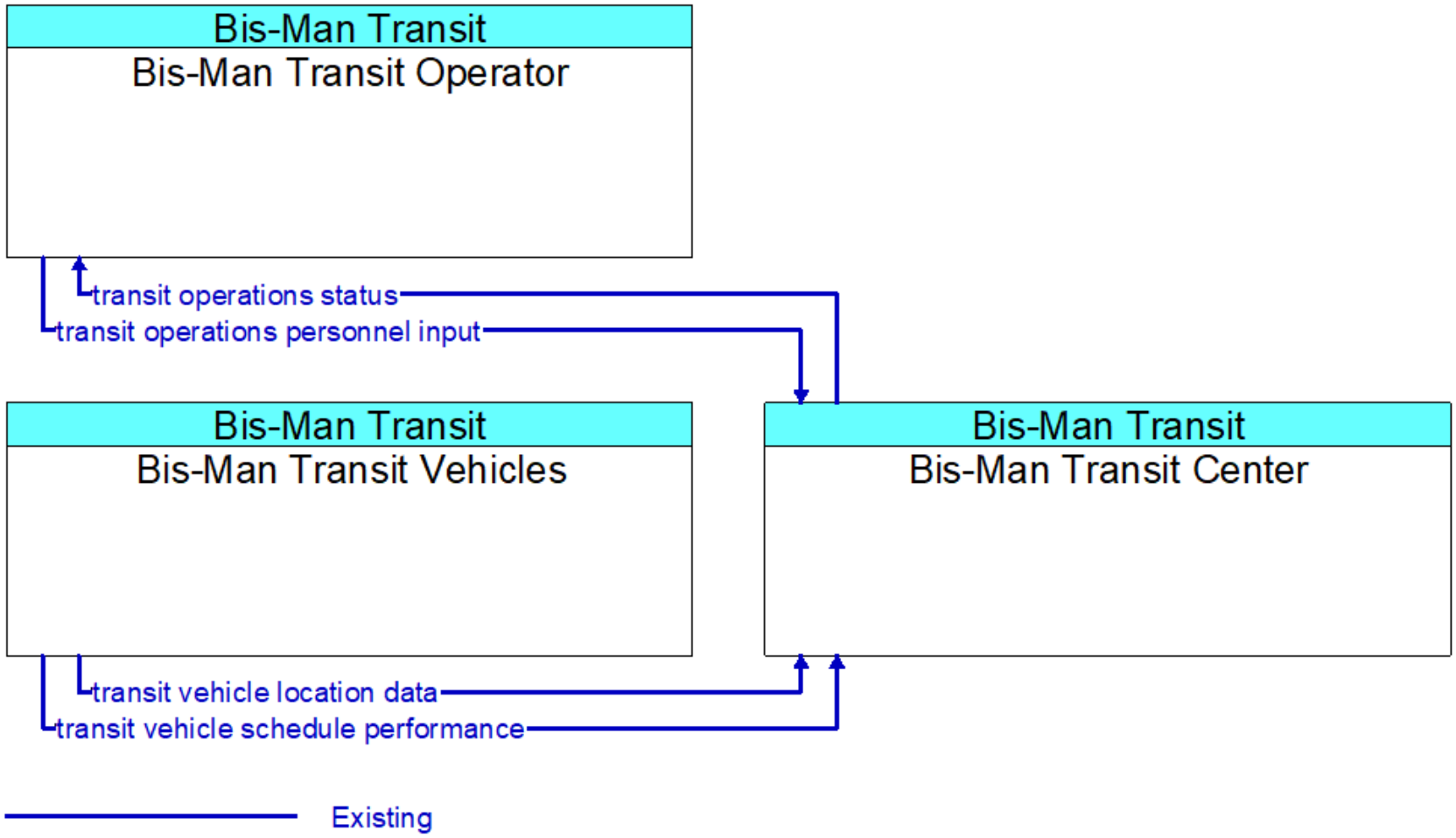
PS12 Disaster Response and Recovery



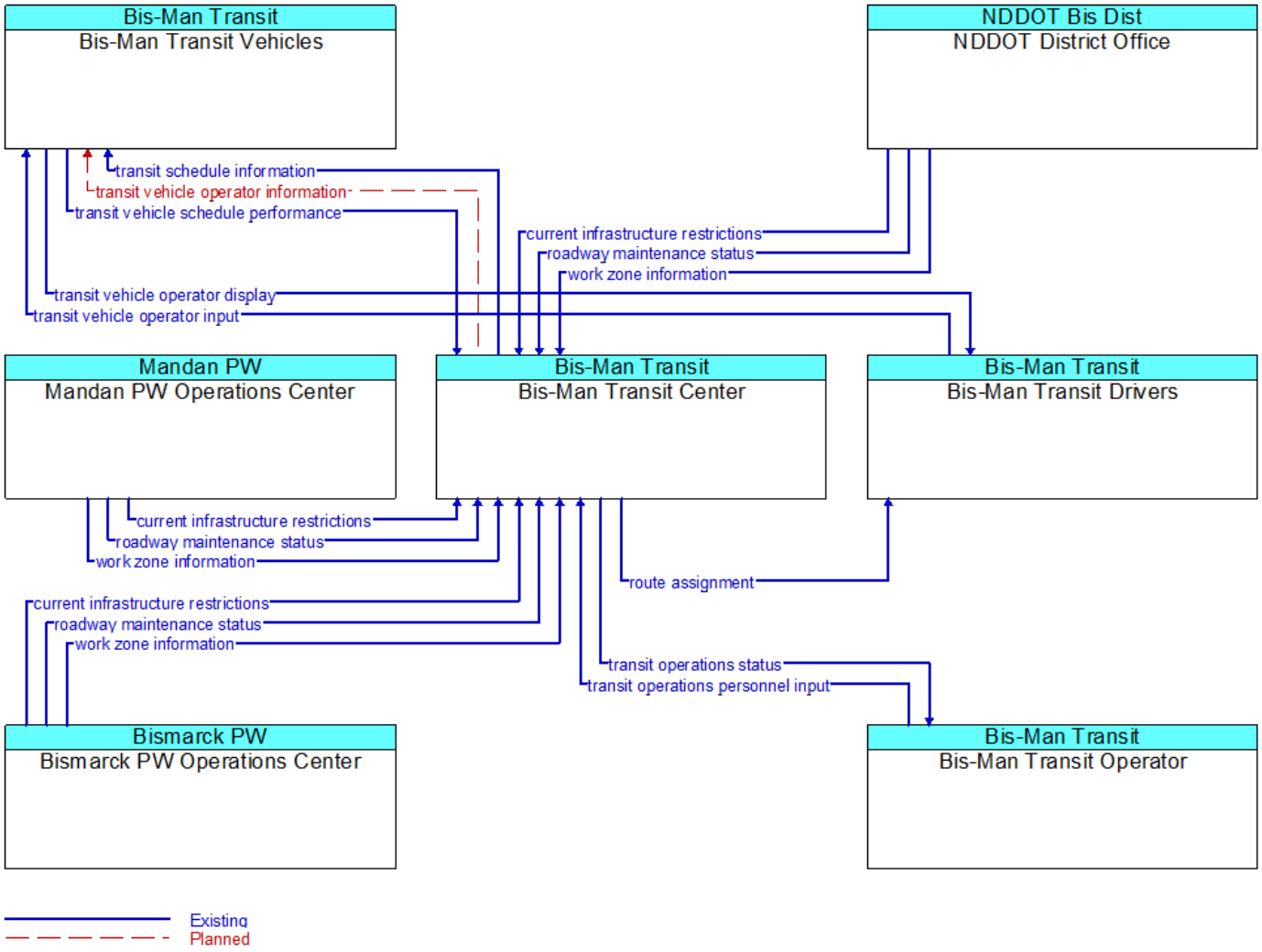
PS13 Evacuation and Reentry Management



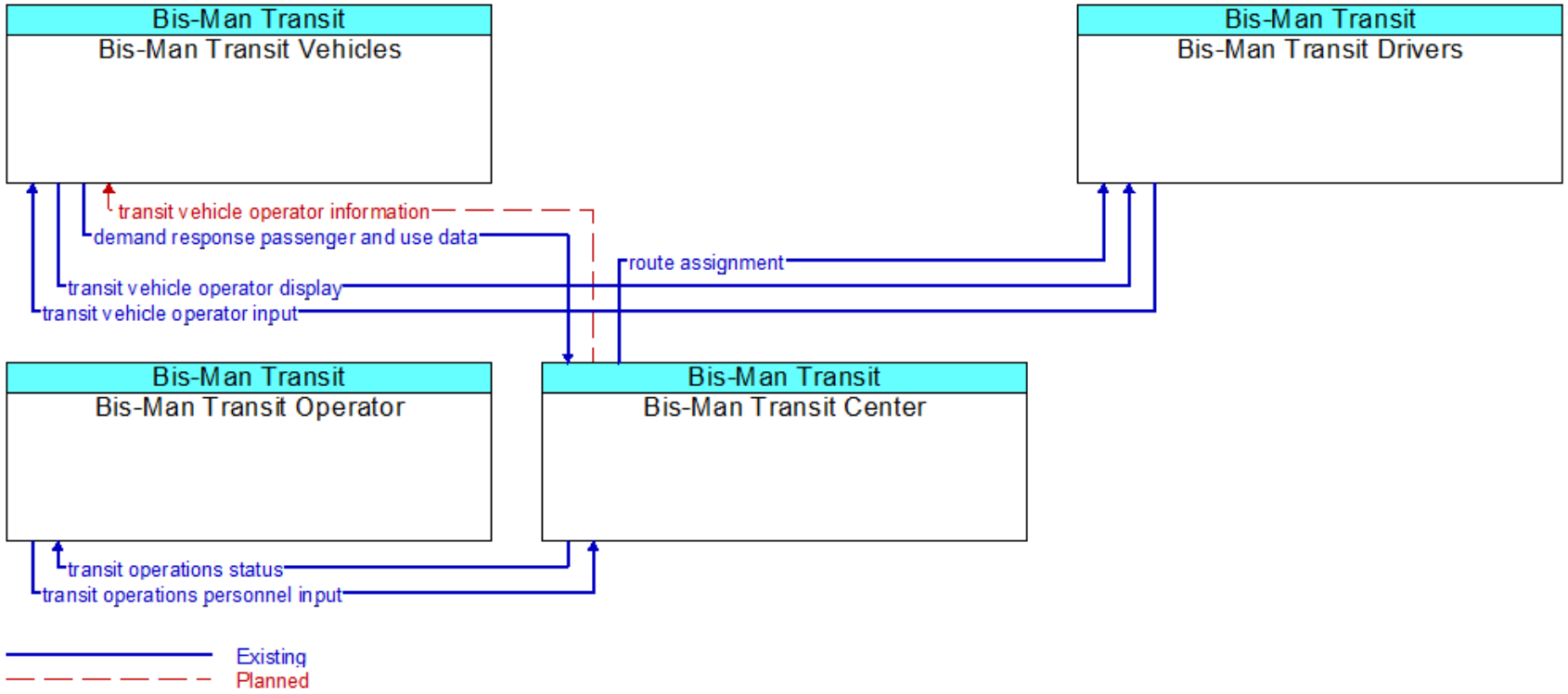
PT01 Transit Vehicle Tracking



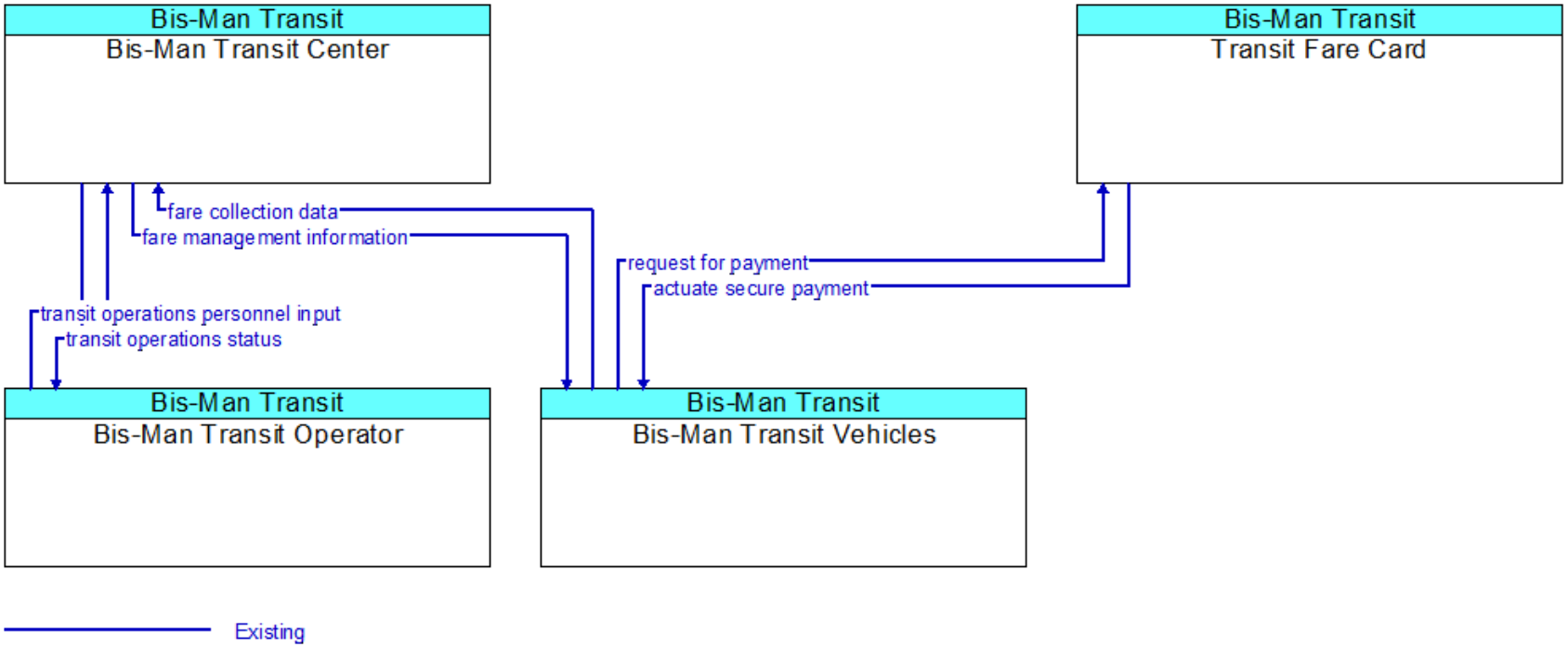
PT02 Transit Fixed-Route Operations



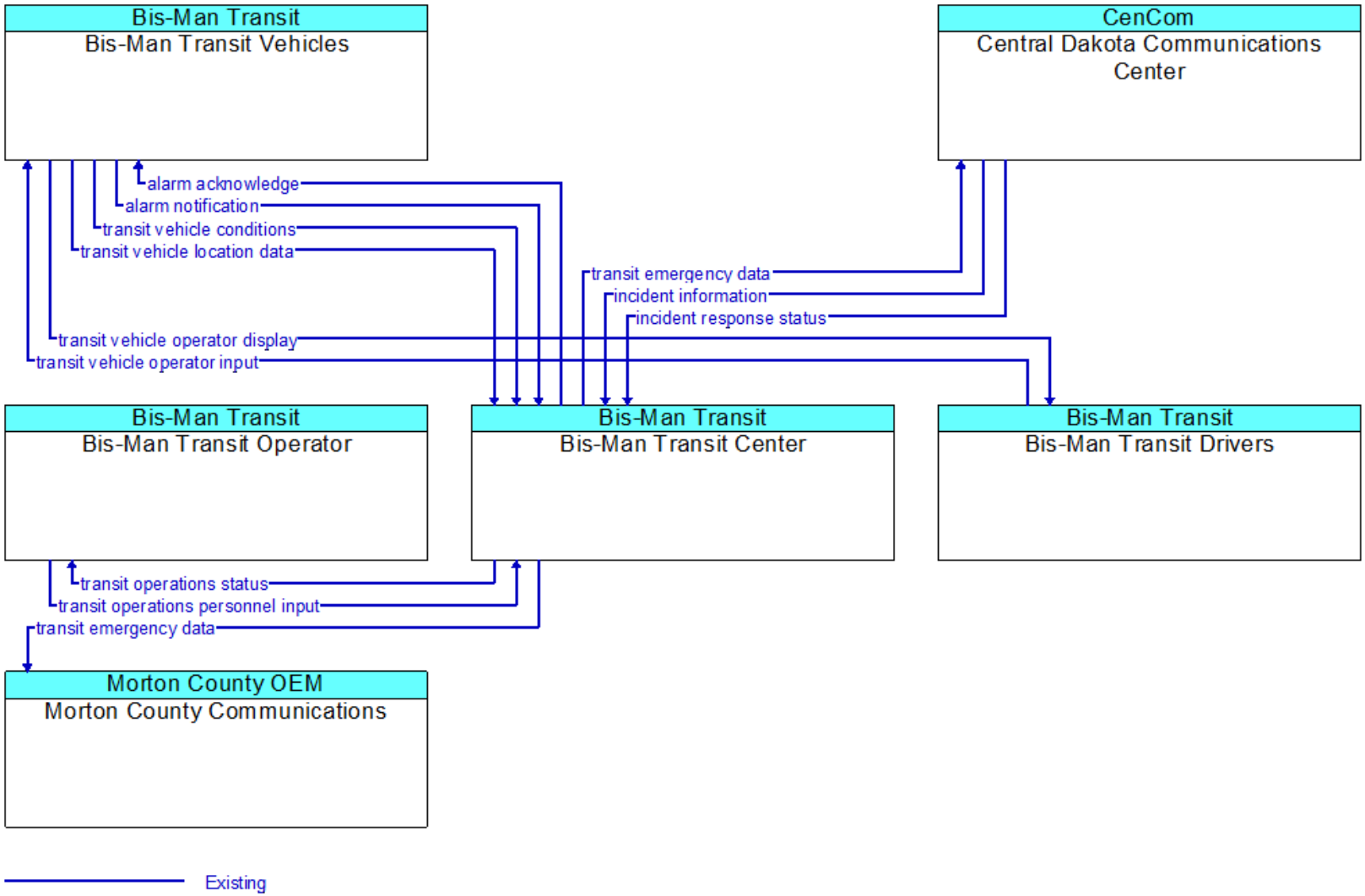
PT03 Dynamic Transit Operations



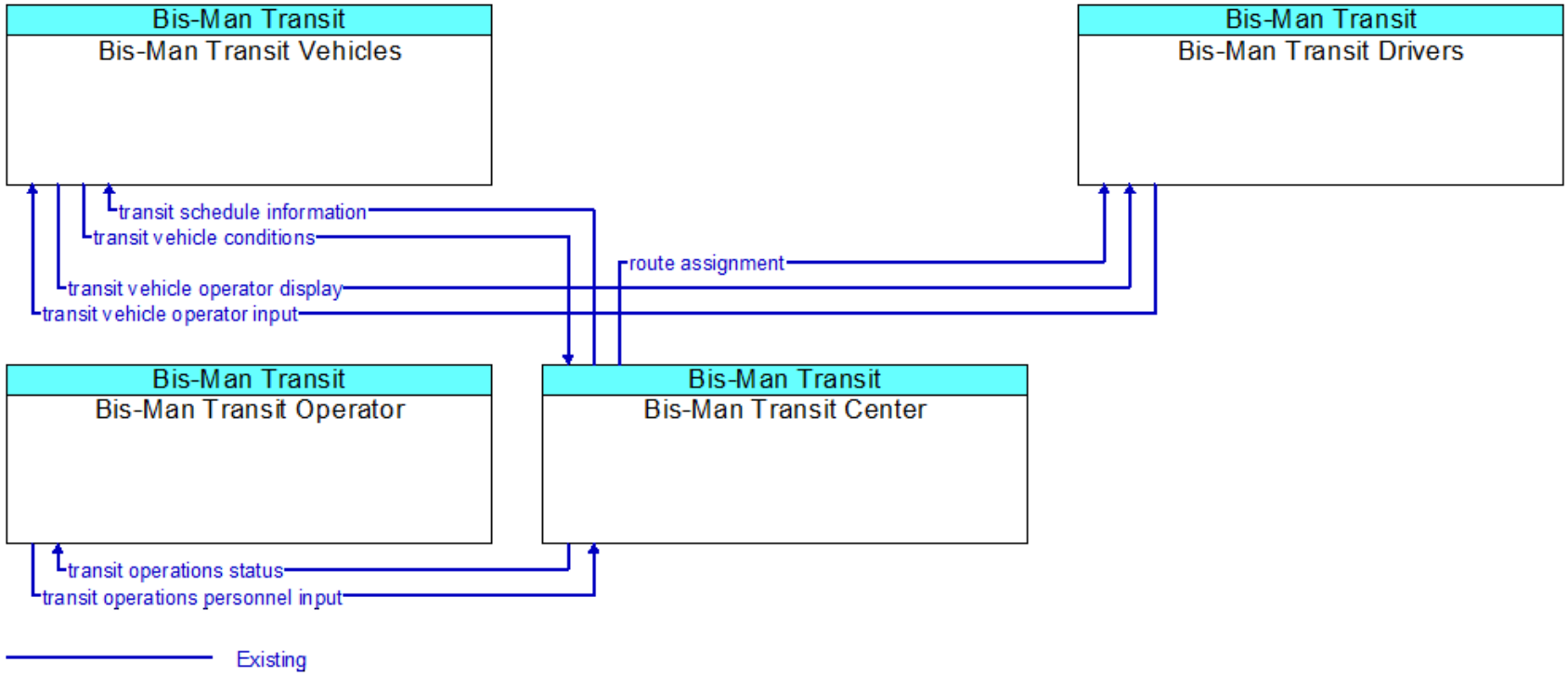
PT04 Transit Fare Collection Management



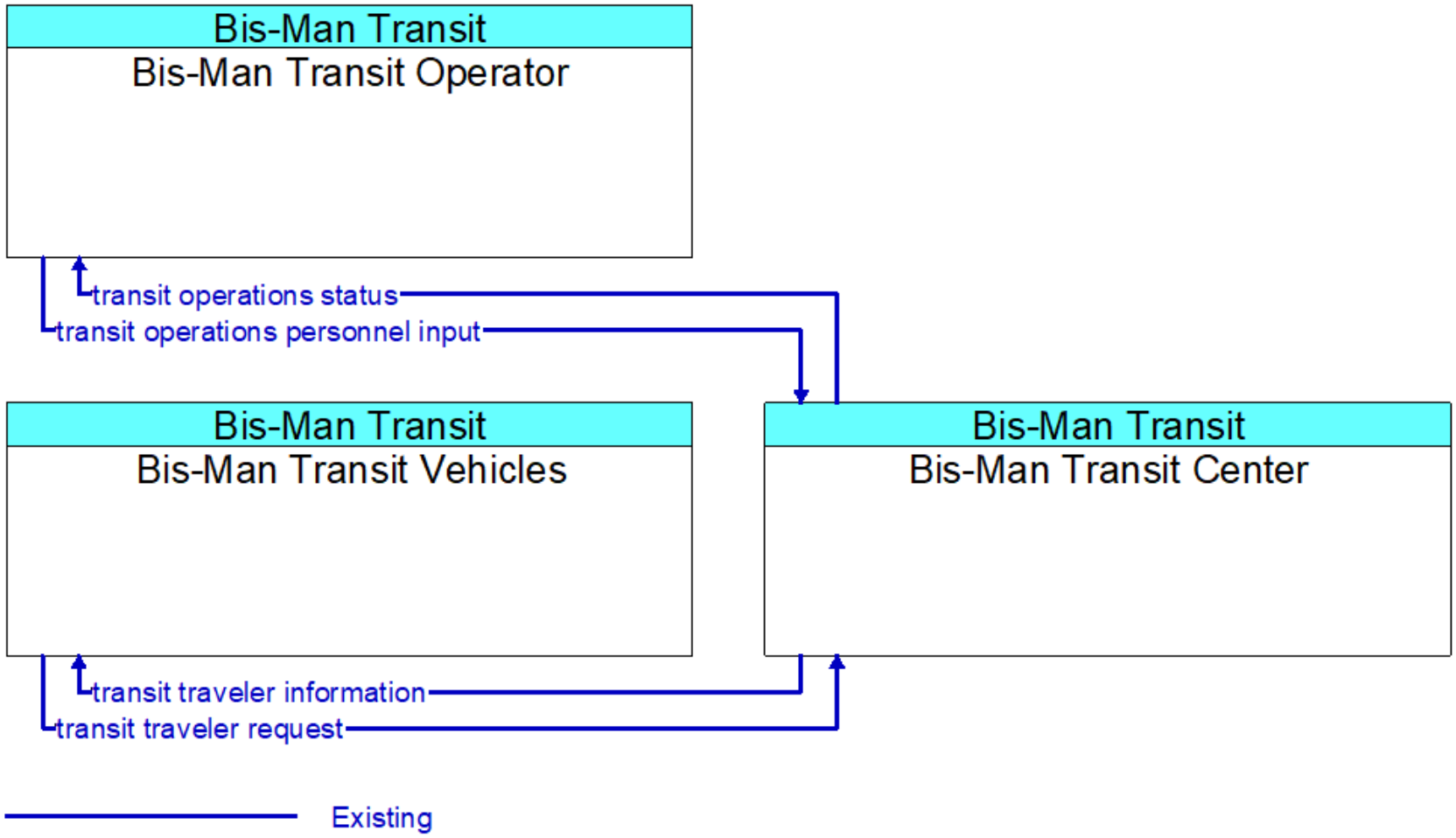
PT05 Transit Security



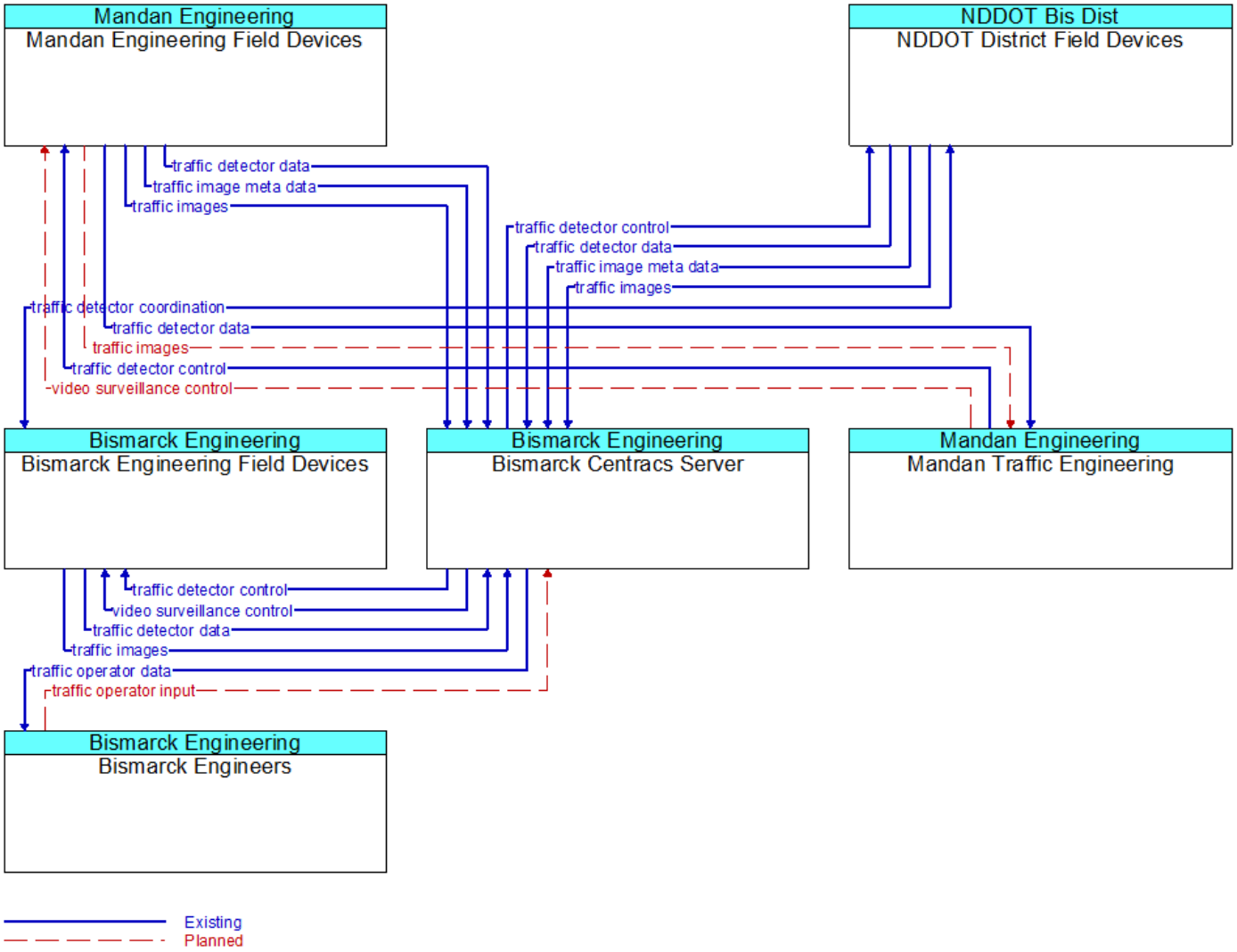
PT06 Transit Fleet Management



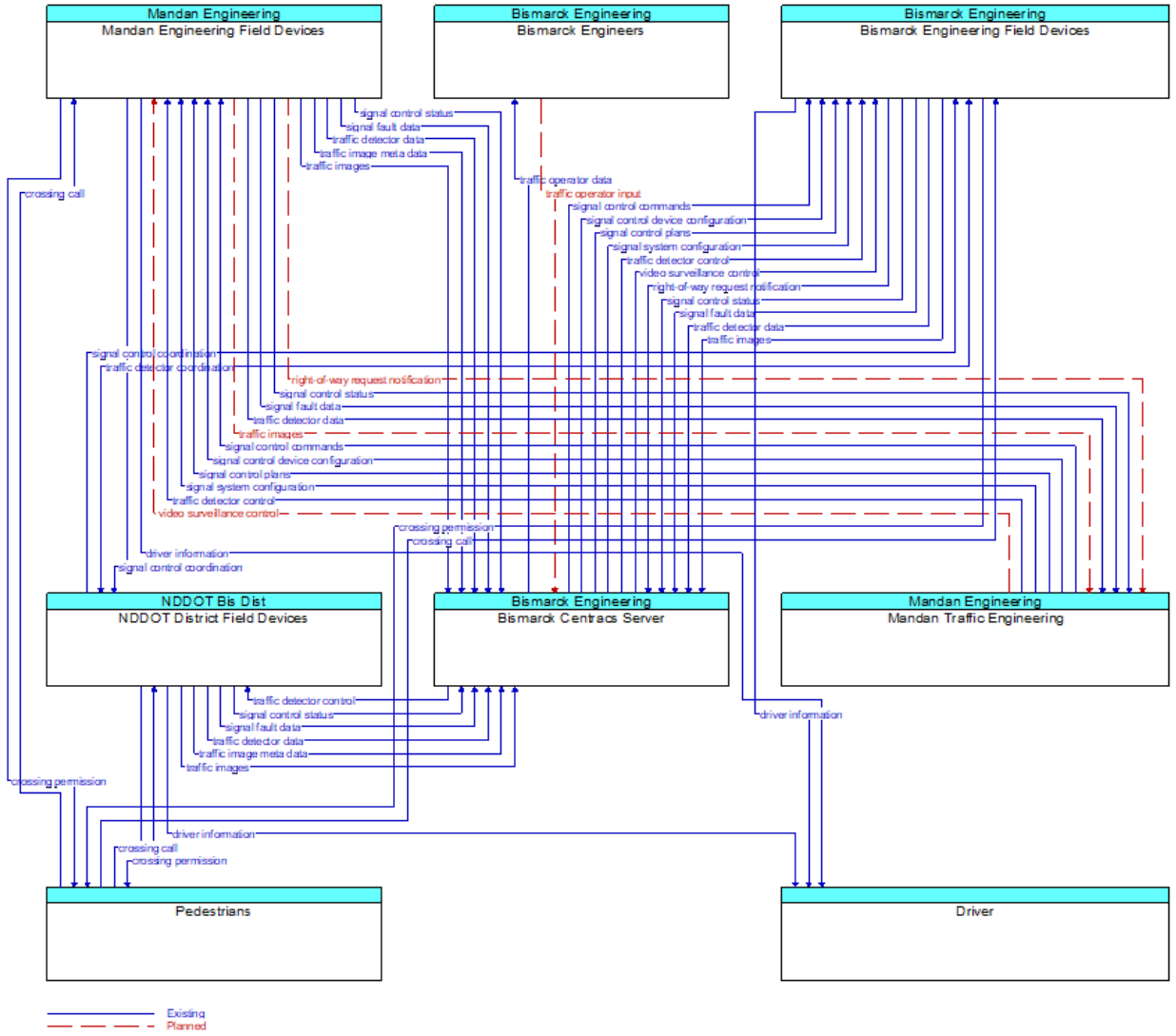
PT08 Transit Traveler Information



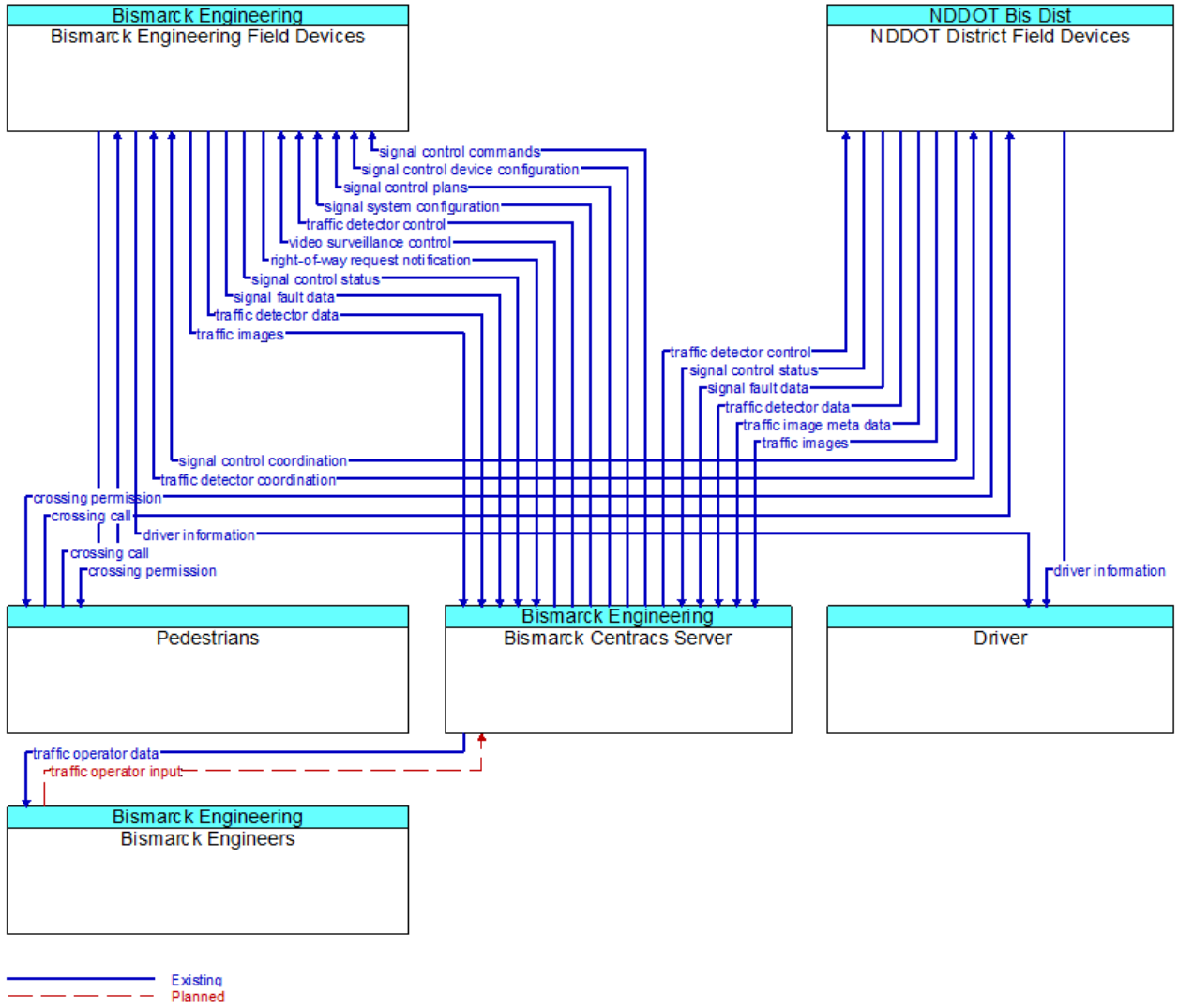
TM01 Infrastructure-Based Traffic Surveillance



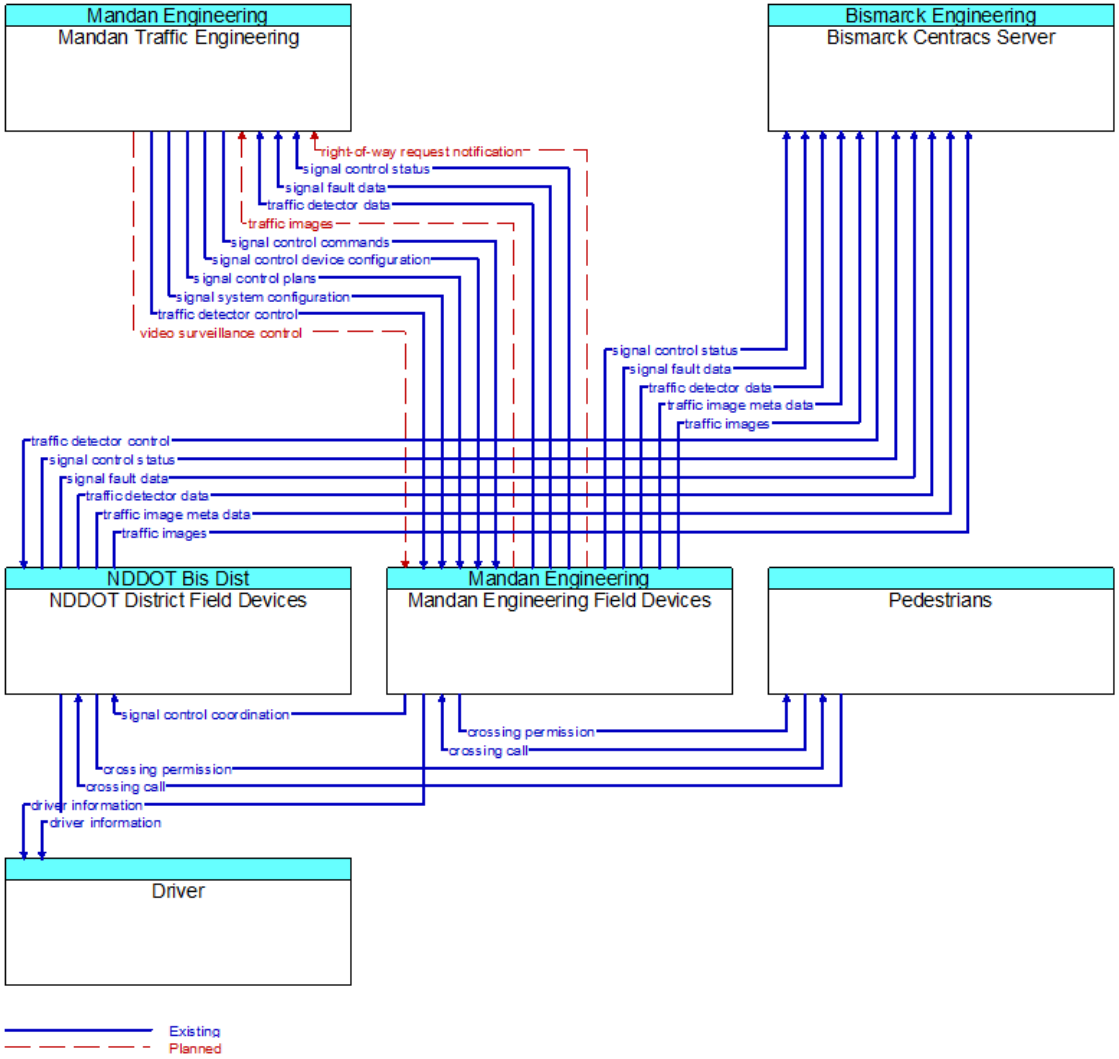
TM03 Traffic Signal Control



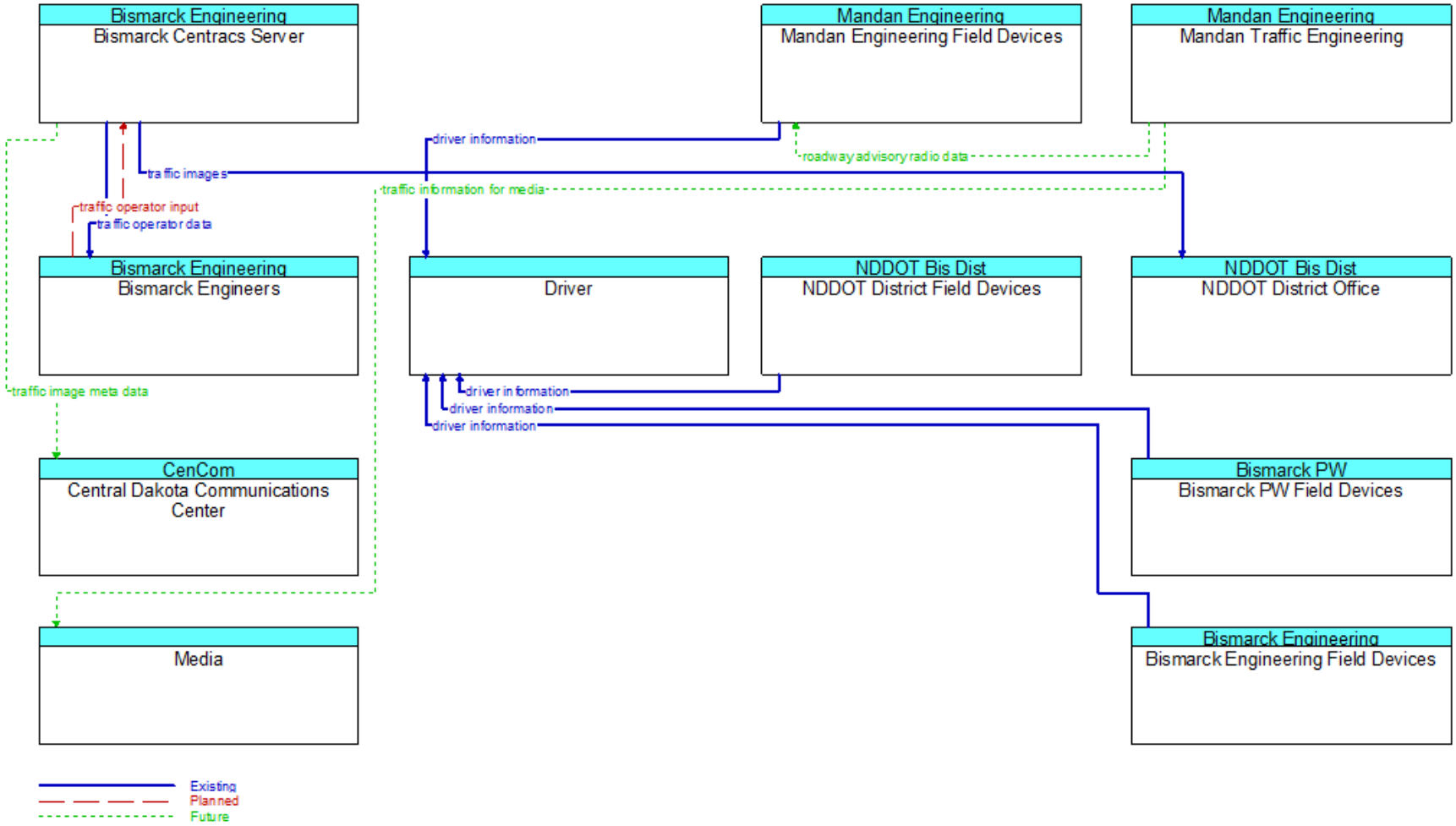
TM03 City of Bismarck Traffic Signal Control



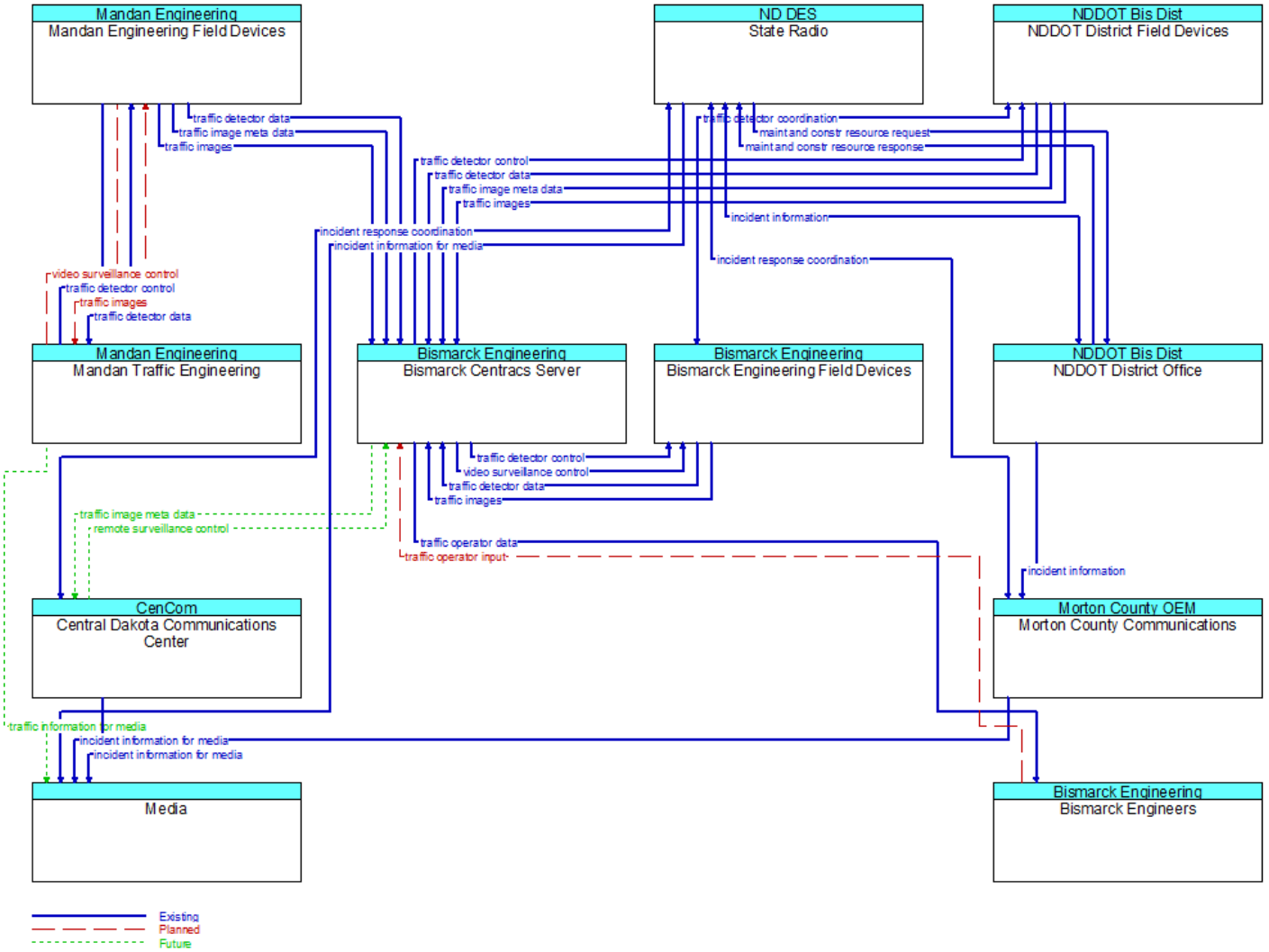
TM03 City of Mandan Traffic Signal Control



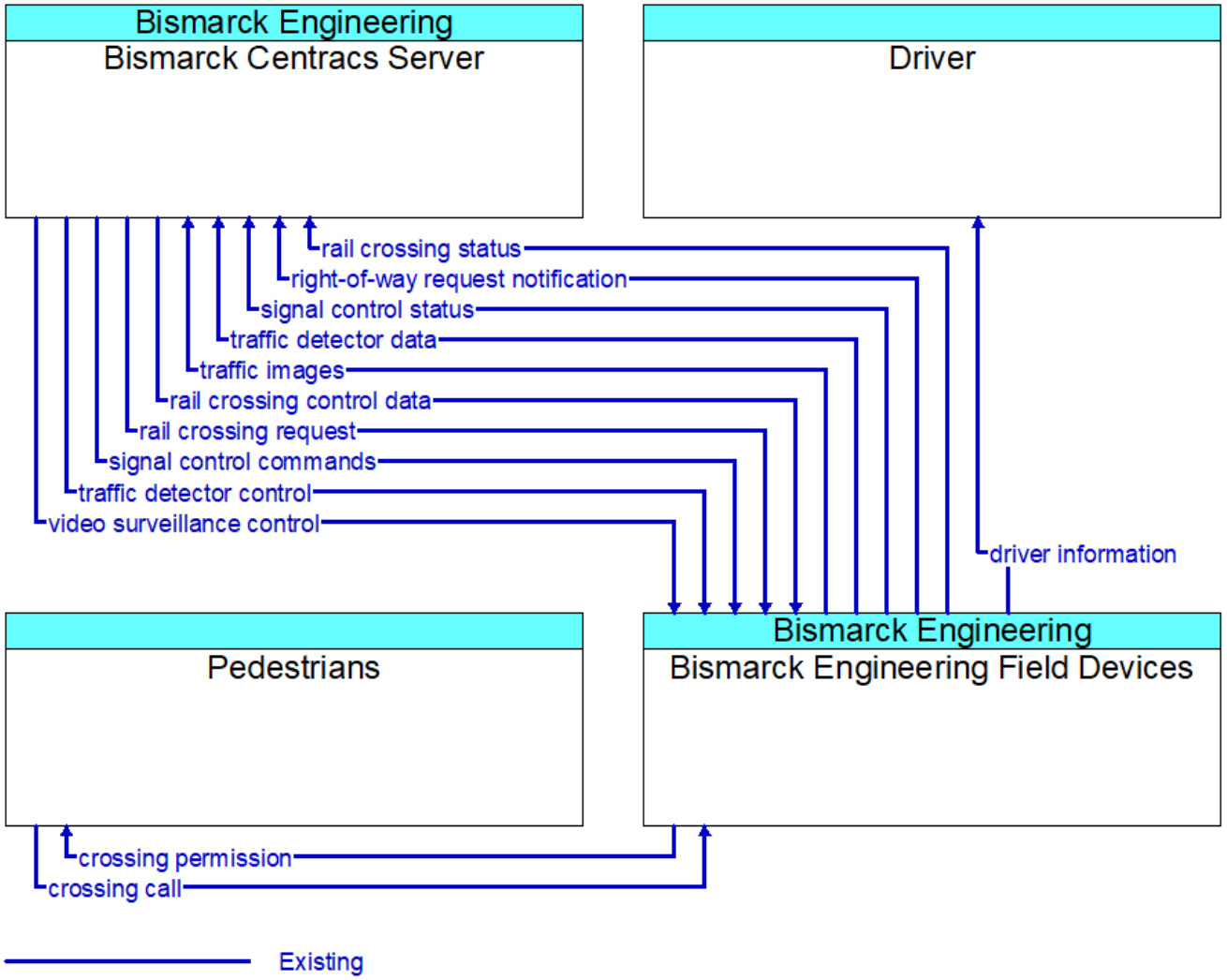
TM06 Traffic Information Dissemination



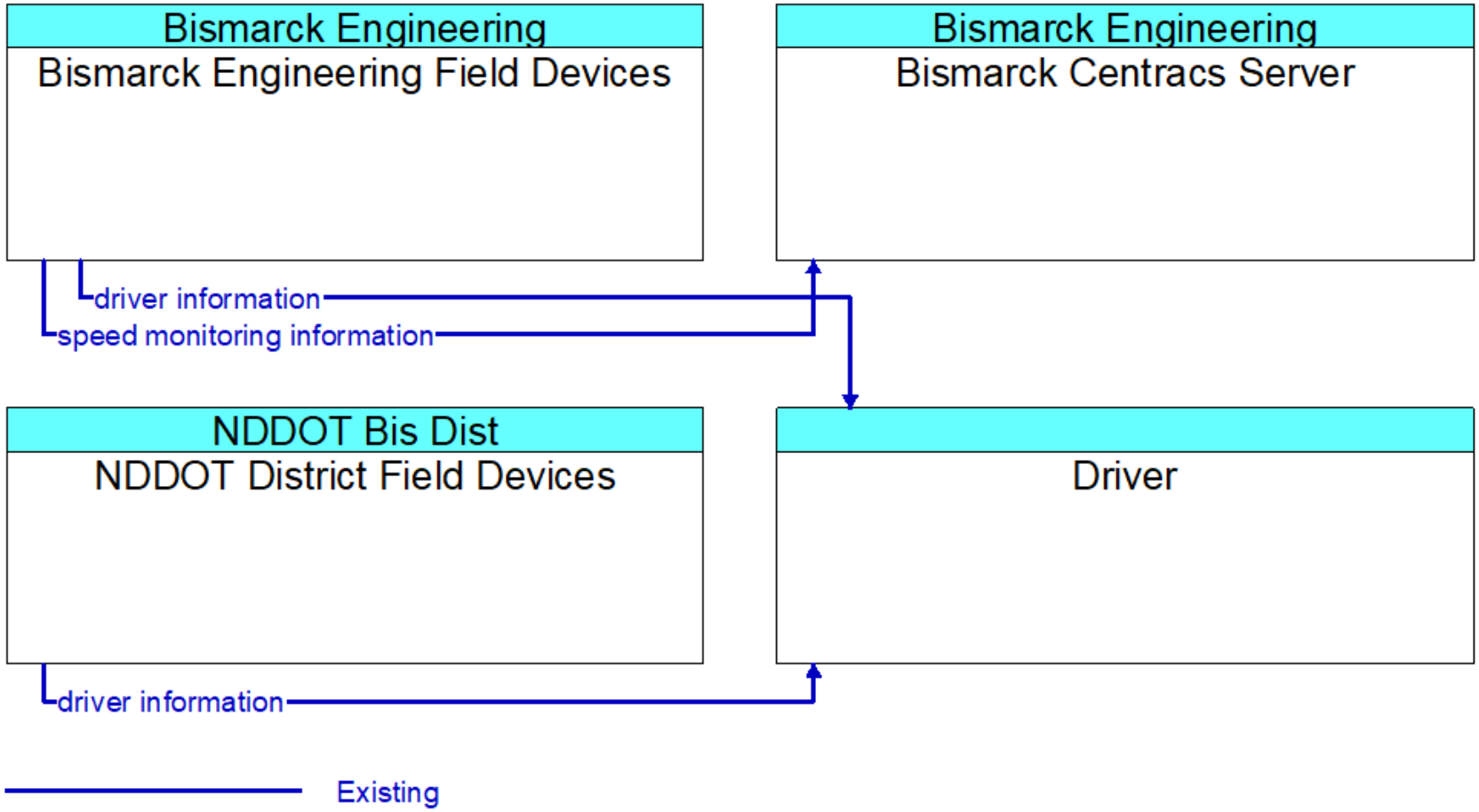
TM08 Traffic Incident Management System



TM13 Standard Railroad Grade Crossing



TM17-Speed Warning and Enforcement



APPENDIX-B

FUNCTIONAL REQUIREMENTS

Table 9: List of Functional Requirements

Element Name	Functional Object	Requirement	Status
Bis-Man Emergency Vehicles	EV On-Board En Route Support	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing
	EV On-Board En Route Support	The emergency vehicle shall send patient status information to the care facility along with a request for further information.	Existing
	EV On-Board En Route Support	The emergency vehicle shall provide the personnel on-board with dispatch information, including incident type and location, and forward an acknowledgment from personnel to the center that the vehicle is on its way to the incident scene.	Existing
	EV On-Board En Route Support	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing
	EV On-Board En Route Support	The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Not Applicable
	EV On-Board En Route Support	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing
	EV On-Board En Route Support	The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Existing
	EV On-Board Incident Management Communication	The emergency vehicle shall receive dispatch instructions sufficient to enable emergency personnel in the field to implement an effective incident response. It includes local traffic, road, and weather conditions, hazardous material information, and the current status of resources that have been allocated to an incident.	Existing

Element Name	Functional Object	Requirement	Status
	EV On-Board Incident Management Communication	The emergency vehicle shall provide an interface to the center for emergency personnel to transmit information about the incident site such as the extent of injuries, identification of vehicles and people involved, hazardous material, etc.	Existing
Bis-Man Traffic Data Archival	Archive Data Repository	The center shall collect data from data distribution systems and other data sources.	Existing
	Archive Data Repository	The center shall collect data from centers.	Existing
	Archive Data Repository	The center shall store collected data in an information repository.	Existing
	Archive Data Repository	The center shall include capabilities for archive to archive coordination.	Existing
	Archive Data Repository	The center shall provide the capability to execute methods on the incoming data such as cleansing, summarizations, aggregations, or transformations applied to the data before it is stored in the archive.	Existing
	Archive Data Repository	The center shall respond to requests for archive data from archive data users (centers, field devices).	Existing
	Archive Government Reporting	The center shall respond to requests for government report data.	Existing
	Archive Government Reporting	The center shall provide archive data to federal, state, and local government reporting systems.	Existing
Bis-Man Transit Center	Transit Center Connection Protection	The center shall send schedule adjustments to a transit vehicle in order to protect a connection made with other transit vehicles.	Existing
	Transit Center Data Collection	The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	Existing
	Transit Center Fare Management	The center shall process requests for transit fares to be paid in advance.	Existing
	Transit Center Fare Management	The center shall support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.	Existing

Element Name	Functional Object	Requirement	Status
	Transit Center Fare Management	The center shall provide the capability for a system operator to manage the transit fares and control the exchange of transit fare information.	Existing
	Transit Center Fixed-Route Operations	The center shall generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	Planned
	Transit Center Fixed-Route Operations	The center shall generate transit routes and schedules based on such factors as parameters input by the system operator, road network conditions, incident information, operational data on current routes and schedules, and digitized map data.	Existing
	Transit Center Fixed-Route Operations	The center shall collect transit operational data for use in the generation of routes and schedules.	Existing
	Transit Center Fixed-Route Operations	The center shall dispatch fixed route or flexible route transit vehicles.	Existing
	Transit Center Operator Assignment	The center shall assign transit vehicle operators to transit schedules based on their eligibility, route preferences, seniority, and transit vehicle availability.	Existing
	Transit Center Operator Assignment	The center shall maintain records of a transit vehicle operator's performance. This may be done utilizing standardized performance evaluation criteria set forth by governmental regulations and transit operating company policies, assessing the transit vehicle operator's driving history, and assessing comments from the transit vehicle operator's supervisor(s) as well as noting any moving violations or accidents, supervisor comments, government regulations, and company policies.	Existing
	Transit Center Paratransit Operations	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

Element Name	Functional Object	Requirement	Status
	Transit Center Paratransit Operations	The center shall monitor the operational status of the demand response vehicles including status of passenger pick-up and drop-off.	Existing
	Transit Center Paratransit Operations	The center shall dispatch demand response (paratransit) transit vehicles.	Existing
	Transit Center Paratransit Operations	The center shall generate demand response transit (including paratransit) routes and schedules based on such factors as parameters input by the system operator, what other demand responsive transit schedules have been planned, the availability and location of vehicles, the relevance of any fixed transit routes and schedules, road network information, and incident information.	Existing
	Transit Center Security	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
Bis-Man Transit Vehicles	Transit Vehicle On-Board Fare Management	The transit vehicle shall provide fare statistics data to the center.	Existing
	Transit Vehicle On-Board Fare Management	The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Existing
	Transit Vehicle On-Board Maintenance	The transit vehicle shall collect and process vehicle mileage data available to sensors on-board.	Existing
	Transit Vehicle On-Board Maintenance	The transit vehicle shall collect and process the transit vehicle's operating conditions such as engine temperature, oil pressure, brake wear, internal lighting, environmental controls, etc.	Existing
	Transit Vehicle On-Board Maintenance	The transit vehicle shall transmit vehicle maintenance data to the center to be used for scheduling future vehicle maintenance.	Existing

Element Name	Functional Object	Requirement	Status
	Transit Vehicle On-Board Paratransit Operations	The transit vehicle shall provide the capability to log passenger boardings and alightings and make passenger use data available to the transit center.	Existing
	Transit Vehicle On-Board Paratransit Operations	The transit vehicle shall manage data input to sensor(s) on-board a transit vehicle to determine the vehicle's availability for use in demand responsive and flexible-route transit services based on identity, type, and passenger capacity.	Planned
	Transit Vehicle On-Board Paratransit Operations	The transit vehicle shall receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.	Existing
	Transit Vehicle On-Board Paratransit Operations	The transit vehicle shall provide the transit vehicle operator instructions about the demand responsive or flexible-route transit schedule that has been confirmed from the center.	Planned
	Transit Vehicle On-Board Trip Monitoring	The transit vehicle shall record transit trip monitoring data including operational status information such as doors open/closed, running times, etc.	Existing
	Transit Vehicle On-Board Trip Monitoring	The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Existing
	Transit Vehicle On-Board Trip Monitoring	The transit vehicle shall track the current location of the transit vehicle.	Planned
	Transit Vehicle On-Board Trip Monitoring	The transit vehicle shall receive transit stop requests from travelers.	Existing
	Transit Vehicle Passenger Counting	The passenger counts shall be timestamped so that ridership can be measured by time of day and day of week.	Planned
	Transit Vehicle Passenger Counting	The transit vehicle shall send the collected passenger count information to the transit center.	Existing

Element Name	Functional Object	Requirement	Status
	Transit Vehicle Passenger Counting	The passenger counts shall be related to location to support association of passenger counts with routes, route segments, or transit stations/stops.	Planned
	Transit Vehicle Passenger Counting	The transit vehicle shall count passengers boarding and alighting.	Planned
	Transit Vehicle Security	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).	Existing
Bismarck Centracs Server	TMC Signal Control	The center shall support requests from emergency management centers to provide responding emergency vehicles with signal preemption.	Existing
	TMC Signal Control	The center shall manage (define, store and modify) control plans to coordinate signalized intersections, to be engaged at the direction of center personnel or according to a daily schedule.	Existing
	TMC Signal Control	The center shall remotely control traffic signal controllers.	Planned
	TMC Signal Control	The center shall collect traffic signal controller fault data from the field.	Existing
	TMC Signal Control	The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Planned
	TMC Signal Control	The center shall adjust signal timing in response to a signal prioritization, signal preemption, pedestrian call, multi-modal crossing activation, or other requests for right-of-way.	Existing
Bismarck Engineering Field Devices	Roadway Basic Surveillance	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.	Existing

Element Name	Functional Object	Requirement	Status
	Roadway Basic Surveillance	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing
	Roadway Basic Surveillance	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing
	Roadway Basic Surveillance	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
	Roadway Data Collection	The field element shall collect traffic, road, and environmental conditions information.	Planned
	Roadway Data Collection	The field element shall collect sensor status and sensor faults from roadside equipment and send it along with the recorded data to a center for archival.	Planned
	Roadway Signal Control	The field element shall receive requests for signal preemption.	Existing
	Roadway Signal Control	The field element shall return traffic signal controller fault data to the center.	Existing
	Roadway Signal Control	The field element shall return traffic signal controller operational status to the center.	Existing
	Roadway Signal Control	The field element shall control traffic signals under center control.	Existing
	Roadway Signal Control	The field element shall respond to pedestrian crossing requests by accommodating the pedestrian crossing.	Existing
	Roadway Signal Preemption	The field element shall respond to signal preemption requests from emergency vehicles.	Existing
	Roadway Traffic Information Dissemination	The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Planned
	Roadway Traffic Information Dissemination	The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing

Element Name	Functional Object	Requirement	Status
	Roadway Traffic Information Dissemination	The field element shall include dynamic message signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
Bismarck PW Field Devices	Roadway Field Device Support	The field element shall provide the capability for field personnel to locally control and configure this equipment.	Existing
	Roadway Traffic Information Dissemination	The field element shall include dynamic message signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
	Roadway Work Zone Traffic Control	Under the control of field personnel within maintenance vehicles, the field element shall include driver information systems (such as dynamic messages signs and highway advisory radios) that advise drivers of activity around a work zone through which they are currently passing.	Existing
Bismarck PW Operations Center	MCM Roadway Maintenance	The center shall report the status of roadway maintenance activities to the centers that operate the equipment.	Existing
	MCM Roadway Maintenance	The center shall dispatch and route maintenance and construction vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
	MCM Roadway Maintenance	The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	Existing

Element Name	Functional Object	Requirement	Status
	MCM Roadway Maintenance	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	Existing
	MCM Vehicle Tracking	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
	MCM Vehicle Tracking	The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.	Existing
	MCM Winter Maintenance Management	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
	MCM Winter Maintenance Management	The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for the scheduling of winter maintenance activities.	Existing
	MCM Winter Maintenance Management	The center shall provide status information about scheduled winter maintenance activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, and the media.	Existing
	MCM Winter Maintenance Management	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

Element Name	Functional Object	Requirement	Status
	MCM Winter Maintenance Management	The center shall receive equipment availability and materials storage status information from storage facilities to support the scheduling of winter maintenance activities.	Existing
	MCM Winter Maintenance Management	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
	MCM Winter Maintenance Management	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
Bismarck PW Vehicles	MCV Environmental Monitoring	The maintenance and construction vehicle shall provide environmental sensor equipment operational status to the center.	Planned
	MCV Environmental Monitoring	The maintenance and construction vehicle shall transmit environmental sensor data to the center. The sensor data includes location and timestamp information.	Existing
	MCV Environmental Monitoring	The maintenance and construction vehicle shall collect environmental data from on-board sensors, including air temperature, wind speed, surface temperature, traction conditions, etc.	Existing
	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall monitor materials information including remaining quantity and current application rate of materials on the vehicle.	Existing

Element Name	Functional Object	Requirement	Status
	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall respond to dispatch information from the center, presented to the vehicle operator for acknowledgement and returning status.	Existing
	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle.	Existing
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall track its current location.	Existing
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Existing
	MCV Winter Maintenance	The maintenance and construction vehicle shall send operational data to the center including the operational state of the winter maintenance equipment (e.g., blade up/down, spreader pattern), types and quantities of materials used for construction and maintenance activities, and a record of the actual work performed.	Existing
	MCV Winter Maintenance	The maintenance and construction vehicle shall monitor winter maintenance materials information including remaining quantity and current application rate of materials on the vehicle.	Existing
	MCV Winter Maintenance	The maintenance and construction vehicle shall respond to winter maintenance dispatch information from the center, presented to the vehicle operator for acknowledgement and returning status.	Existing
Burleigh County PW	MCM Roadway Maintenance	The center shall report the status of roadway maintenance activities to the centers that operate the equipment.	Existing

Element Name	Functional Object	Requirement	Status
	MCM Roadway Maintenance	The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	Existing
	MCM Roadway Maintenance	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	Existing
	MCM Vehicle Tracking	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
	MCM Winter Maintenance Management	The center shall dispatch and route winter maintenance vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
Burleigh County PW Vehicles	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall respond to dispatch information from the center, presented to the vehicle operator for acknowledgement and returning status.	Planned
	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle.	Planned
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall track its current location.	Planned
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Planned
	MCV Winter Maintenance	The maintenance and construction vehicle shall track the vehicle's location and status of safety systems on-board the winter maintenance vehicle.	Planned

Element Name	Functional Object	Requirement	Status
Central Dakota Communications Center	Emergency Call-Taking	The emergency call-taking center shall update the incident information log once the emergency system operator has verified the incident.	Existing
	Emergency Call-Taking	The emergency call-taking center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
	Emergency Call-Taking	The emergency call-taking 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
	Emergency Call-Taking	The emergency call-taking center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
	Emergency Call-Taking	The emergency call-taking center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing
	Emergency Call-Taking	The emergency call-taking center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
	Emergency Dispatch	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
	Emergency Dispatch	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
	Emergency Dispatch	The center shall relay location and incident details to the responding vehicles.	Existing

Element Name	Functional Object	Requirement	Status
	Emergency Dispatch	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
	Emergency Dispatch	The center shall store and maintain the emergency service responses in an action log.	Existing
	Emergency Dispatch	The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing
	Emergency Routing	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
	Emergency Routing	The center shall calculate emergency vehicle routes, under center personnel control, based on the collected traffic and road conditions information.	Existing
Lincoln PW	MCM Vehicle Maintenance Management	The center shall collect and analyze vehicle diagnostics information from maintenance and construction vehicles. The information includes engine temperature, mileage, tire wear, brake wear, belt wear, and any warnings or alarms concerning the operational condition of the vehicle and ancillary equipment.	Existing
Lincoln PW Vehicles	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall respond to dispatch information from the center, presented to the vehicle operator for acknowledgement and returning status.	Existing
	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall send operational data to the center including the operational state of the maintenance equipment (e.g., blade up/down, spreader pattern), types and quantities of materials used for construction and maintenance activities, and a record of the actual work performed.	Existing
Mandan Engineering Field Devices	Roadway Signal Control	The field element shall receive requests for signal preemption.	Not Applicable
	Roadway Signal Control	The field element shall control traffic signals under center control.	Existing

Element Name	Functional Object	Requirement	Status
Mandan PW Operations Center	MCM Roadway Maintenance	The center shall report the status of roadway maintenance activities to the centers that operate the equipment.	Existing
	MCM Roadway Maintenance	The center shall dispatch and route maintenance and construction vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
	MCM Roadway Maintenance	The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	Existing
	MCM Roadway Maintenance	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	Existing
	MCM Vehicle Tracking	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
	MCM Winter Maintenance Management	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
	MCM Winter Maintenance Management	The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for the scheduling of winter maintenance activities.	Existing

Element Name	Functional Object	Requirement	Status
	MCM Winter Maintenance Management	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
	MCM Winter Maintenance Management	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
	MCM Winter Maintenance Management	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
Mandan PW Vehicles	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall monitor materials information including remaining quantity and current application rate of materials on the vehicle.	Existing
	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle.	Existing
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall track its current location.	Existing
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Existing
	MCV Winter Maintenance	The maintenance and construction vehicle shall track the vehicle's location and status of safety systems on-board the winter maintenance vehicle.	Planned

Element Name	Functional Object	Requirement	Status
	MCV Winter Maintenance	The maintenance and construction vehicle shall monitor winter maintenance materials information including remaining quantity and current application rate of materials on the vehicle.	Existing
	MCV Winter Maintenance	The maintenance and construction vehicle shall respond to winter maintenance dispatch information from the center, presented to the vehicle operator for acknowledgement and returning status.	Existing
Mandan Traffic Engineering	TMC Signal Control	The center shall remotely control traffic signal controllers.	Planned
	TMC Signal Control	The center shall collect traffic signal controller fault data from the field.	Existing
Morton County Communications	Emergency Call-Taking	The emergency call-taking center shall update the incident information log once the emergency system operator has verified the incident.	Existing
	Emergency Call-Taking	The emergency call-taking center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
	Emergency Call-Taking	The emergency call-taking 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
	Emergency Call-Taking	The emergency call-taking center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
	Emergency Call-Taking	The emergency call-taking center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing

Element Name	Functional Object	Requirement	Status
	Emergency Dispatch	The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing
	Emergency Dispatch	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
	Emergency Dispatch	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
	Emergency Dispatch	The center shall relay location and incident details to the responding vehicles.	Existing
	Emergency Dispatch	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
	Emergency Dispatch	The center shall store and maintain the emergency service responses in an action log.	Existing
	Emergency Routing	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
Morton County PW	MCM Roadway Maintenance	The center shall report the status of roadway maintenance activities to the centers that operate the equipment.	Existing
	MCM Roadway Maintenance	The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	Not Applicable
	MCM Roadway Maintenance	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	Planned

Element Name	Functional Object	Requirement	Status
	MCM Vehicle Tracking	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
	MCM Winter Maintenance Management	The center shall dispatch and route winter maintenance vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
Morton County PW vehicles	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall respond to dispatch information from the center, presented to the vehicle operator for acknowledgement and returning status.	Not Applicable
	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle.	Not Applicable
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall track its current location.	Not Applicable
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Not Applicable
	MCV Winter Maintenance	The maintenance and construction vehicle shall track the vehicle's location and status of safety systems on-board the winter maintenance vehicle.	Existing
NDDOT District Field Devices	Roadway Speed Monitoring and Warning	The field element shall include sensors to detect vehicle speeds, under traffic or maintenance center control.	Planned
	Roadway Traffic Information Dissemination	The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Existing
	Roadway Traffic Information Dissemination	The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing

Element Name	Functional Object	Requirement	Status
	Roadway Traffic Information Dissemination	The field element shall include driver information systems that communicate directly from a center to the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers, under center control.	Existing
	Roadway Traffic Information Dissemination	The field element shall include dynamic message signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
NDDOT District Office	MCM Roadway Maintenance	The center shall report the status of roadway maintenance activities to the centers that operate the equipment.	Existing
	MCM Roadway Maintenance	The center shall dispatch and route maintenance and construction vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
	MCM Roadway Maintenance	The center shall exchange information with administrative systems to support the planning and scheduling of maintenance activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract administration.	Existing
	MCM Roadway Maintenance	The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	Existing

Element Name	Functional Object	Requirement	Status
	MCM Roadway Maintenance	The center shall receive equipment availability and materials storage status information from storage facilities to support the scheduling of roadway maintenance and construction activities.	Existing
	MCM Roadway Maintenance	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	Existing
	MCM Roadway Maintenance	The center shall maintain an interface with asset management systems to track the inventory, restrictions, repair needs and status updates of transportation assets (pavement, bridges, signs, etc.) including location, installation and materials information, vendor/contractor, current maintenance status, standard height, width, and weight restrictions.	Existing
	MCM Vehicle Tracking	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
	MCM Vehicle Tracking	The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.	Existing
	MCM Winter Maintenance Management	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
	MCM Winter Maintenance Management	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

Element Name	Functional Object	Requirement	Status
	MCM Winter Maintenance Management	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
	MCM Winter Maintenance Management	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
NDDOT District Vehicles	MCV Roadway Maintenance and Construction	The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle.	Existing
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall track its current location.	Existing
	MCV Vehicle Location Tracking	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Existing
	MCV Winter Maintenance		
State Radio	Emergency Dispatch	The center shall store and maintain the emergency service responses in an action log.	Existing
	Emergency Dispatch	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
	Emergency Dispatch	The center shall relay location and incident details to the responding vehicles.	Existing

Element Name	Functional Object	Requirement	Status
	Emergency Dispatch	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
	Emergency Dispatch	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
	Emergency Routing	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing