METROCOG
FM REGIONAL TRANSPORTATION PLANNING ORGANIZATION

Fargo-Moorhead Metropolitan Council of Governments
(Metro COG)

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Fargo- Moorhead Regional ITS Architecture Update

Version 4.0

Final Report

December 2022

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

Fargo- Moorhead
Regional ITS Architecture Update
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The information contained in this report was obtained through extensive input from various stakeholders in the Fargo- Moorhead region. The report's contents were written by a research team from the Advanced Traffic Analysis Center of the Upper Great Plains Transportation Institute at North Dakota State University, facilitating the development of the Regional ITS Architecture.

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ACRONYMS

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
F-M	Fargo-Moorhead
Fargo FD	Fargo Fire Department
Fargo PD	Fargo Police Department
Fargo PW	Fargo Public Works
CAD	Computer Aided Dispatch
CCTV	Closed Circuit Television
Constr	Construction
DMS	Dynamic Message Sign
DOT	Department of Transportation
EAS	Emergency Alert System
EV	Emergency Vehicle/ Electric Vehicle
FHWA	Federal Highway Administration
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
LOS	Level of Service
Moorhead FD	Moorhead Fire Department
Moorhead PD	Moorhead Police Department
Moorhead PW	Moorhead Public Works
Maint	Maintenance
MCO	Maintenance and Construction Operations
Metro COG	Metropolitan Council of Governments
NDDOT	North Dakota Department of Transportation
NDHP	North Dakota Highway Patrol
RA	Regional Architecture
RAD-IT	Regional Architecture Development for Intelligent Transportation
SDO	Standard Development Organization
SP	Service Package
TOC	Traffic Operations Center
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
ST	Sustainable Travel
TI	Traveler Information
TM	Traffic Management

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EXECUTIVE SUMMARY

The Fargo- Moorhead Regional Intelligent Transportation Systems (ITS) Architecture Update was prepared under the Fargo-Moorhead Metropolitan Council of Governments (Metro COG) leadership. The architecture was first developed in 2005, and since then, it has been updated three times in 2007, 2014, and 2022. The F-M regional architecture (RA) aims to guide the implementation of ITS systems in the F-M region and coordinate funding, deployment, information sharing, and operations of ITS technologies in the region. The main ITS goal areas for the F-M region include enhanced traveler safety, effective traffic and transit management; coordinated incident management; and enhanced traveler information. A 5-year planning horizon was considered in the RA development.

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

This version of the RA is the fourth 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 RA is based on the national Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT 9.1).

The geographic boundaries of the Metro COG fall within North Dakota and Minnesota, and each state maintains a separate statewide ITS architecture. Such unique positioning requires special attention to maintain consistency and avoid conflicts between the regional and statewide architectures. The statewide architecture scope focuses on state-level services, while the MPO architectures focus on local and urban services resulting in limited overlap and seamless integration. In Minnesota, one architecture is maintained by MnDOT that covers the entire scope of services, including at the state and local levels. Due to the large number of agencies involved, MnDOT utilizes generic descriptions to cover multiple agencies (e.g., Local Transit Management Centers is an element that represents all Minnesota transit agencies outside of the Twin Cities metro area). In contrast, in the F-M regional architecture, the elements and services are customized (e.g., Metro Area Transit (MATBUS) is identified as the transit agency in the region, and transit service packages reflect MATBUS's operations and plans). Major jurisdictions included in this updated version of the regional architecture are:

1. City of Fargo.
2. City of West Fargo.
3. City of Moorhead.
4. Cass County
5. Clay County
6. City of Horace
7. City of Dilworth

In addition to these jurisdictions, the RA recognizes other associated member cities of Metro COG and interfaces with statewide architectures in North Dakota.

The RA development was guided by various regional stakeholders who owned and operated ITS in the F-M region and included:

- Metro COG staff
- City engineering and maintenance staff
- Transit staff
- State DOT district engineering and maintenance staff
- FHWA representative
- Law enforcement and emergency responders
- County emergency and maintenance staff
- Other agencies responsible for system operations and maintenance

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

ITS user services for the region were initially identified from previous ITS planning efforts as well as input from regional stakeholders. The National ITS Architecture was used to map these services and develop service packages supporting these services. A total of 36 Service Packages were identified in three categories of existing, planned, and future for the F-M area of which 13 service packages are identified with instances to support the region's vision for the establishment of a traffic operations center (TOC) that will enhance arterial and freeway traffic operations. The RA includes options for a short-term goal of a hybrid TOC where interconnect among the traffic operators and with other relevant agencies is established; signal operations are coordinated; and data, including surveillance video, are shared among agencies in the area. In addition to the hybrid TOC scenario, the RA supports the regional longer-term goal for establishing a centralized TOC where all traffic operations functions in the area would be collocated.

Service packages are comprised of the agencies, devices, and information flows needed to achieve each ITS service. Those packages were also used to survey roles and responsibilities for each system. System interconnections and relevant information flows were identified for major ITS systems in the region. These systems include traffic management, transit management, emergency management, and maintenance and construction management.

Based on information flows, access sharing, and funding partnerships, potential agency agreements were identified. The format for each agreement includes the purpose, entities included, and items covered. Seven potential agreements were identified for the F-M region, including transit security, network surveillance, traffic information dissemination, incident management, data archival, and regional transportation management.

1.0 INTRODUCTION

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

The Fargo-Moorhead Regional Intelligent Transportation Systems (ITS) Architecture was prepared under the leadership of the Fargo-Moorhead Metropolitan Transportation Organization (Metro COG). The goal of the F-M regional architecture (RA) is to guide the implementation of ITS systems in the F-M area and coordinate funding, deployment, information sharing, and operations of ITS systems in the region. The main ITS goal areas for the F-M area include enhanced traveler safety, effective traffic and transit management; coordinated incident management; and enhanced traveler information. A 5-year planning horizon was considered in the RA development.

The development and current update of the RA were facilitated by the Advanced Traffic Analysis Center (ATAC) of the Upper Great Plains Transportation Institute at North Dakota State University. ATAC has also facilitated prior RA updates in 2007 and 2014.

1.1 Report Organization

The F-M RA Report is organized into several main sections to facilitate the report's use. In addition, an electronic file has been prepared using the FHWA's regional architecture development for intelligent transportation (RAD-IT) software to access the architecture and make changes or future updates.

Below is a description for each of the remaining sections of this report:

2 Scope and Region	Identifies the geographical and architecture scope
3 Stakeholders	Agencies participating in the architecture
4 System Inventory	Existing and planned ITS systems
5 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 RA
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 F-M region. It also discusses the scope of the regional architecture, providing a high-level outline of the range of ITS services and systems used.

2.1 Geographical Boundaries

The geographical areas included in the F-M RA primarily consisted of the Metro COG's metropolitan planning area. Major jurisdictions within the region include the following:

1. City of Fargo.
2. City of Moorhead.
3. City of West Fargo.
4. City of Horace
5. City of Dilworth
6. Cass County.
7. Clay County.
8. Other associated jurisdictions (City of Barnesville, Casselton, Glyndon, Harwood, Hawley, and Mapleton)

In addition, the North Dakota Department of Transportation (NDDOT) is responsible for operating and maintaining the state system within Fargo, including sections of two major Interstate highways (I-29 and I-94). The NDDOT also operates several traffic signals, primarily located at Interstate ramp termini. Similarly, the Minnesota Department of Transportation (MnDOT) is responsible for operating the state system on the Minnesota side as well as traffic signal operations on state owned roads through cities like Moorhead and Dilworth. The Federal Highway Administration (FHWA) were also an active participant in the RA development.

2.2 Scope of the RA

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

1. Travel and Traffic Management
    a. Traffic control
    b. Traveler information
    c. Traffic surveillance
2. Public Transportation Management
    a. Fixed route and demand response transit services.
    b. Fleet management (real-time information)
    c. Automated Passenger and Fare Management
    d. 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. Automated treatment (anti-icing systems)
    b. Winter maintenance
    c. Fleet management

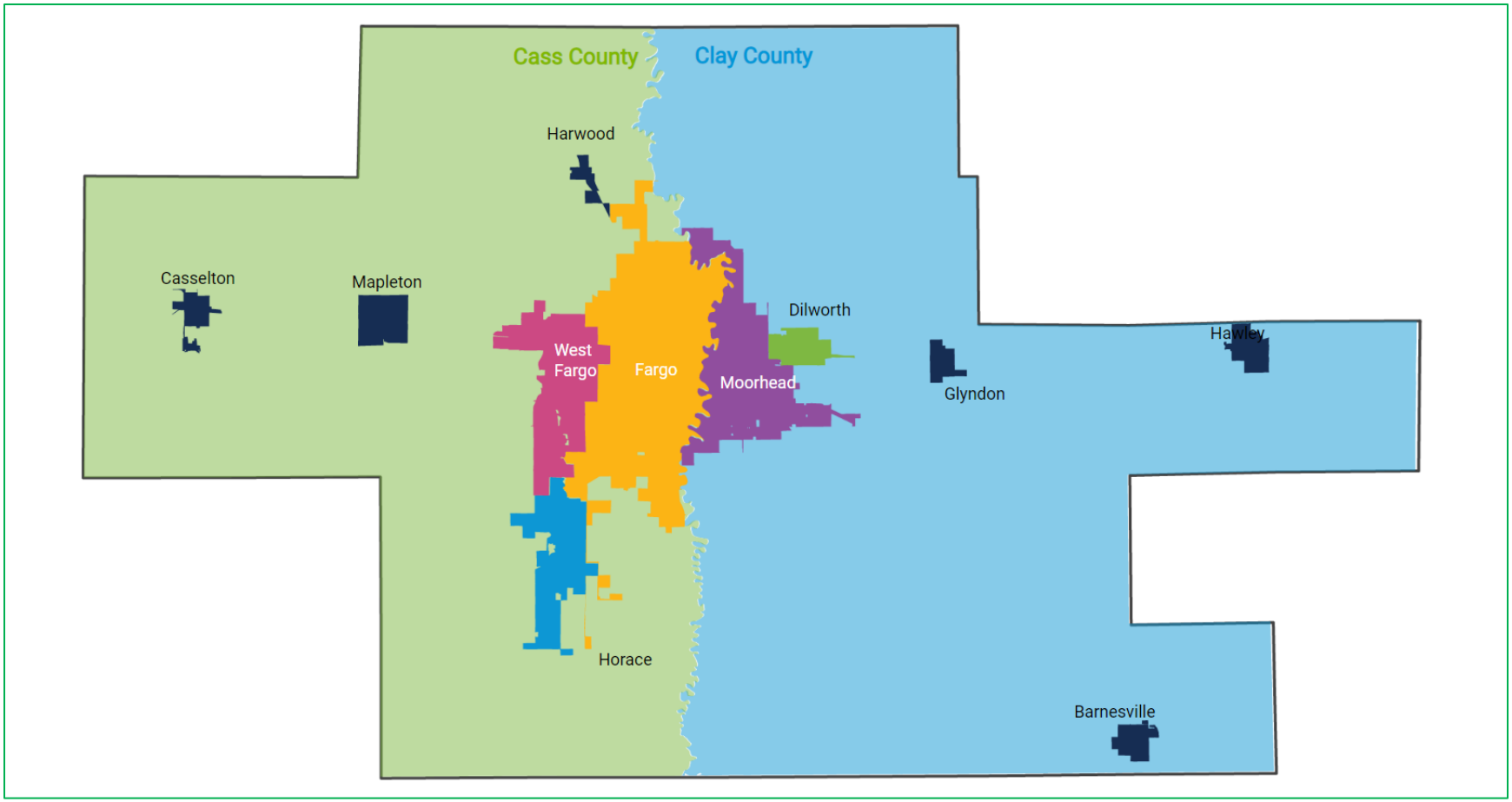


Figure 1 Metro COG Metropolitan Planning Area

3.0 STAKEHOLDERS

ITS stakeholders in the F-M RA include transportation, public works, law enforcement, emergency management, transit, and other related agencies.

Table 1: List of **Stakeholders**

Stakeholder	Stakeholder Description	Element Name
ATAC	Advanced Traffic Analysis Center - Upper Great Plains Transportation Institute - North Dakota State University	FM Data Warehouse
BNSF Fargo	Burlington Northern Santa Fe Railway Fargo office	BNSF, Rail Wayside Equipment
Cass County	Cass County Engineering and Maintenance Departments	Cass County Maint Vehicles, Cass County Maintenance, Cass County Personnel
Clay County	Clay County Engineering and Maintenance departments	Clay County Maintenance
County Sheriffs	Cass and Clay County Sheriff Departments	County Sheriff Vehicles
DOTs		FM FAST Anti-icing Systems, FM Information Service Providers
Fargo Engineering	City of Fargo Engineering Department	Fargo Cameras, Fargo Engineers, Fargo TOC, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals
Fargo FD	City of Fargo Fire Department	Fargo FD Vehicles
Fargo FM	The City of Fargo Facilities Management Department	EV Charging Station
Fargo PD	City of Fargo Police Department	Fargo PD Vehicles
Fargo PW	City of Fargo Public Works Department	Fargo PW Operations Center, Fargo PW Roadside Equipment, Fargo PW Vehicle
FM Emergency Group	Fargo Moorhead Emergency Management Agencies	Emergency Operators, Emergency Personnel, Emergency Personnel Device, FM Emergency Management, FM Emergency Vehicles
FM Event Venues	Fargodome, Fargo Civic Center	Event Promoters

Stakeholder	Stakeholder Description	Element Name
FM Maintenance Group		FM Maintenance and Construction Management, FM Maintenance Personnel, FM Maintenance Vehicles
FM Traffic Operations Group		FM Cameras, FM DMS, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM TOC, FM Traffic Operations, FM Traffic Sensors
Metro Area Transit	Fargo-Moorhead Metro Area Transit	MAT Bus Drivers, MAT Kiosks, MAT Operators, MAT Traveler Card, MAT Vehicles, MATBus
MnDOT D4	MnDOT District 4	MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Maint Vehicles, MnDOT D4 Maintenance, MnDOT D4 Maintenance Personnel, MnDOT D4 TOC, MnDOT D4 Traffic Personnel, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals
MnTOC Partners	Agencies making up the Minnesota TOC for singals on the Minnesota side of the F-M area. Currently MnDOT District 4 and the City of Moorhead are planned participants.	MnTOC, MnTOC Operators
Moorhead Engineering	City of Moorhead Engineering Department	Moorhead Engineers, Moorhead TOC, Moorhead Traffic Sensors, Moorhead Traffic Signals
Moorhead FD	City of Moorhead Fire Department	Moorhead FD Vehicles
Moorhead PD	City of Moorhead Police Department	Moorhead DMS, Moorhead PD Vehicles
Moorhead PW	City of Moorhead Public Works Department	Moorhead DMS, Moorhead PW Operations Center, Moorhead PW Vehicles
MSP Central	Minnesota State Patrol Central Office	MN State Radio
MSP DL	Minnesota State Patrol Detroit Lakes District	MSP DL District, MSP DL Vehicles
ND DES	North Dakota Division of Emergency Services	ND State Radio

Stakeholder	Stakeholder Description	Element Name
NDDOT Fargo	NDDOT Fargo District	NDDOT Cameras, NDDOT DMS, NDDOT Engineers, NDDOT Fargo Maintenance, NDDOT Fargo Maintenance Personnel, NDDOT Maint Vehicles, NDDOT Ramp Meters, NDDOT TOC, NDDOT Traffic Sensors, NDDOT Traffic Signals
NDHP Fargo	North Dakota Highway Patrol Fargo District	NDHP Fargo District, NDHP Vehicles
RRRDC Regional Partners	Partner jurisdictions covered by the Red River Regional Dispatch Center	RRRDC
Sanford Ambulance	Ambulance Service for the Fargo-Moorhead Area	Sanford Ambulance Vehicles
West Fargo Engineering	City of West Fargo Engineering Department	West Fargo Cameras, West Fargo PW Operations center, West Fargo PW Vehicles, West Fargo TOC, West Fargo TOC Signals, West Fargo Traffic Sensors

Additionally, RA stakeholder groups were utilized to simplify services when many agencies from the same area of specialty participated in performing a service. Six stakeholder group was created in the emergency management area.

Table 2: Stakeholder Group Members

Stakeholder Name	Stakeholder Group Members
DOTs	MnDOT Central
	MnDOT D4
	NDDOT Central
	NDDOT Fargo
FM Emergency Group	Cass County EM
	Clay County EM
	County Sheriffs
	Fargo FD
	Fargo PD
	Moorhead FD
	Moorhead PD
	MSP DL
	NDHP Fargo
	RRRDC
	Sanford Ambulance
	West Fargo FD
	West Fargo PD
FM Maintenance Group	Cass County
	Clay County
	Fargo PW
	MnDOT D4
	Moorhead PW
	NDDOT Fargo
	West Fargo PW
FM Traffic Operations Group	Fargo Engineering
	MnDOT D4
	Moorhead Engineering
	NDDOT Fargo
	West Fargo Engineering
MnTOC Partners	MnDOT D4
	Moorhead Engineering

Stakeholder Name	Stakeholder Group Members
RRRDC Regional Partners	Barnesville PD
	Cass County EM
	Clay County EM
	County Sheriffs
	Dilworth PD
	Fargo FD
	Fargo PD
	Glyndon PD
	Hawley PD
	Moorhead FD
	Moorhead PD
	RRRDC
	Rural Volunteer Ambulance
	Rural Volunteer EMS
	Rural Volunteer FD
	Sanford Ambulance
	West Fargo FD
	West Fargo PD

4.0 SYSTEM INVENTORY

This section summarizes the results of the system inventory process for the F-M RA. Information developed for the inventory was obtained through extensive input from stakeholders. interviews, and small group meetings were used to obtain and verify the inventory information. Follow-up interviews were conducted to identify changes for the RA update.

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

Using the Physical Architecture, four types of entities were identified for the F-M 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 ITS inventory in the F-M region for each stakeholder.

4.1 F-M Centers

These are the locations where functions are performed (i.e., process information, issue control commands, and produce output information). There are various centers in the National ITS Architecture that provide management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions. A representation of the F-M area Physical Architecture is shown in Figure 2.

4.1.1 Traffic Management Center

The Traffic Management Center (subsystem) monitors and controls traffic and the road network. It communicates with the Roadway Subsystem to monitor and manage traffic flow and monitor the condition of the roadway, surrounding environmental conditions, and field equipment status. The traffic management system in the region covers a broad range of transportation facilities in coordination with NDDOT's Fargo district office. The specific traffic management systems within the F-M area classified by the agency are discussed in the next section.

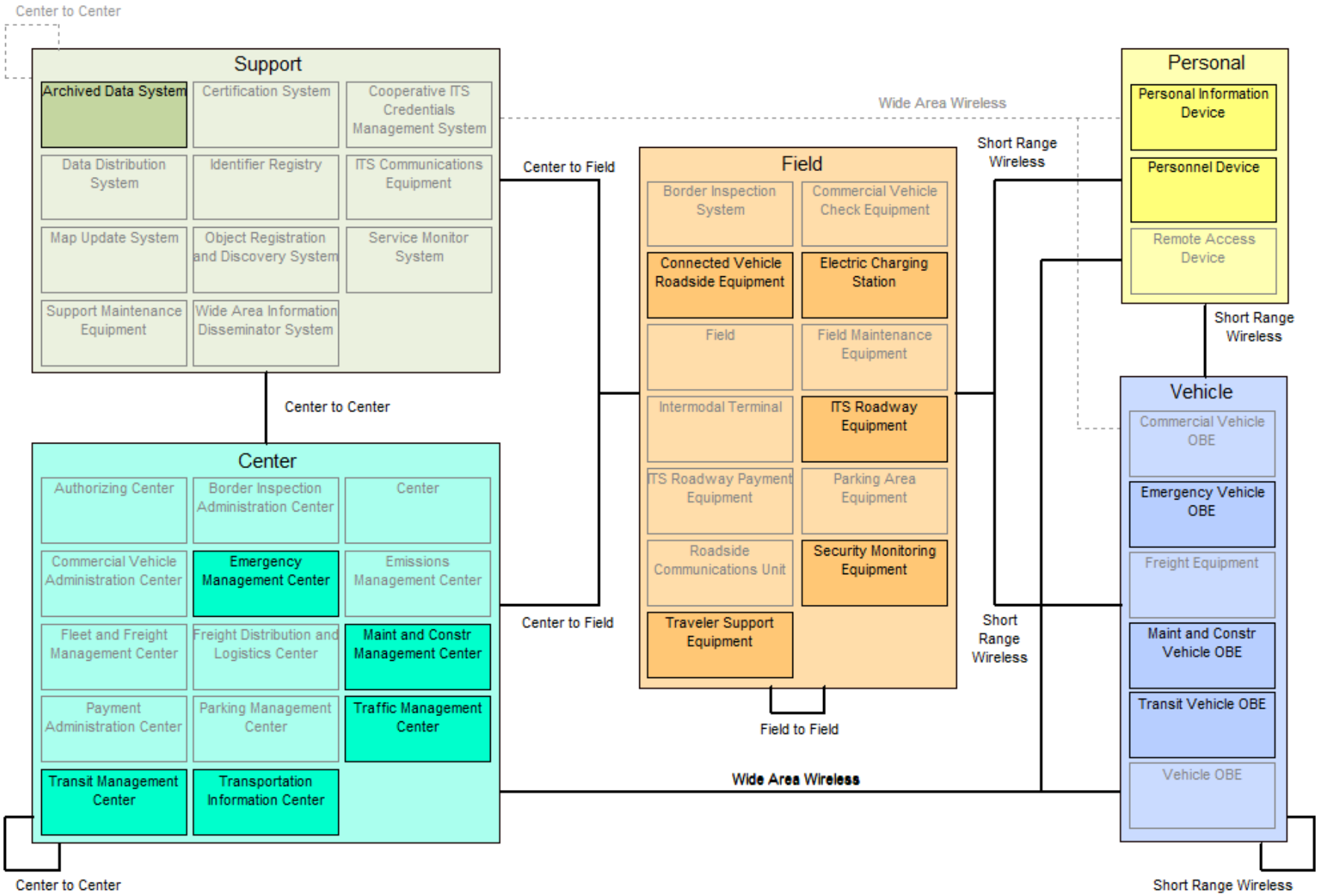


Figure 2 F-M Physical Architecture

NDDOT Traffic Operations Center (TOC)

The NDDOT Fargo District has been actively deploying ITS technologies along the two major Interstate segments of I-29 and I-94 in the Fargo area. The District has been planning for the TOC to serve as a focal point for collecting information about system operations, actively managing the system, and coordinating traffic operations and information with the City of Fargo. Currently the TOC receives information from video camera on I-29 and I-94 and handles traffic signal operations for Interstate ramps in the Fargo area. It can also broadcast traveler information via permanent and portable dynamic message signs (DMS), local media, and a traveler information web page.

City of Fargo Traffic Operations Center

The City of Fargo maintains a modern traffic signal control system which consists of approximately 180 signals. Most of these signals have communication capabilities using dial-up modems as well as fiber cable. The city uses the Centracs central control software to facilitate effective traffic signal control management, facilitate traffic data collection, and support traffic flow analysis.

City of Moorhead Engineering

The City of Moorhead is in the process of converting all their signals to utilize the Voyage rail preemption controllers. The department has access to the MnDOT's Maxview system.

MnDOT TOC

MnDOT District 4 has performed a major update on their signal and communications system in Moorhead. An agreement is being worked out with the City of Moorhead to combine traffic operations.

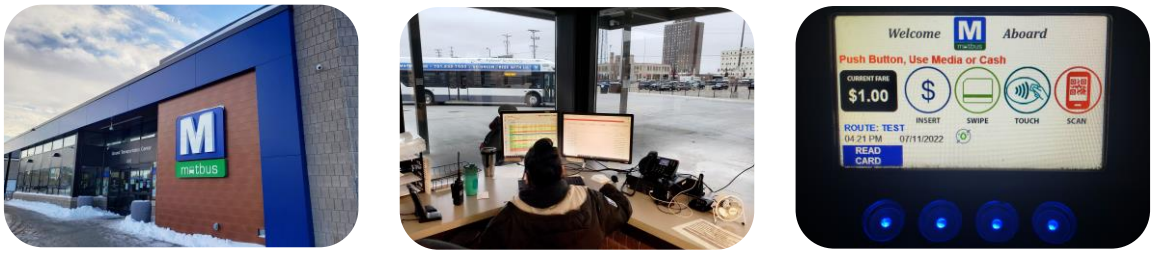
MnTOC

As per state of Minnesota's request, the city of Moorhead perform the state's operation and maintenance responsibilities for the signal system of the stae. This TOC represents the combined signal operations in Moorhead for city and MnDOT owned signals. This arrangement is supported by the regional TOC concept of operations effort.

Figure 3: MnDOT District 4 Building (Source: Stakeholder)

4.1.2 Transit Management Center

The Metro Area Transit (MAT) provides public transportation services for the cities of Fargo and Moorhead. MAT operates several fixed routes in Fargo and Moorhead in addition to paratransit services. The Ground Transportation Center in Fargo provides the majority of support and management services, including a wireless system for downloading fare-box and bus data. MAT makes use of an automated fare box system which provides enhanced management capabilities, including revenue analysis, ridership analysis, GPS bus location, and transit traveler information.



Transit Center | Dispatch View | Mat Kiosk

Figure 4: MATBus Transit Center (Source: Stakeholder)

4.1.3 Emergency Management Center

The Emergency Management center includes the functions associated with a full array, from the notification of an emergency to supporting the incident management. The Red River Regional Dispatch Center (RRRDC) is among the few examples nationwide of coordinated dispatch centers. The RRRDC provides dispatch services to the cities of Fargo, Moorhead, and West Fargo as well as Cass and Clay Counties. It also coordinates emergency management with the North Dakota Highway Patrol (NDHP), the Minnesota State Patrol (MSP), and other local law enforcement. The RRRDC is located in a state-of-the-art facility which contains secure communications, computer-aided dispatch, and other support systems. In addition to the RRRDC, each jurisdiction within the F-M area maintains an Emergency Operations Center (EOC). The EOC brings together law enforcement, fire, emergency management, and public works agencies to coordinate response to emergencies. These EOCs currently rely on traditional phone line communications for sharing information. Metro COG had conducted emergency planning and within the process, ITS has been identified as a valuable asset. Appropriate emergency management service packages were incorporated into the RA in this update.

4.1.4 Maintenance and Construction Management Center

Currently, there are five entities that handle Maintenance and Construction Management (MCO) in the F-M area, including: Fargo Public Works, West Fargo Public Works, Moorhead Public Works, NDDOT, and MnDOT. The NDDOT will in the future coordinate its MCO activities through the TOC. It has the most significant

equipment and systems in place to allow for MCO. NDDOT partnered with MnDOT and jointly deployed an automated anti-icing system on the Red River Bridge on I-94. Other agencies are adding fleet management capabilities.

4.1.5 Information Service Provider

Functions associated with an Information Service Provider (ISP) are currently provided through multiple agencies in the F-M region. The NDDOT TOC is planned to coordinate traveler information dissemination especially for the freeway system. This includes providing video snapshots at key locations and issuing road condition advisories for winter weather conditions.

4.1.6 Archived Data Management Center

Several agencies currently collect data from ITS sensors. However, there currently is no single center for archiving or processing these data. The Advanced Traffic Analysis Center (ATAC) at North Dakota State University has been designated as the future data warehouse entity for the F-M area. A fiber optics communication link between the City of Fargo and ATAC exists to facilitate data transfer and access.

4.2 F-M Field Devices

This type of physical entity refers to field devices used to support ITS systems. The majority of field devices in the F-M area may be classified under the Roadway Subsystem. Below is a listing of these devices by the agency.

4.2.1 NDDOT Field Devices

1. Sensors
    a. Weather
        i. Environmental Sensor Stations (ESS) (located on I-94 (NDDOT) and Road Weather Information System (RWIS)

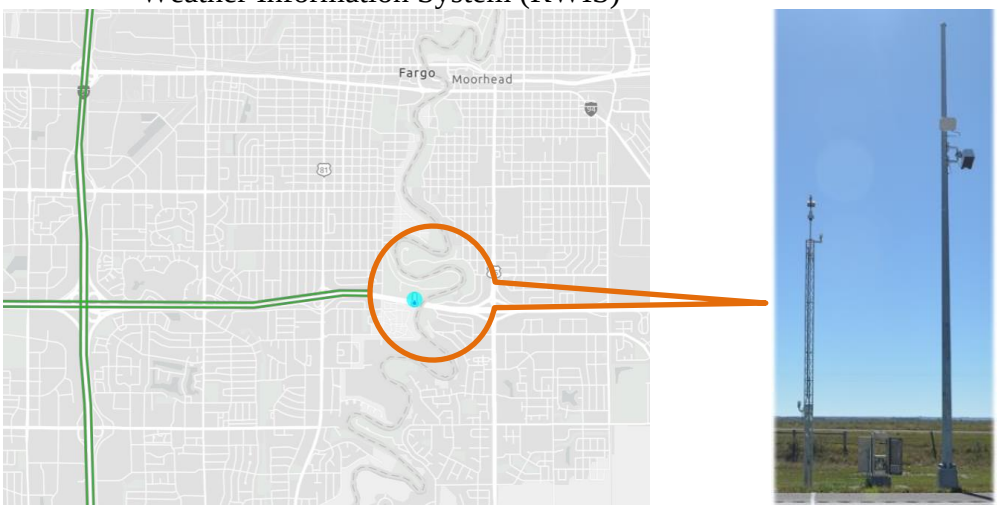


Figure 5: NDDOT Environmental Sensor Station and RWIS (Source: NDDOT Website and ND ROADS)

2. Traffic
    a. Video traffic detectors
    b. Loop detectors
3. Surveillance/monitoring
    a. PTZ video cameras

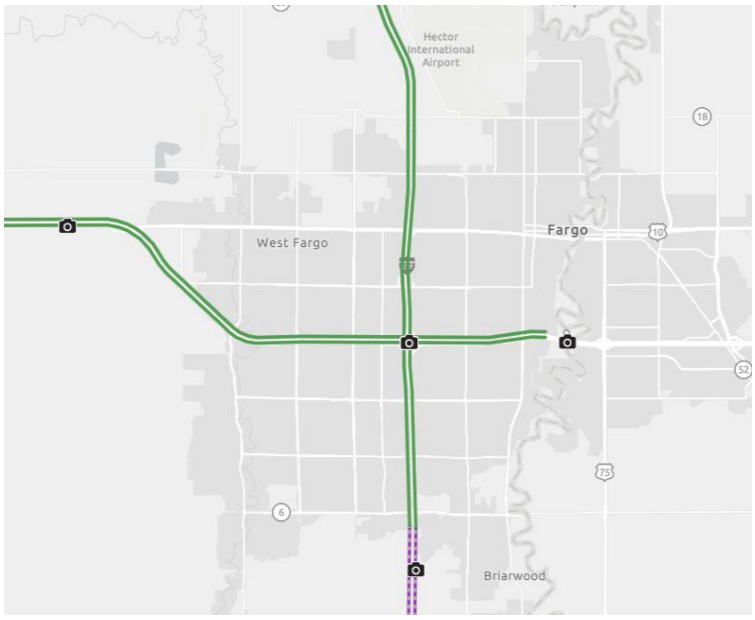


Figure 6: NDDOT PTZ Camera Locations (Source: ND Roads)

4. Control devices
    a. Traffic signal controllers
5. Warning/advisory devices
    a. Permanent DMS

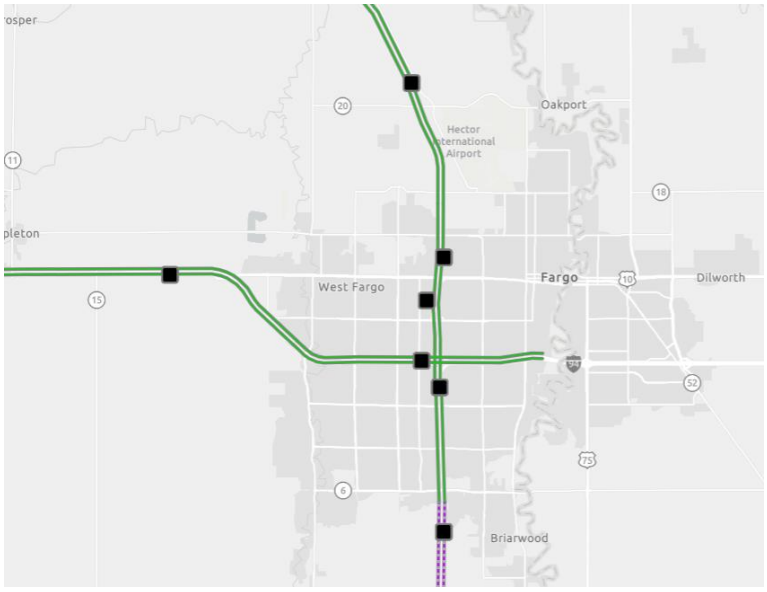


Figure 7: NDDOT Permanent DMS Locations (Source: ND Roads)

6. Roadway treatment devices
    a. Red River Bridge automated anti-icing system


Figure 8: Red River Bridge automated anti-icing system (Source: UGPTI Site Visit)

4.2.2 City of Fargo Field Devices

1. Sensors
   a. Traffic
      i. Loop detectors
      ii. Video traffic detectors
2. Surveillance/monitoring
   a. PTZ video cameras
3. Control devices
   a. Traffic signal controllers
4. Warning/advisory devices
   a. Permanent DMS

Figure 9: Fargo Downtown DMS Board (Source: Google Map)

4.2.3 City of West Fargo Field Devices

1. Sensors
   a. Video traffic detector
2. Control devices
   a. Traffic signal controllers
3. Surveillance/monitoring
   a. PTZ video cameras

4.2.4 MnDOT Field Devices

1. Sensors
   a. Weather Stations

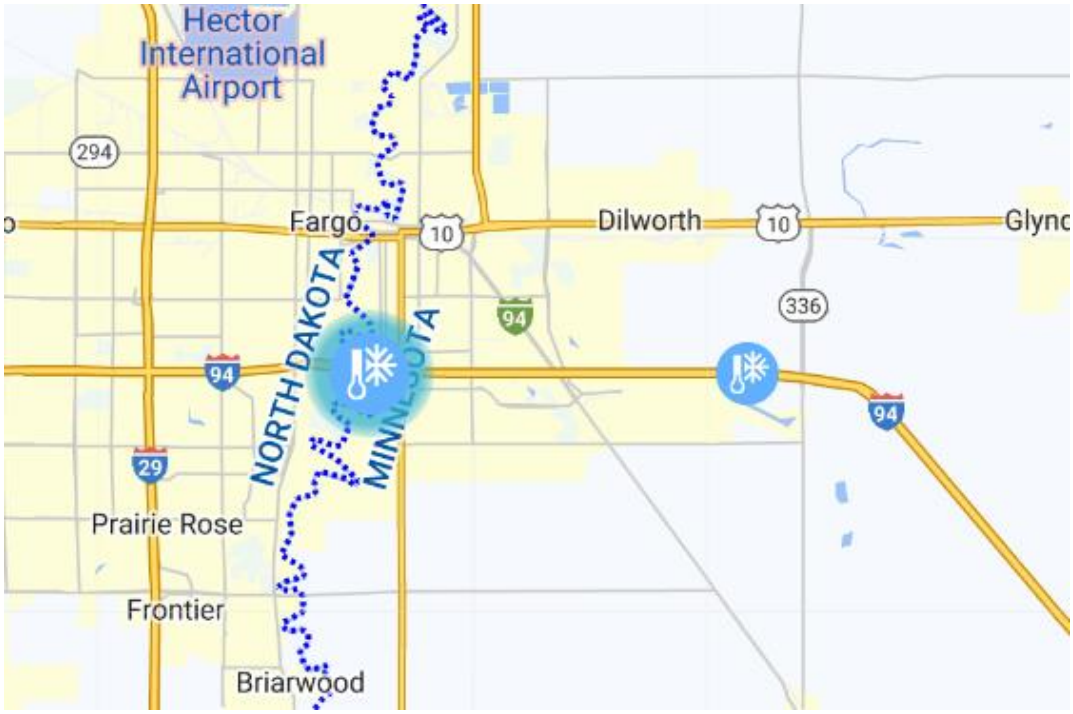


Figure 10: MnDOT Weather Stations (Source: 511mn.org)

   b. Traffic
      i. Loop detectors
      ii. Video traffic detectors
2. Surveillance/monitoring
      i. PTZ video cameras

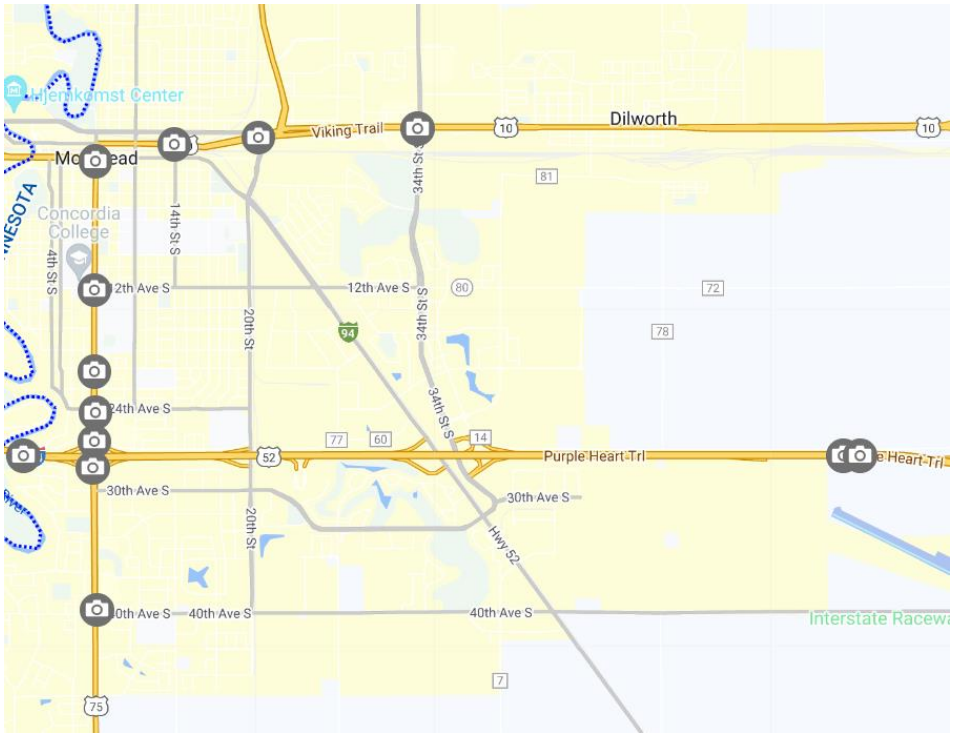


Figure 11: MnDOT Camera Locations (Source: 511mn.org)

3. Control devices
   a. Traffic signal controllers
   b. Other
      i. Radar train detector for supporting Moorhead Area Train Detection and Traffic Control System
4. Warning/advisory devices
   a. Permanent DMS on I-94 and TH10 4.
5. Roadway treatment devices
   a. Red River Bridge automated anti-icing system

4.2.5 City of Moorhead Field Devices

1. Sensors
   a. Traffic
      i. Loop detectors
      ii. Video traffic detectors
2. Surveillance/monitoring
   a. PTZ video cameras
3. Control devices
   a. Traffic signal controllers
   b. Other
      i. Radar train detector for supporting Moorhead Area Train Detection and Traffic Control System
4. Warning/advisory devices
   a. Portable DMS

4.3 F-M Vehicles

There are three types of vehicles included in the F-M RA. 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 F-M area

1. Law enforcement (AVL)
2. Fire (signal preemption)

Figure 12: Volunteer Fire Department Vehicle (Source: Stakeholder)

3. Sanford Ambulance (signal preemption)

4.3.2 MCO vehicles for City of Fargo and Moorhead

1. Trucks with atmospheric sensor
2. Snowplows equipped with AVL
3. Advanced Sander control

4.3.3 Transit Vehicle for F-M area

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

Accessibility Feature

Farebox

Paratransit

Figure 13: Transit Vehicles for F-M Area (Source: Stakeholder)

4.4 F-M Communication Infrastructure

Below is a brief description of existing and planned communication infrastructure in the F-M area. It should be noted that this infrastructure has been agency-specific so far, with little integration. However, more integration activities are expected in the future as the F-M RA is implemented.

1. Fiber
    a. I-29 and I-94 (NDDOT)
    b. Arterial network (Fargo)
    c. Arterial network (West Fargo)
    d. Arterial network (Moorhead) (Planned)
    e. MnDOT state highway system
2. Wireless/cellular
    a. Most of the emergency vehicles
    b. NDDOT portable DMS
    c. Public work vehicles

4.5 Summary of F-M Inventory

Table 3: List of Inventory

Element Name	Element Description	Associated Physical Objects	Stakeholder
Basic Vehicle		Basic Vehicle	
BNSF	Burlington Northern Santa Fe control point	Rail Operations Center	BNSF Fargo
Cass County Maint Vehicles	Cass County public work vehicles, snow plows, and other maintenance vehicles	Maint and Constr Vehicle OBE	Cass County
Cass County Maintenance	Cass County Highway Department	Maint and Constr Management Center	Cass County
Cass County Personnel	Staff in Cass County Highway Department	Maint and Constr Center Personnel	
Clay County Maint Vehicles	Clay County public work vehicles, snow plows, and other maintenance vehicles	Maint and Constr Vehicle OBE	Clay County
Clay County Maintenance	Clay County Highway Department	Maint and Constr Management Center	Clay County
Clay County Personnel	Staff in Clay County Highway Department	Maint and Constr Field Personnel	
County Sheriff Vehicles	Cass and Clay County sheriff vehicles	Emergency Vehicle OBE	County Sheriffs
Driver		Driver	
Emergency Operators	Dispatchers and operators at the RRRDC, NDHP, and MSP.	Emergency System Operator	FM Emergency Group
Emergency Personnel		Emergency Personnel	FM Emergency Group

Element Name	Element Description	Associated Physical Objects	Stakeholder
Emergency Personnel Device		Personnel Device	FM Emergency Group
EV Charging Station	Electric Vehicle Charging Station; Vendor: Chargepoint	Electric Charging Station	Fargo FM
Event Promoters	Fargo Dome, Civic Center, Air Show, Fair Grounds, Area Colleges, and other event promoters.	Event Promoter System	FM Event Venues
Fargo Cameras	City of Fargo surveillance PTZ cameras	ITS Roadway Equipment	Fargo Engineering
Fargo Engineers	Fargo TOC Engineers	Traffic Operations Personnel	Fargo Engineering
Fargo FD Vehicles	City of Fargo Fire Department vehicles	Emergency Vehicle OBE	Fargo FD
Fargo PD Vehicles	City of Fargo Police Department Vehicles	Basic Emergency Vehicle, Emergency Vehicle OBE	Fargo PD
Fargo PW Operations Center	City of Fargo Public Works Department	Maint and Constr Management Center	Fargo PW
Fargo PW Personnel	City of Fargo Public Works operations personnel	Maint and Constr Center Personnel	
Fargo PW Roadside Equipment	City of Fargo Public Works roadside equipment	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	Fargo PW
Fargo PW Vehicle	City of Fargo Public Works vehicles, snow plows, and other maintenance vehicles	Maint and Constr Vehicle OBE	Fargo PW
Fargo TOC	City of Fargo Surface Street Traffic Operations Center	Archived Data User System, Traffic Management Center	Fargo Engineering

Element Name	Element Description	Associated Physical Objects	Stakeholder
Fargo TOC DMS	City of Fargo Traffic Engineering Dynamic Message Sign	ITS Roadway Equipment, Wayside Equipment	Fargo Engineering
Fargo Traffic Sensors	City of Fargo traffic detectors, environmental sensors, traffic signals, highway advisory radios, CCTV cameras and video image processing systems, and grade crossing warning systems.	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	Fargo Engineering
Fargo Traffic Signals	City of Fargo traffic signal equipment	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	Fargo Engineering
FM Cameras	Surveillance cameras from all FM agencies	ITS Roadway Equipment	FM Traffic Operations Group
FM Data Warehouse	Fargo-Moorhead data archival	Archived Data System	ATAC
FM DMS	Dynamic message signs from all FM agencies	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	FM Traffic Operations Group
FM Emergency Management	A single architecture element representing emergency management agencies in the region consisting of:-Cass County Emergency Management-Clay County Emergency Management-NDHP Fargo District-MSP Detroit Lakes-ND Division of Emergency Services (DES)-MN Homeland Security and Emergency Management (HSEM)In addition to emergency responding agencies represented in the RRRDC Regional Partners stakeholder group (law enforcement, fire departments, and EMS) in the FM region.The purpose of a single element is to simplify architecture flows in certain complex service packages, individual entities are referenced independent ally as needed.	Emergency Management Center	FM Emergency Group

Element Name	Element Description	Associated Physical Objects	Stakeholder
FM Emergency Vehicles	A single architecture element representing all the region's law enforcement, fire, and EMS vehicles.	Emergency Vehicle OBE	FM Emergency Group
FM FAST Anti-icing Systems	Fixed automated spray technology systems for anti-icing treatment	ITS Roadway Equipment	DOTs
FM Information Service Providers	This element represents the interface to both NDDOT's and MnDOT's traveler information systems (web, mobile, and 511).	Transportation Information Center	DOTs
FM Maintenance and Construction Management	A single architecture element representing maintenance agencies in the region consisting of:-NDDOT Fargo District Maintenance-MnDOT District 4 Maintenance-Cass County Maintenance-Clay County Maintenance-Fargo, Moorhead, West Fargo Public WorksThe purpose of using a single element is to simplify architecture flows in complex service packages, individual entities are referenced independentally as needed.	Maint and Constr Management Center	FM Maintenance Group
FM Maintenance Personnel	A single architecture element representing maintenance personnel for:-NDDOT-MnDOT-Cass County-Clay County-Fargo, Moorhead, and West Fargo Public Works	Maint and Constr Center Personnel, Maint and Constr Field Personnel, Maint and Constr Vehicle Operator	FM Maintenance Group
FM Maintenance Vehicles	A single architecture element representing maintenance vehicles for:-NDDOT-MnDOT-Cass County-Clay County-Fargo, Moorhead, and West Fargo Public Works	Maint and Constr Vehicle OBE	FM Maintenance Group
FM Rail Crossing Equipment	Railroad crossing arm gates, silene whistle, and other equipment at railrold grade crossings in the FM area.	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	FM Traffic Operations Group

Element Name	Element Description	Associated Physical Objects	Stakeholder
FM Signals	Traffic signals from all FM agencies	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	FM Traffic Operations Group
FM Speed Warning Devices	Speed feedback and warning devices.	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	FM Traffic Operations Group
FM TOC	Fargo-Moorhead Metro area centralized TOC for signal and freeway operations.	Archived Data User System, Traffic Management Center	FM Traffic Operations Group
FM TOC Operators	Personnel operating the centralized TOC.	Traffic Operations Personnel	
FM Traffic Operations	A single architecture element representing traffic operators in the region consisting of:-NDDOT Fargo District-MnDOT District 4-Fargo, Moorhead, West Fargo EngineeringThe purpose of using a single element is to simplify architecture flows in complex Emergency Management service packages, individual entities are referenced independentally as needed.	Archived Data User System, Traffic Management Center	FM Traffic Operations Group
FM Traffic Sensors	Traffic sensors from all FM agencies	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	FM Traffic Operations Group
MAT Bus Drivers		Transit Vehicle Operator	Metro Area Transit
MAT Kiosks	Kiosks are public informational displays supporting various levels of interaction and information access.	Security Monitoring Equipment, Traveler Support Equipment	Metro Area Transit
MAT Operators	MAT Personnel	Transit Operations Personnel	Metro Area Transit

Element Name	Element Description	Associated Physical Objects	Stakeholder
MAT Traveler Card	Traveler Cards enable the actual transfer of electronic information from the user of a service (I.e. a traveler) to the provider of the service.	Payment Device, Traveler Card	Metro Area Transit
MAT Vehicles	Transit vehicles include ITS devices that support the safe and efficient movement of passengers. These systems collect, manage, and disseminate transit-related information to the driver, operations and maintenance personnel, and transit system patrons.	Transit Vehicle OBE	Metro Area Transit
MATBus	Fargo-Moorhead Metropolitan Area Transit's Ground Transportation Center	Archived Data User System, Transit Management Center, Transportation Information Center	Metro Area Transit
Media		Media	
MN State Radio	MN State Radio	Alerting and Advisory System	MSP Central
MnDOT D4 Cameras	MnDOT surveillance PTZ cameras	ITS Roadway Equipment	MnDOT D4
MnDOT D4 DMS	MnDOT D4 Dynamic Message Signas	ITS Roadway Equipment	MnDOT D4
MnDOT D4 Maint Vehicles	MnDOT D4 snow plows and other maintenance vehicles	Maint and Constr Vehicle OBE	MnDOT D4
MnDOT D4 Maintenance	MnDOT District 4 Maintenance and Construction Management	Maint and Constr Management Center	MnDOT D4
MnDOT D4 Maintenance Personnel		Maint and Constr Center Personnel	MnDOT D4

Element Name	Element Description	Associated Physical Objects	Stakeholder
MnDOT D4 TOC	MnDOT District 4 Traffic Operations Center	Archived Data User System, Traffic Management Center	MnDOT D4
MnDOT D4 Traffic Personnel	MnDOT traffic/maintenance and construction engineers	Traffic Operations Personnel	MnDOT D4
MnDOT D4 Traffic Sensors	MnDOT D4 Traffic sensors	ITS Roadway Equipment	MnDOT D4
MnDOT D4 Traffic Signals	MnDOT D4 Traffic Signals	ITS Roadway Equipment	MnDOT D4
MnTOC	Minnesota TOC for combined operations on MnDOT and Moorhead signal.	Archived Data User System, Traffic Management Center	MnTOC Partners
MnTOC Operators		Traffic Operations Personnel	MnTOC Partners
Moorhead Cameras	Ciy of Moorhead surveillance PTZ cameras	ITS Roadway Equipment	
Moorhead DMS	City of Moorhead Synamic Message Signs	ITS Roadway Equipment	Moorhead PD, Moorhead PW
Moorhead Engineers	Moorhead TOC Engineers	Traffic Operations Personnel	Moorhead Engineering
Moorhead FD Vehicles	City of Moorhead Fire Department vehicles	Emergency Vehicle OBE	Moorhead FD
Moorhead PD Vehicles	City of Moorhead Police Department Vehicles	Emergency Vehicle OBE	Moorhead PD
Moorhead PW Operations Center	City of Moorhead Public Works	Maint and Constr Management Center	Moorhead PW

Element Name	Element Description	Associated Physical Objects	Stakeholder
Moorhead PW Personnel	City of Moorhead Public Works operations personnel	Maint and Constr Center Personnel	
Moorhead PW Vehicles	City of Moorhead Public Works vehicles, snow plows, and other maintenance vehicles	Maint and Constr Vehicle OBE	Moorhead PW
Moorhead TOC	City of Moorhead Local Traffic Control Operations	Archived Data User System, Traffic Management Center	Moorhead Engineering
Moorhead Traffic Sensors	City of Moorhead traffic detectors	ITS Roadway Equipment	Moorhead Engineering
Moorhead Traffic Signals	City of Moorhead Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic.	ITS Roadway Equipment	Moorhead Engineering
MSP DL District	Minnesota State Patrol Detroit Lakes District	Emergency Management Center	MSP DL
MSP DL Vehicles	Minnesota State Patrol Detroit Lakes district vehicles	Emergency Vehicle OBE	MSP DL
ND State Radio	ND State Radio	Alerting and Advisory System	ND DES
NDDOT Cameras	NDDOT surveillance PTZ cameras	ITS Roadway Equipment	NDDOT Fargo
NDDOT DMS	NDDOT dynamic message signs	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	NDDOT Fargo
NDDOT Engineers	NDDOT traffic engineers	Traffic Operations Personnel	NDDOT Fargo
NDDOT Fargo Maintenance	NDDOT Fargo District maintenance	Maint and Constr Management Center	NDDOT Fargo

Element Name	Element Description	Associated Physical Objects	Stakeholder
NDDOT Fargo Maintenance Personnel		Maint and Constr Center Personnel	NDDOT Fargo
NDDOT Maint Vehicles	NDDOT snow plows and other maintenance vehicles	Maint and Constr Vehicle OBE	NDDOT Fargo
NDDOT Ramp Meters, NDDOT Traffic Sensors		Connected Vehicle Roadside Equipment, ITS Roadway Equipment	NDDOT Fargo
NDDOT TOC	NDDOT Traffic Operations Center, handles freeway operations and signal control at ramp termini.	Archived Data User System, Traffic Management Center	NDDOT Fargo
NDDOT Traffic Signals	Roadside Equipment includes any and all equipment distributed on and along the roadway which monitors and controls traffic.	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	NDDOT Fargo
NDHP Fargo District	NDHP Fargo District	Emergency Management Center	NDHP Fargo
NDHP Vehicles	NDHP vehicles	Emergency Vehicle OBE	NDHP Fargo
Other Roadway		Other ITS Roadway Equipment	
Pedestrians		Cyclist, Pedestrian	
Rail Wayside Equipment		Wayside Equipment	BNSF Fargo
RRRDC	Red River Regional Dispatch Center	Emergency Management Center	RRRDC Regional Partners
Sanford Ambulance Vehicles	Sanford Ambulance vehicles	Emergency Vehicle OBE	Sanford Ambulance

Element Name	Element Description	Associated Physical Objects	Stakeholder
Traffic		Vehicles	
Traveler		Traveler	
User Personal Computing Devices	User Personal Computing Devices refers to equipment an individual owns and can personalize with their choices for information about transportation networks. E.g., smart phones and internet-connected PCs.	Personal Information Device	
Weather Service System		Weather Service System	
West Fargo Cameras	City of West Fargo surveillance PTZ cameras.	ITS Roadway Equipment	West Fargo Engineering
West Fargo Engineers	City of West Fargo TOC Engineers	Traffic Operations Personnel	
West Fargo PW Operations center	City of Fargo Public Works department	Maint and Constr Management Center	West Fargo Engineering
West Fargo PW Vehicles	City of West Fargo Public Works vehicles, snow plows, and other maintenance vehicles	Maint and Constr Vehicle OBE	West Fargo Engineering
West Fargo TOC	City of West Fargo Surface Street Traffic Management Center	Archived Data User System, Traffic Management Center	West Fargo Engineering
West Fargo TOC Signals	City of West Fargo traffic control devices	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	West Fargo Engineering
West Fargo Traffic Sensors	City of Fargo traffic detection sensors	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	West Fargo Engineering

5.0 SERVICE PACKAGES

This section describes the ITS services selected for the F-M area. These services were identified from previous ITS planning efforts, stakeholders' input throughout the RA update process, 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 components 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 F-M region. The descriptions are from the National ITS Architecture and have been augmented with the narrative about the service in F-M. The status of each service package is also indicated (i.e., existing, planned, or future). Based on different levels of element deployment and capability of the agencies some service packages are identified with instances. Basically, a service package instance is a copy of an ARC-IT service package to allow variations in service deployments in referring the capability of different agencies. Customized F-M service packages and their information flow diagrams are shown in Appendix A.

Table 4: List of Service Packages

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
DM01	ITS Data Warehouse	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
DM02	Performance Monitoring	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.	No	Planned
MC01	Maintenance and Construction Vehicle and Equipment Tracking	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
MC02	Maintenance and Construction Vehicle Maintenance	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.	No	Planned
MC03	Roadway Automated Treatment	This service package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The service package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated.	No	Planned
MC04	Winter Maintenance	This service package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
MC05	Roadway Maintenance and Construction	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.	No	Planned
MC06	Work Zone Management	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.	No	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
MC08	Maintenance and Construction Activity Coordination	This service package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to Transportation Information Centers who can provide the information to travelers. Center to center coordination of work plans supports adjustments to reduce disruption to regional transportation operations.	No	Planned
PS01	Emergency Call-Taking and Dispatch	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PS01	Emergency Call-Taking and Dispatch (Centralized), Emergency Call-Taking and Dispatch (Hybrid)	This service package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Subsystem and an Emergency Vehicle supports dispatch and provision of information to responding personnel.	Yes	Planned
PS01	Emergency Routing (Centralized)	This service package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions, and suggested routing information are provided to enhance emergency vehicle routing. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short-range communications for local signal preemption and the transmission of alerts to surrounding vehicles. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.	Yes	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PS01	Emergency Routing (Hybrid)	This service package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions, and suggested routing information are provided to enhance emergency vehicle routing. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short-range communications for local signal preemption and the transmission of alerts to surrounding vehicles. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PS02	Emergency Response	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.	No	Planned

PS02	Emergency Response (Centralized), Emergency Response (Hybrid)	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 center subsystems. 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 field personnel. The coordination can also	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
		extend to tow trucks and other allied response agencies and field service personnel.		
PS03	Emergency Vehicle Preemption	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PS03	Emergency Vehicle Preemption (Centralized)	This service package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions, and suggested routing information are provided to enhance emergency vehicle routing. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short-range communications for local signal preemption and the transmission of alerts to surrounding vehicles. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.	Yes	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PS03	Emergency Vehicle Preemption (Hybrid)	This service package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions, and suggested routing information are provided to enhance emergency vehicle routing. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short-range communications for local signal preemption and the transmission of alerts to surrounding vehicles. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PS10	Wide-Area Alert	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PS10	Wide-Area Alert (Centralized)	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 web sites.	Yes	Existing

PS12	Disaster Response and Recovery	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	No	Existing

		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 provide 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		

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
		management of traffic-related incidents and occasional management of disasters that require extraordinary response. Disaster Response and Recovery is also supported by PS14, the "Disaster Traveler Information" service package that keeps the public informed during a disaster response. See that service package for more information.		

PS13	Evacuation and Reentry Management	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	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
		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.		

PS14	Disaster Traveler Information	This service package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This service package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems. A disaster will stress the surface transportation system since it may damage transportation facilities at the same time that it places unique demands on these facilities to support public evacuation and provide access for emergency responders. Similarly, a disaster may interrupt or degrade the operation of many traveler information systems at the same time that safety-critical information must be provided to the traveling public. This service package keeps the public informed in these scenarios, using all available means to provide information about the disaster area including damage to the transportation system, detours and closures in effect, special traffic restrictions and allowances, special transit schedules, and real-time information on traffic conditions and transit system performance in and around the disaster. This service package also provides emergency information to assist the public with evacuations when necessary. Information on mandatory and voluntary evacuation zones, evacuation times, and instructions are	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
		provided. Available evacuation routes and destinations and current and anticipated travel conditions along those routes are provided so evacuees are prepared and know their destination and preferred evacuation route. Information on available transit services and traveler services (shelters, medical services, hotels, restaurants, gas stations, etc.) is also provided. In addition to general evacuation information, this service package provides specific evacuation trip planning information that is tailored for the evacuee based on origin, selected destination, and evacuee-specified evacuation requirements and route parameters. This service package augments the Traveler Information (TI) service packages that provide traveler information on a day-to-day basis for the surface transportation system. This service package provides focus on the special requirements for traveler information dissemination in disaster situations.		
PT01	Transit Vehicle Tracking	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PT02	Transit Fixed-Route Operations	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.	No	Existing
PT03	Dynamic Transit Operations	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.	No	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PT04	Transit Fare Collection Management	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. This service supports ad-hoc payments to the transport provider (typically through the 'payment' and 'fare' flows), payments using a transport provider's account system using account-based tokens or integrated multi-provider account systems (typically through the 'account', 'secureID' and 'authorization' flows).	No	Existing

PT05	Transit Security	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	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
		remote transit vehicle disabling and transit vehicle operator authentication by the Transit Management Center.		
PT06	Transit Fleet Management	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.	No	Existing
PT07	Transit Passenger Counting	This service package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.	No	Existing
PT08	Transit Traveler Information	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
PT09	Transit Signal Priority	The Transit Signal Priority service package uses transit vehicle to infrastructure communications to allow a transit vehicle to request priority at one or a series of intersections. The service package provides feedback to the transit driver indicating whether the signal priority has been granted or not. This service package can contribute to improved operating performance of the transit vehicles by reducing the time spent stopped at a red light.	No	Existing
ST05	Electric Charging Stations Management	The Electric Charging Station Management service package provides an exchange of information between the electric vehicle and charging station to manage the charging operation. The agency or company operating the charging station can use vehicle information such as the capability of the vehicle (e.g. operational status of the electrical system, how many amps can the vehicle handle, and % charge complete) to determine that the charge is being properly applied and determine an estimated time to complete charging.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TI01	Broadcast Traveler Information	This service package provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies. This service package also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short-Range Communications (DSRC) infrastructure supporting mobility service packages for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This service package provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM01	Infrastructure-Based Traffic Surveillance	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM01	Infrastructure-Based Traffic Surveillance (Centralized), Infrastructure-Based Traffic Surveillance (Hybrid)	This service package includes traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this 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 Information Service Provider Subsystem.	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM03	Traffic Signal Control	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 strategy 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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM03	Traffic Signal Control (Centralized), Traffic Signal Control (Hybrid)	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 strategy 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 ATMS07-Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM05	Traffic Metering	This service package provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp, interchange, and mainline metering. This package incorporates the instrumentation included in the TM01 service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.	No	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM05	Traffic Metering (Centralized), Traffic Metering (Hybrid)	This service package provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp, interchange, and mainline metering. This package incorporates the instrumentation included in the Network Surveillance service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM06	Traffic Information Dissemination	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM06	Traffic Information Dissemination (Centralized), Traffic Information Dissemination (Hybrid)	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 Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated. The sharing of transportation operations data described in this service package also supports other services like ATMS09-Traffic Decision Support and Demand Management.	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM07	Regional Traffic Management	This service package provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This service package advances the TM03-Traffic Signal Control and TM05-Traffic Metering service packages by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering service packages and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.	No	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM07	Regional Traffic Management (Centralized), Regional Traffic Management (Hybrid)	This service package provides for the sharing of traffic information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This service package advances the ATMS03-Traffic Signal Control and ATMS04-Traffic Metering service packages by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering service packages and adds hardware, software, and fixed-point to fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.	Yes	Planned

TM08	Traffic Incident Management System	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	No	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
		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.		

TM08	Traffic Incident Management System (Centralized), Traffic Incident Management System (Hybrid)	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 center subsystems. 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 field personnel. The coordination can also	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
		extend to tow trucks and other allied response agencies and field service personnel.		
TM13	Standard Railroad Grade Crossing	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM13	Standard Railroad Grade Crossing (Centralized), Standard Railroad Grade Crossing (Hybrid)	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 roadway subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. 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 subsystem.	Yes	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM17	Speed Warning and Enforcement	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.	No	Existing

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM17	Speed Warning and Enforcement (Centralized), Speed Warning and Enforcement (Hybrid)	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 ATMS22-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.	Yes	Planned
TM25	Wrong Way Vehicle Detection and Warning	This service package detects wrong way vehicles on the main roadway and at the exit of divided freeways, tunnels, and bridges. Wrong way vehicle drivers are immediately warned. If the driver continues onto the roadway, warnings are issued to oncoming drivers of the wrong way entry and traffic management and public safety centers are notified.	No	Planned

Service Package	Service Package Name	Service Package Description	Service Package Instance	Service Package Status
TM25	Wrong Way Vehicle Detection and Warning (Centralized), Wrong Way Vehicle Detection and Warning (Hybrid)	--Instance of TM25-- This service package detects wrong way vehicles on the main roadway and at the exit of divided freeways, tunnels, and bridges. Wrong way vehicle drivers are immediately warned. If the driver continues onto the roadway, warnings are issued to oncoming drivers of the wrong way entry and traffic management and public safety centers are notified.	Yes	Planned

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

The set of service packages for the F-M area was the deciding factor used for facilitating the operational concept development. From the Service Package graphics, stakeholders were able to identify their roles and responsibilities to be performed for given events, current links with other stakeholders, and additional links or coordination that could be achieved.

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

The following section outlines the roles and responsibilities of stakeholders in the F-M RA.

6.1 Operational Roles and Responsibilities

Table 5: List of Roles and Responsibilities

Roles and Responsibilities Area	Stakeholder	Roles and Responsibilities Description
Archived Data Systems for Fargo-Moorhead Regional ITS Architecture	ATAC	Store data, Perform studies, Provide access to data
	Fargo Engineering, MnDOT D4, Moorhead Engineering, NDDOT Fargo, West Fargo Engineering	Collect and provide traffic data for archival
Emergency Management for Fargo-Moorhead Regional ITS Architecture	County Sheriffs	Respond to events in county jurisdictions, Coordinate with other law enforcement agencies
	Fargo PD	Coordinate with other law enforcement agencies, Respond to emergencies
	FM Emergency Group	Coordinate plans for large scale incidents/disasters
	Moorhead PD	Respond to emergencies, Coordinate with other law enforcement agencies
	MSP Central	Issue Amber Alerts in Minnesota
	ND DES	Issue Amber Alerts in ND
	NDHP Fargo	Coordinate Amber Alert efforts
	RRRDC Regional Partners	Coordinate with NDHP, MSP, Cass, and Clay counties including all the cities and other agencies, Provide 9-1-1 services for the Fargo-Moorhead area, • Provide dispatch for the city of Fargo, Moorhead, West Fargo, Dilworth, Hawley, Barnesville and Glyndon, Cass, and Clay counties
Freeway Management for Fargo-Moorhead Regional ITS Architecture	MnDOT D4	Manage traffic operations on Minnesota's state system
	NDDOT Fargo	Manage traffic operations on North Dakota's state system
Incident Management for Fargo-Moorhead	County Sheriffs	Respond to incidents on county road system

Roles and Responsibilities Area	Stakeholder	Roles and Responsibilities Description
Regional ITS Architecture	Fargo Engineering	Develop, maintain, and apply incident signal plans, Provide surveillance images to RRRDC and other agencies
	Fargo PD	Direct traffic on city streets, Respond to incidents, Send information out to media, Coordinate response with other law enforcement agencies
	Fargo PW, Moorhead PW, West Fargo PW	Provide resources for clearing incidents
	FM Event Venues	Provide event plans
	MnDOT D4	Provide resources for clearing incidents, Provide surveillance images to MSP and other agencies
	Moorhead Engineering, West Fargo Engineering	Develop, maintain, and apply incident signal plans
	Moorhead PD	Respond to incidents, Send information out to media, Direct traffic on city streets, Coordinate response with other law enforcement agencies
	MSP DL	Respond to incidents on MN state system, Coordinate with other law enforcement and emergency management agencies
	NDDOT Fargo	Provide resources for clearing incidents, Provide surveillance images to NDHP and other agencies, Broadcast traveler information
	NDHP Fargo	Coordinate with other law enforcement and emergency management agencies, Respond to incidents on ND state system
	RRRDC Regional Partners	Provide dispatch and communications, • Coordinate plans for large-scale incidents/ disasters., Coordinate response
	West Fargo PD	Direct traffic on city streets, Coordinate response with other law enforcement agencies

Roles and Responsibilities Area	Stakeholder	Roles and Responsibilities Description
Maintenance and Construction for Fargo-Moorhead Regional ITS Architecture	Fargo PW	Winter maintenance (snow plow operations, sanding, anti-icing) on Fargo city system, Provide maintenance traveler information, City system road maintenance
	MnDOT D4	Winter maintenance (snow plow operations, sanding, anti-icing) on MN state system, Provide maintenance traveler information, Roadway maintenance on MN state system
	Moorhead PW	Moorhead city system road maintenance, Provide maintenance traveler information, Winter maintenance (snow plow operations, sanding, anti-icing) on Moorhead city system
	NDDOT Fargo	Roadway maintenance on ND state system, Provide maintenance traveler information, Winter maintenance (snow plow operations, sanding, anti-icing) on ND state system
	West Fargo PW	City system road maintenance, Provide maintenance traveler information, Winter maintenance (snow plow operations, sanding, anti-icing) on West Fargo city system
Surface Street Management for Fargo-Moorhead Regional ITS Architecture	Fargo Engineering	Design, operate, and maintain signal control in Fargo city system, Coordinate with NDDOT.
	MnDOT D4	Design, operate, and maintain signal control on MN state roads in Moorhead
	Moorhead Engineering	Design, operate, and maintain signal control in Fargo city system, Coordinate activities with MnDOT
	NDDOT Fargo	Signal control at freeway exit ramps
	West Fargo Engineering	Design, operate, and maintain signal control in West Fargo city system, • Coordinate surface street management with NDDOT and the city of Fargo.

Roles and Responsibilities Area	Stakeholder	Roles and Responsibilities Description
Transit Services for Fargo-Moorhead Regional ITS Architecture	Metro Area Transit	Prove transit traveler information via web, kiosks, and mobile app, • Operate transit fixed route and demand response services in Fargo in Fargo and West Fargo, ND, and Moorhead and Dilworth, MN.
Traveler Information for Fargo-Moorhead Regional ITS Architecture	Fargo Engineering	Provide oncoming train information using dynamic message signs.
	MnDOT D4	Provide traveler information on Minnesota state system
	NDDOT Fargo	Provide traveler information on ND state system

7.0 AGREEMENTS

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

The table on the following page shows a summary of potential agreements in the F-M 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 6: List of Potential Agreements

Area	Purpose	Lead Stakeholder	Associated Stakeholders
Centralized TOC	Complete development of Memorandum of Understand (MOU) between MnDOT, NDDOT, Fargo, Moorhead, and West Fargo regarding centralized Traffic Operations for the FM Metropolitan area	FM Traffic Operations Group	Fargo Engineering, MnDOT D4, Moorhead Engineering, NDDOT Fargo, West Fargo Engineering
Connecting Moorhead and Fargo Signal Systems	MOU/JPA between MnTOC and City of Fargo for connecting TOCs on both sides of the river		Fargo Engineering, MnTOC Partners
DM2-ITS Data Warehouse	ATAC will house traffic data for studies and analyses	ATAC	ATAC, Fargo Engineering, Metro Area Transit, MnDOT D4, Moorhead Engineering, NDDOT Fargo, West Fargo Engineering
JPA for Establishing MnTOC	Joint powers agreements for the establishment of MnTOC where the City of Moorhead would take over signal operations for MnDOT signals in Moorhead.	Moorhead Engineering	MnDOT D4
NDDOT Fargo District and City of Fargo Signal Interconnect	The purpose of this agreement is to interconnect NDDOT and City of Fargo signals on shared corridors.	NDDOT Fargo	Fargo Engineering, NDDOT Fargo
NDDOT Fargo District and City of West Fargo Signal Interconnect	Signal interconnect between NDDOT and West Fargo signals on shared corridors.	NDDOT Fargo	NDDOT Fargo, West Fargo Engineering
TM07-Regional Traffic Control	Corridor operations coordination	FM Traffic Operations Group	Fargo Engineering, MnDOT D4, Moorhead Engineering, NDDOT Fargo, West Fargo Engineering

8.0 FUNCTIONAL REQUIREMENTS

This section discusses detailed functional requirements for the user services and service packages identified for the F-M region. The requirements were selected from the National ITS Architecture template based on desired functions for each system. RAD-IT software was used to build the functional requirements and produce 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: the element from F-M 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 7: Sample of Functional Requirements

Element Name	Functional Object	Requirement #	Requirement	Status
County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	2	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
County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	3	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing
County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	4	The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Planned

9.0 ITS STANDARDS

This section identifies applicable ITS Standards identified for the F-M RA. It should be noted that the development of ITS Standards is an ongoing process. Therefore, the set of applicable ITS standards should be updated as new standards are approved. The following table shows applicable standards for the F-M RA based on RAD-IT output. The information in the table is arranged in the following columns:

- SDO: standard development organization
- Standard Number: name and ID number of the document containing the standard
- Standard Title
- Element: the relevant F-M architecture element

Table 8: List of Standards

SDO	Standard Number	Standard Title	Element Name
Advanced Traffic Controller Joint Committee	ITE ATC 5201	Advanced Transportation Controller	Fargo Cameras, Fargo PW Roadside Equipment, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM DMS, FM FAST Anti-icing Systems, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, Moorhead Cameras, Moorhead DMS, Moorhead Traffic Sensors, Moorhead Traffic Signals, NDDOT Cameras, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo Cameras, West Fargo TOC Signals, West Fargo Traffic Sensors

SDO	Standard Number	Standard Title	Element Name
Advanced Traffic Controller Joint Committee	ITE ATC 5202	Model 2070 Controller Standard	Fargo Cameras, Fargo PW Roadside Equipment, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM DMS, FM FAST Anti-icing Systems, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, Moorhead Cameras, Moorhead DMS, Moorhead Traffic Sensors, Moorhead Traffic Signals, NDDOT Cameras, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo Cameras, West Fargo TOC Signals, West Fargo Traffic Sensors

SDO	Standard Number	Standard Title	Element Name
Advanced Traffic Controller Joint Committee	ITE ATC 5301	Intelligent Transportation System Standard Specification for Roadside Cabinets	Fargo Cameras, Fargo PW Roadside Equipment, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM DMS, FM FAST Anti-icing Systems, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, Moorhead Cameras, Moorhead DMS, Moorhead Traffic Sensors, Moorhead Traffic Signals, NDDOT Cameras, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo Cameras, West Fargo TOC Signals, West Fargo Traffic Sensors

SDO	Standard Number	Standard Title	Element Name
Advanced Traffic Controller Joint Committee	ITE ATC 5401	Application Programming Interface Standard for the Advanced Transportation Controller	Fargo Cameras, Fargo PW Roadside Equipment, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM DMS, FM FAST Anti-icing Systems, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, Moorhead Cameras, Moorhead DMS, Moorhead Traffic Sensors, Moorhead Traffic Signals, NDDOT Cameras, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo Cameras, West Fargo TOC Signals, West Fargo Traffic Sensors

International Organization for Standardization	ISO 21217	Intelligent transport systems -- Communications access for land mobiles (CALM) -- Architecture	Cass County Maint Vehicles, Cass County Maintenance, Clay County Maintenance, County Sheriff Vehicles, Emergency Personnel Device, EV Charging Station, Fargo Cameras, Fargo FD Vehicles, Fargo PD Vehicles, Fargo PW Operations Center, Fargo PW Roadside Equipment, Fargo PW Vehicle, Fargo TOC, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM Data Warehouse, FM DMS, FM Emergency Management, FM Emergency Vehicles, FM FAST Anti-icing Systems, FM Information Service Providers, FM Maintenance and Construction Management, FM Maintenance Vehicles, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM TOC, FM Traffic Operations, FM Traffic Sensors, MAT Kiosks, MAT Vehicles, MATBus, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Maint Vehicles, MnDOT D4 Maintenance, MnDOT D4 TOC, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, MnTOC, Moorhead Cameras, Moorhead DMS, Moorhead FD Vehicles, Moorhead PD Vehicles, Moorhead PW Operations Center, Moorhead PW Vehicles, Moorhead TOC, Moorhead Traffic Sensors, Moorhead Traffic Signals, MSP DL District, MSP DL Vehicles, NDDOT Cameras, NDDOT DMS, NDDOT

SDO	Standard Number	Standard Title	Element Name
			Fargo Maintenance, NDDOT Maint Vehicles, NDDOT Ramp Meters, NDDOT TOC, NDDOT Traffic Sensors, NDDOT Traffic Signals, NDHP Fargo District, NDHP Vehicles, RRRDC, Sanford Ambulance Vehicles, User Personal Computing Devices, West Fargo Cameras, West Fargo PW Operations center, West Fargo PW Vehicles, West Fargo TOC, West Fargo TOC Signals, West Fargo Traffic Sensors
National Electrical Manufacturers Association	NEMA TS 5	Portable Traffic Signal Systems (PTSS) Standard	Fargo Cameras, Fargo PW Roadside Equipment, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM DMS, FM FAST Anti-icing Systems, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, Moorhead Cameras, Moorhead DMS, Moorhead Traffic Sensors, Moorhead Traffic Signals, NDDOT Cameras, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo Cameras, West Fargo TOC Signals, West Fargo Traffic Sensors

SDO	Standard Number	Standard Title	Element Name
National Electrical Manufacturers Association	NEMA TS 8	Cyber and Physical Security for Intelligent Transportation Systems	Cass County Maintenance, Clay County Maintenance, Fargo Cameras, Fargo PW Operations Center, Fargo PW Roadside Equipment, Fargo TOC, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM Data Warehouse, FM DMS, FM Emergency Management, FM FAST Anti-icing Systems, FM Maintenance and Construction Management, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM TOC, FM Traffic Operations, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Maintenance, MnDOT D4 TOC, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, MnTOC, Moorhead Cameras, Moorhead DMS, Moorhead PW Operations Center, Moorhead TOC, Moorhead Traffic Sensors, Moorhead Traffic Signals, MSP DL District, NDDOT Cameras, NDDOT DMS, NDDOT Fargo Maintenance, NDDOT Ramp Meters, NDDOT TOC, NDDOT Traffic Sensors, NDDOT Traffic Signals, NDHP Fargo District, RRRDC, West Fargo Cameras, West Fargo PW Operations center, West Fargo TOC, West Fargo TOC Signals, West Fargo Traffic Sensors

SDO	Standard Number	Standard Title	Element Name
National Electrical Manufacturers Association	NEMA TS2	Traffic Controller Assemblies with NTCIP Requirements	Fargo Cameras, Fargo PW Roadside Equipment, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM DMS, FM FAST Anti-icing Systems, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, Moorhead Cameras, Moorhead DMS, Moorhead Traffic Sensors, Moorhead Traffic Signals, NDDOT Cameras, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo Cameras, West Fargo TOC Signals, West Fargo Traffic Sensors

SDO	Standard Number	Standard Title	Element Name
National Electrical Manufacturers Association	NEMA TS4	Hardware Standards for Dynamic Message Signs (DMS) With NTCIP Requirements	Fargo Cameras, Fargo PW Roadside Equipment, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM DMS, FM FAST Anti-icing Systems, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, Moorhead Cameras, Moorhead DMS, Moorhead Traffic Sensors, Moorhead Traffic Signals, NDDOT Cameras, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo Cameras, West Fargo TOC Signals, West Fargo Traffic Sensors

National Institute for Standards and Technology	NIST FIPS PUB 140-2	Security Requirements for Cryptographic Modules	Cass County Maint Vehicles, Cass County Maintenance, Clay County Maintenance, County Sheriff Vehicles, Emergency Personnel Device, EV Charging Station, Fargo Cameras, Fargo FD Vehicles, Fargo PD Vehicles, Fargo PW Operations Center, Fargo PW Roadside Equipment, Fargo PW Vehicle, Fargo TOC, Fargo TOC DMS, Fargo Traffic Sensors, Fargo Traffic Signals, FM Cameras, FM Data Warehouse, FM DMS, FM Emergency Management, FM Emergency Vehicles, FM FAST Anti-icing Systems, FM Information Service Providers, FM Maintenance and Construction Management, FM Maintenance Vehicles, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM TOC, FM Traffic Operations, FM Traffic Sensors, MAT Kiosks, MAT Vehicles, MATBus, MnDOT D4 Cameras, MnDOT D4 DMS, MnDOT D4 Maint Vehicles, MnDOT D4 Maintenance, MnDOT D4 TOC, MnDOT D4 Traffic Sensors, MnDOT D4 Traffic Signals, MnTOC, Moorhead Cameras, Moorhead DMS, Moorhead FD Vehicles, Moorhead PD Vehicles, Moorhead PW Operations Center, Moorhead PW Vehicles, Moorhead TOC, Moorhead Traffic Sensors, Moorhead Traffic Signals, MSP DL District, MSP DL Vehicles, NDDOT Cameras, NDDOT DMS, NDDOT

SDO	Standard Number	Standard Title	Element Name
			Fargo Maintenance, NDDOT Maint Vehicles, NDDOT Ramp Meters, NDDOT TOC, NDDOT Traffic Sensors, NDDOT Traffic Signals, NDHP Fargo District, NDHP Vehicles, RRRDC, Sanford Ambulance Vehicles, User Personal Computing Devices, West Fargo Cameras, West Fargo PW Operations center, West Fargo PW Vehicles, West Fargo TOC, West Fargo TOC Signals, West Fargo Traffic Sensors
	CTI 4001	Dedicated Short-Range Communications Roadside Unit Specifications (FHWA-JPO-17-589)	Fargo PW Roadside Equipment, Fargo Traffic Sensors, Fargo Traffic Signals, FM DMS, FM Rail Crossing Equipment, FM Signals, FM Speed Warning Devices, FM Traffic Sensors, NDDOT DMS, NDDOT Ramp Meters, NDDOT Traffic Sensors, NDDOT Traffic Signals, West Fargo TOC Signals, West Fargo Traffic Sensors

10.0 PLANNING ASPECTS

This section recognizes the relationship between the region's long-term planning process and ITS architecture. Particularly, the ITS operational objective, strategies, and associated performance measures are directly associated with the ITS services and projects of an ITS architecture. Therefore, established objectives within different goal areas with specific and measurable action plan should be identified and linked with appropriate service packages in the architecture. This will essentially help defining projects required to be attempted or completed for the successful implementation of the Transportation Systems Management and Operations (TSMO) strategies.

In this architecture, two levels of planning components are applied. Those components are customized as 'Goal' and 'Objective' to coordinate with the 2045 Fargo-Moorhead Transportation Plan document, also known as Metro Grow. However, the prioritization metrics of the Metro Grow document is identified as 'Performance Measure'. The associated service packages for the applicable goals and objectives are depicted in Table 10.1.

10.1 Planning and the Regional ITS Architecture (Metro Grow)

Goal	Objective	Performance Measure	Service Package
System safety and security	Reduce the number and rate of serious injury and fatal crashes.	Review crash modification factors to determine potential project impact on these individual safety categories.	PS03: Emergency Vehicle Preemption PS03: Emergency Vehicle Preemption (Centralized) PS03: Emergency Vehicle Preemption (Hybrid) PT05: Transit Security
	Policy Objective: Improve transit system security.	Policy objective, no project scoring	
Travel Efficiency and Reliability	Improve the connectivity of the street network and promote a grid street pattern.	Project would complete a street system connection where one does not currently exist, has the potential to reduce out-of-direction travel, and is context sensitive.	DM02: Performance Monitoring MC04: Winter Maintenance MC06: Work Zone Management MC08: Maintenance and

Goal	Objective	Performance Measure	Service Package
	Improve travel reliability on the NHS and arterial roadways.	Project would improve safety or system management in a corridor with reliability issues. At a policy level, this would be part of the Congestion Management Plan and on-going system monitoring.	Construction Activity Coordination TM01: Infrastructure-Based Traffic Surveillance TM01: Infrastructure-Based Traffic Surveillance (Centralized) TM01: Infrastructure-Based Traffic Surveillance (Hybrid) TM03: Traffic Signal Control TM03: Traffic Signal Control (Centralized) TM03: Traffic Signal Control (Hybrid) TM07: Regional Traffic Management TM07: Regional Traffic Management (Centralized) TM07: Regional Traffic Management (Hybrid)
	Limit recurring peak period delay on the NHS and arterial roadways.	Project would improve traffic operations/ improve forecasted level-of-service (use LOS E/F as deficiency). At a policy level, this would be part of the Congestion Management Plan and on-going system monitoring.	
	Promote consistent corridor traffic flow with reduced starting and stopping.	Project would reduce create less starting and stopping of traffic. Examples include: innovative intersections, minimize traffic signals, adaptive signals, freeway and arterial management technologies, and innovative street treatments.	
Transit Access	Develop transit-intensive corridors with supportive structures	Policy objective, no project scoring. Potential to score transit projects.	PT09: Transit Signal Priority
Maintain Transportation Infrastructure	Continue to maintain NHS routes in good condition, and minimize NHS routes in poor condition.	Policy and system performance objectives, no project scoring in Plan. Use pavement and bridge investment models to estimate long term asset management investment needs. Maintenance projects will be included in MTP project list.	MC05: Roadway Maintenance and Construction MC08: Maintenance and Construction Activity Coordination
Environmental Sustainability	Reduce transportation system energy consumption.	Evaluate project-level VMT / VHT for potential reduced energy, and consider	ST05: Electric Charging Stations Management

Goal	Objective	Performance Measure	Service Package
		projects that promote transportation technology (ITS, system management, autonomous vehicles). Air Quality is a secondary benefit of this objective.	
Emerging Transportation Trends	Identify projects and strategies that can accommodate emerging transportation technologies.	"Does project improve system communications? Policy-based objective with MTP narrative."	TM25: Wrong Way Vehicle Detection and Warning TM25: Wrong Way Vehicle Detection and Warning (Centralized) TM25: Wrong Way Vehicle Detection and Warning (Hybrid)

Couple of planning goals are recognized in this architecture as per the existing Fargo-Moorhead ITS deployment plan and ongoing performance measurement effort among stakeholders.

10.2 Planning and the Regional ITS Architecture (Other)

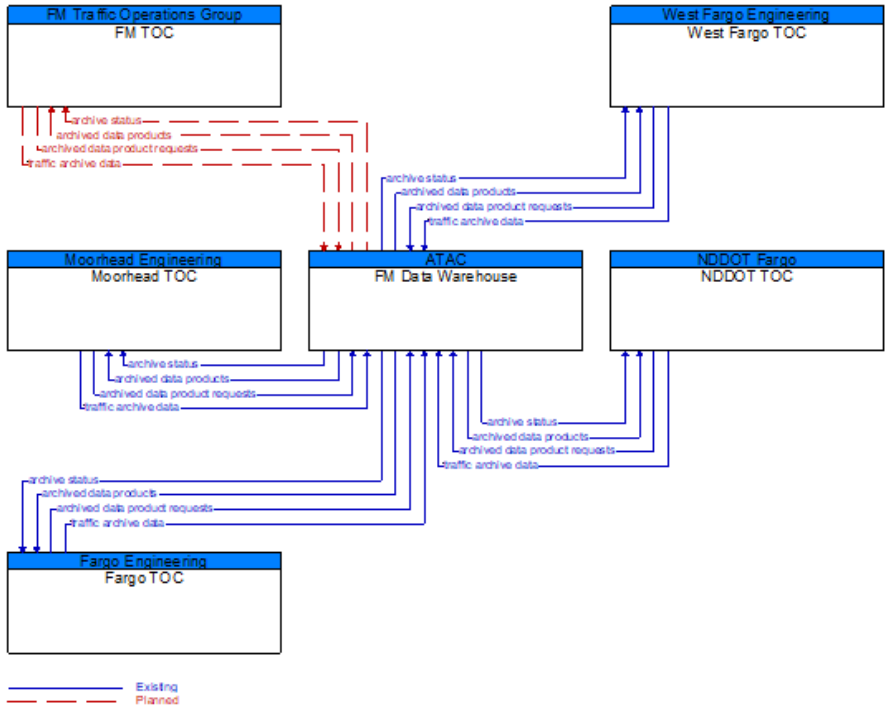
Goal	Service Package
Enhance coordination among regional transportation agencies	MC08: Maintenance and Construction Activity Coordination PS12: Disaster Response and Recovery PS13: Evacuation and Reentry Management PS14: Disaster Traveler Information PT08: Transit Traveler Information TM06: Traffic Information Dissemination TM06: Traffic Information Dissemination (Centralized) TM06: Traffic Information Dissemination (Hybrid) TM07: Regional Traffic Management TM07: Regional Traffic Management (Centralized) TM07: Regional Traffic Management (Hybrid) TM08: Traffic Incident Management System TM08: Traffic Incident Management System (Centralized) TM08: Traffic Incident Management System (Hybrid)
Performance Measures	DM01: ITS Data Warehouse DM02: Performance Monitoring

APPENDIX-A

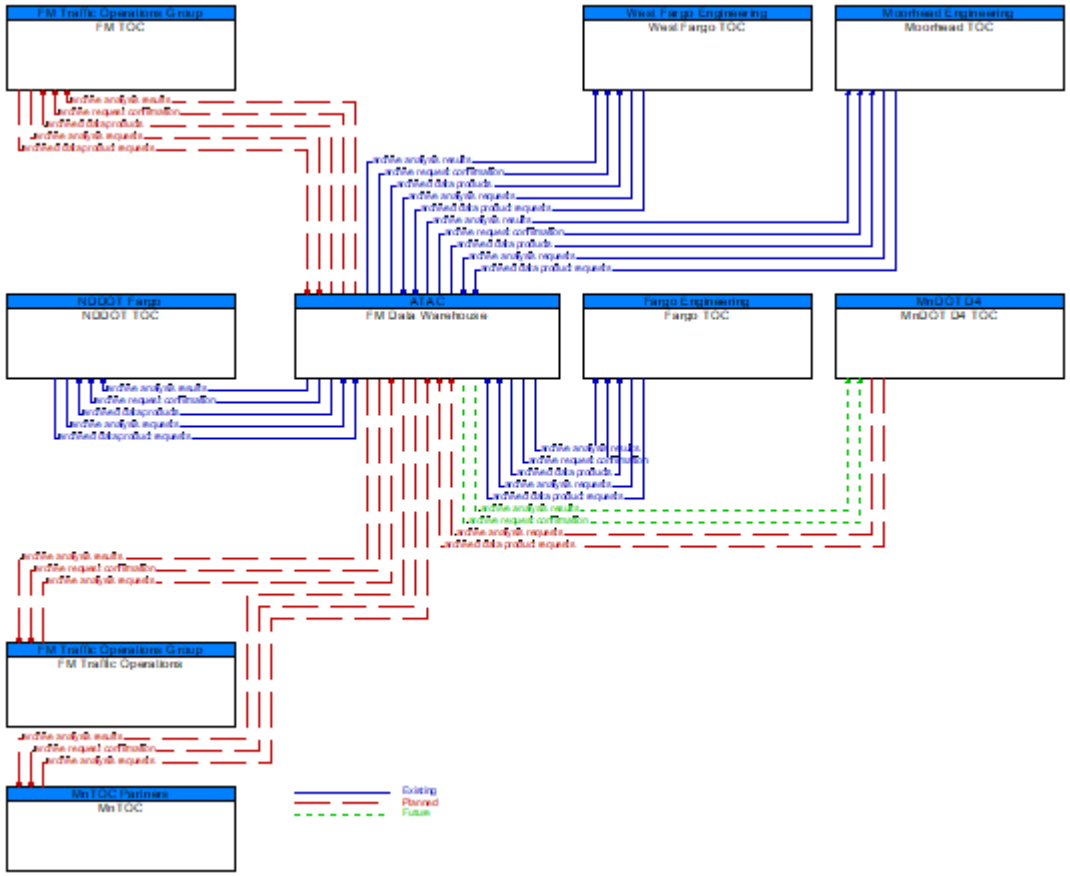
FARGO-MOORHEAD SERVICE PACKAGES AND INFORMATION FLOWS

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

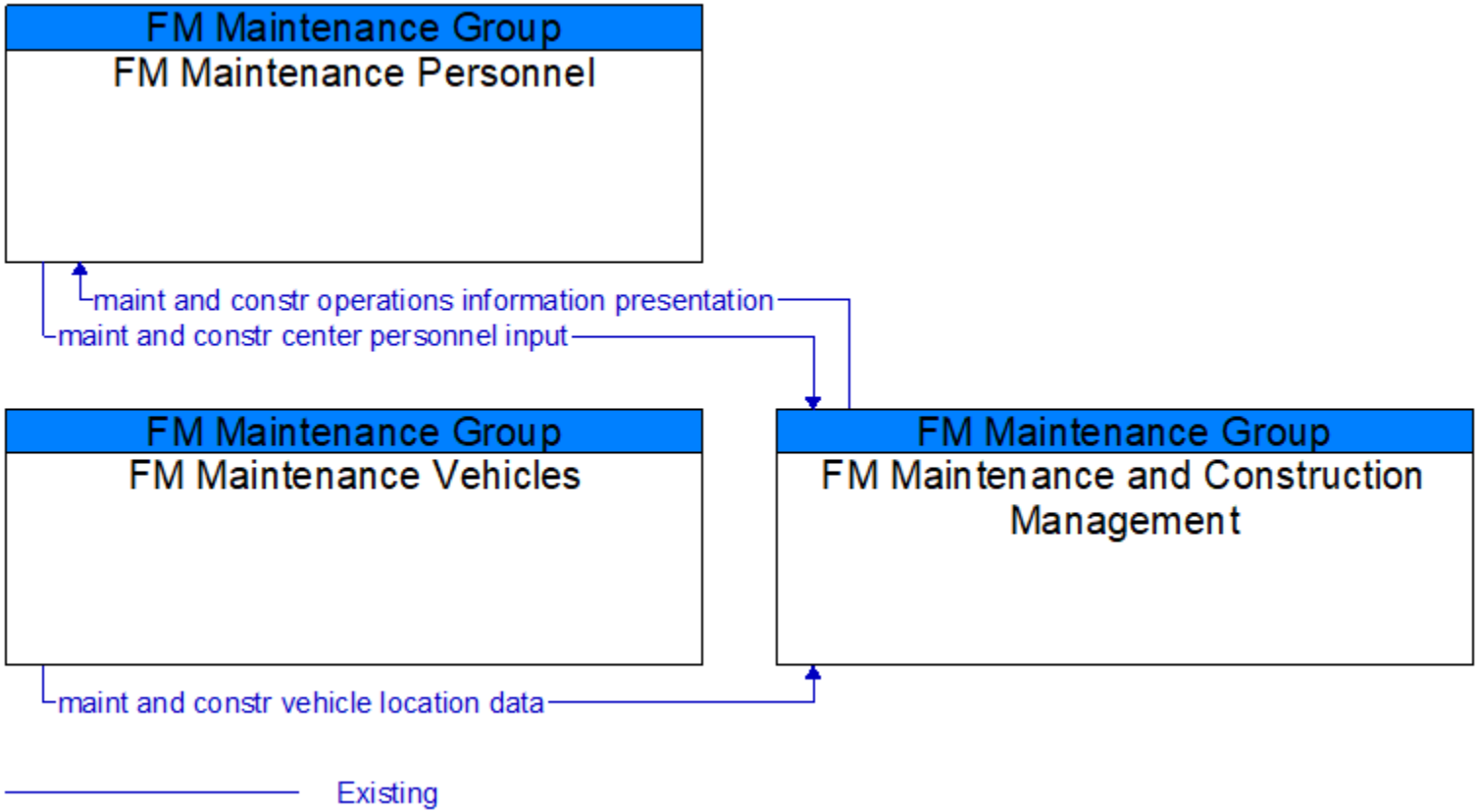
DM01 ITS Data Warehouse



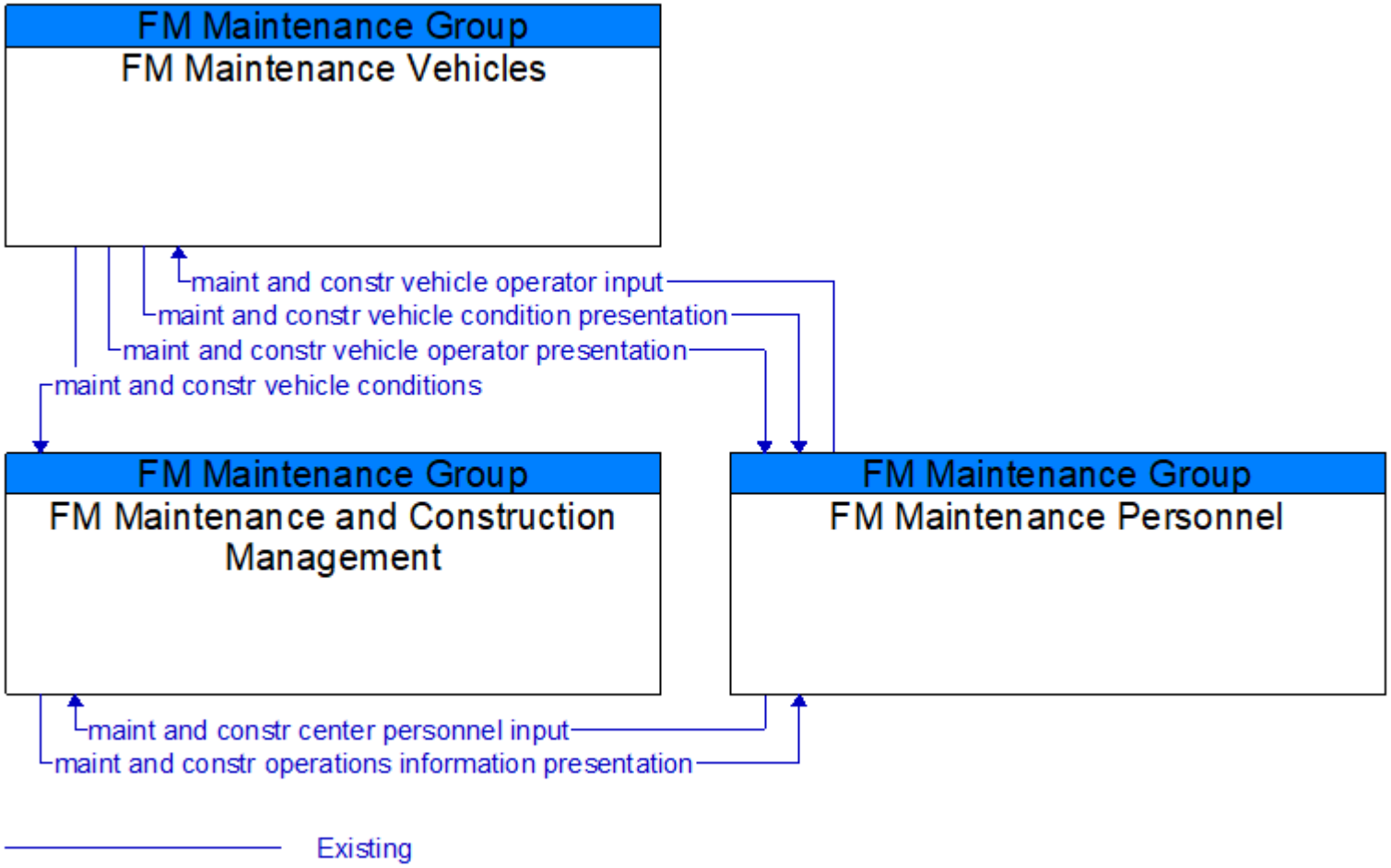
DM02 Performance Monitoring



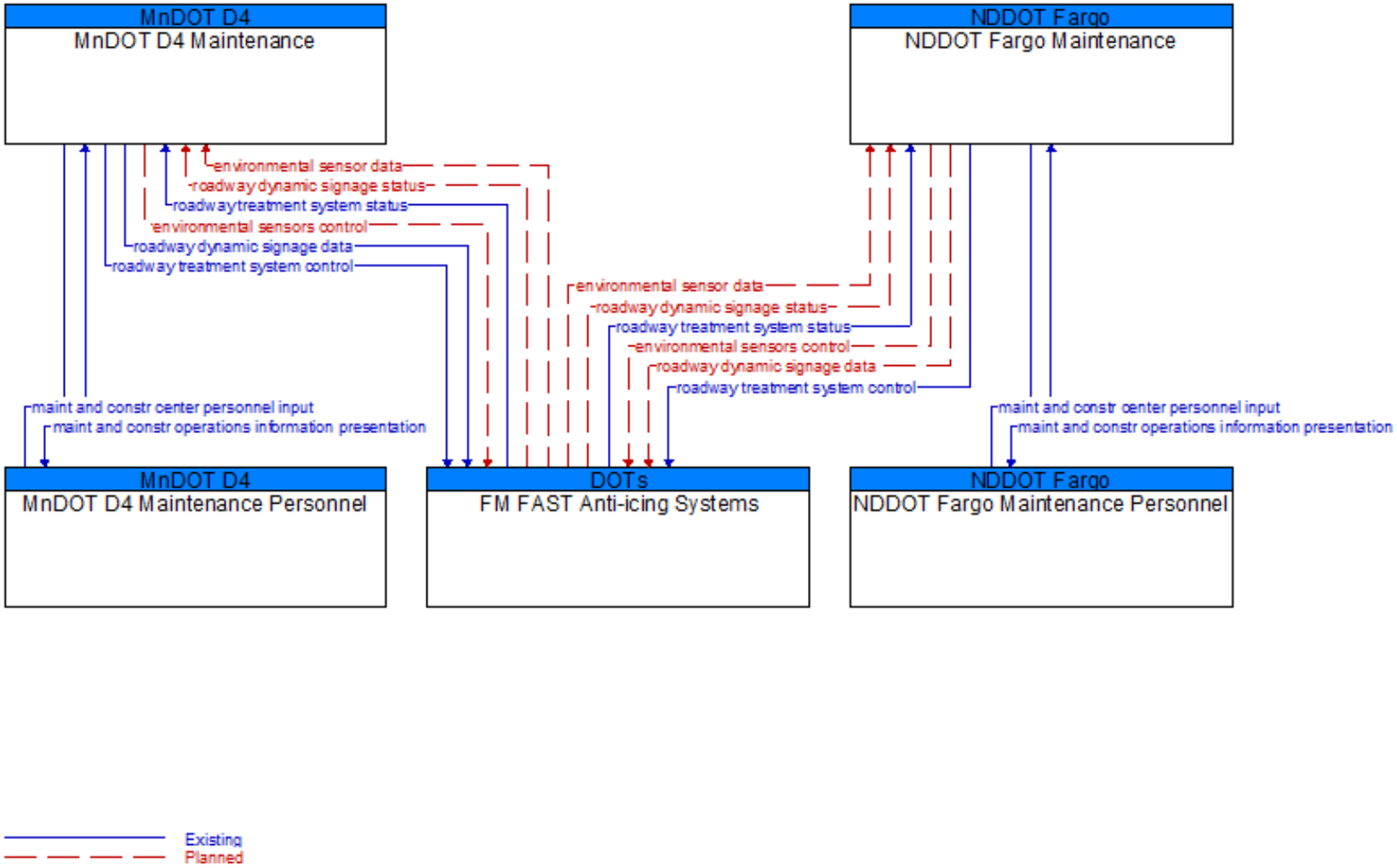
MC01 Maintenance and Construction Vehicle and Equipment Tracking



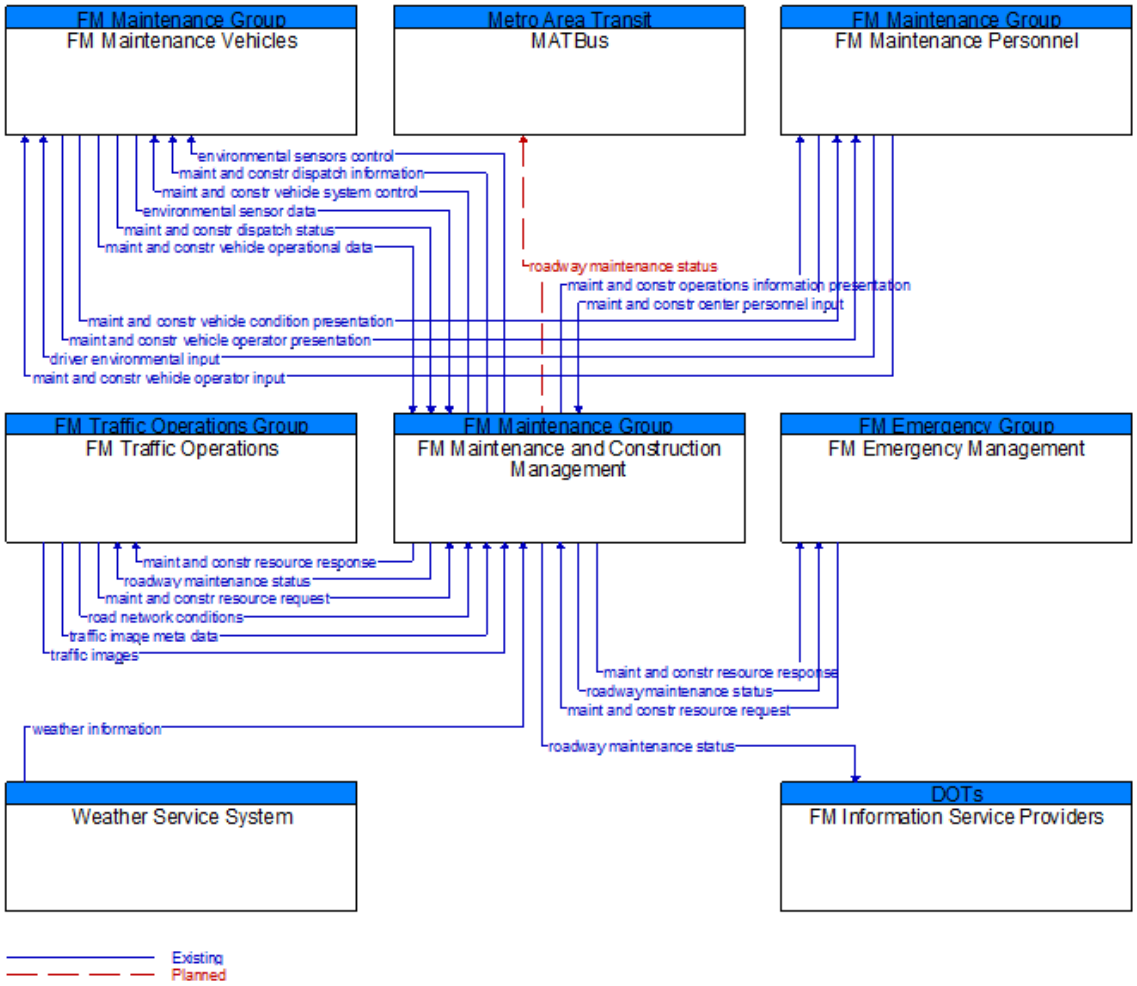
MC02 Maintenance and Construction Vehicle Maintenance



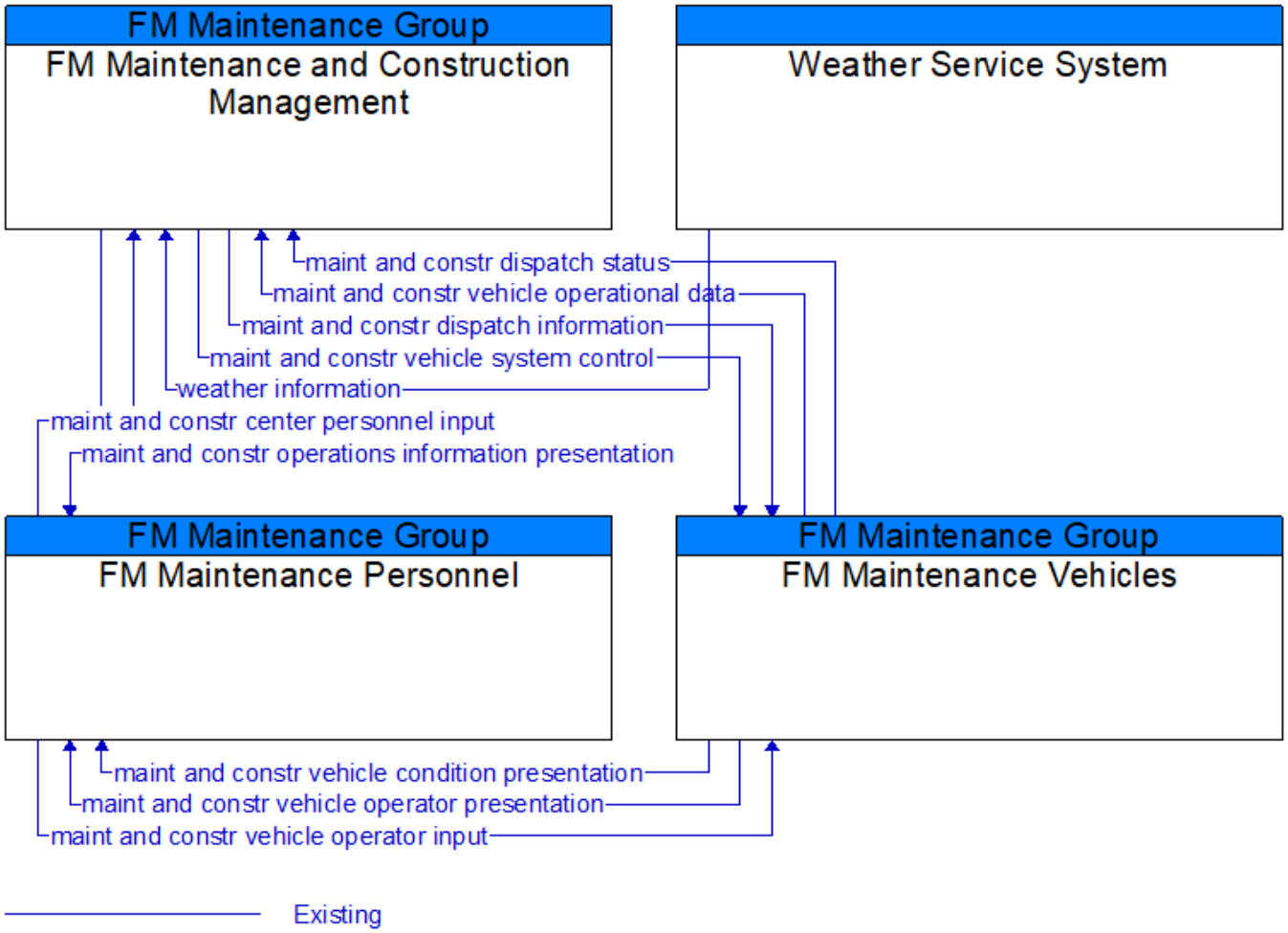
MC03-RoadwayAutomatedTreatment



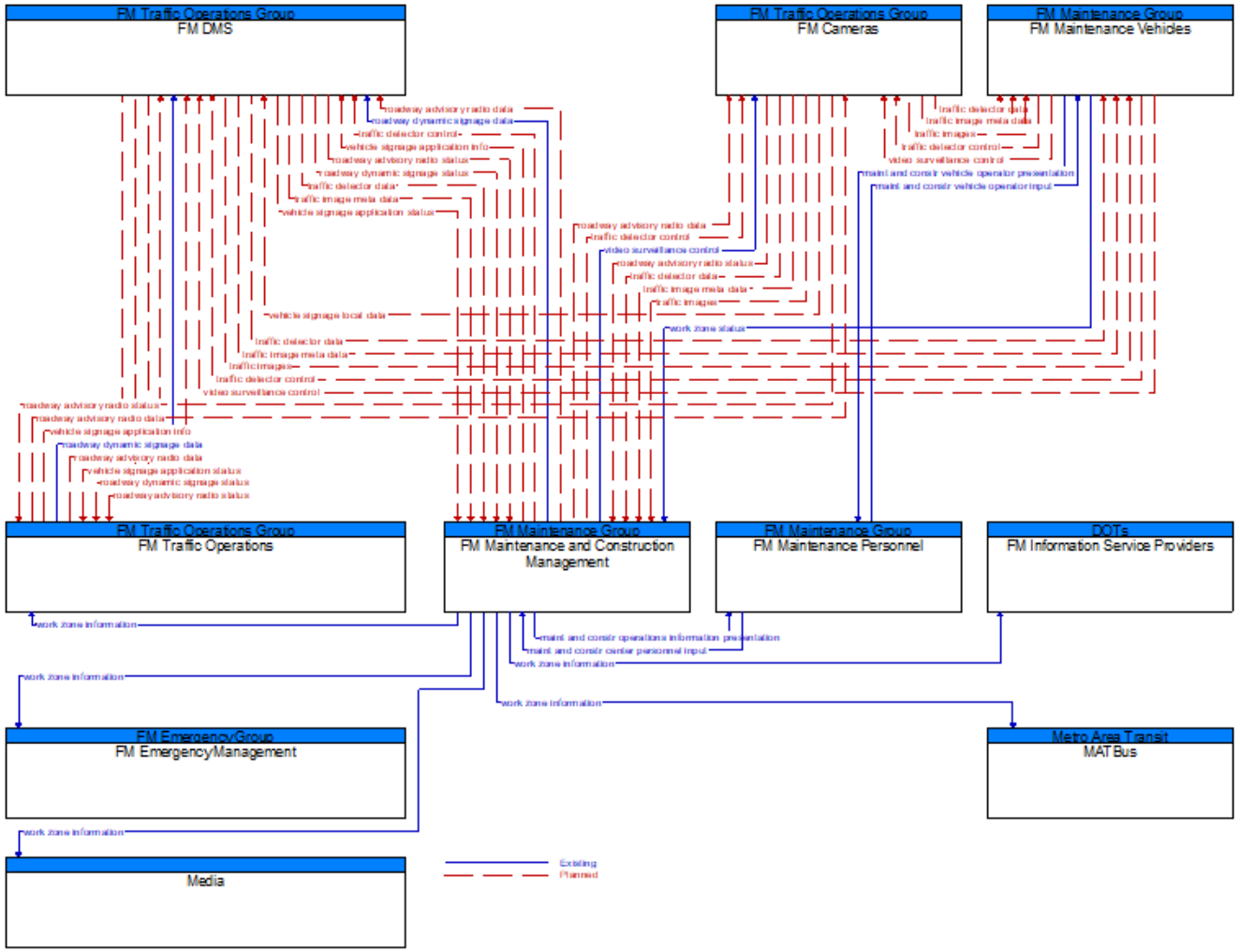
MC04 Winter Maintenance



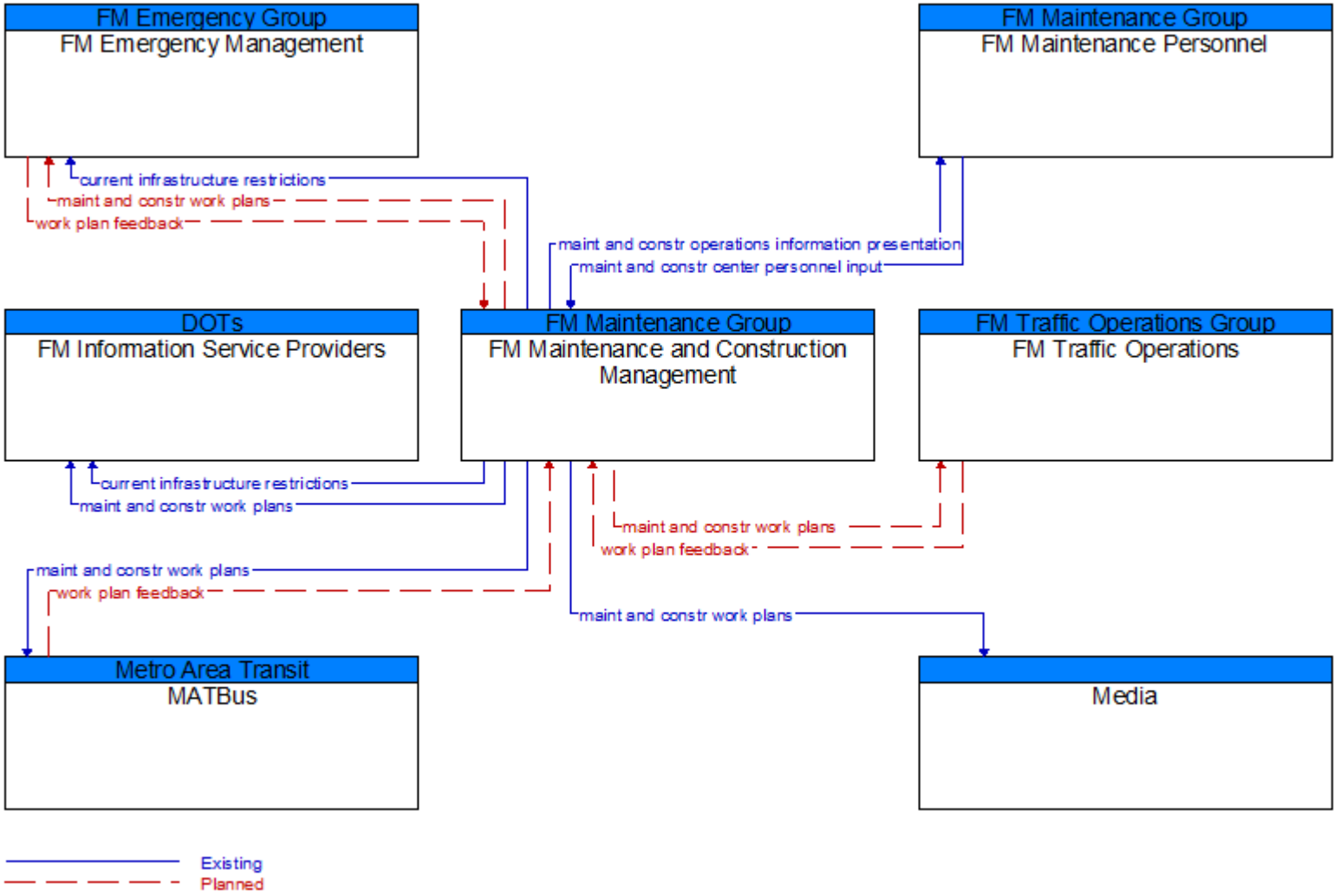
MC05 Roadway Maintenance and Construction



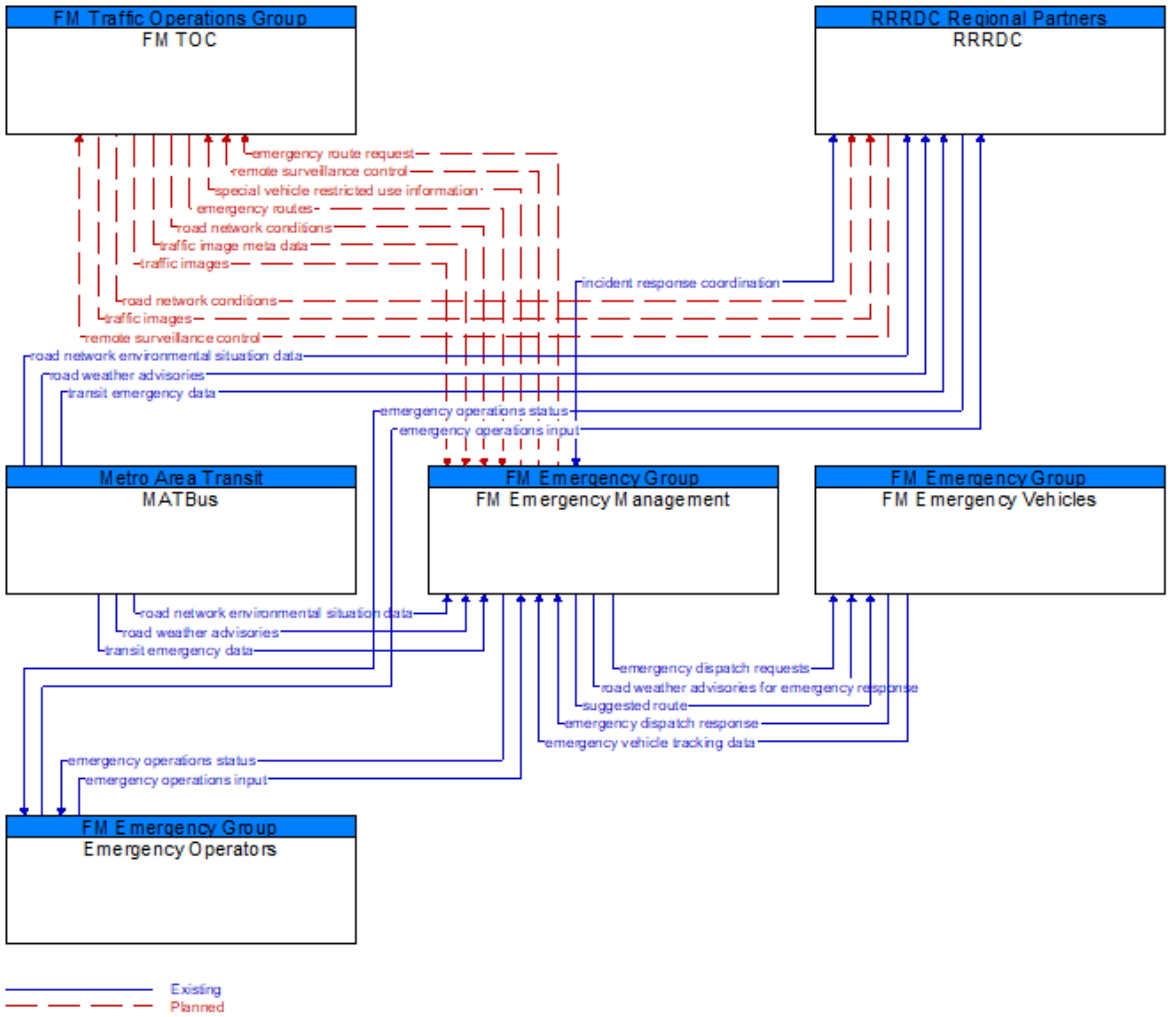
MC06 Work Zone Management

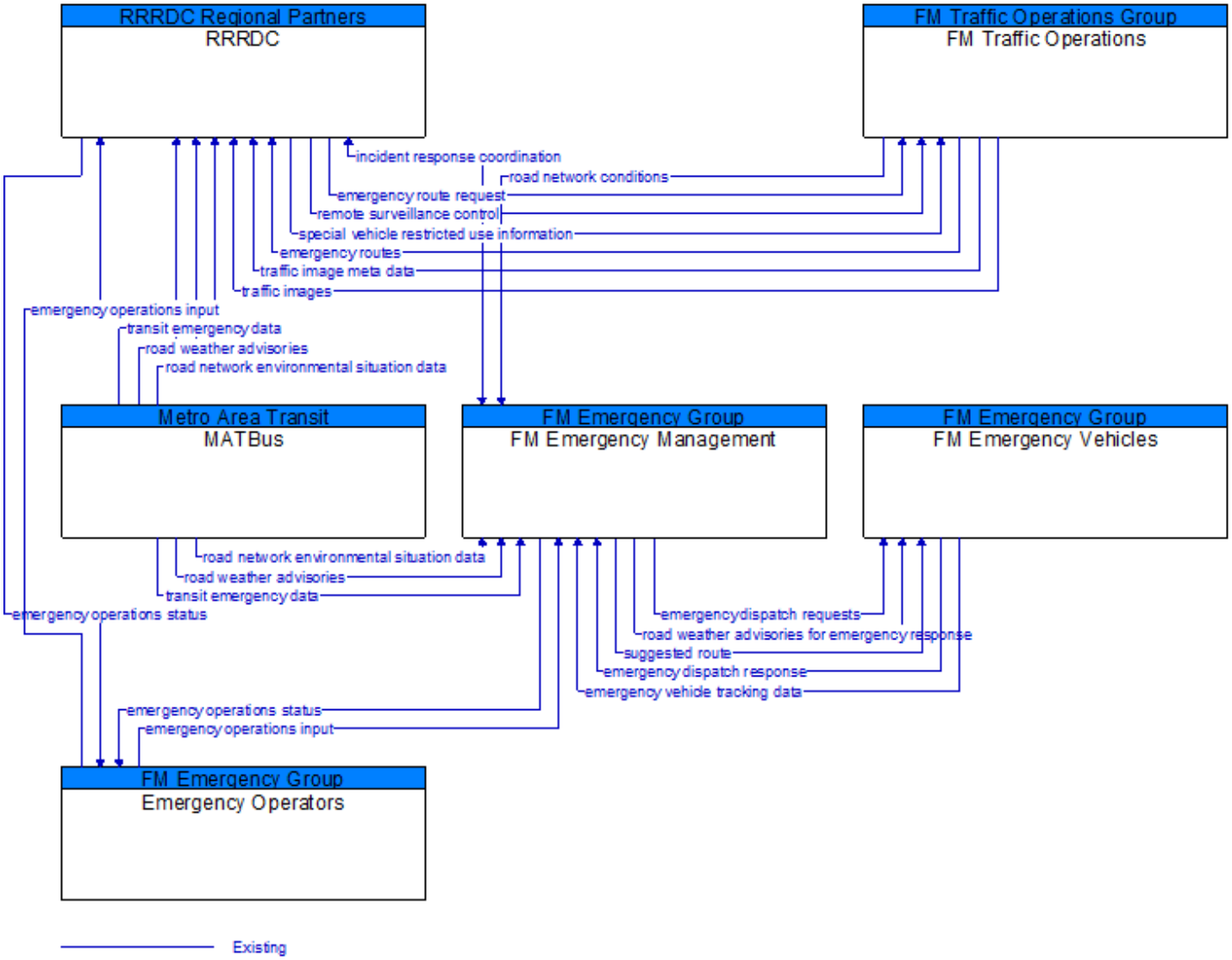


MC08-Maintenanceand Construction Activity Coordination



PS01 Emergency Call-Taking and Dispatch




RRRDC Regional Partners
RRRDC
FM Traffic Operations Group
FM Traffic Operations
incident response coordination
road network conditions
emergency route request
remote surveillance control
special vehicle restricted use information
emergency routes
traffic image meta data
traffic images
emergency operations input
transit emergency data
road weather advisories
road network environmental situation data
Metro Area Transit
MATBus
FM Emergency Group
FM Emergency Management
FM Emergency Group
FM Emergency Vehicles
road network environmental situation data
road weather advisories
transit emergency data
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emergency dispatch response
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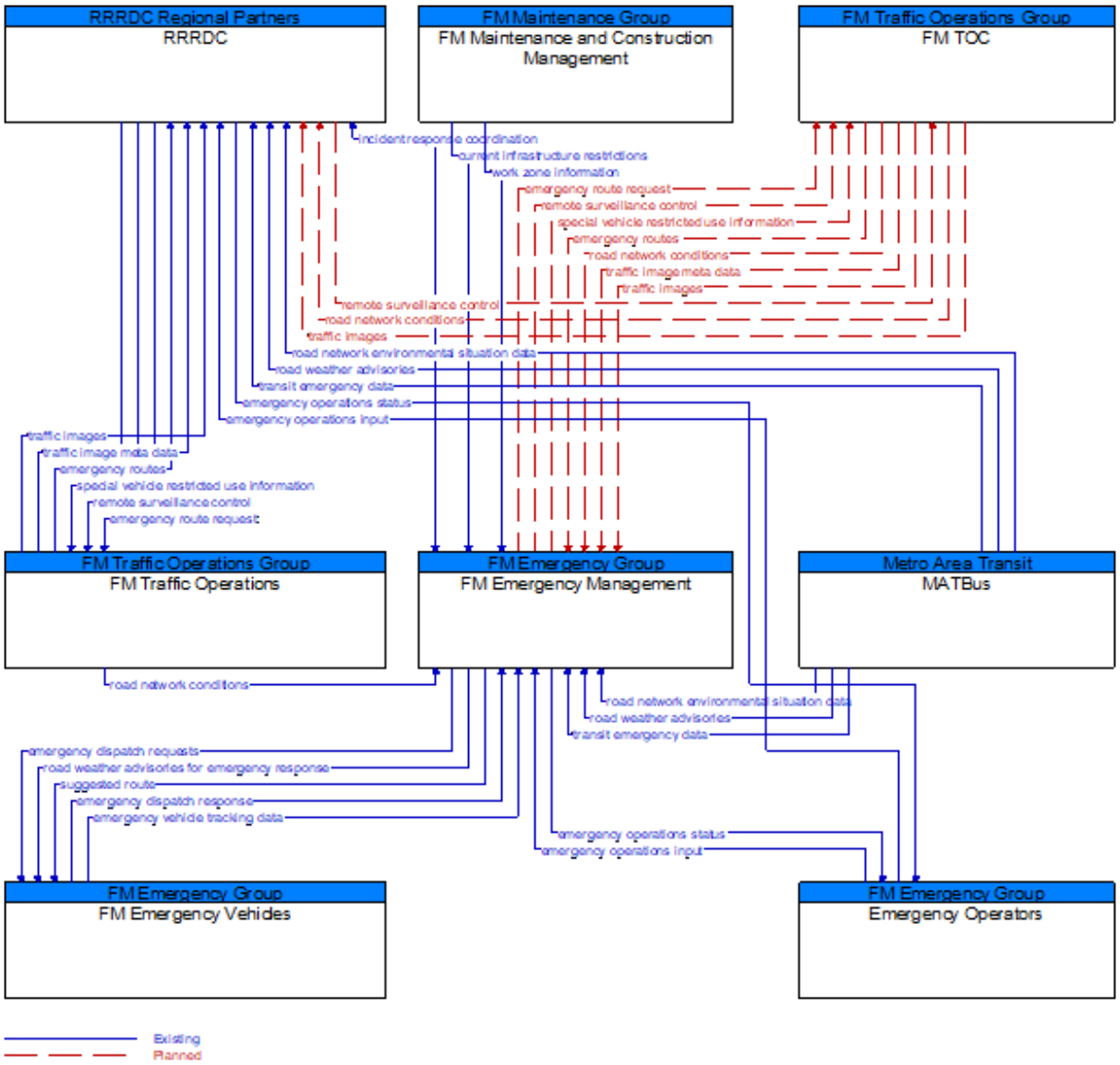
emergency operations input
FM Emergency Group
Emergency Operators
Existing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FM Traffic Operations Group
FM Traffic Operations
FM Emergency Group
FM Emergency Management
Metro Area Transit
MATBus
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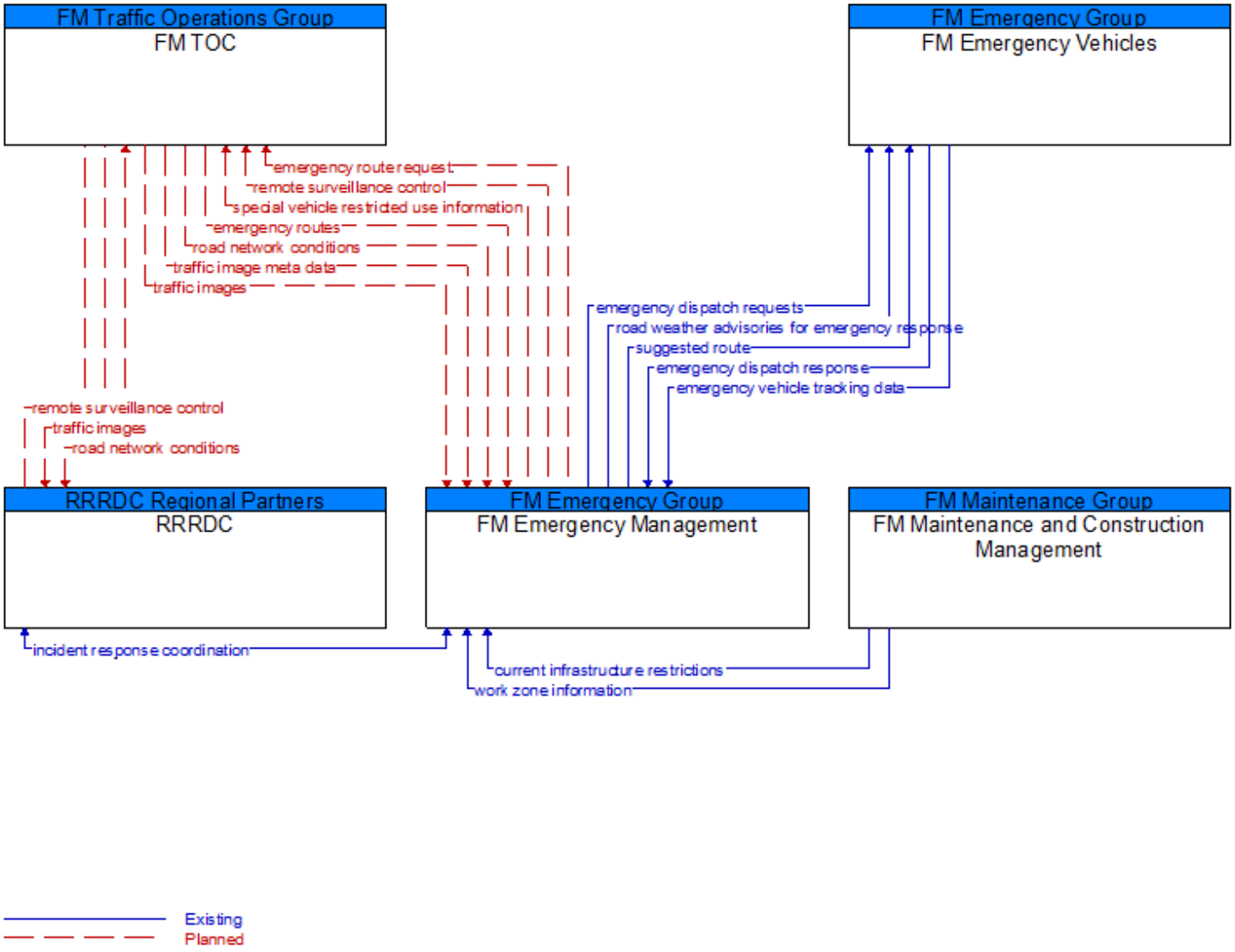
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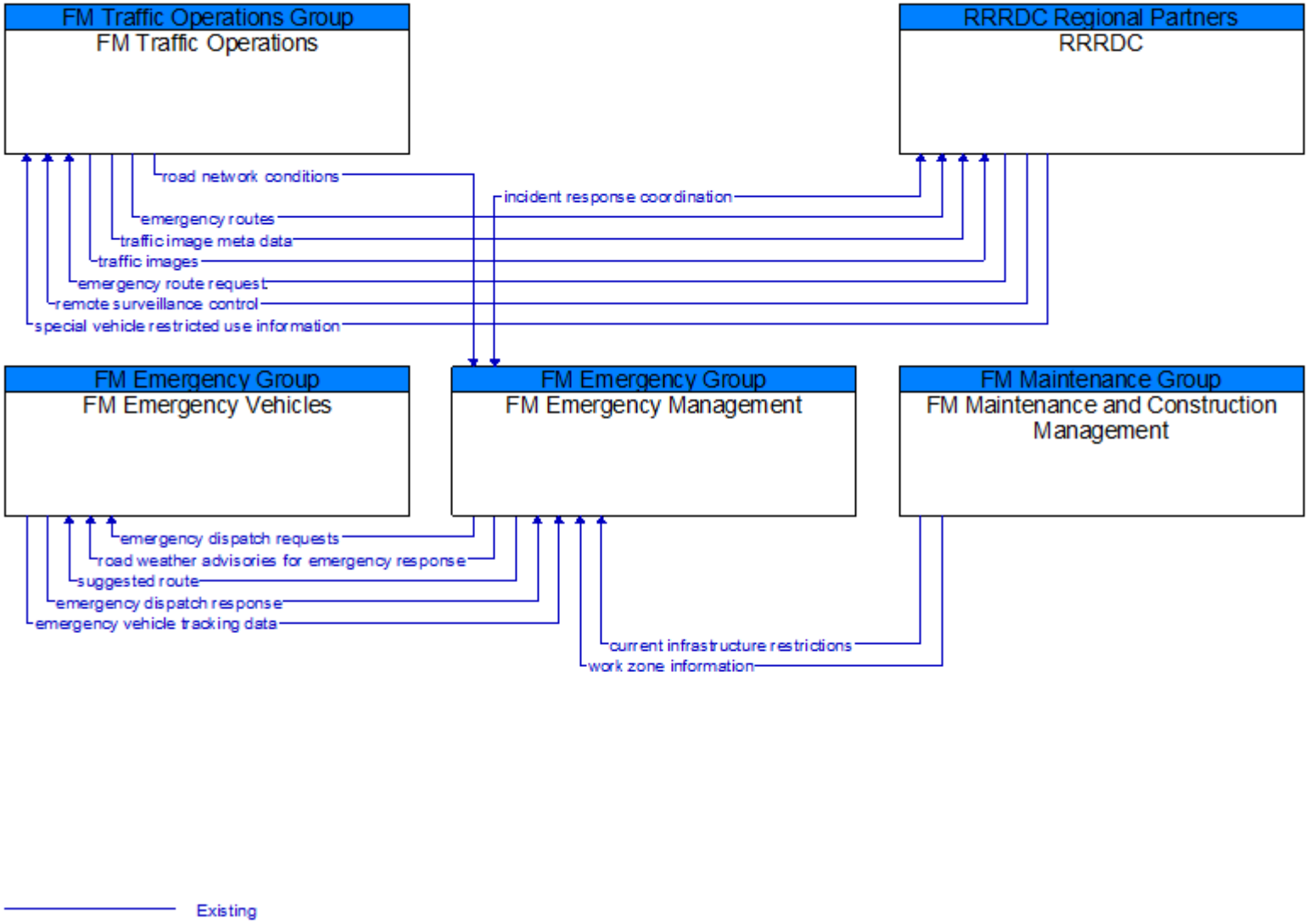
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FM Maintenance Group
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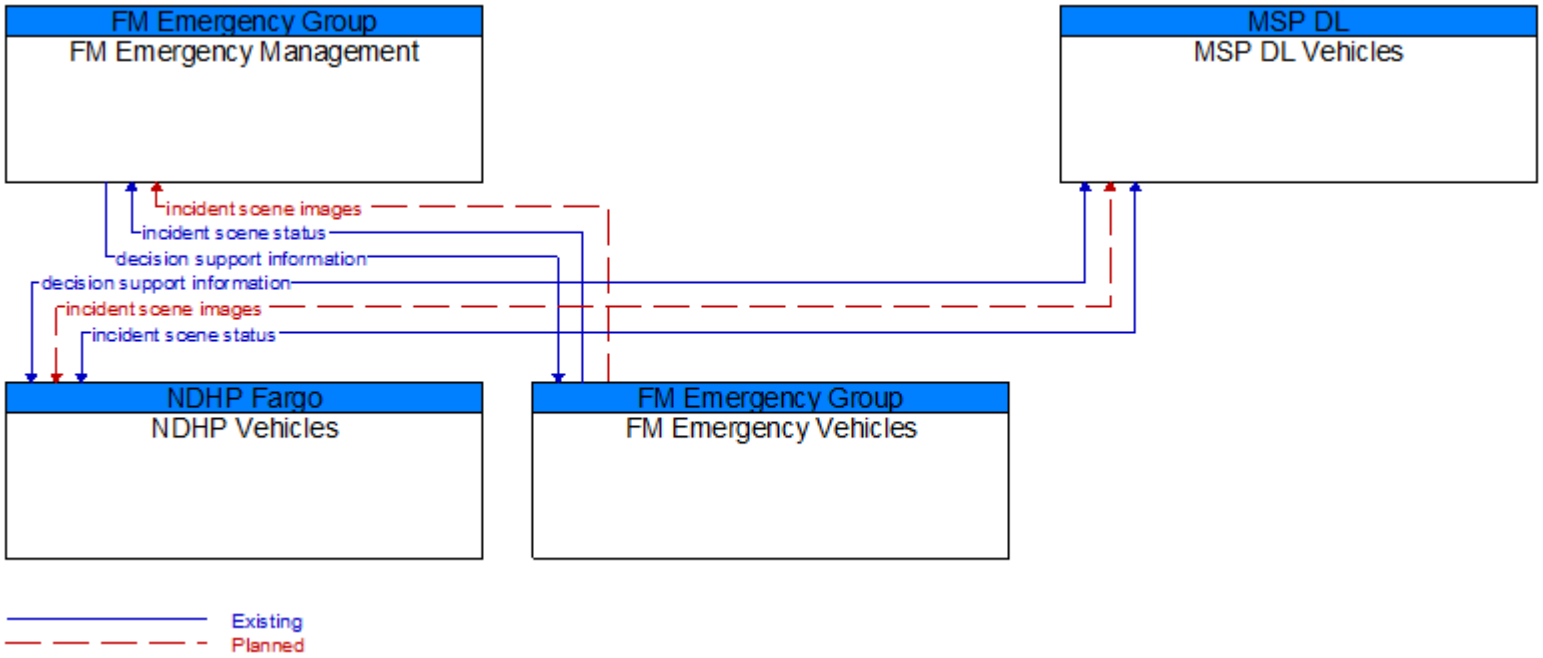
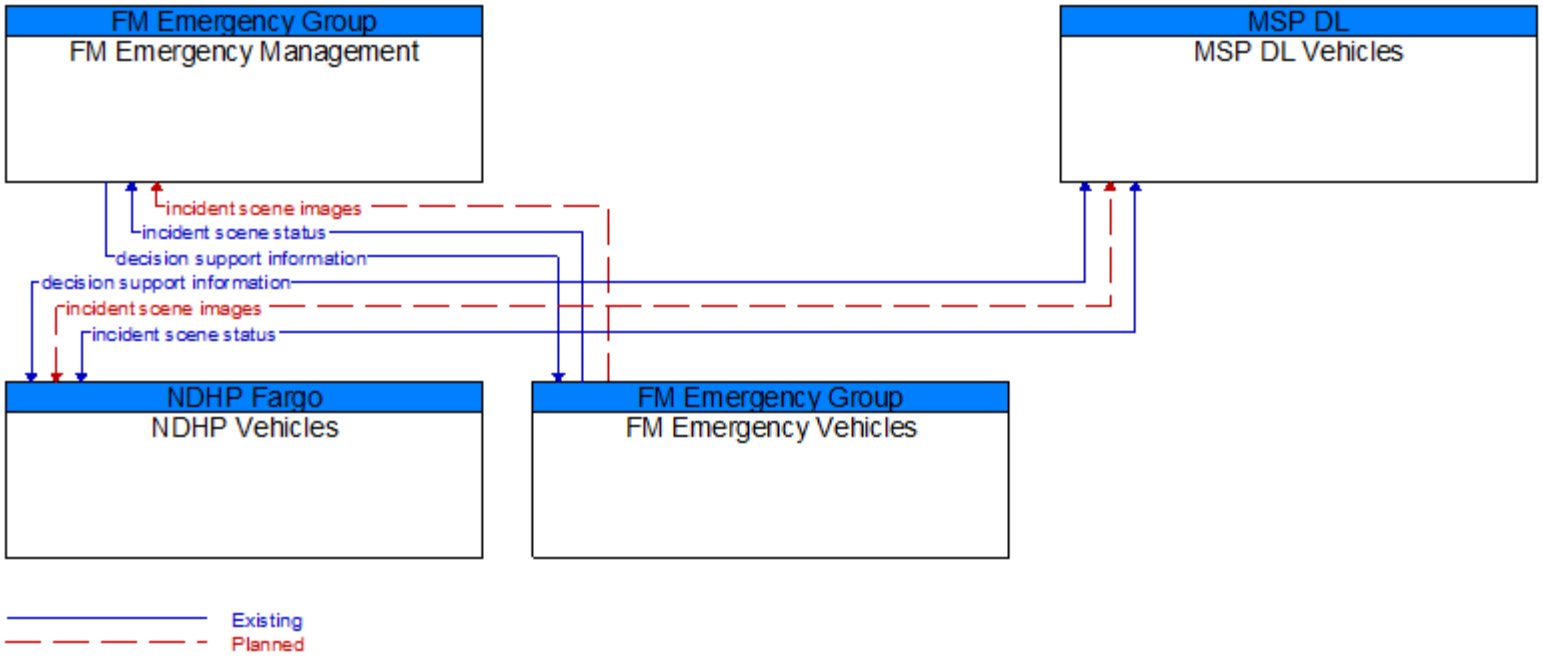
road weather advisories for emergency response
suggested route
emergency dispatch response
emergency vehicle tracking data
current infrastructure restrictions
work zone information
Existing

PS02 Emergency Response

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FM Emergency Management
MSP DL
MSP DL Vehicles
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decision support information
decision support information
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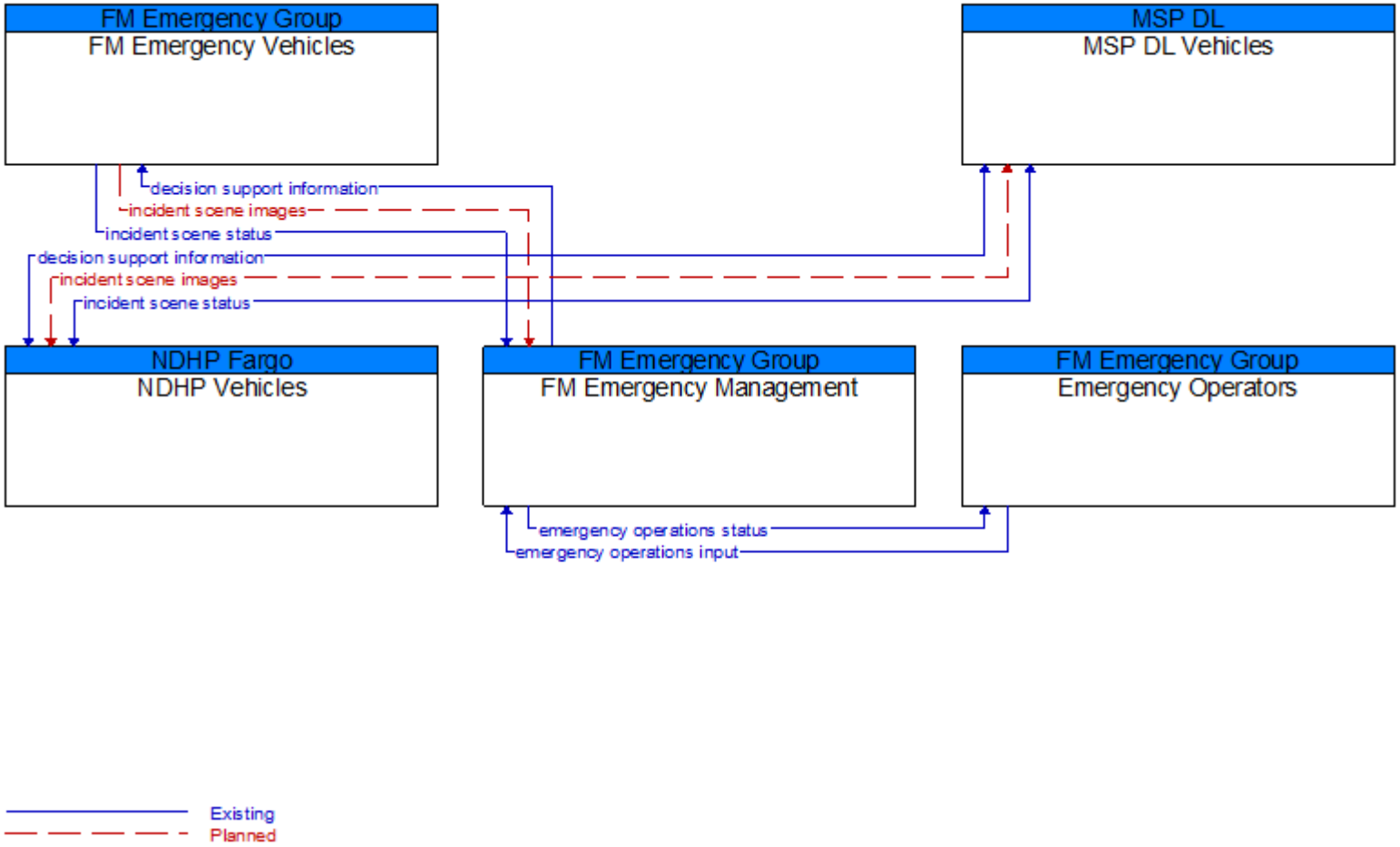
incident scene status
NDHP Fargo
NDHP Vehicles
FM Emergency Group
FM Emergency Vehicles
Existing
Planned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FM Emergency Vehicles
MSP DL
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decision support information
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NDHP Fargo
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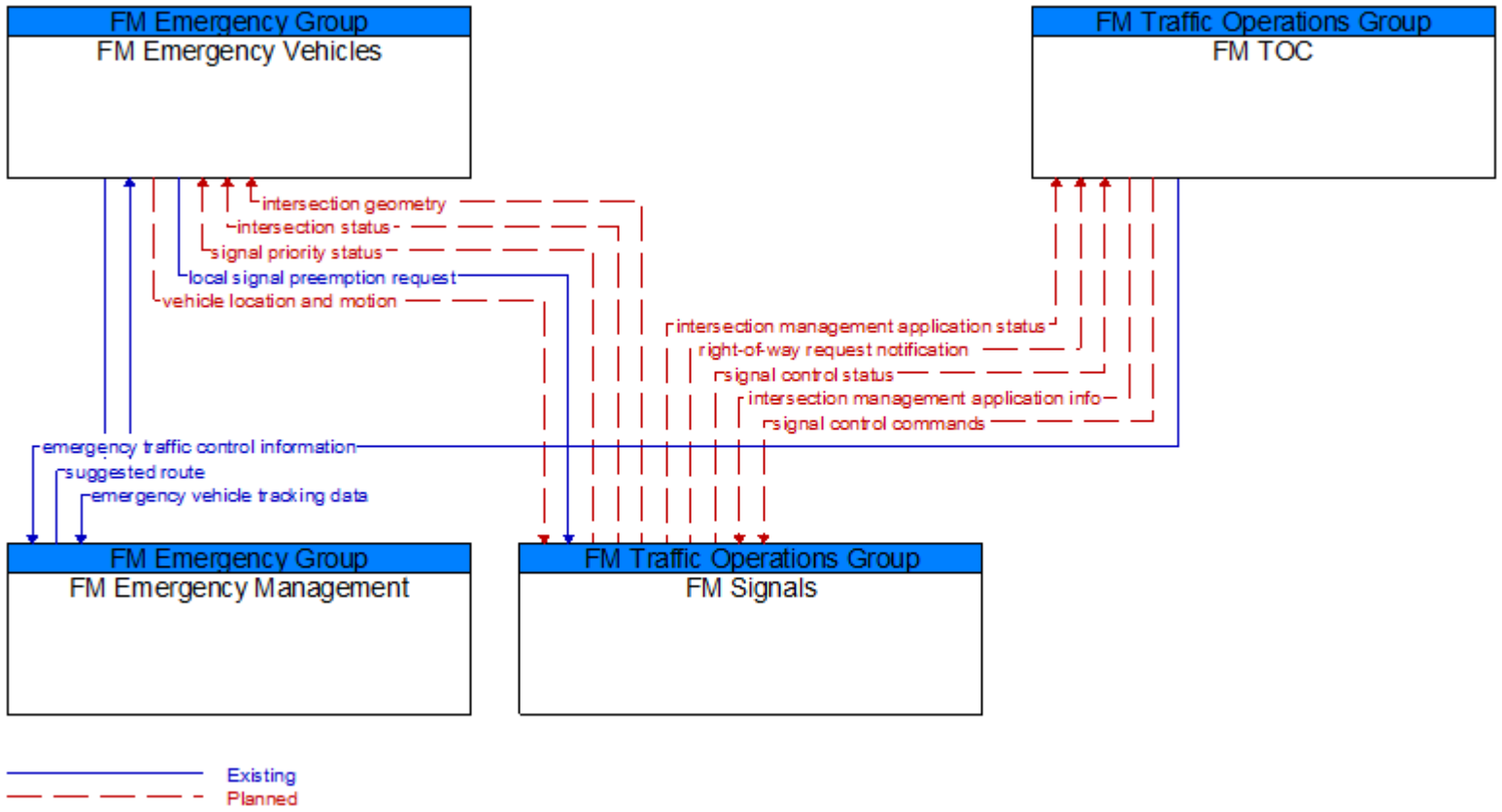
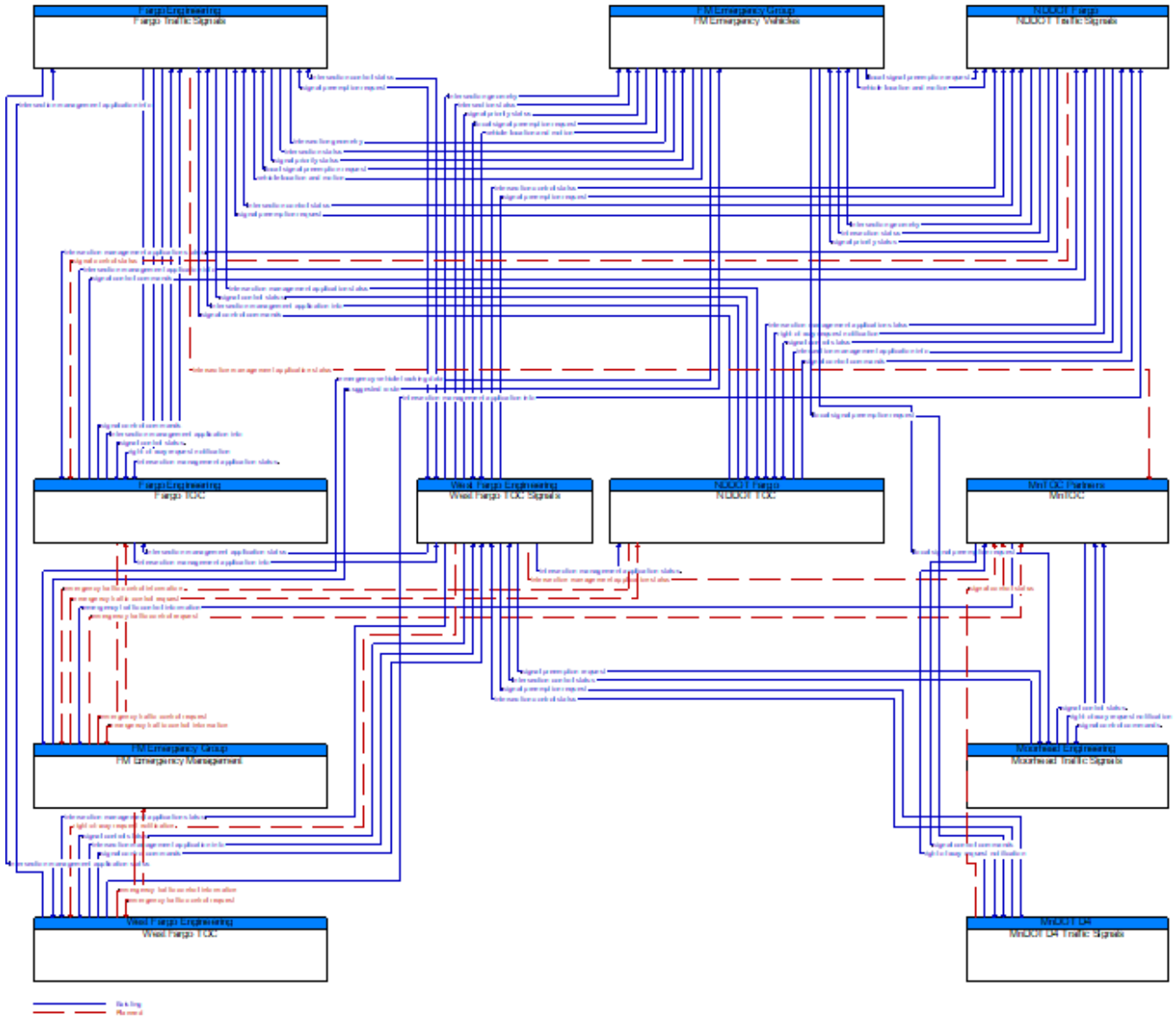
FM Emergency Management
FM Emergency Group
Emergency Operators
emergency operations status
emergency operations input
Existing
Planned

PS03 Emergency Vehicle Preemption

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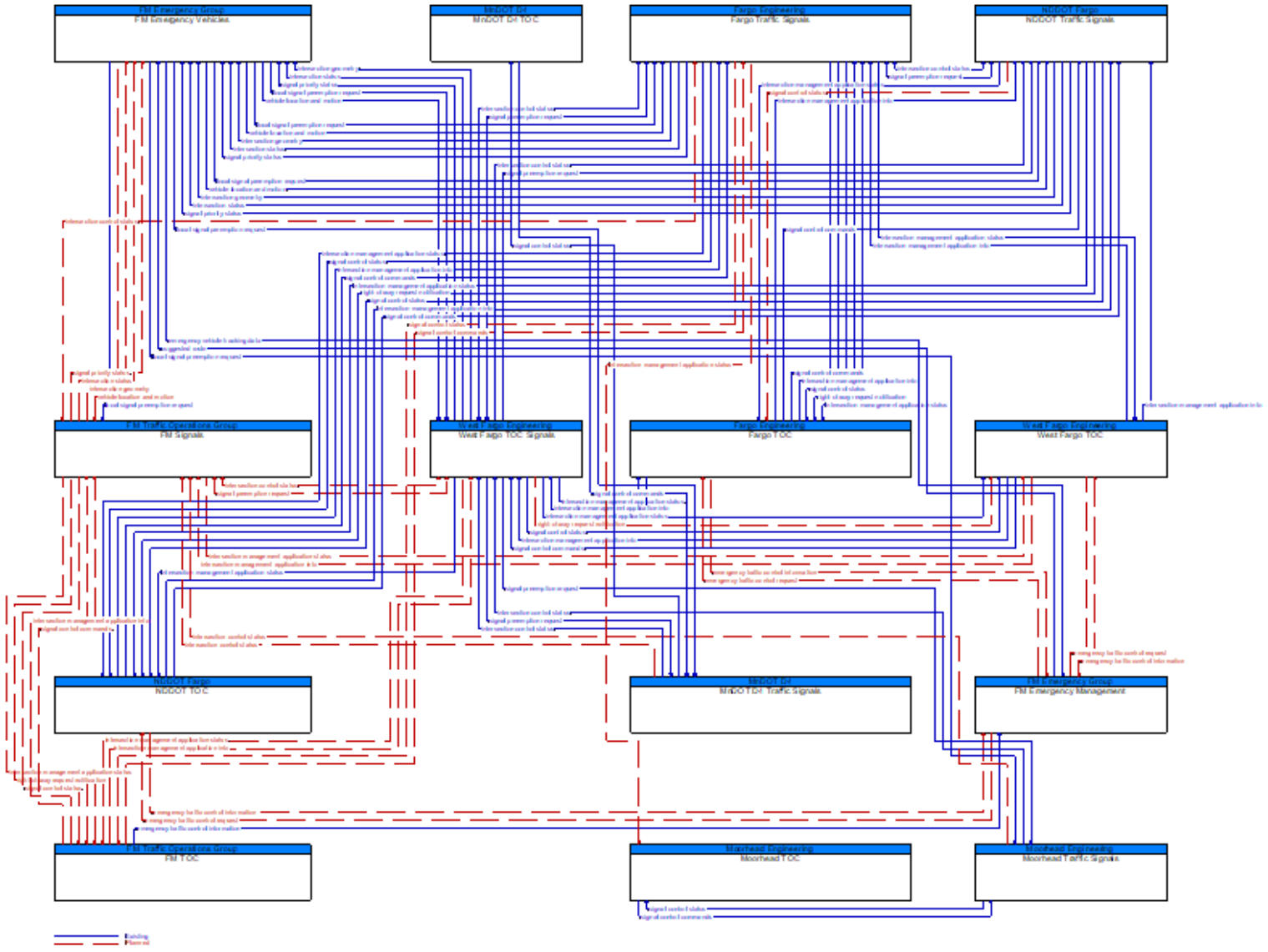
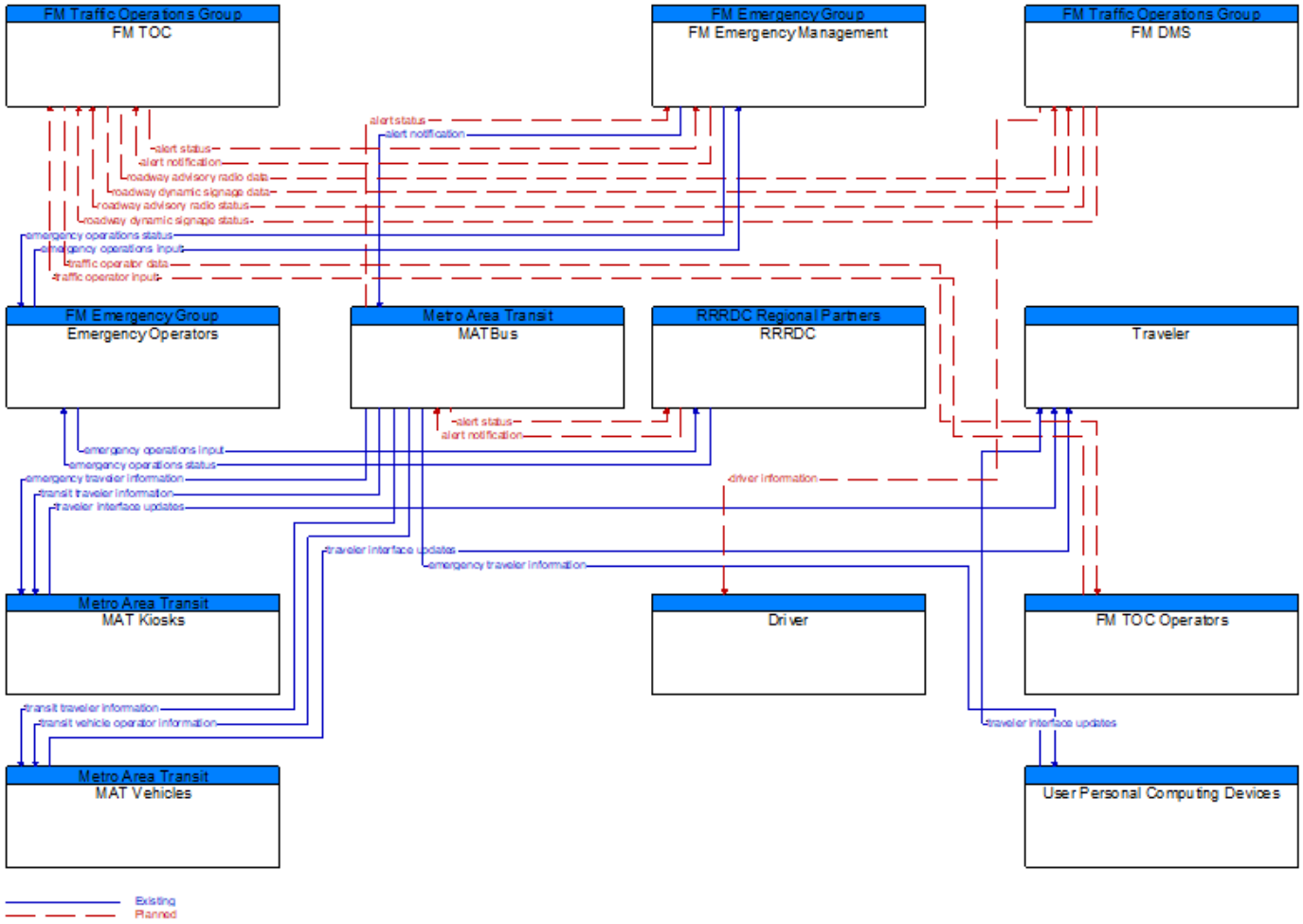
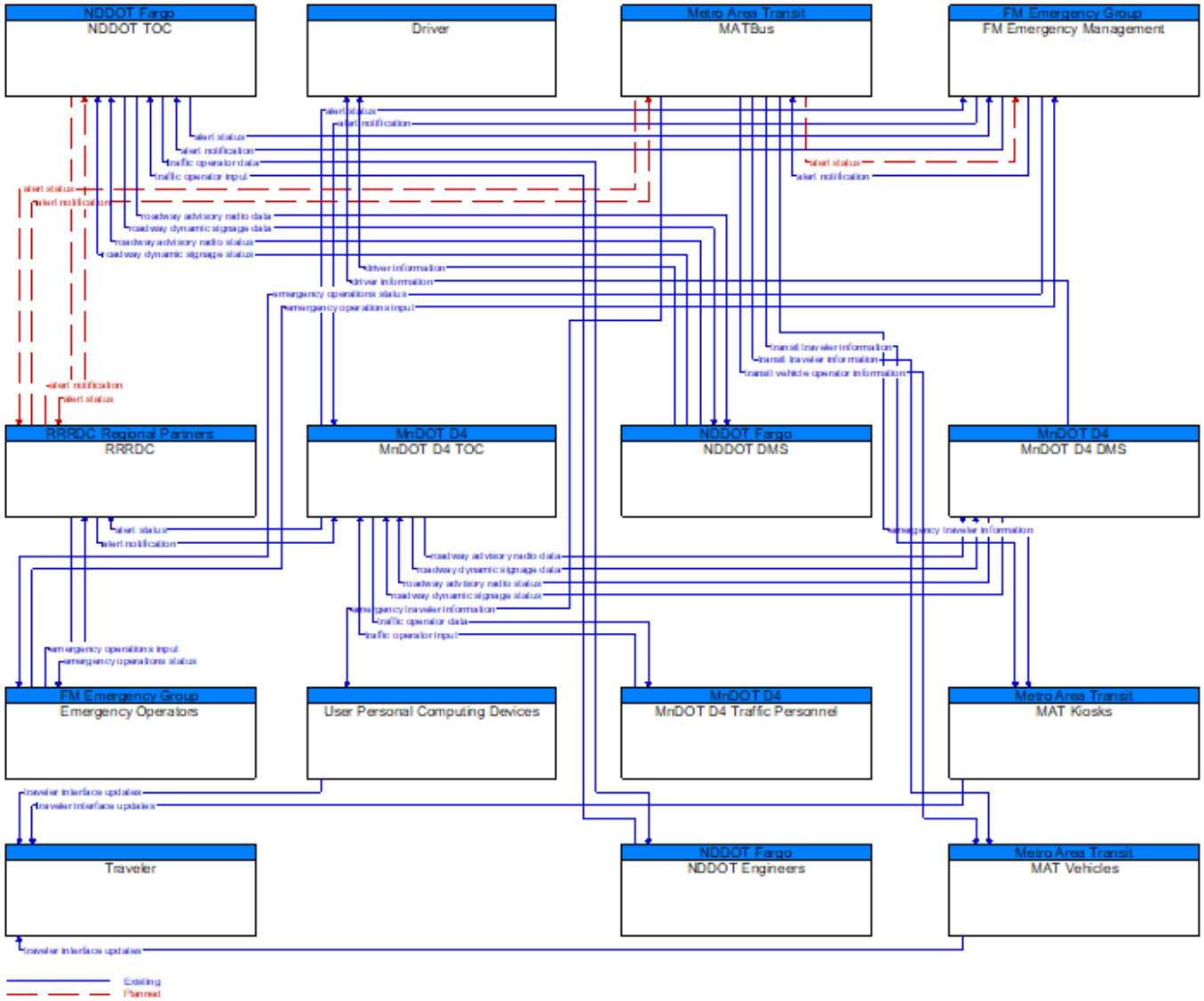
Fargo Engineering
Fargo TOC
West Fargo Engineering
West Fargo TOC Signals
NDDOT Fargo
NDDOT TOC
MnTOC Partners
MnTOC
FM Emergency Group
FM Emergency Management
Moorhead Engineering
Moorhead Traffic Signals
West Fargo Engineering
West Fargo TOC
MnDOT D4
MnDOT D4 Traffic Signals

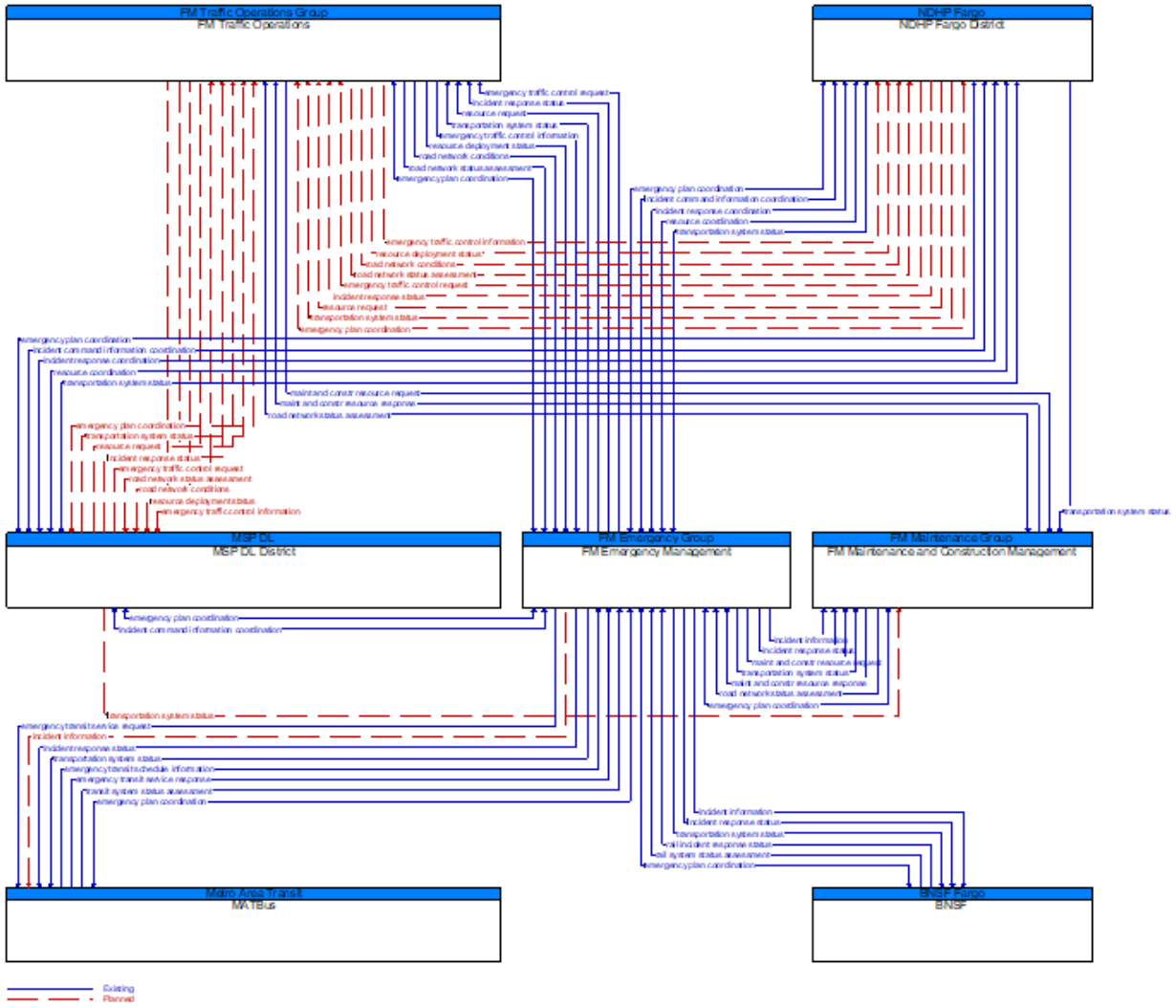

FM Emergency Group
FM Emergency Vehicles
MNDOT D7
MNDOT D7 TOC
Fargo Engineering
Fargo Traffic Signals
NDDOT Fargo
NDDOT Traffic Signals
FM Traffic Operations Group
FM Signals
West Fargo Engineering
West Fargo TOC Signals
Fargo TOC
West Fargo Engineering
West Fargo TOC
NDDOT Fargo
NDDOT TOC
MNDOT D7
MNDOT D7 Traffic Signals
FM Emergency Management
FM Traffic Operations Group
FM TOC
Moorhead Engineering
Moorhead TOC
Moorhead Engineering
Moorhead Traffic Signals

PS10 Wide-Area Alert

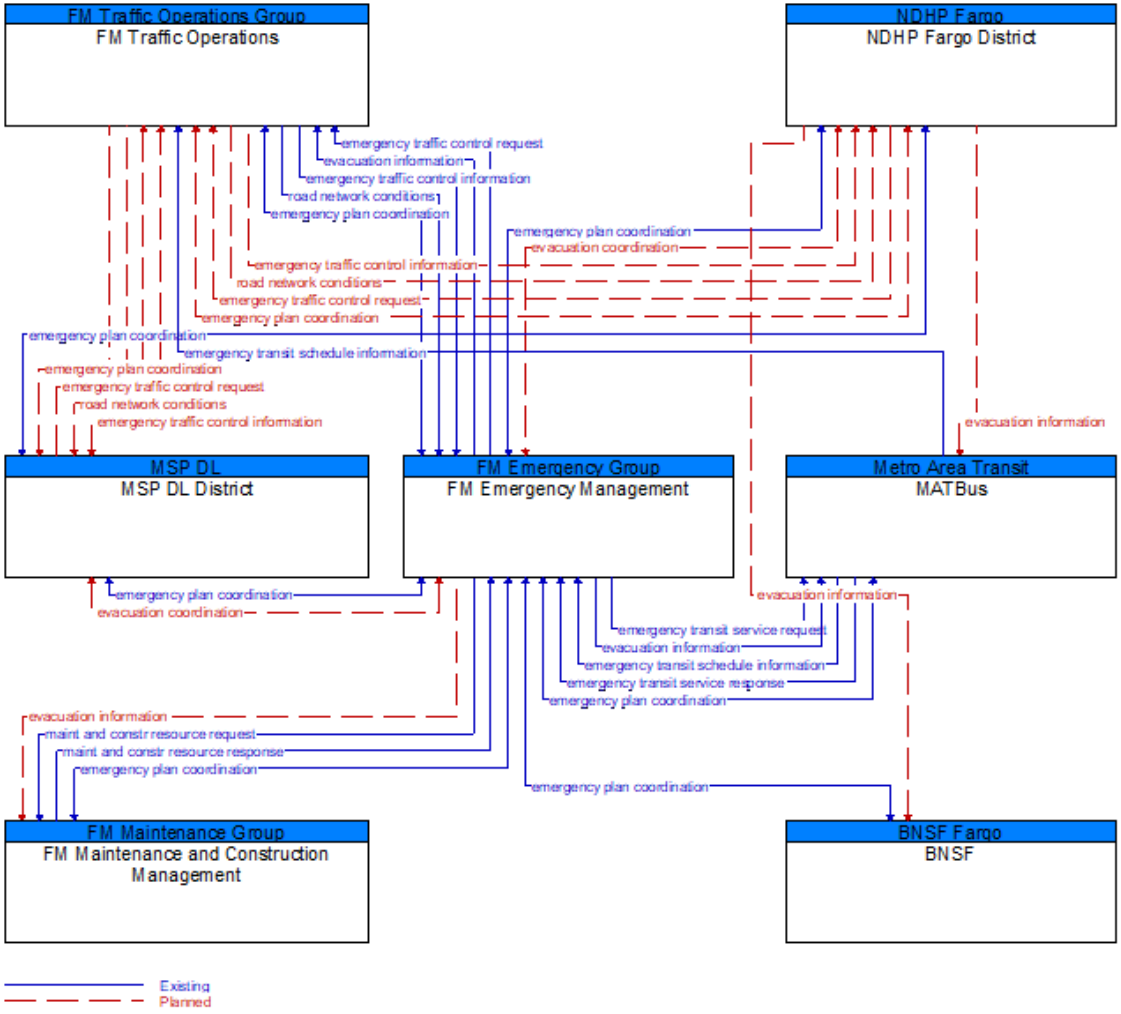



NDDOT Fargo
NDDOT TOC
Driver
Metro Area Transit
MATBus
FM Emergency Group
FM Emergency Management
RRRDC Regional Partners
RRRDC
MnDOT D4
MnDOT D4 TOC
NDDOT Fargo
NDDOT DMS
MnDOT D4
MnDOT D4 DMS
FM Emergency Group
Emergency Operators
User Personal Computing Devices
MnDOT D4
MnDOT D4 Traffic Personnel
Metro Area Transit
MAT Kiosks
Traveler
NDDOT Fargo
NDDOT Engineers
Metro Area Transit
MAT Vehicles
alert status
alert notification
traffic operator data
traffic operator input
roadway advisory radio data
roadway dynamic signage data
roadway advisory radio status
roadway dynamic signage status
driver information
emergency operations status
emergency operations input
transit traveler information
transit vehicle operator information
emergency traveler information
traveler interface updates
Existing
Planned

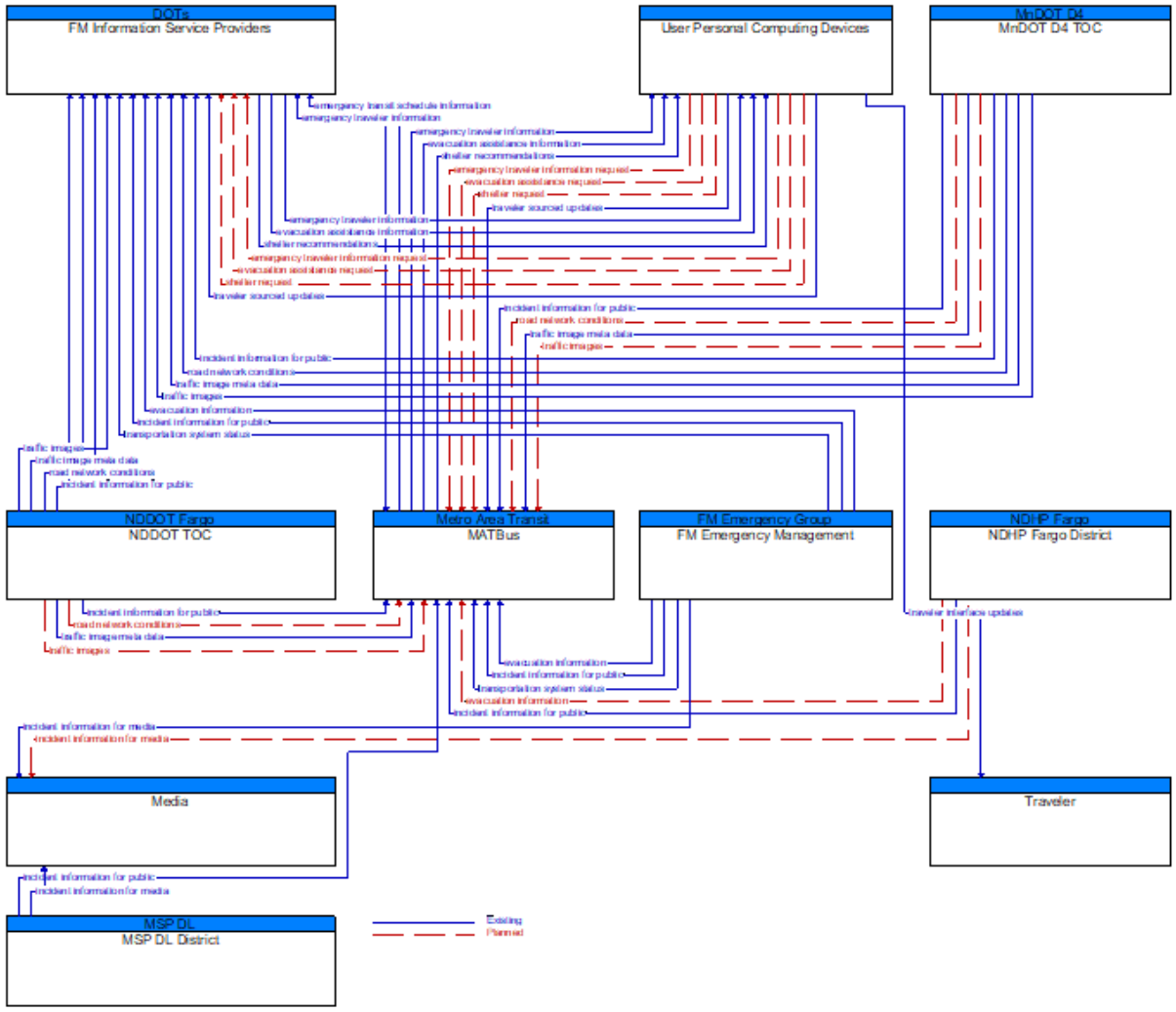
PS12 Disaster Response and Recovery



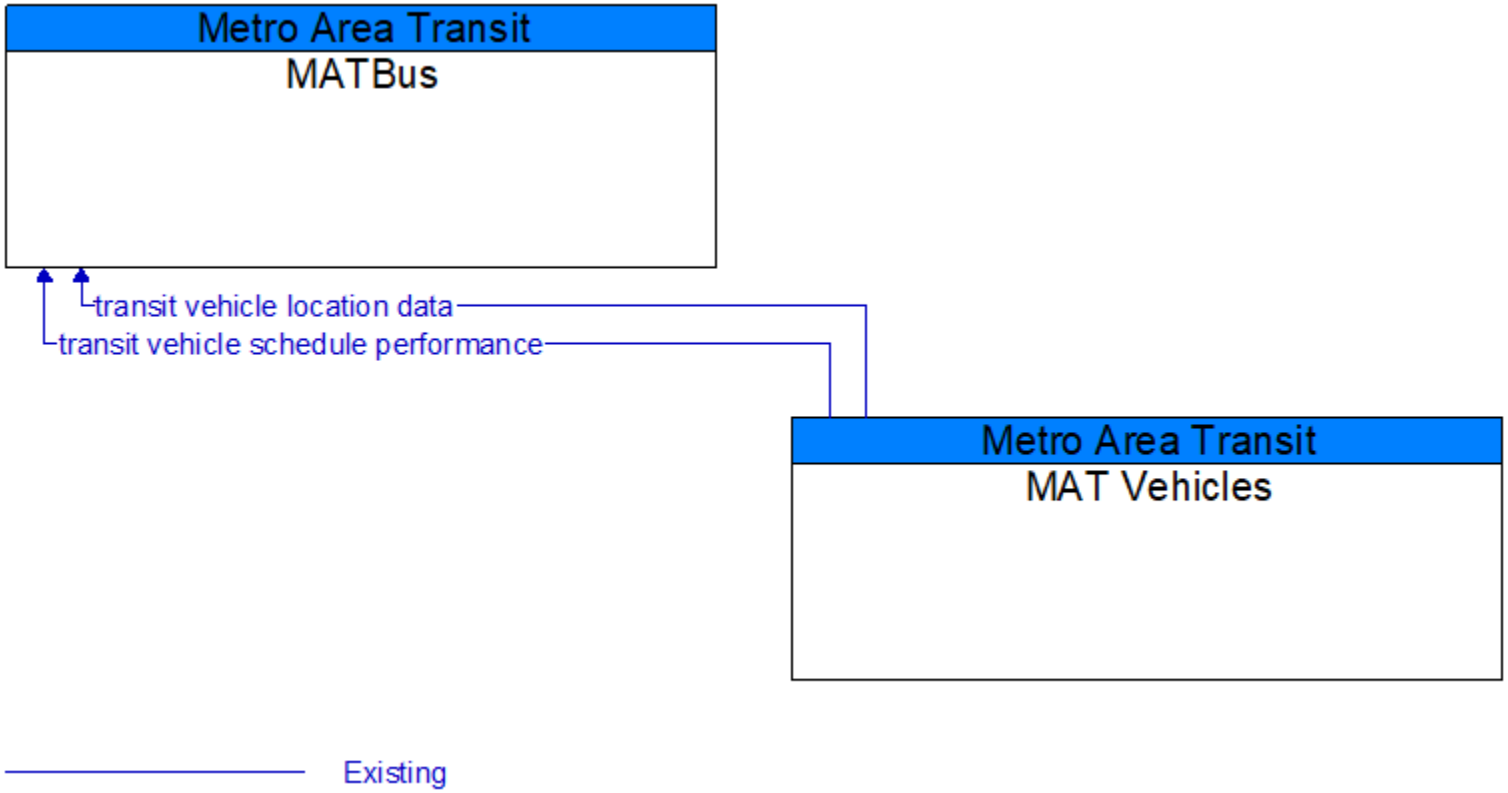
PS13 Evacuation and Reentry Management



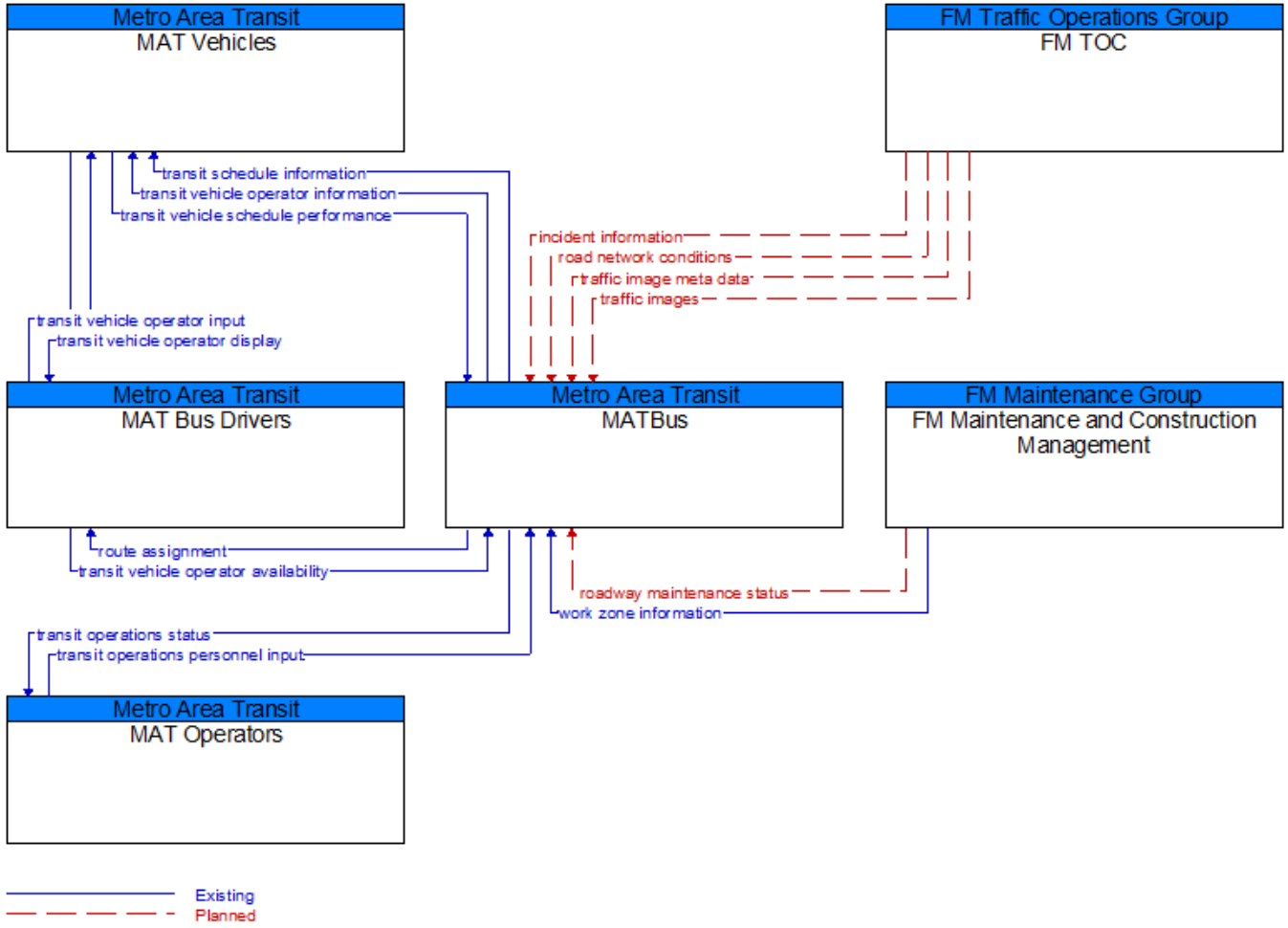
PS14-DisasterTravelerInformation



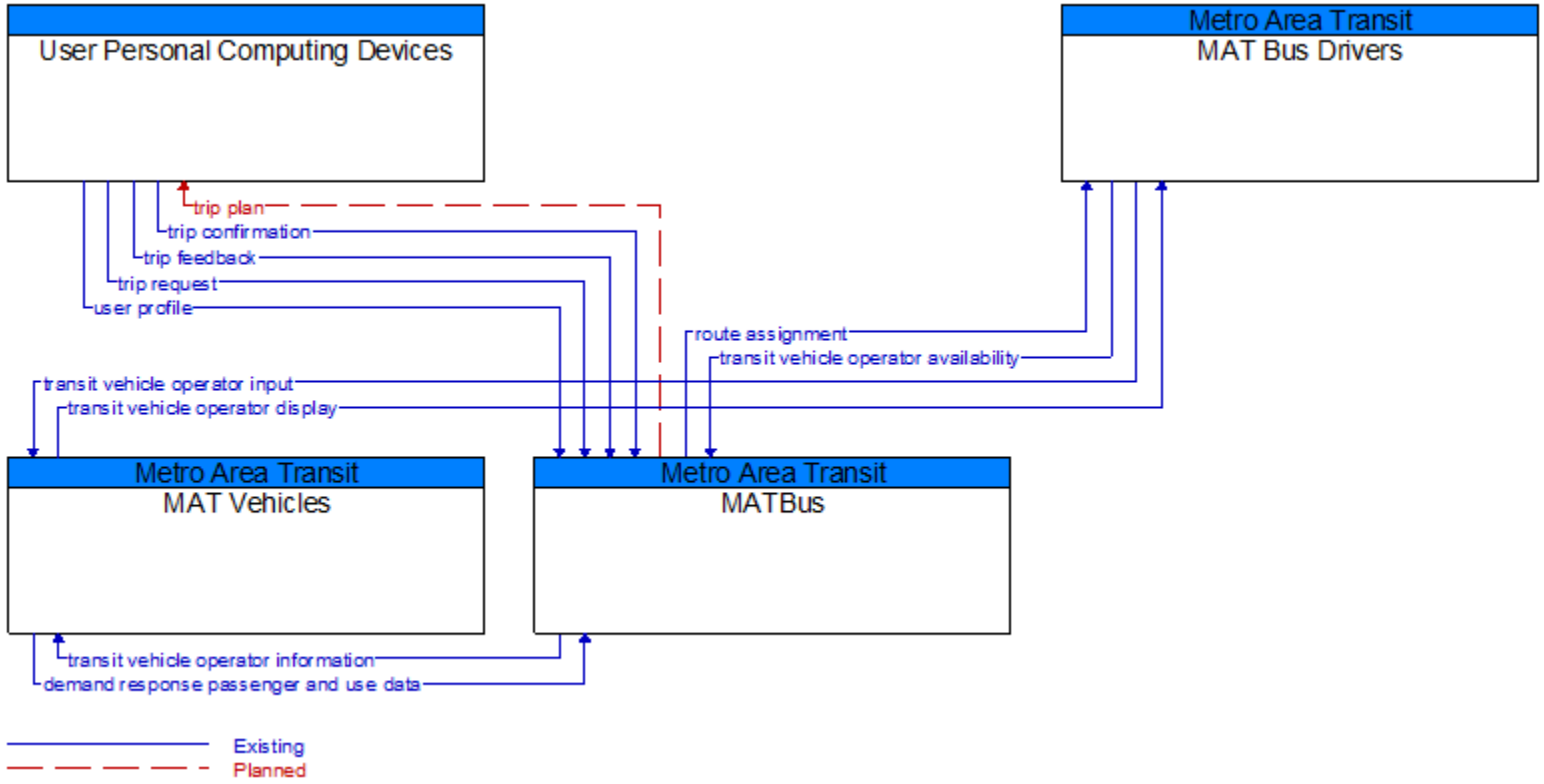
PT01 Transit Vehicle Tracking



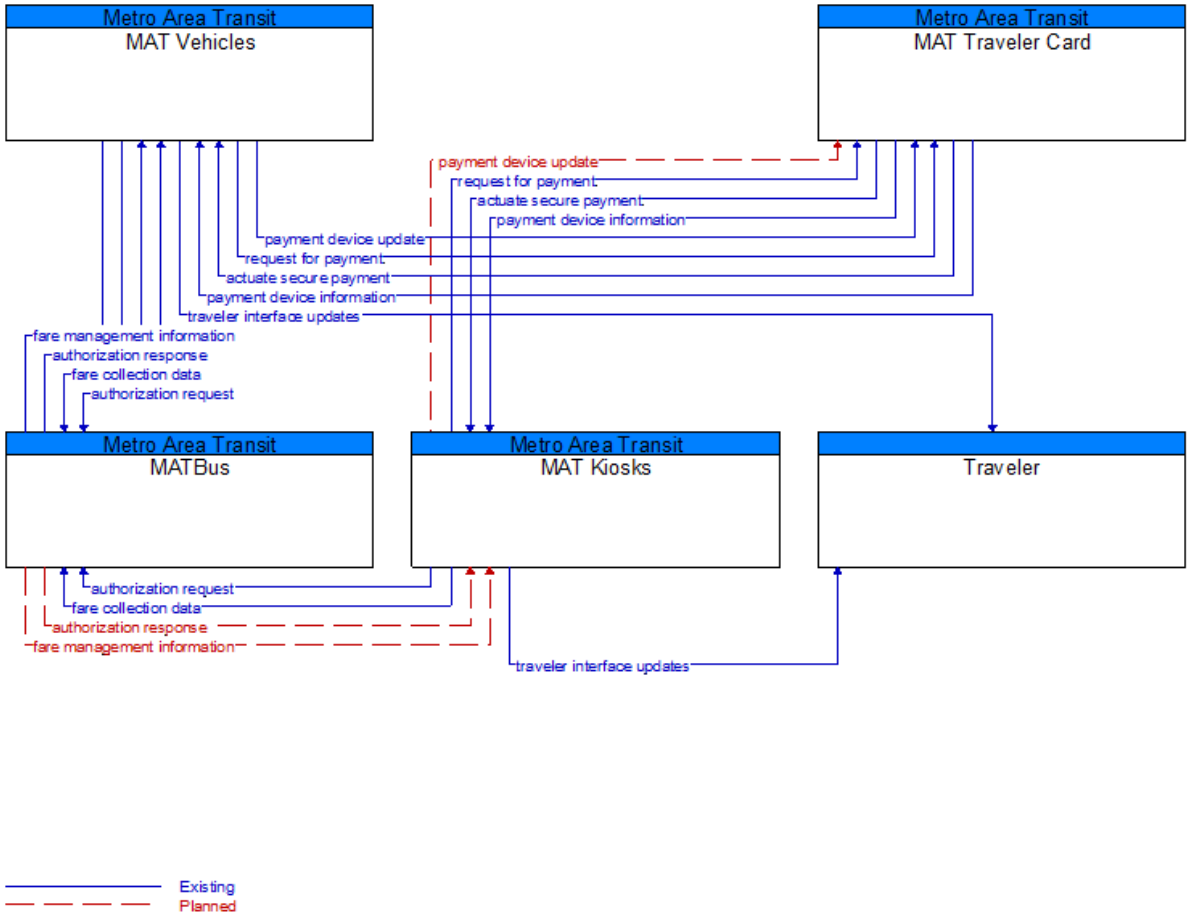
PT02 Transit Fixed-Route Operations



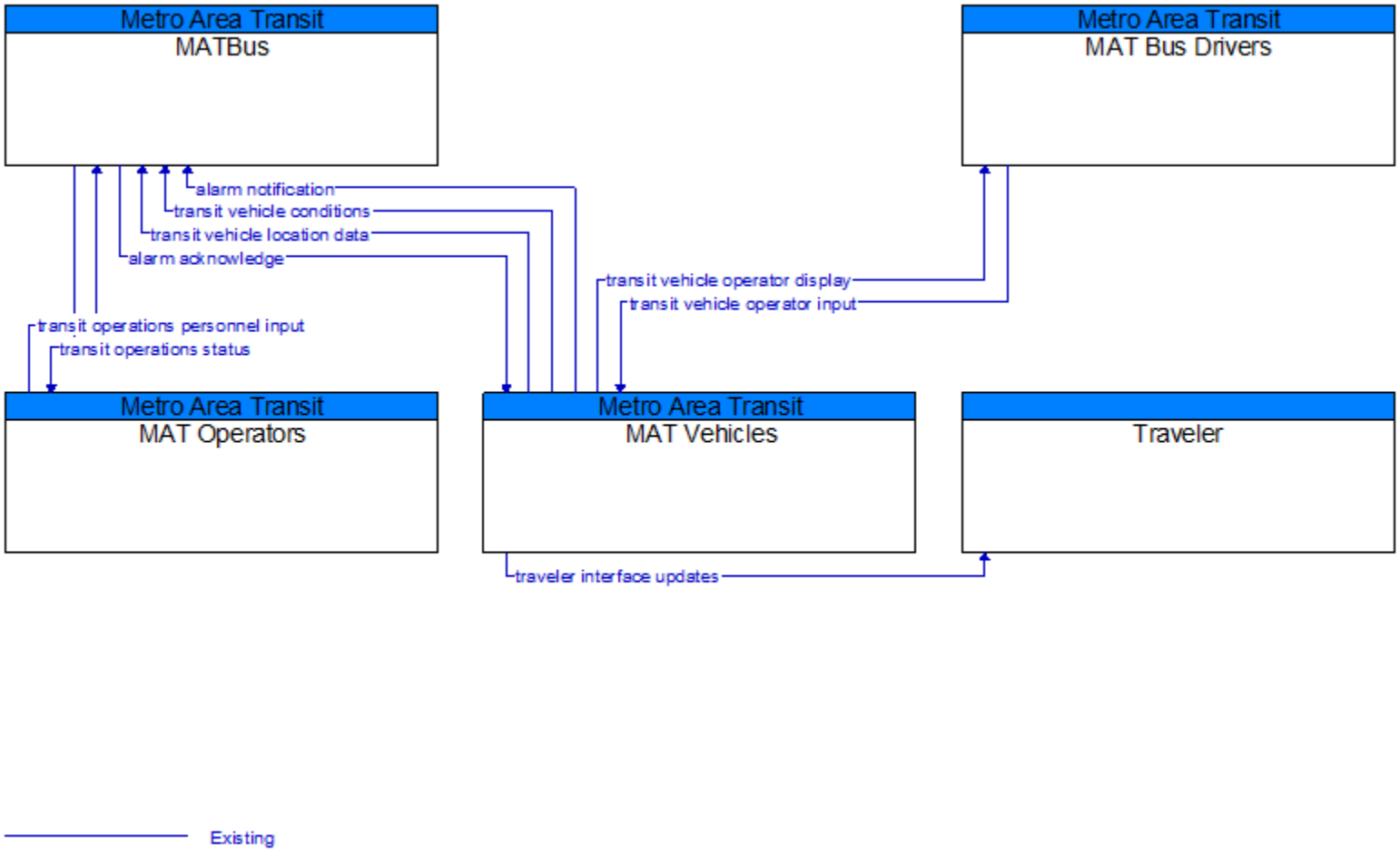
PT03 Dynamic Transit Operations



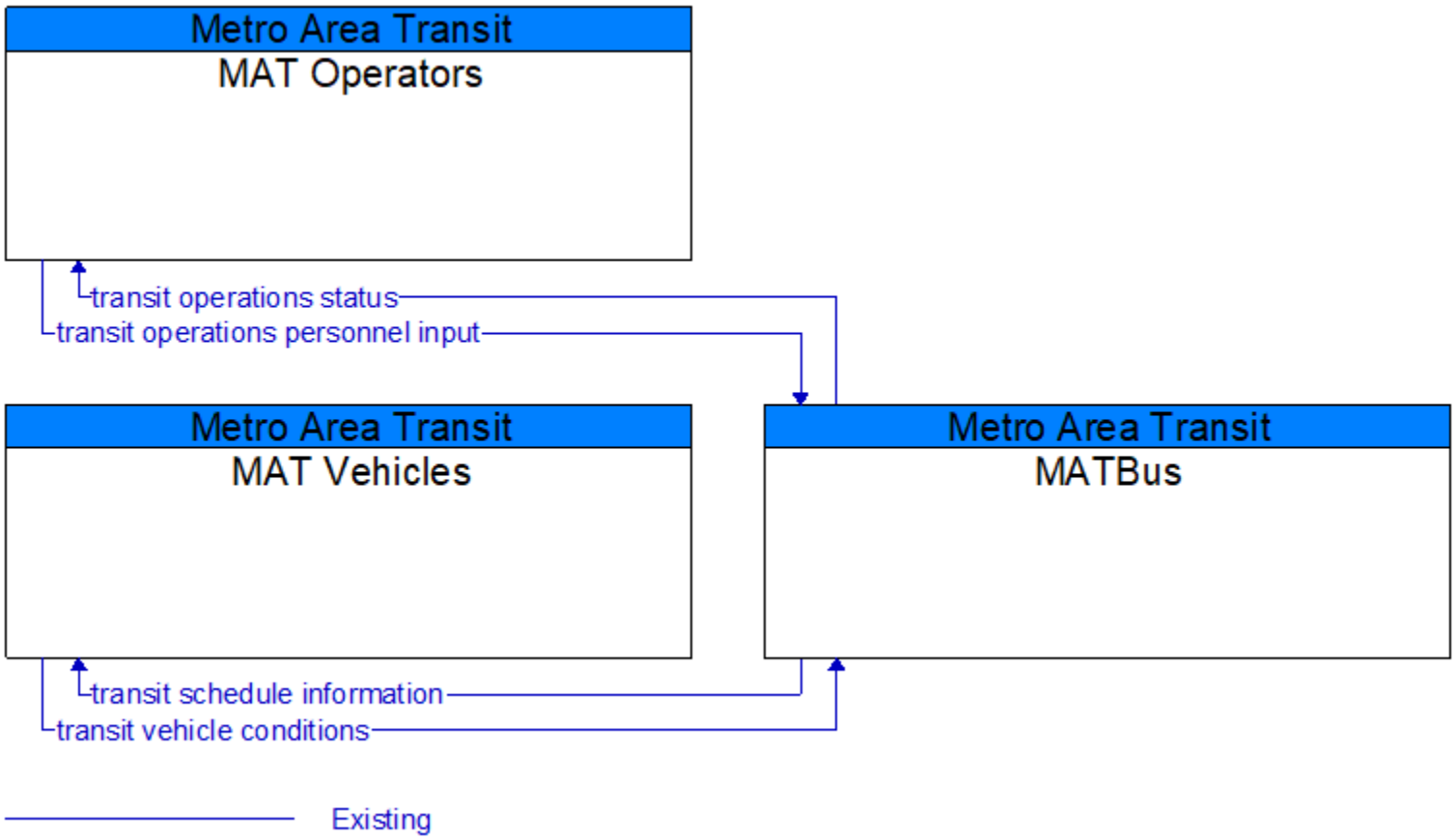
PT04 Transit Fare Collection Management



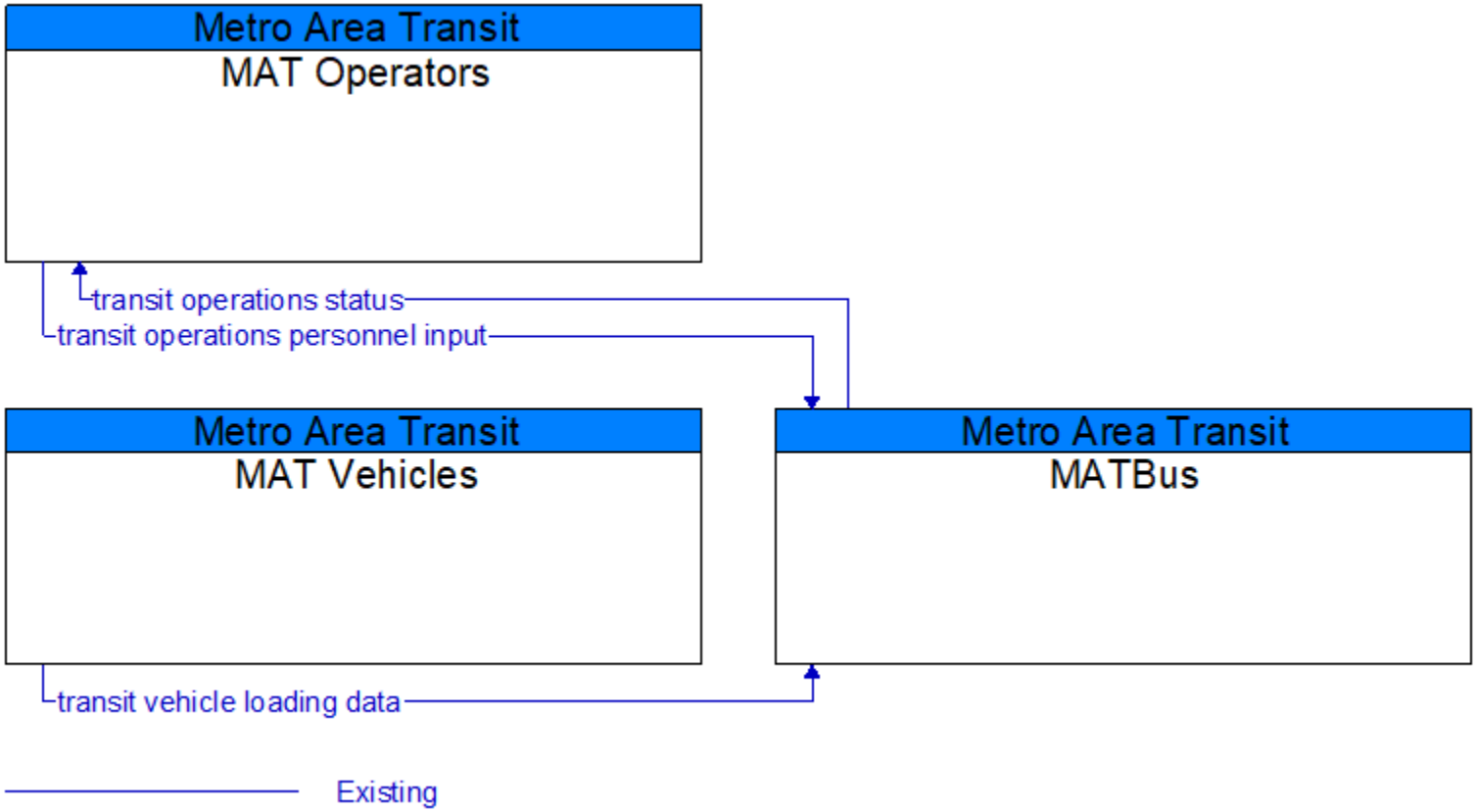
PT05 Transit Security



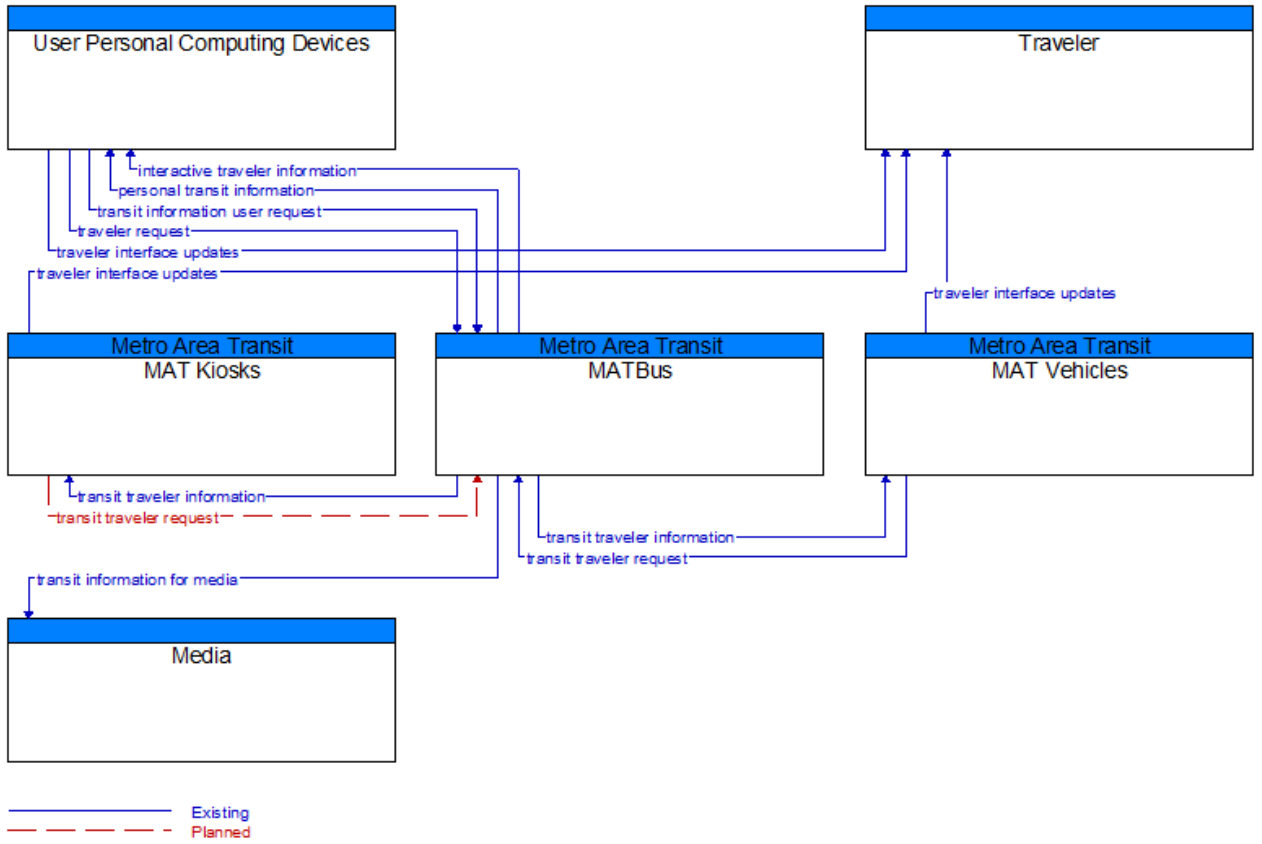
PT06 Transit Fleet Management



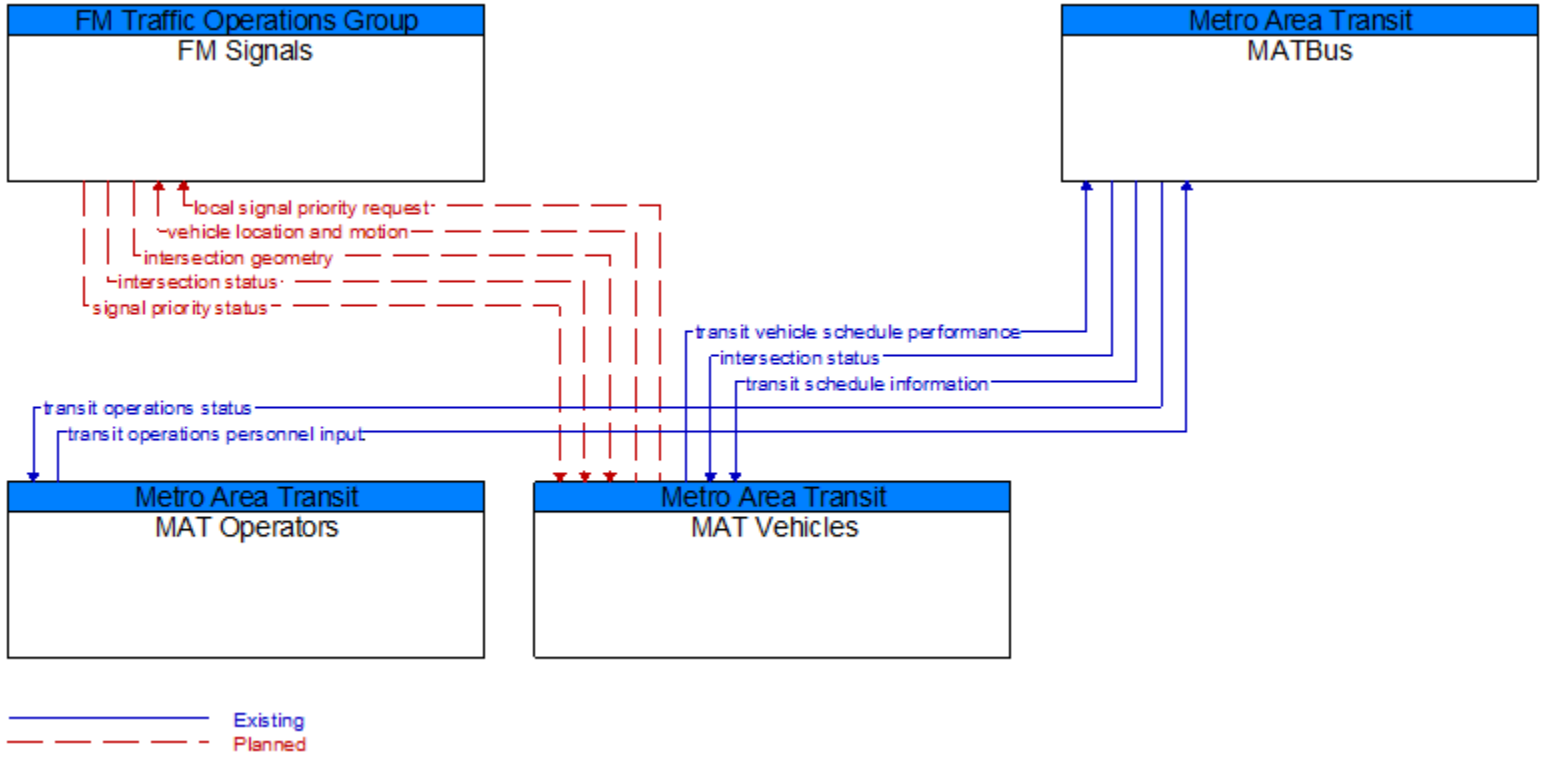
PT07 Transit Passenger Counting



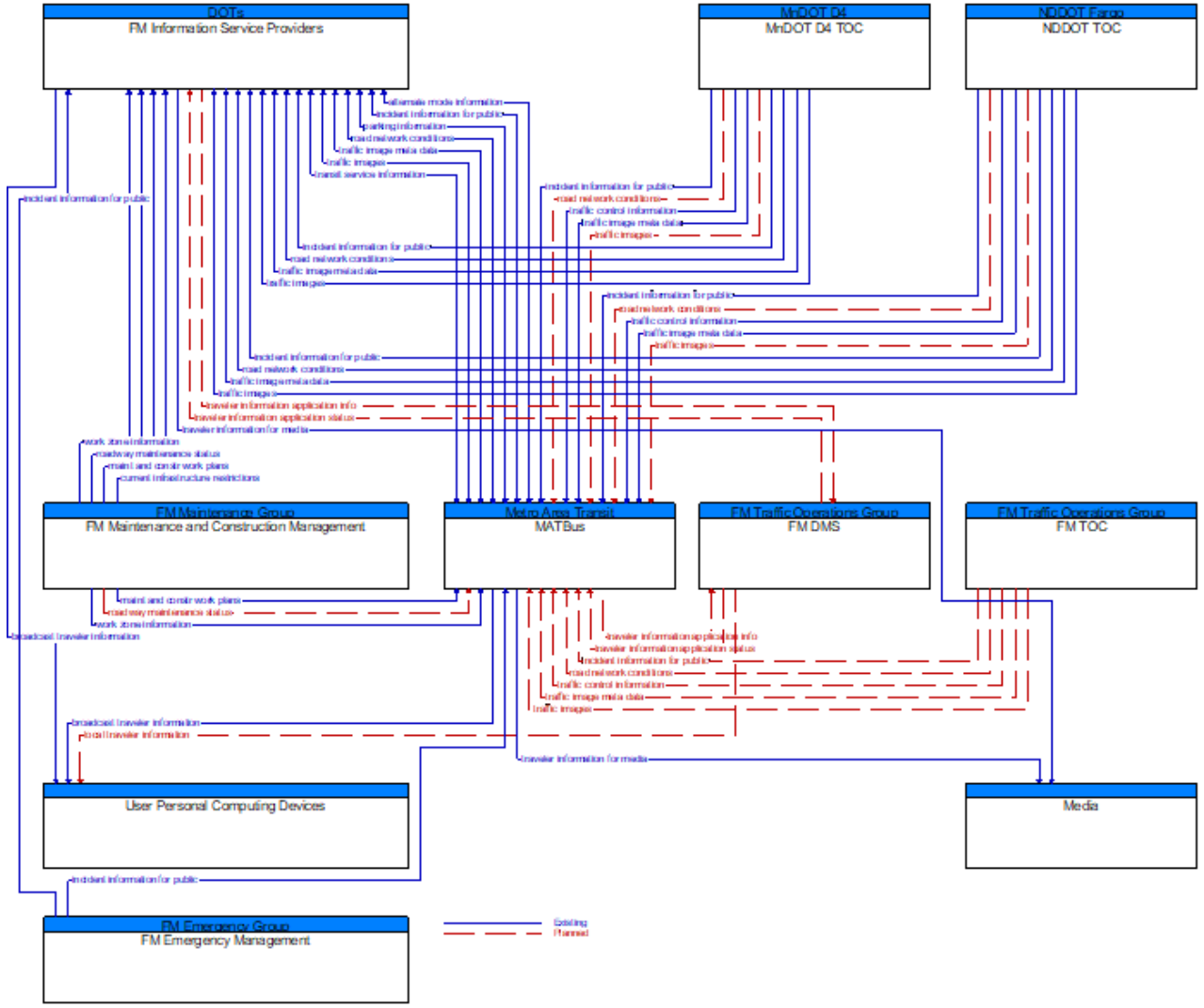
PT08 Transit Traveler Information



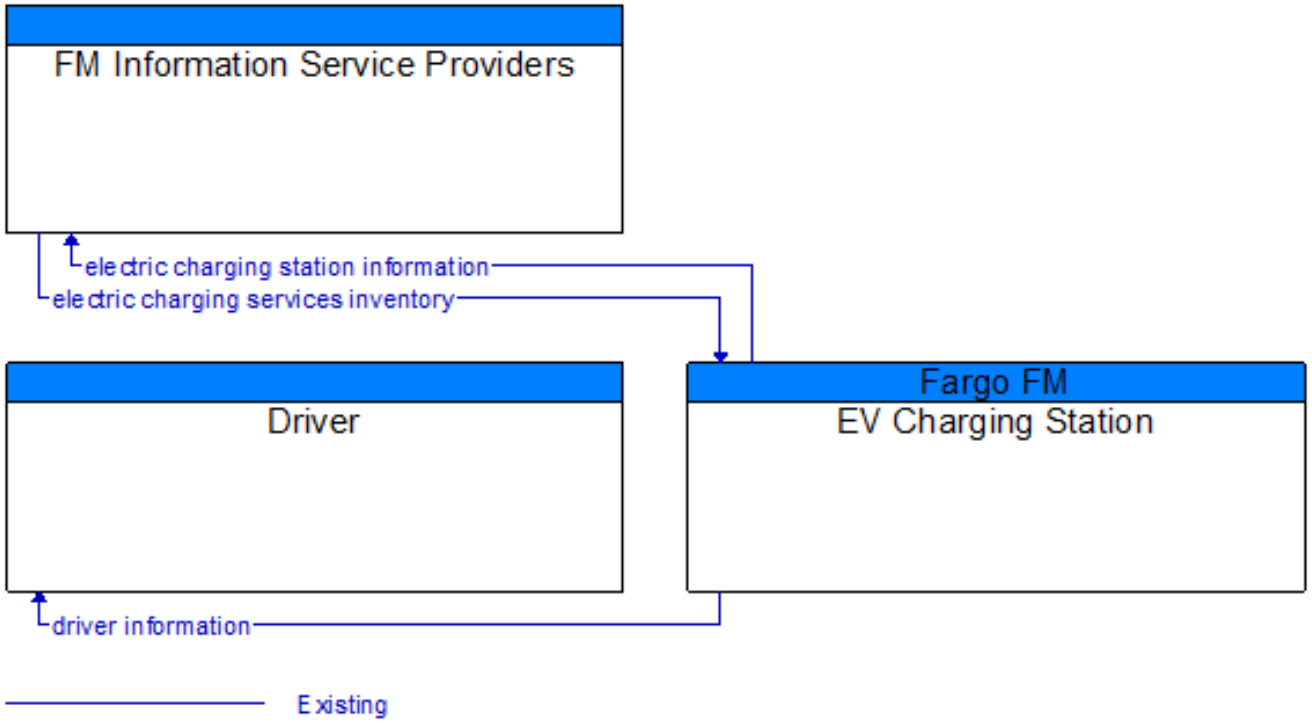
PT09 Transit Signal Priority



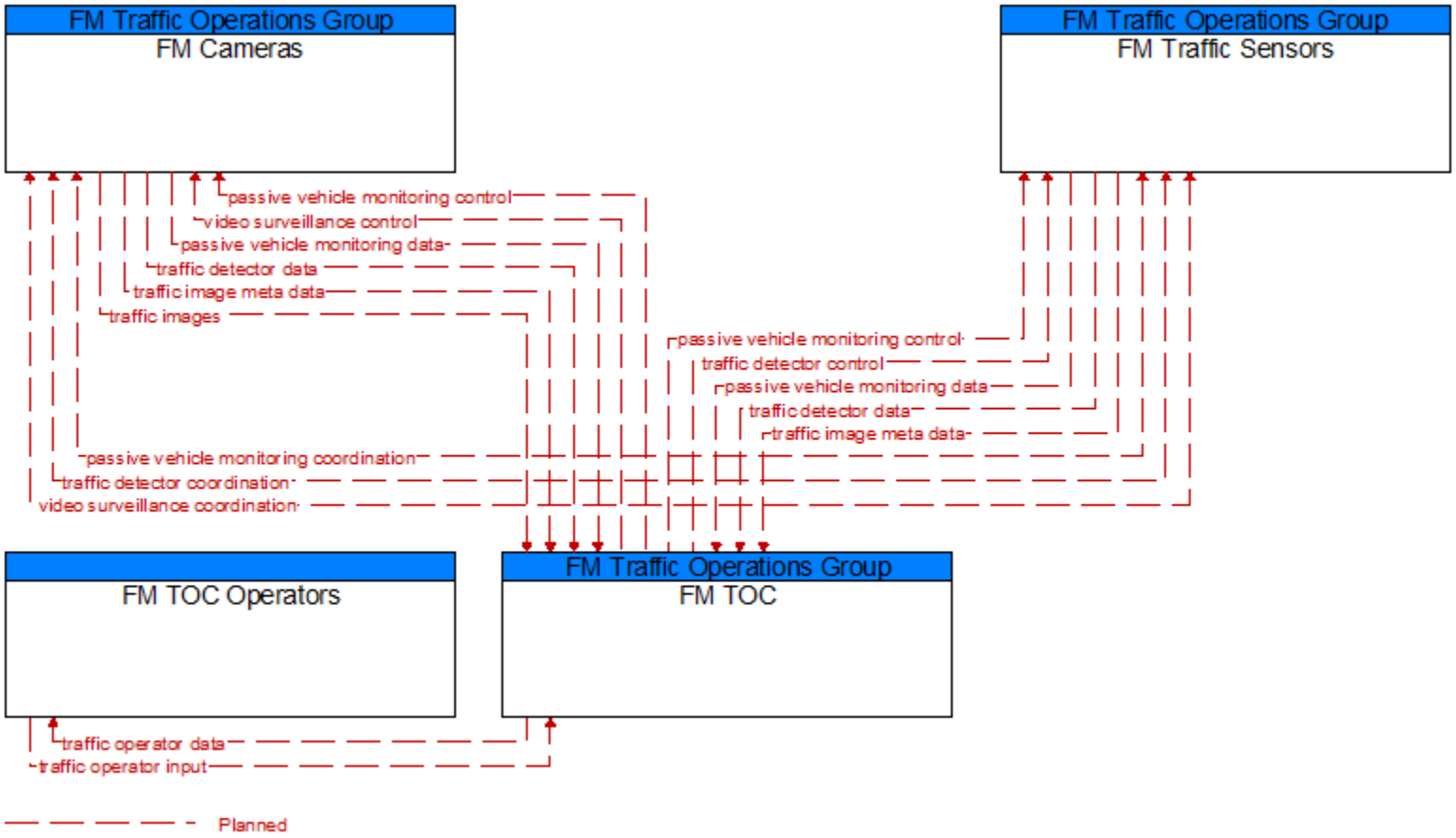
TI01-Broadcast Traveler Information

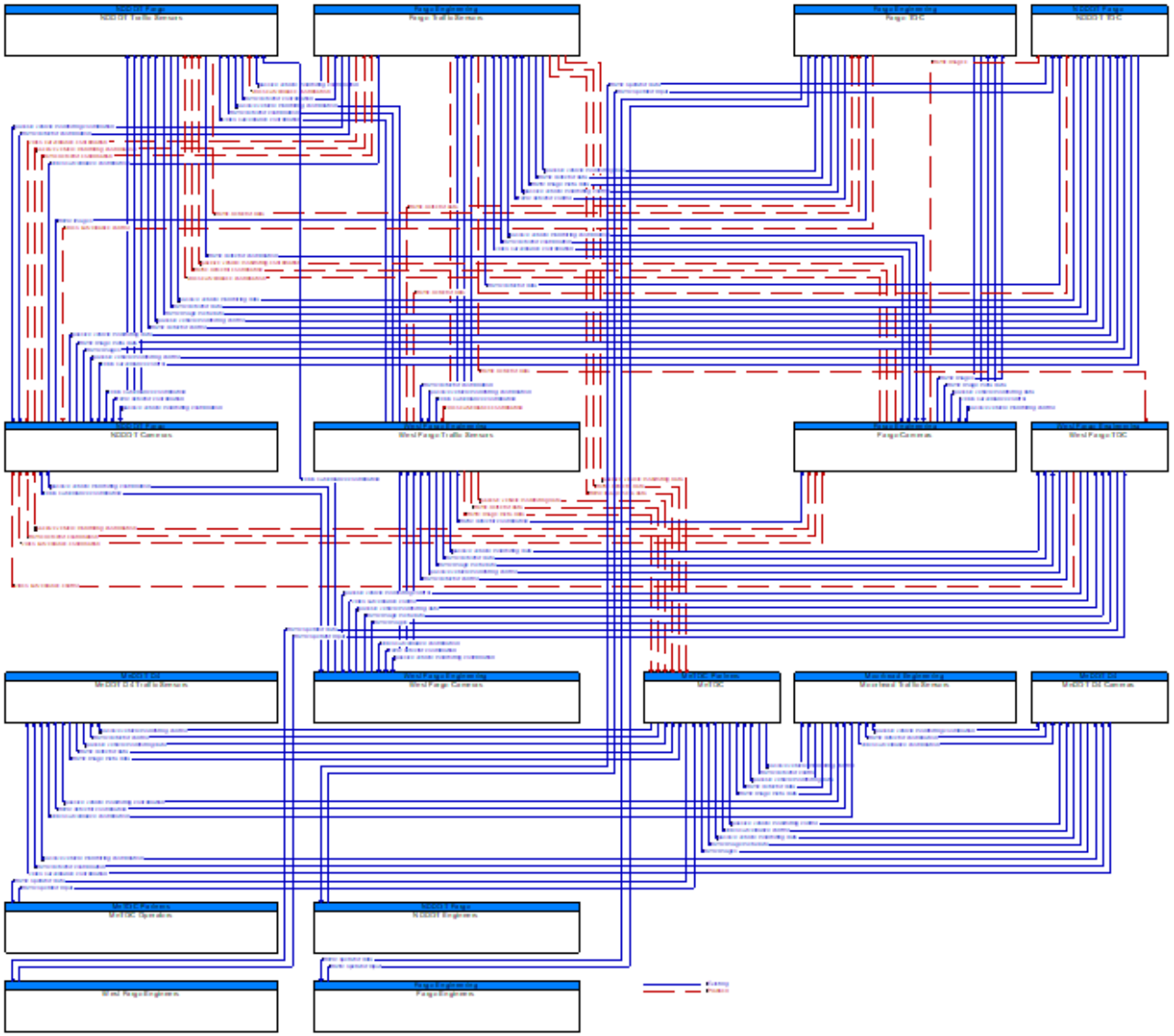


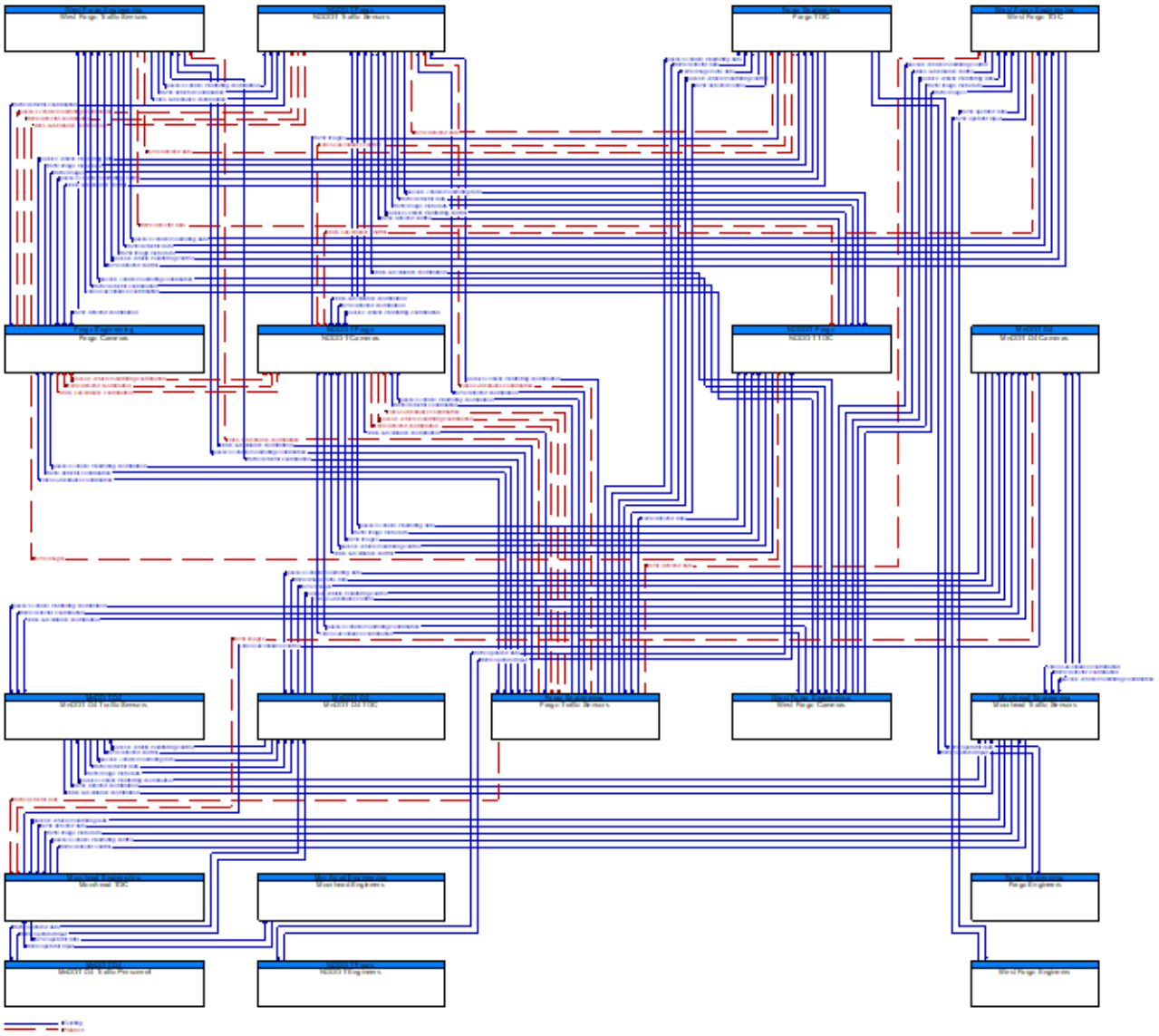
ST05: Electric Charging Stations Management



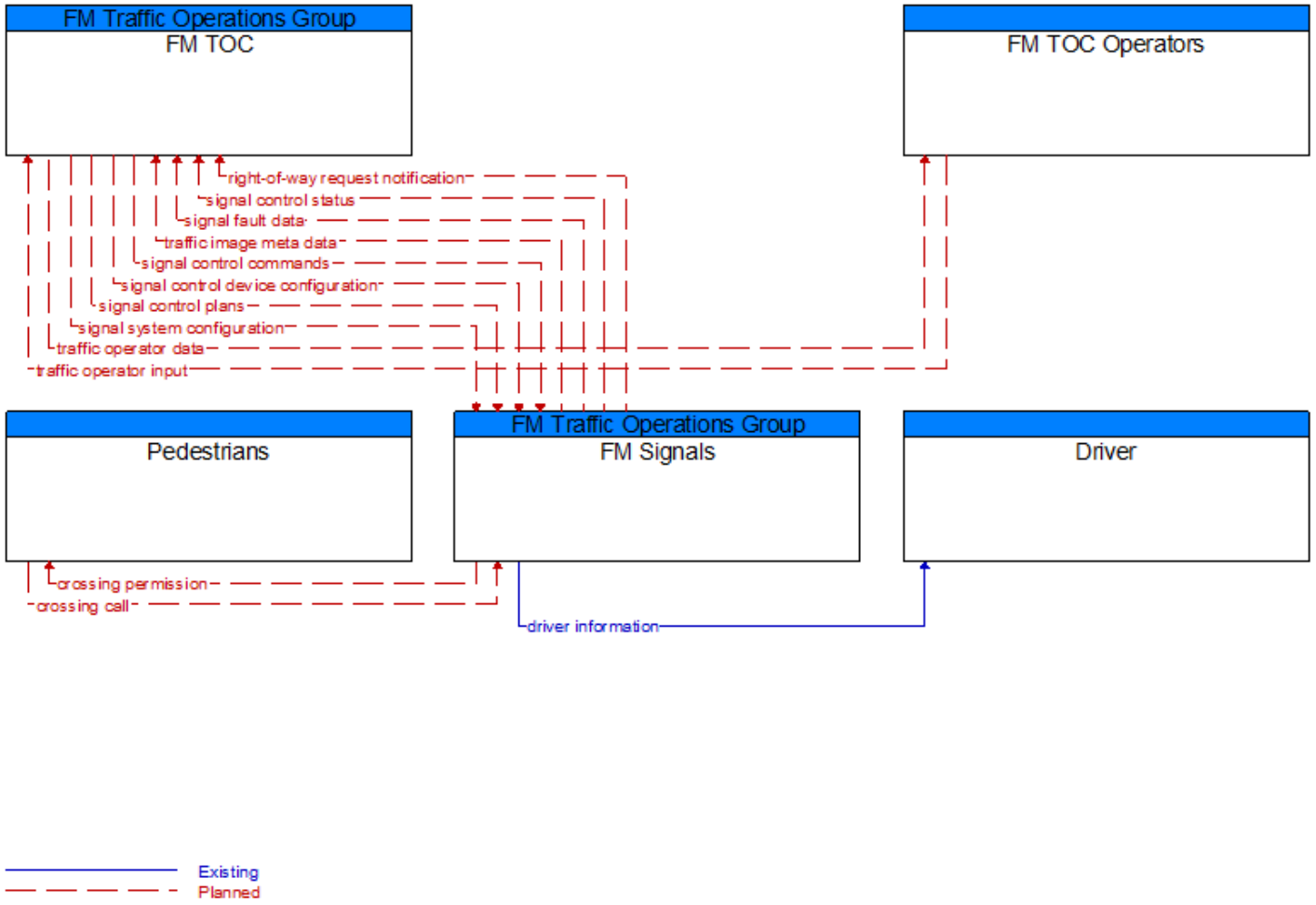
TM01 Infrastructure-Based Traffic Surveillance

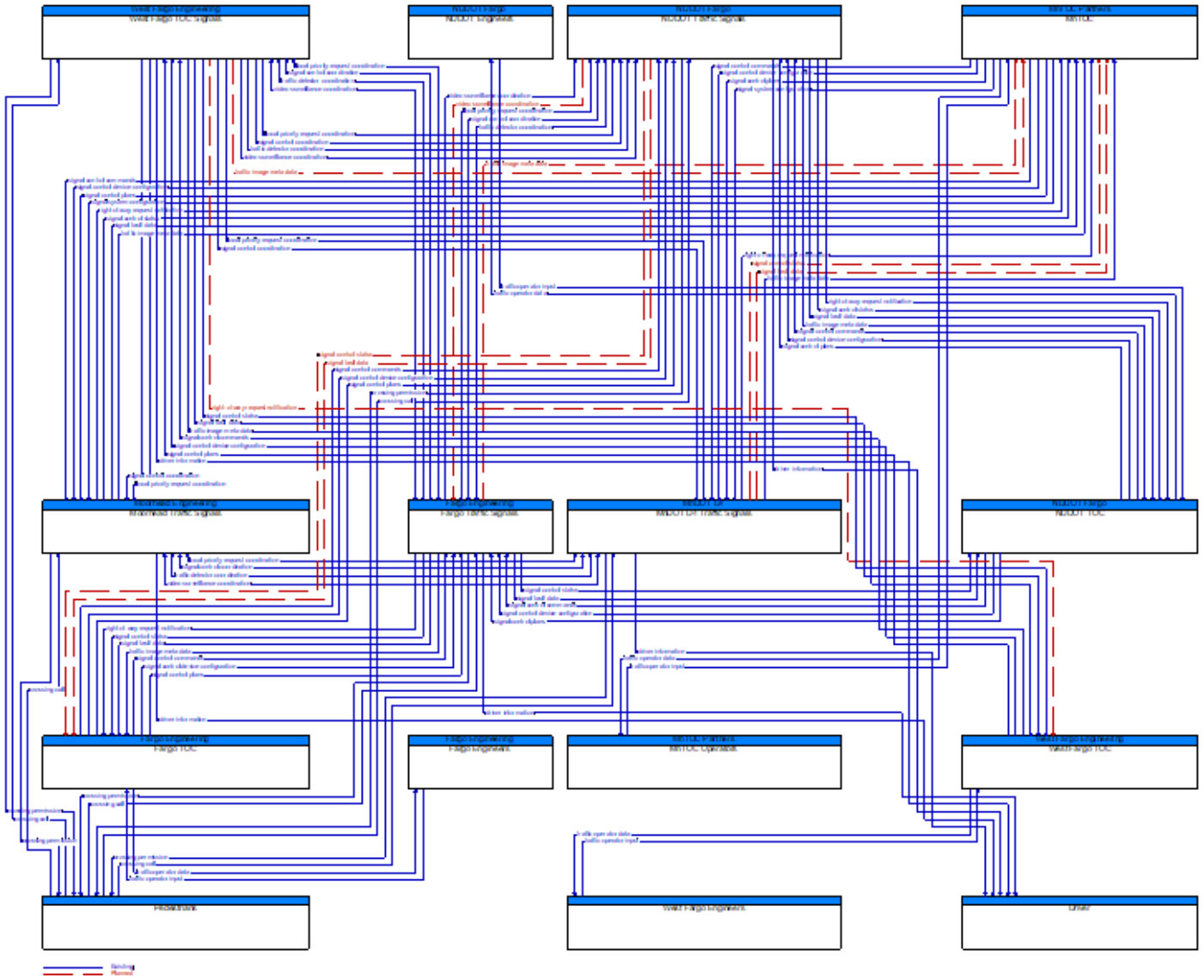


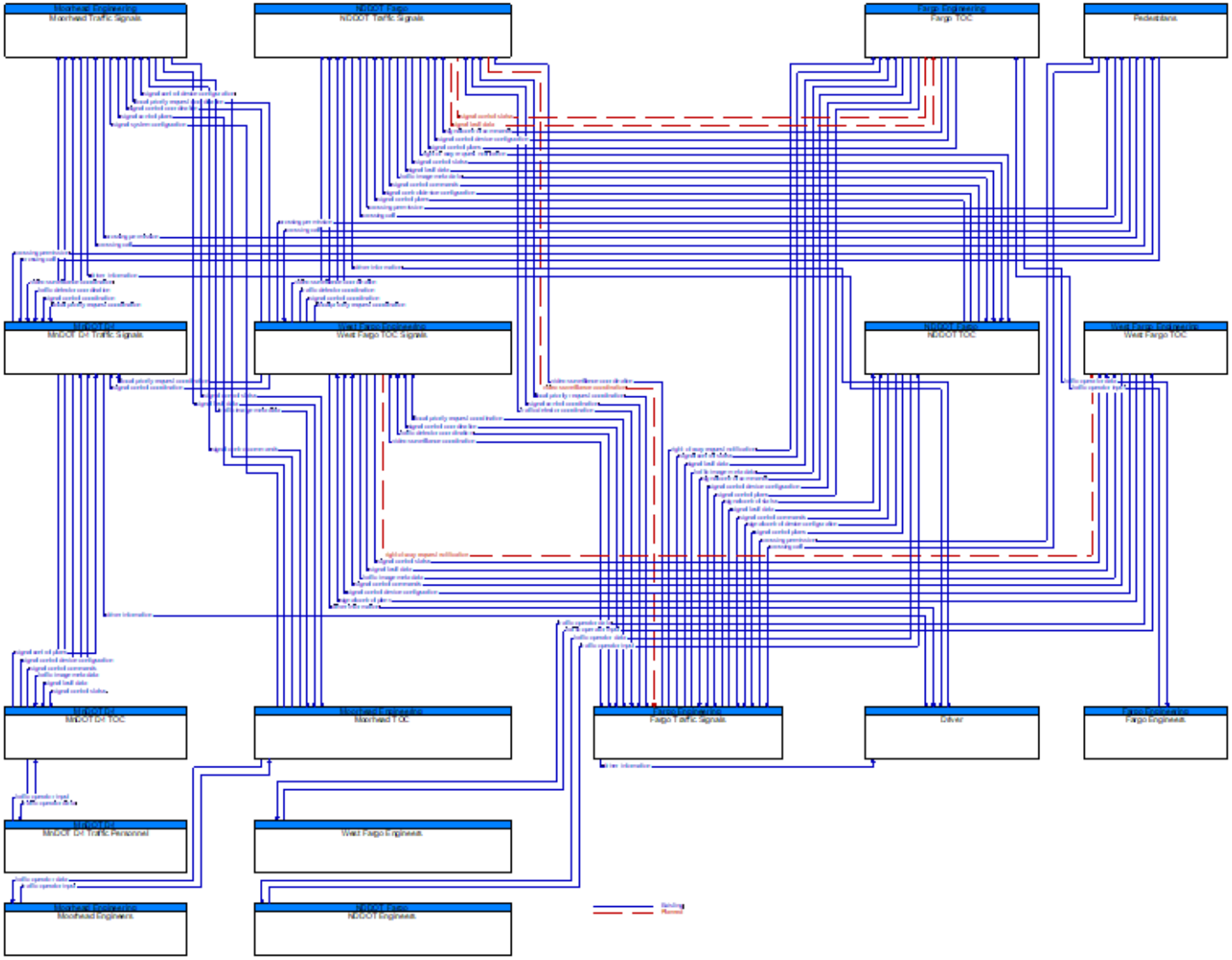




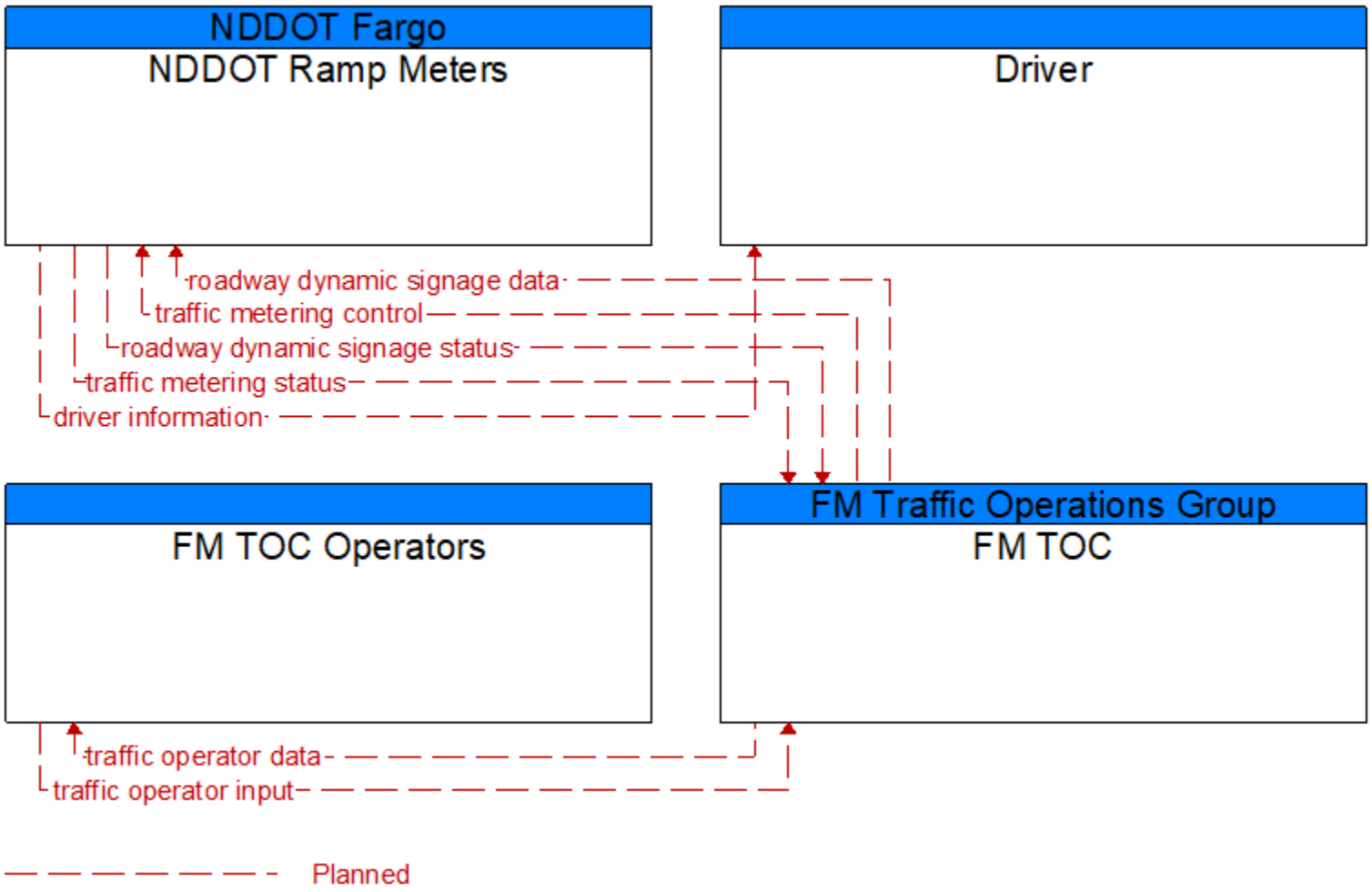
TM03 Traffic Signal Control

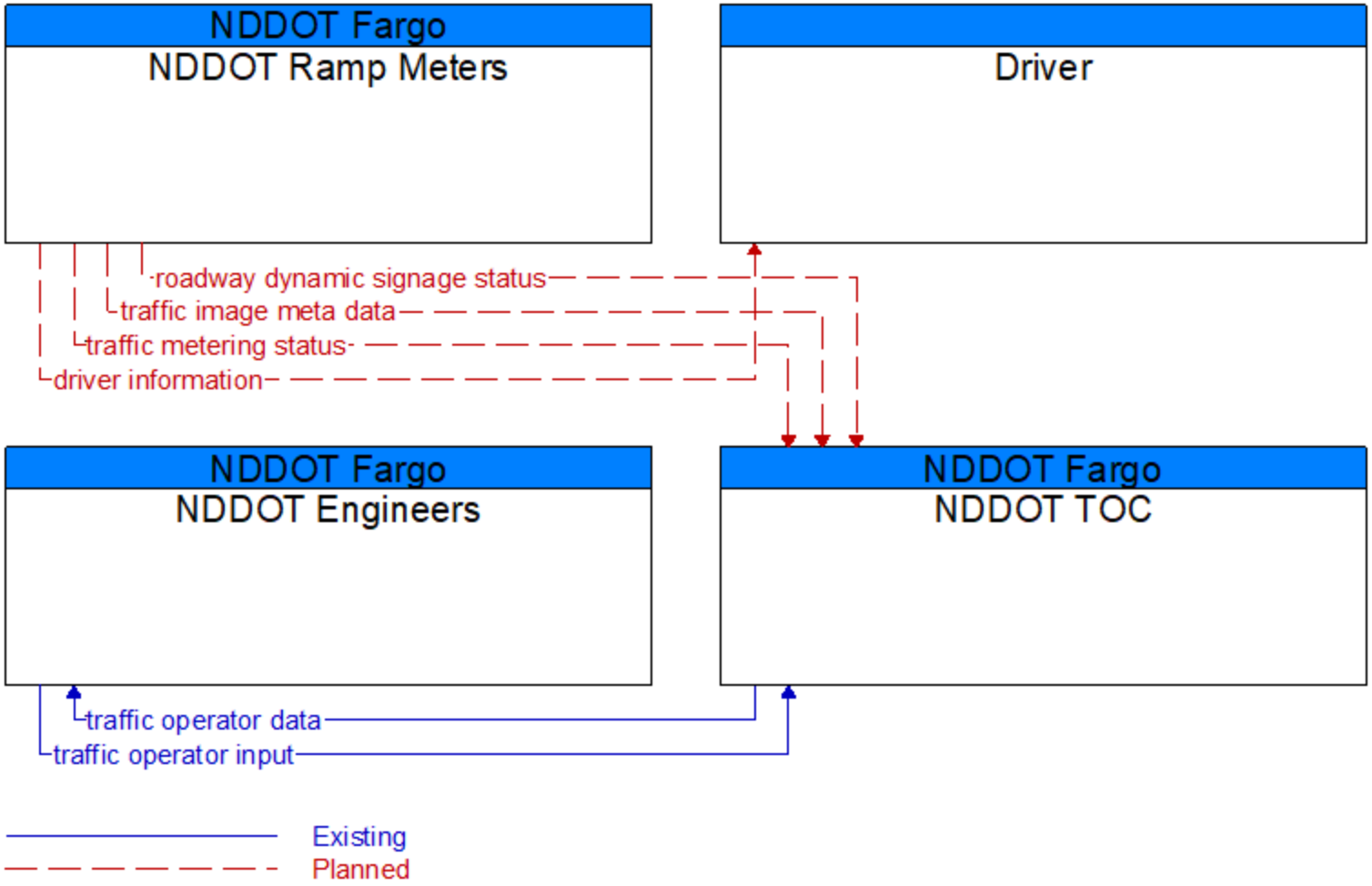


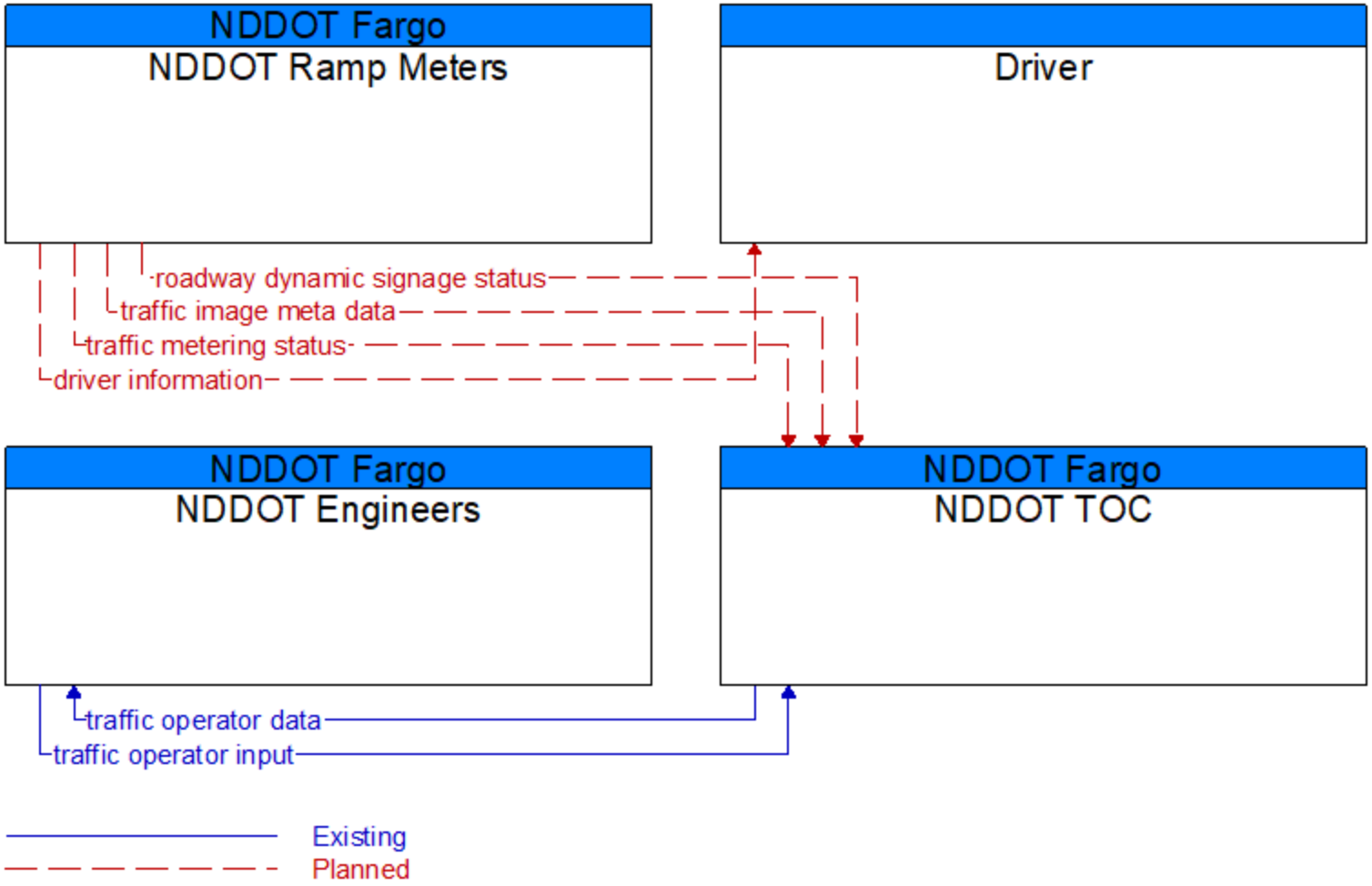



Moorhead Engineering
Moorhead Traffic Signals
NDDOT Fargo
NDDOT Traffic Signals
Fargo Engineering
Fargo TOC
Pedestrians
MnDOT D4
MnDOT D4 Traffic Signals
West Fargo Engineering
West Fargo TOC Signals
NDDOT FMC
NDDOT TOC
West Fargo Engineering
West Fargo TOC
MnDOT D4
MnDOT D4 TOC
Moorhead Engineering
Moorhead TOC
Fargo Traffic Signals
Driver
Fargo Engineering
Fargo Engineers
MnDOT D4
MnDOT D4 Traffic Personnel
West Fargo Engineers
Moorhead Engineering
Moorhead Engineers
NDDOT Fargo
NDDOT Engineers
Existing
Planned

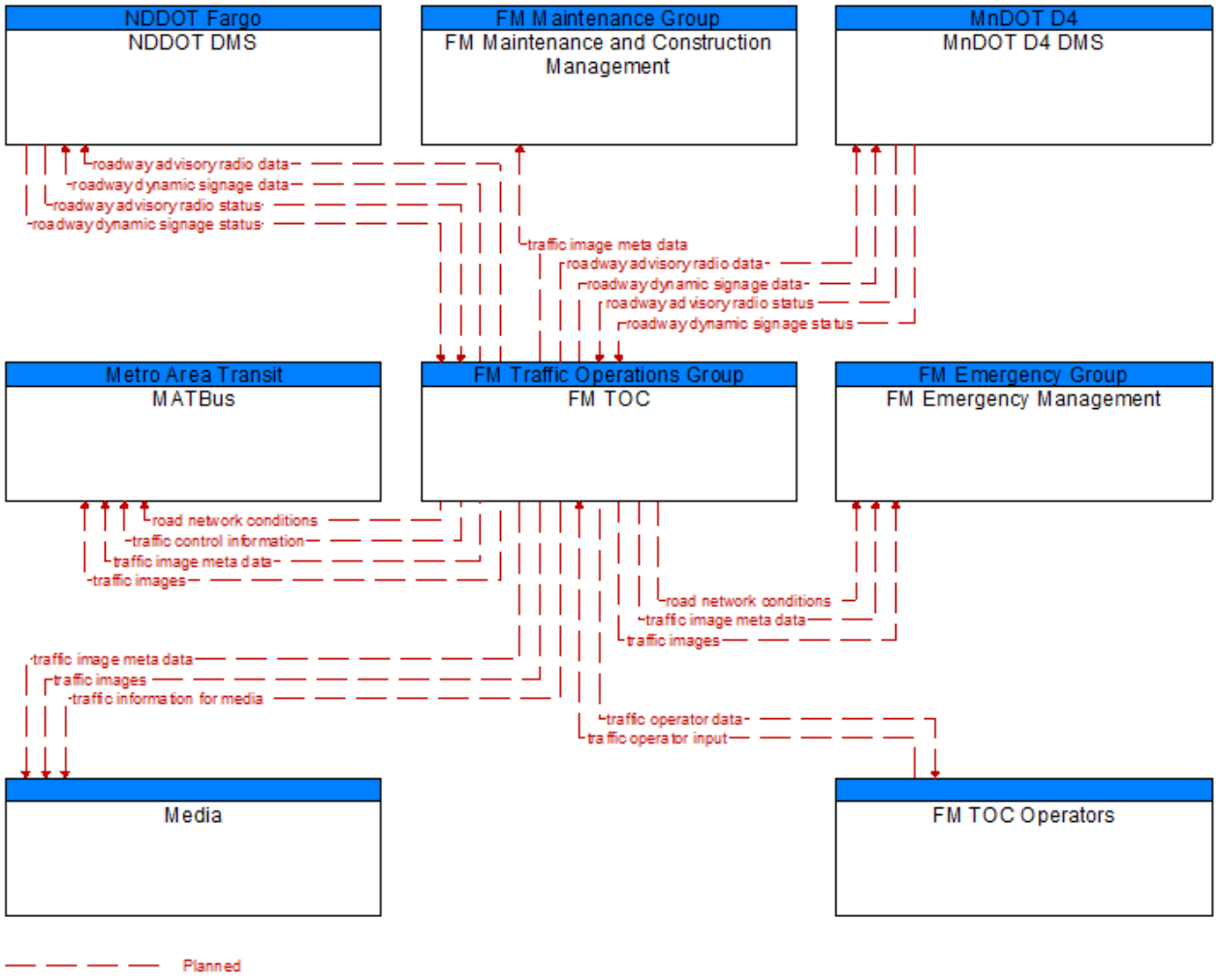
TM05-TrafficMetering

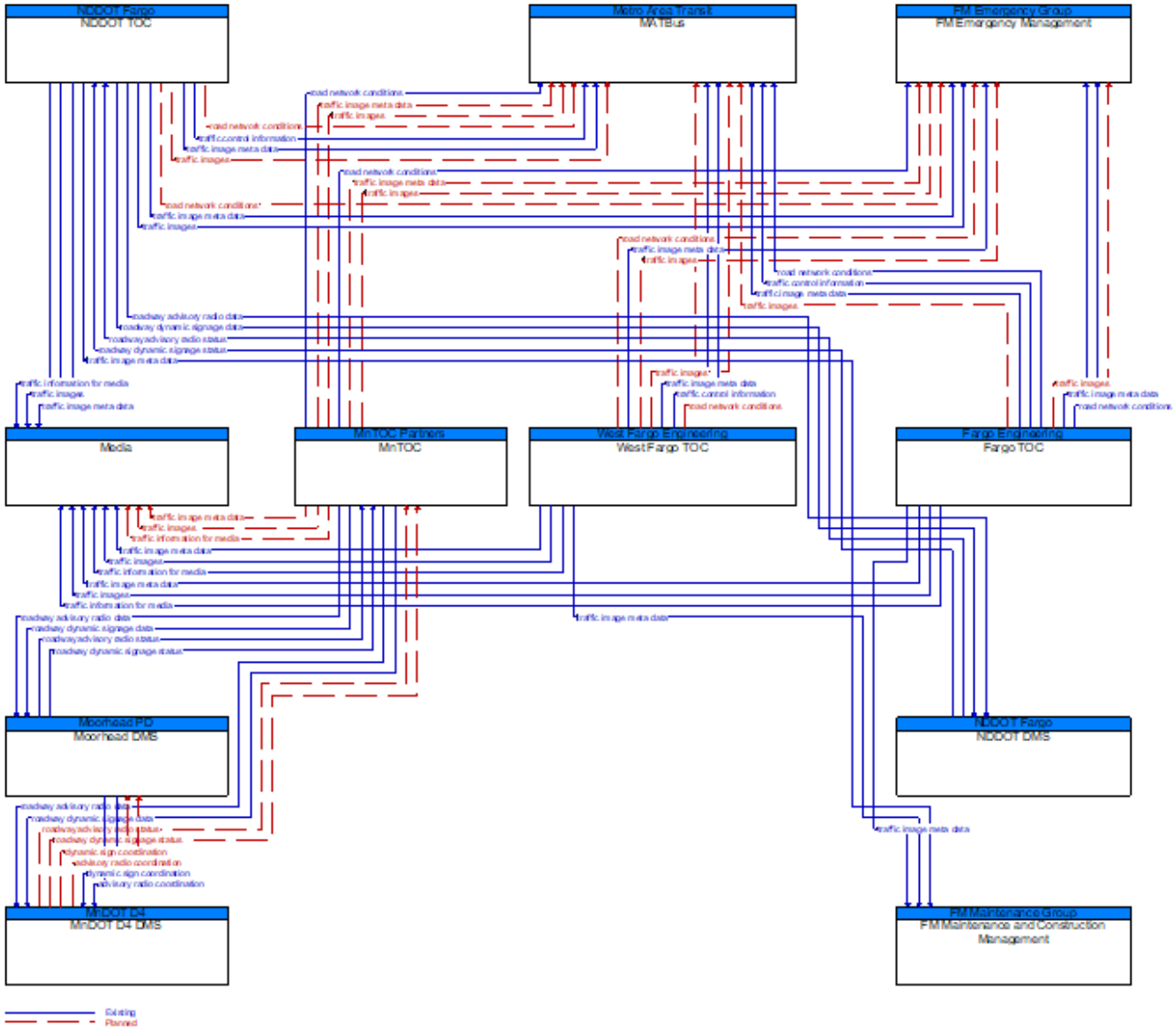


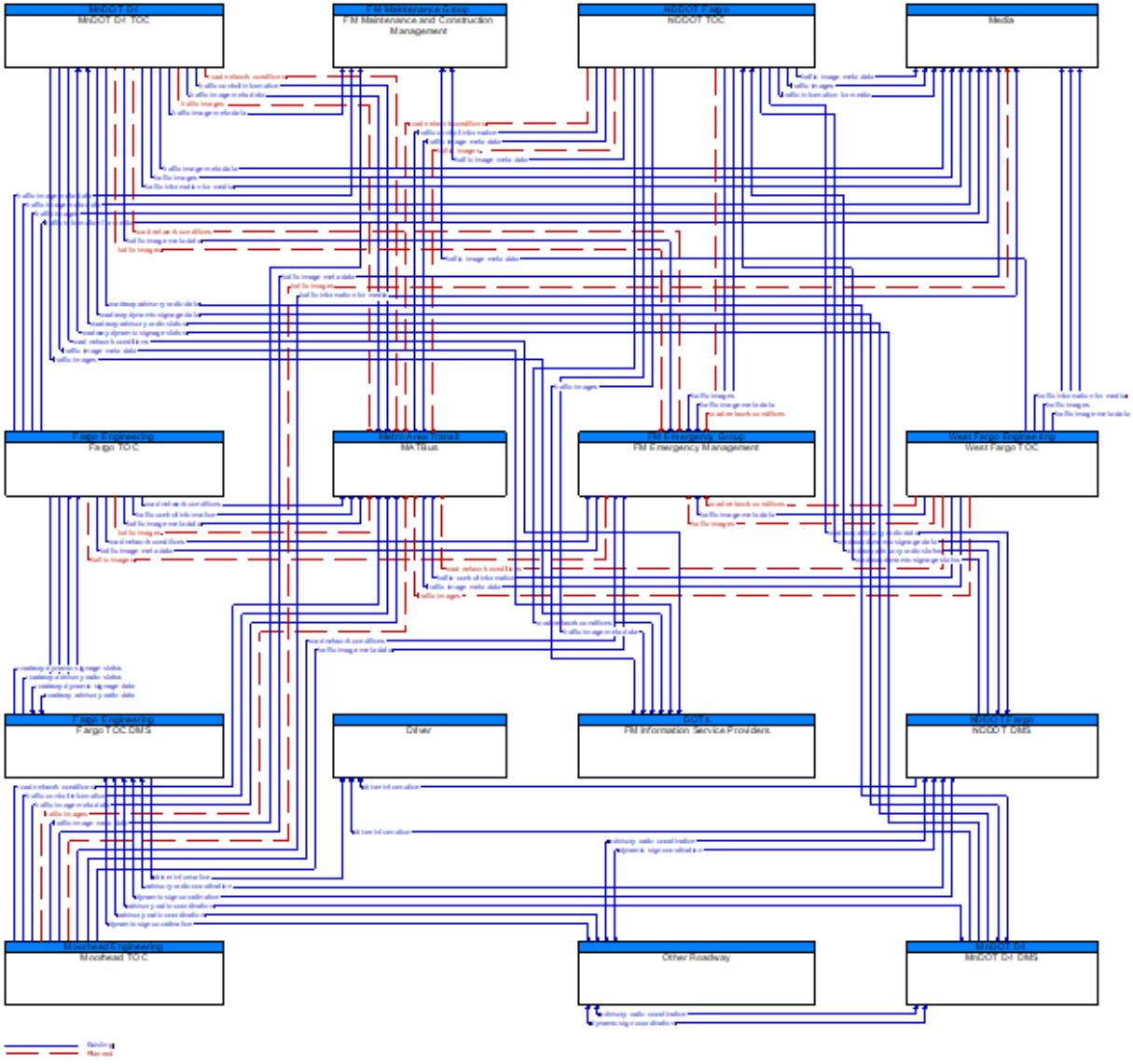

NDDOT Fargo
NDDOT Ramp Meters
Driver
roadway dynamic signage status
traffic image meta data
traffic metering status
driver information
NDDOT Fargo
NDDOT Engineers
NDDOT Fargo
NDDOT TOC
traffic operator data
traffic operator input
Existing
Planned


NDDOT Fargo
NDDOT Ramp Meters
Driver
roadway dynamic signage status
traffic image meta data
traffic metering status
driver information
NDDOT Fargo
NDDOT Engineers
NDDOT Fargo
NDDOT TOC
traffic operator data
traffic operator input
Existing
Planned

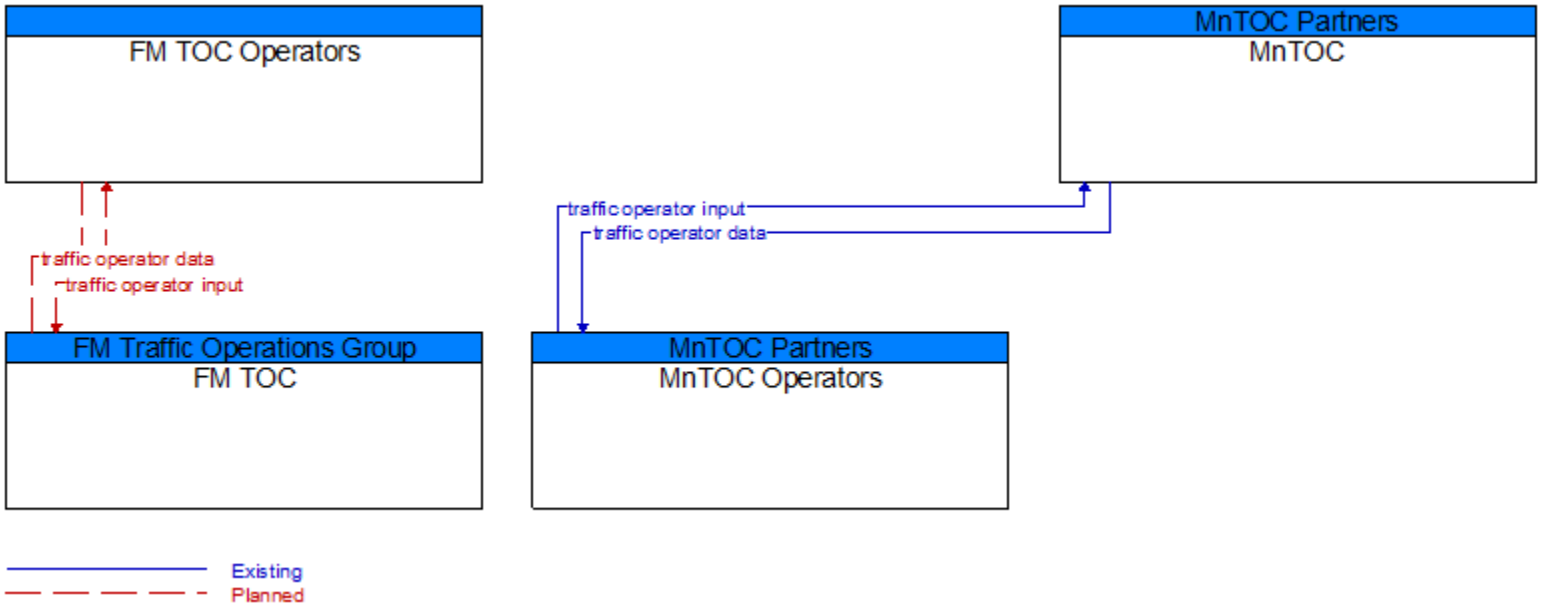
TM06 Traffic Information Dissemination

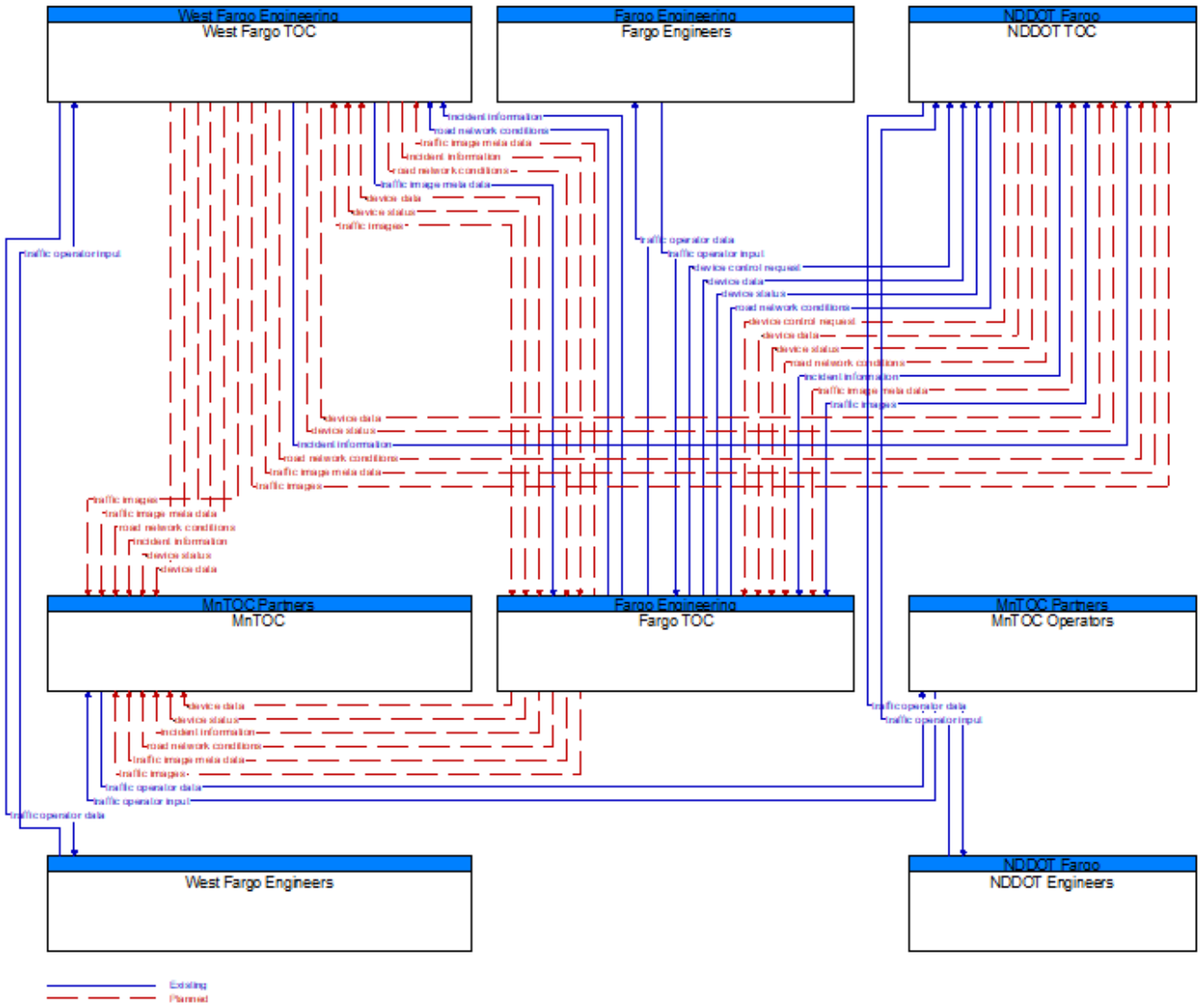


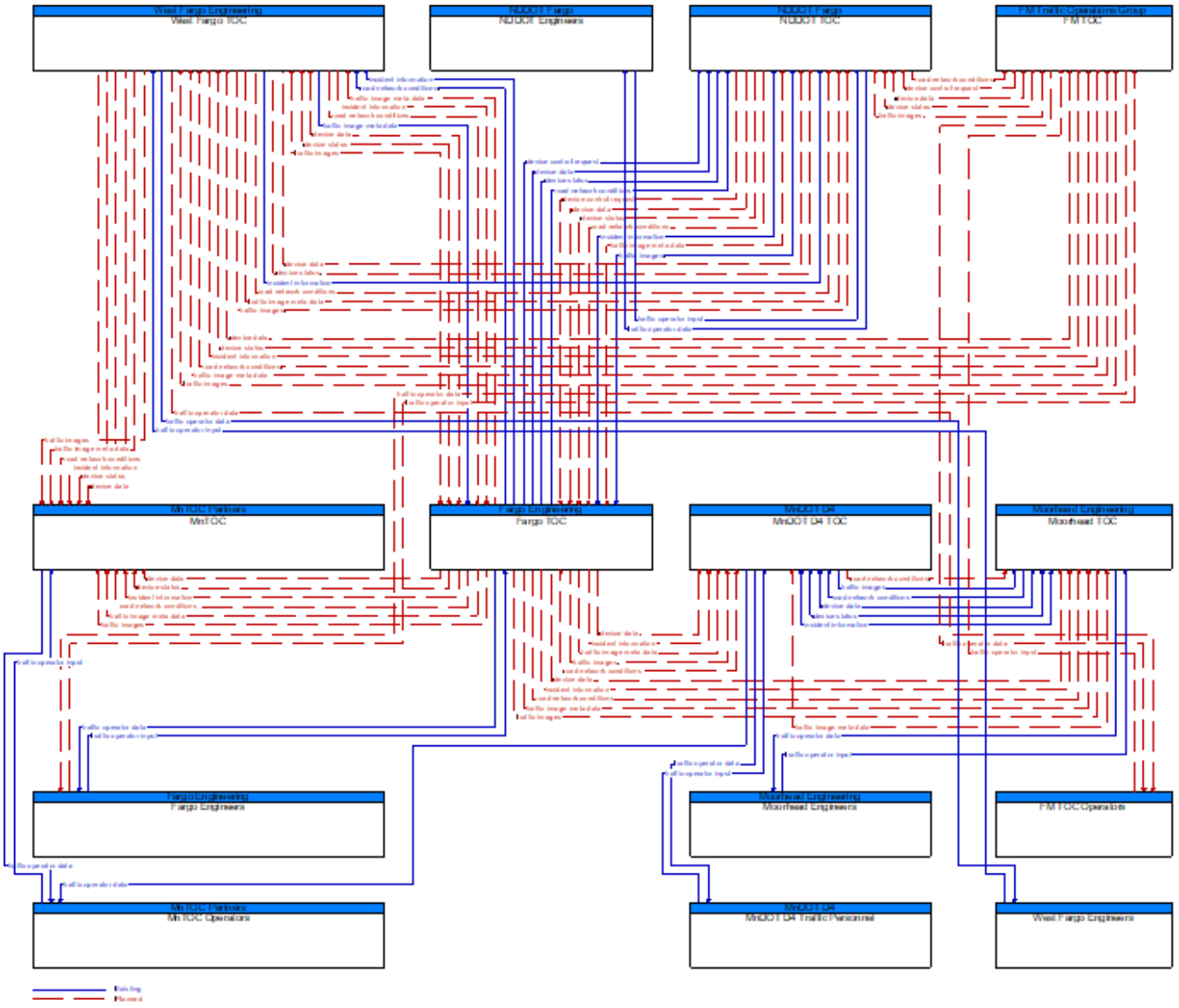

NDDOT Fargo
NDDOT TOC
Metro Area Transit
MATBus
FM Emergency Group
FM Emergency Management
Media
MnTOC Partners
MnTOC
West Fargo Engineering
West Fargo TOC
Fargo Engineering
Fargo TOC
Moorhead PD
Moorhead DMS
NDDOT Fargo
NDDOT DMS
MnDOT D4
MnDOT D4 DMS
FM Maintenance Group
FM Maintenance and Construction Management
Existing
Planned


MnDOT D4
MnDOT D4 TOC
FM Maintenance Group
FM Maintenance and Construction Management
NDDOT Fargo
NDDOT TOC
Media
Fargo Engineering
Fargo TOC
MnDOT Muni Fleet
MN Muni
FM Emergency Management
FM Emergency Management
West Fargo Engineering
West Fargo TOC
Fargo Engineering
Fargo TOC DMS
Driver
TRCs
FM Information Service Providers
NDDOT Fargo
NDDOT DMS
MnDOT Bdwd Engineering
Moorhead TOC
Other Roadway
MnDOT D4
MnDOT D4 DMS

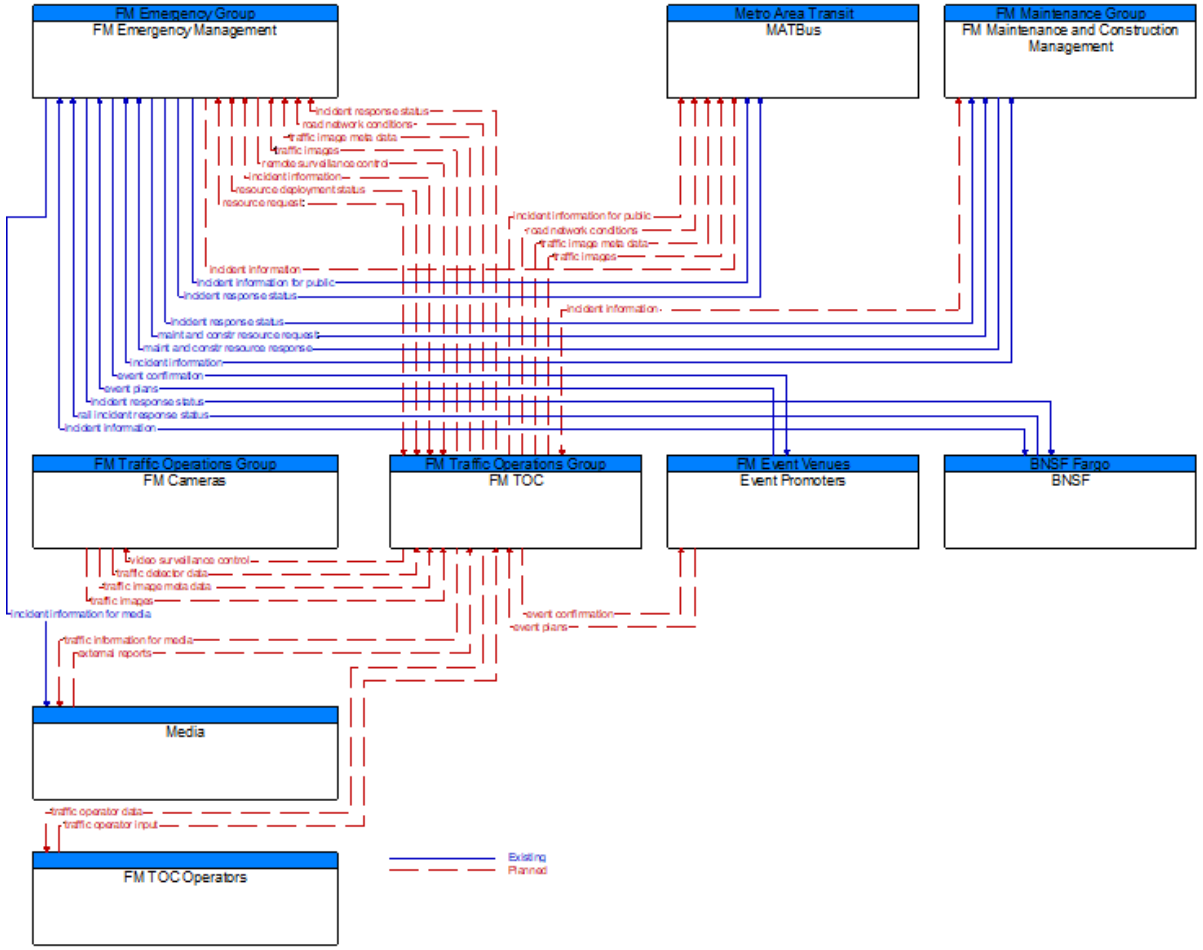
TM07 Regional Traffic Management

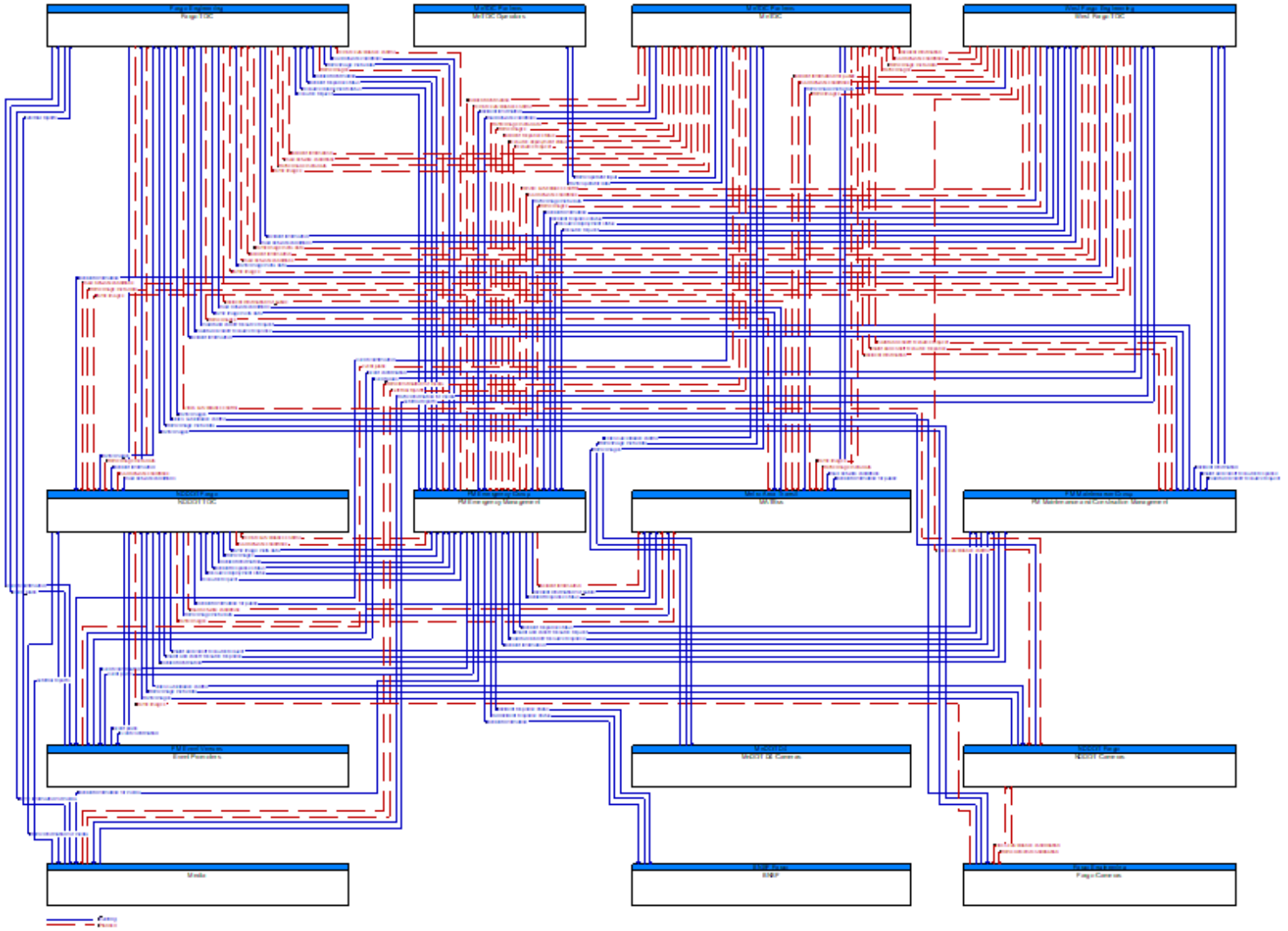


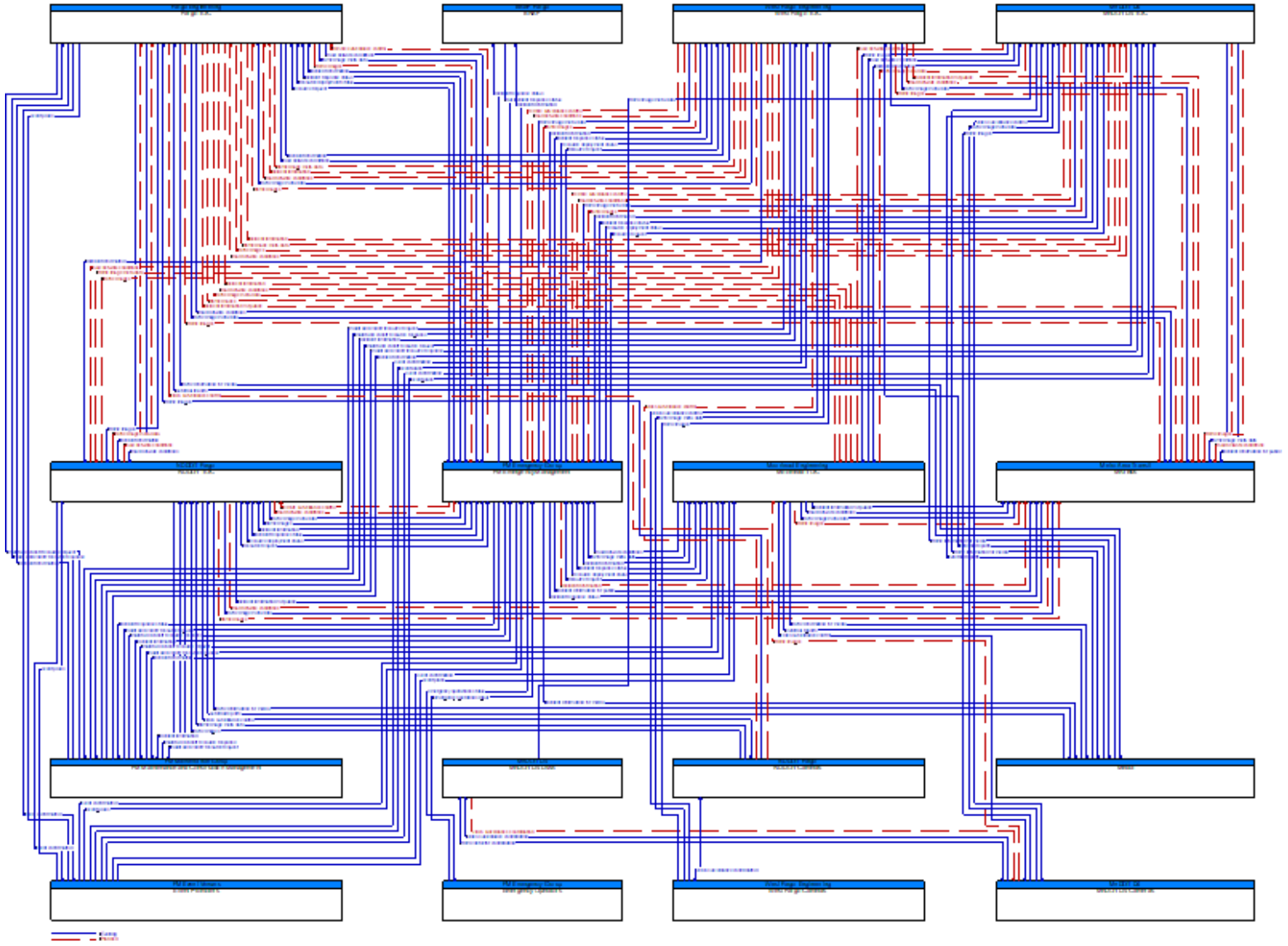

West Fargo Engineering
West Fargo TOC
Fargo Engineering
Fargo Engineers
NDDOT Fargo
NDDOT TOC
MnTOC Partners
MnTOC
Fargo Engineering
Fargo TOC
MnTOC Partners
MnTOC Operators
West Fargo Engineers
NDDOT Fargo
NDDOT Engineers
Existing
Planned


West Fargo Engineering
West Fargo TOC
NDDOT Fargo
NDDOT Engineers
NDDOT Fargo
NDDOT TOC
FM Traffic Operations Group
FM TOC
MnTOC Partners
MnTOC
Fargo Engineering
Fargo TOC
MnDOT D4
MnDOT D4 TOC
Moorhead Engineering
Moorhead TOC
Fargo Engineering
Fargo Engineers
Moorhead Engineering
Moorhead Engineers
FM TOC Operators
MnTOC Partners
MnTOC Operators
MnDOT D4
MnDOT D4 Traffic Personnel
West Fargo Engineers

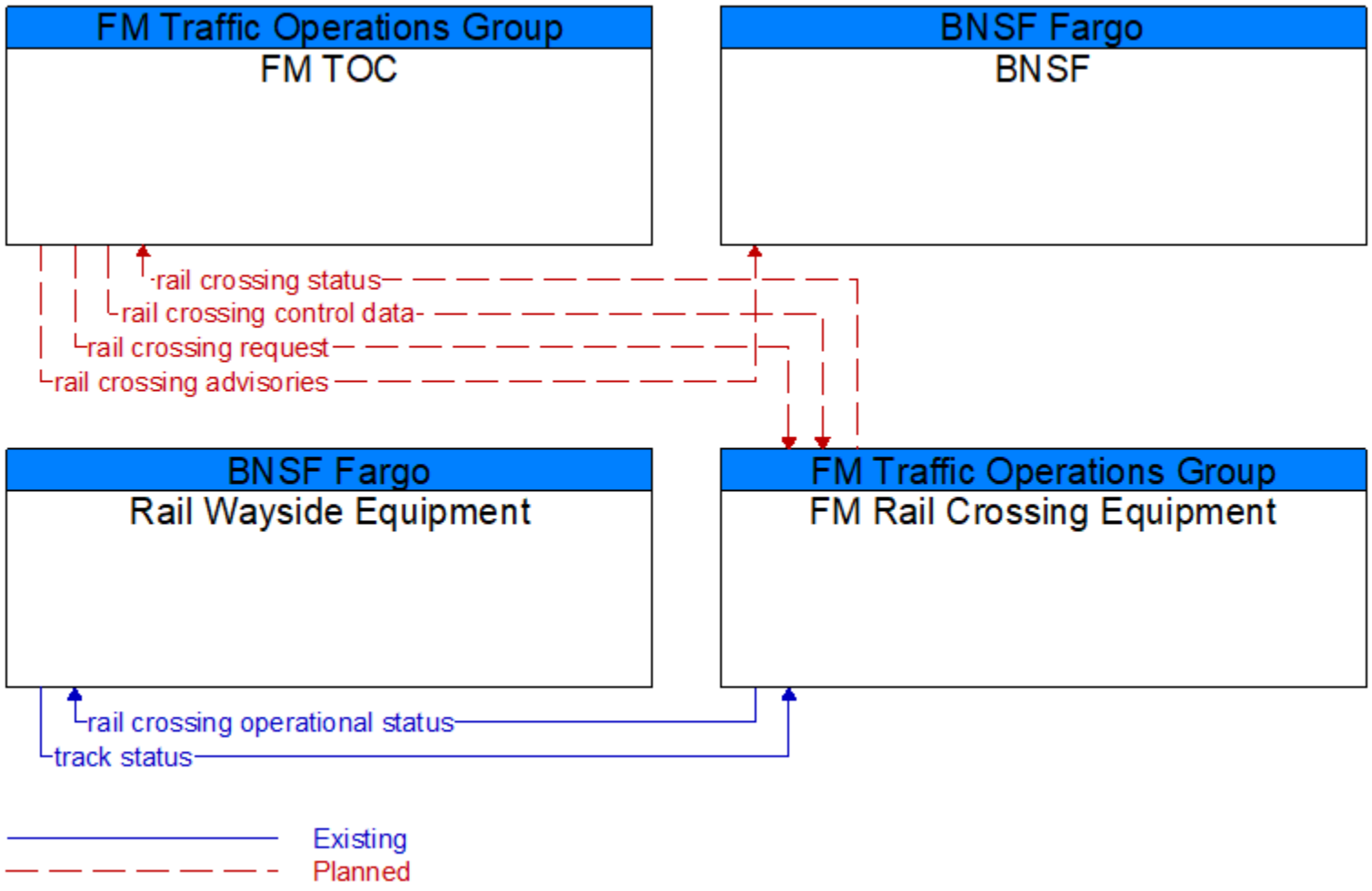
TM08 Traffic Incident Management System

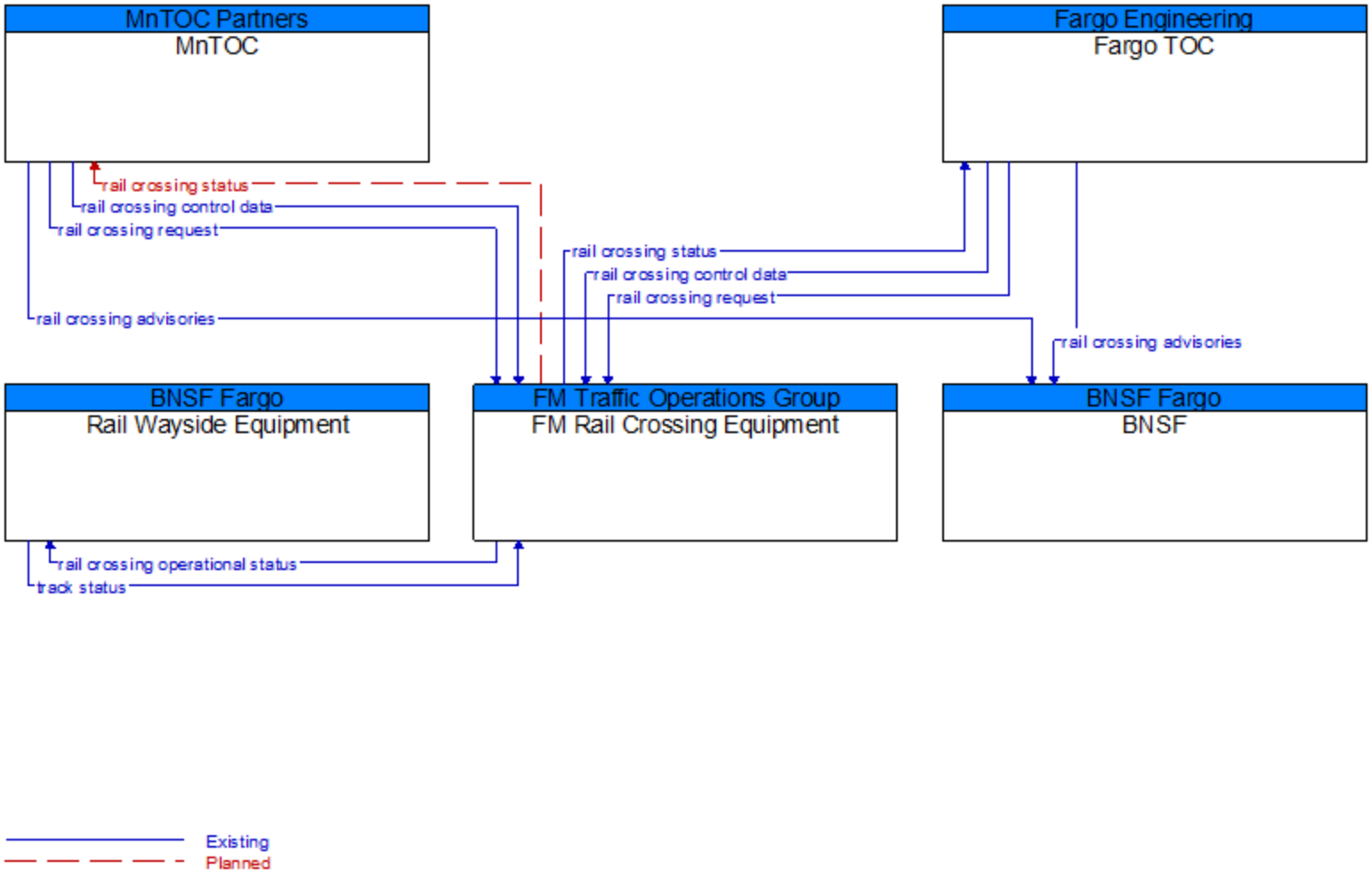


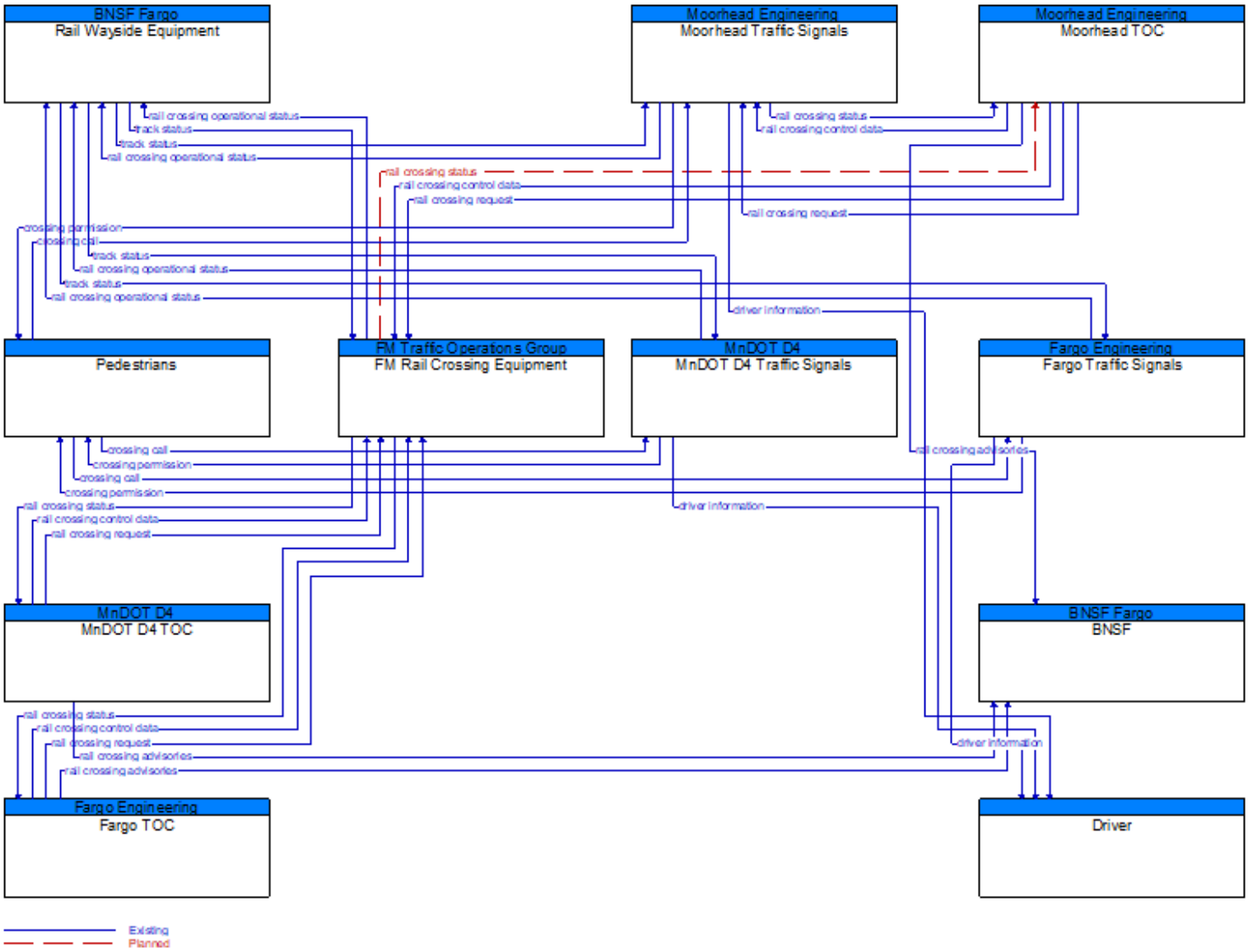




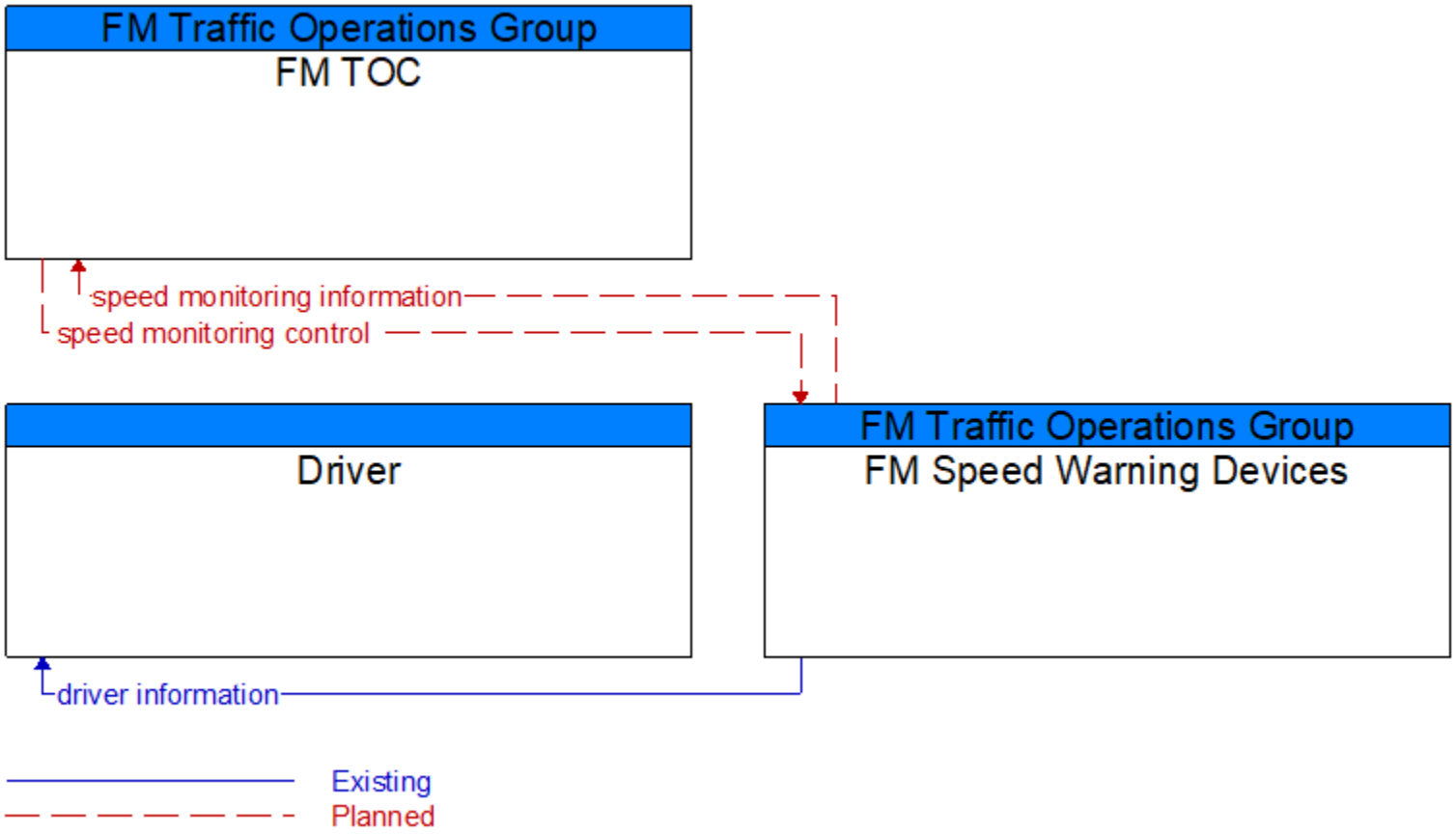
TM13 Standard Railroad Grade Crossing

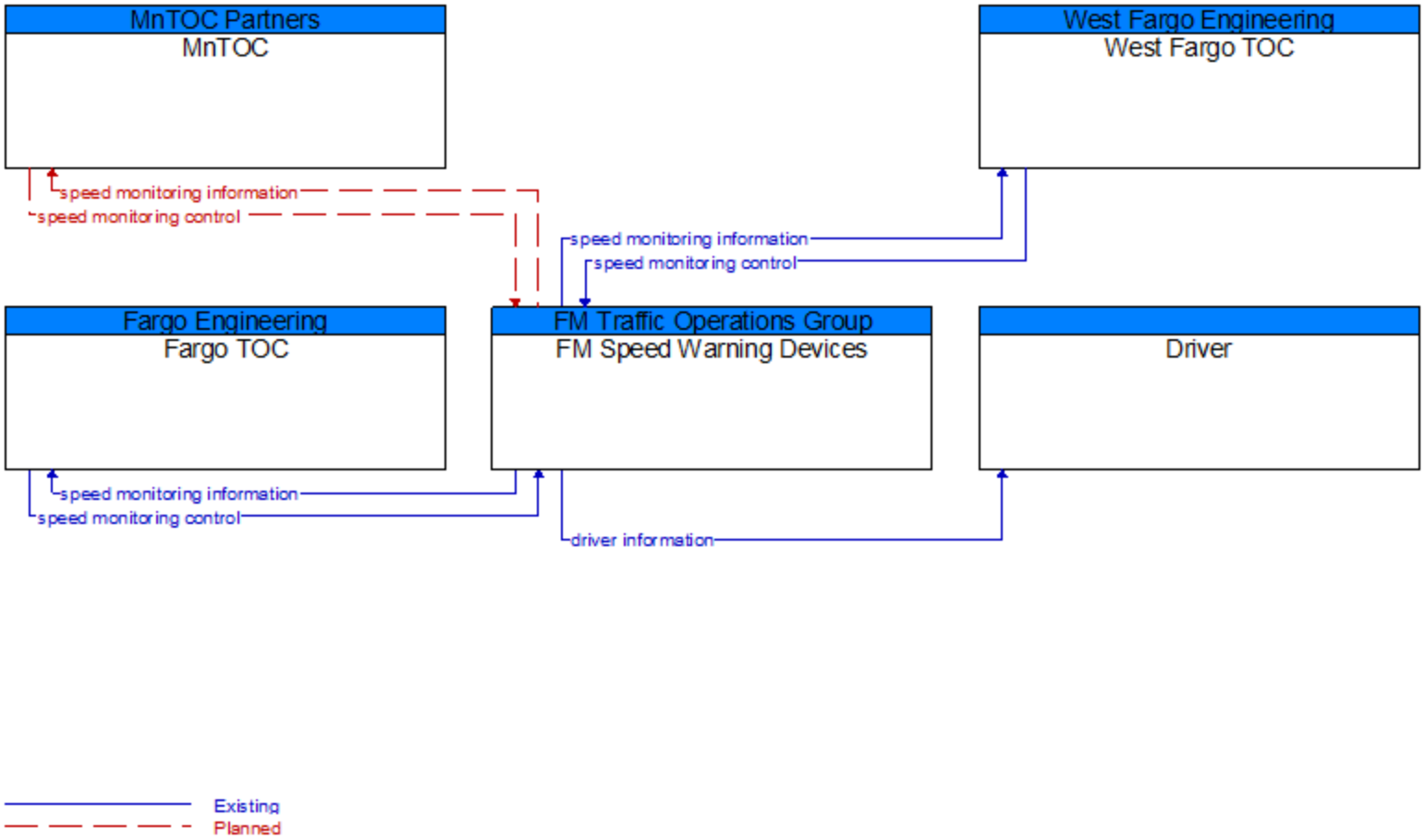


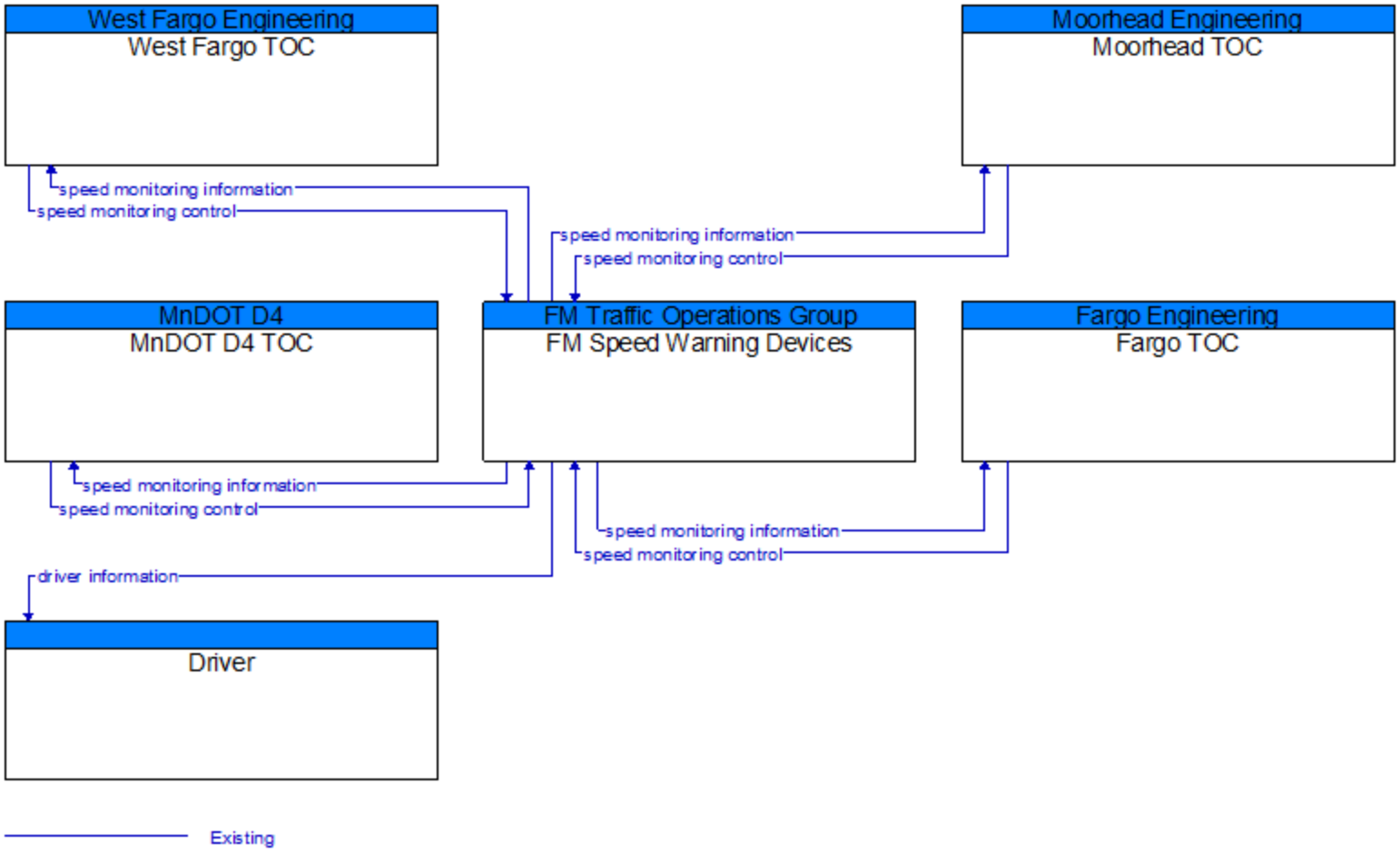

MnTOC Partners
MnTOC
Fargo Engineering
Fargo TOC
rail crossing status
rail crossing control data
rail crossing request
rail crossing advisories
rail crossing status
rail crossing control data
rail crossing request
rail crossing advisories
BNSF Fargo
Rail Wayside Equipment
FM Traffic Operations Group
FM Rail Crossing Equipment
BNSF Fargo
BNSF
rail crossing operational status
track status
Existing
Planned


BNSF Fargo
Rail Wayside Equipment
Moorhead Engineering
Moorhead Traffic Signals
Moorhead Engineering
Moorhead TOC
rail crossing operational status
track status
track status
rail crossing operational status
rail crossing status
rail crossing control data
rail crossing request
rail crossing status
rail crossing control data
rail crossing request
crossing permission
crossing call
track status
rail crossing operational status
track status
rail crossing operational status
driver information
Pedestrians
FM Traffic Operations Group
FM Rail Crossing Equipment
MnDOT D4
MnDOT D4 Traffic Signals
Fargo Engineering
Fargo Traffic Signals
crossing call
crossing permission
crossing call
crossing permission
rail crossing advisories
rail crossing status
rail crossing control data
rail crossing request
driver information
MnDOT D4
MnDOT D4 TOC
BNSF Fargo
BNSF
rail crossing status
rail crossing control data
rail crossing request
rail crossing advisories
rail crossing advisories
driver information
Fargo Engineering
Fargo TOC
Driver
Existing
Planned

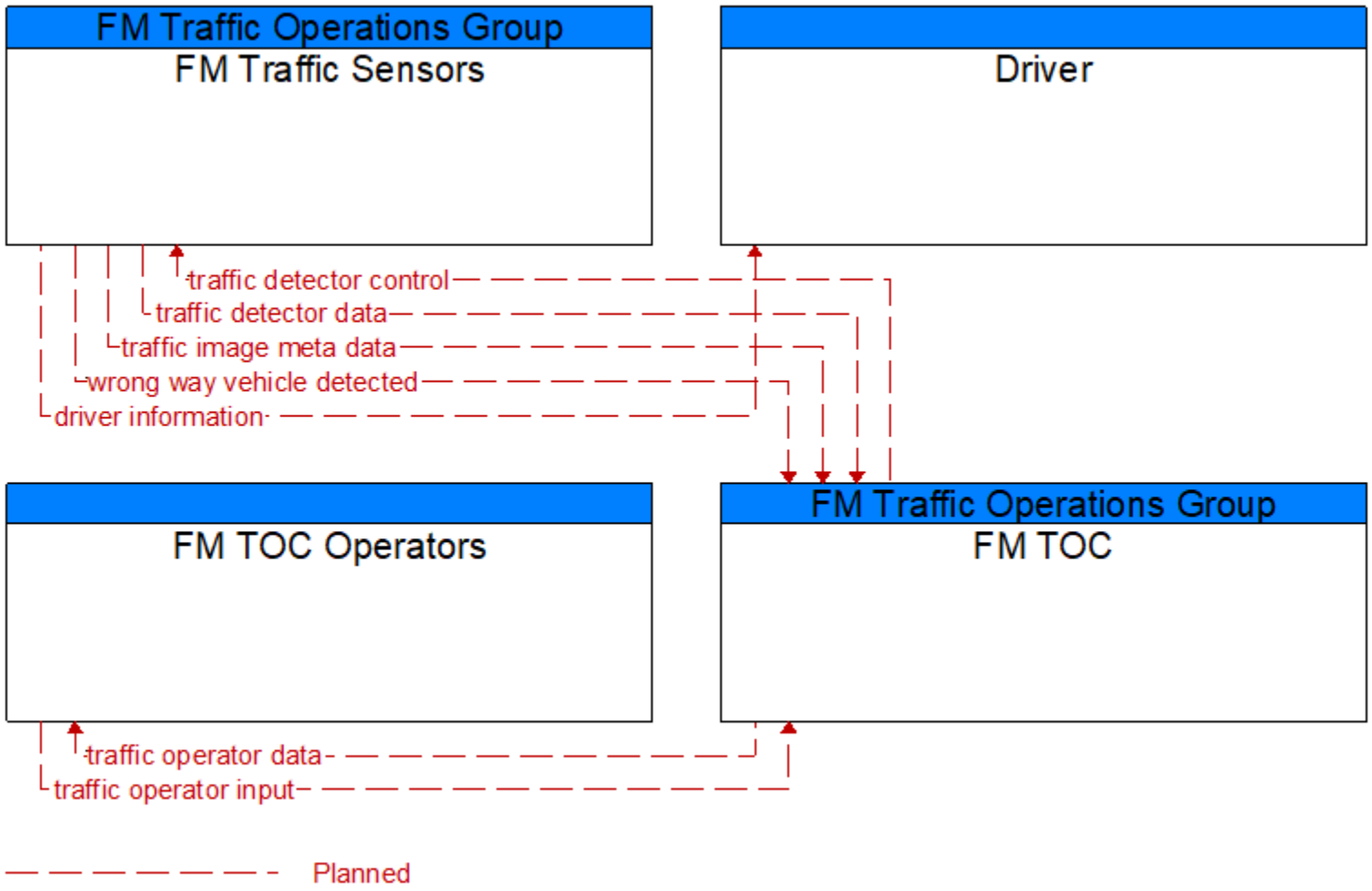
TM17-Speed Warning and Enforcement

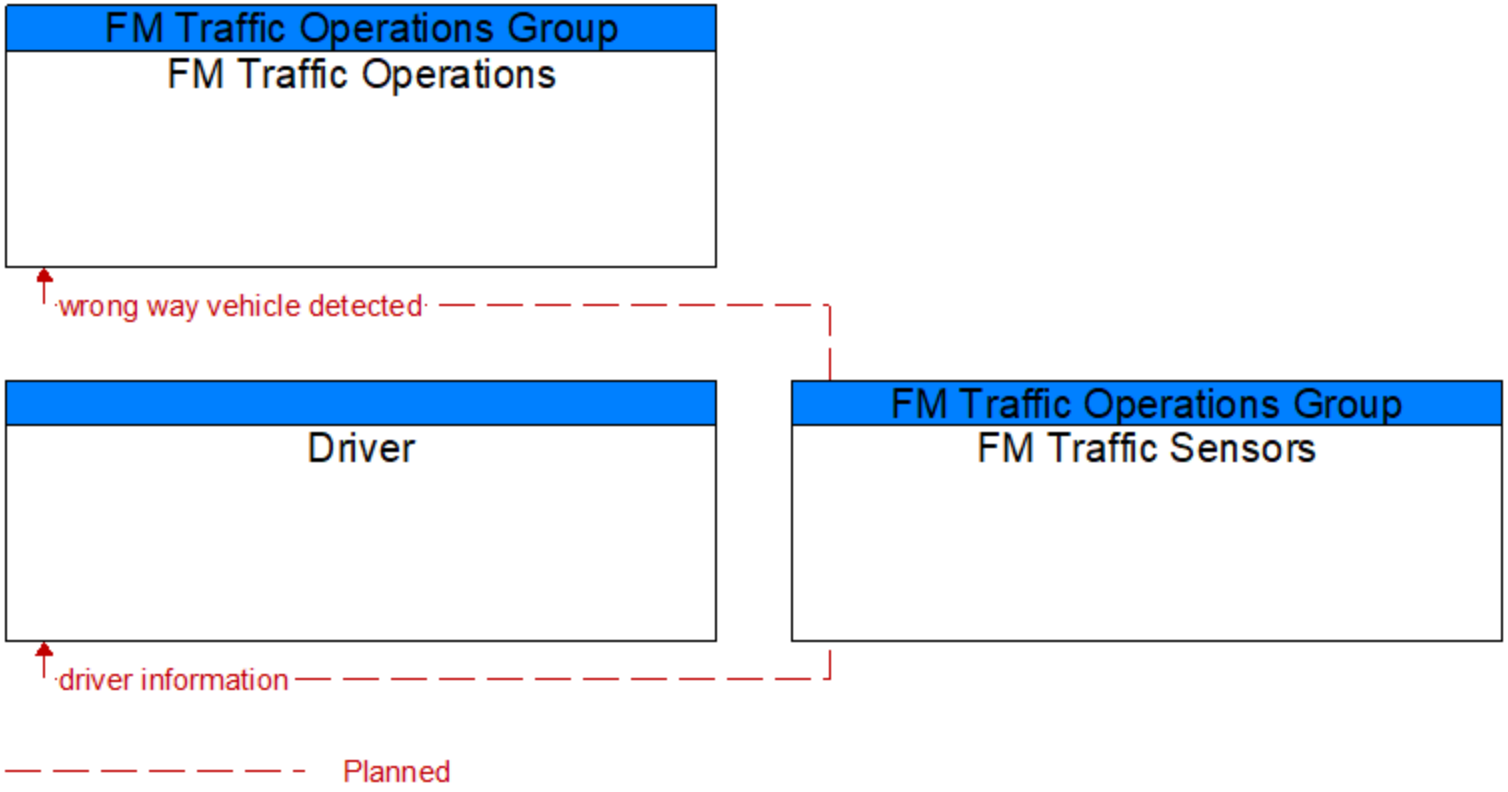


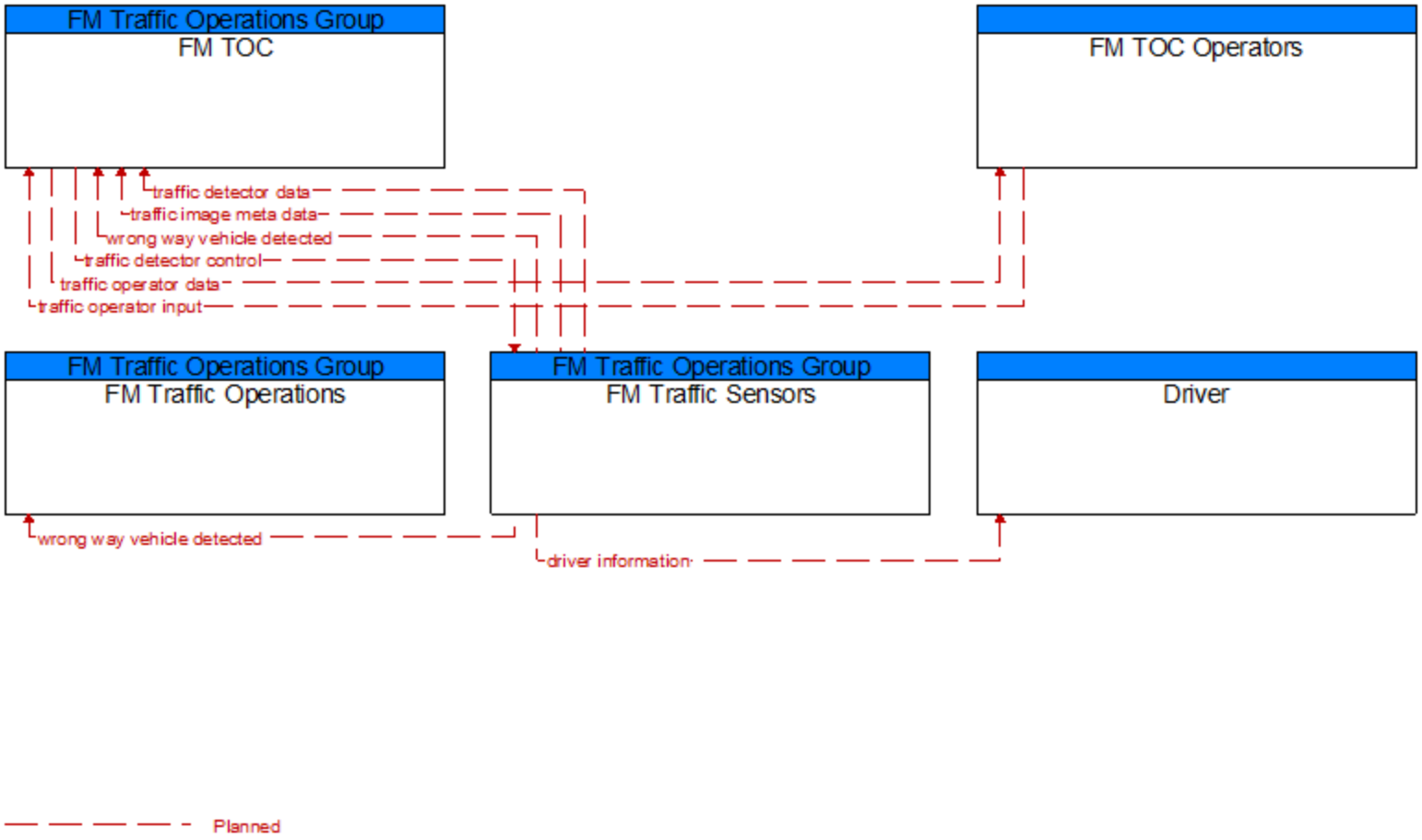

MnTOC Partners
MnTOC
West Fargo Engineering
West Fargo TOC
speed monitoring information
speed monitoring control
speed monitoring information
speed monitoring control
Fargo Engineering
Fargo TOC
FM Traffic Operations Group
FM Speed Warning Devices
Driver
speed monitoring information
speed monitoring control
driver information
Existing
Planned


West Fargo Engineering
West Fargo TOC
Moorhead Engineering
Moorhead TOC
speed monitoring information
speed monitoring control
speed monitoring information
speed monitoring control
MnDOT D4
MnDOT D4 TOC
FM Traffic Operations Group
FM Speed Warning Devices
Fargo Engineering
Fargo TOC
speed monitoring information
speed monitoring control
speed monitoring information
speed monitoring control
driver information
Driver
Existing

TM25-Wrong Way Vehicle Detection and Warning




FM Traffic Operations Group
FM Traffic Operations
wrong way vehicle detected
Driver
FM Traffic Operations Group
FM Traffic Sensors
driver information
Planned


FM Traffic Operations Group
FM TOC
FM TOC Operators
traffic detector data
traffic image meta data
wrong way vehicle detected
traffic detector control
traffic operator data
traffic operator input
FM Traffic Operations Group
FM Traffic Operations
FM Traffic Operations Group
FM Traffic Sensors
Driver
wrong way vehicle detected
driver information
Planned

APPENDIX-B

FUNCTIONAL REQUIREMENTS

Table 9: List of Functional Requirements

Element Name	Functional Object	Requirement #	Requirement	Status
County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	2	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
County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	3	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing
County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	4	The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Planned
EV Charging Station	Electric Charging Station Management	1	The field element shall provide the current charging status including current charge rate, estimated time to completion, and cost associated with the charge to the vehicle.	Existing
EV Charging Station	Electric Charging Station Management	2	The field element shall provide the current vehicle charging status directly to drivers.	Existing
EV Charging Station	Electric Charging Station Management	3	The field element shall provide charging station information, including location, operating hours, current availability, charging capacity and standards supported, access restrictions, and rates/fee structure, to traveler information systems.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
Fargo TOC	TMC Regional Traffic Management	1	The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Existing
Fargo TOC, NDDOT TOC, West Fargo TOC	TMC Regional Traffic Management	2	The center shall exchange traffic control information with other traffic management centers to support remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	Planned
Fargo Traffic Sensors	Roadway Data Collection	2	The field element shall include the sensors and supporting roadside devices that sense, collect, and send traffic, road, and environmental conditions information to a center for archival.	Existing
Fargo Traffic Sensors, FM Traffic Sensors	Roadway Data Collection	1	The field element shall collect traffic, road, and environmental conditions information.	Existing
Fargo Traffic Sensors, FM Traffic Sensors	Roadway Data Collection	3	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.	Existing
Fargo Traffic Signals	Roadway Signal Control	3	The field element shall provide the capability to notify the traffic management center of pedestrian calls and pedestrian accommodations.	Planned
Fargo Traffic Signals	Roadway Signal Control	9	The field element shall report current intersection signal timing information to roadside equipment for transmission to connected vehicles.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
Fargo Traffic Signals	Roadway Signal Preemption	2	The field element shall inform the controlling center when preemption requests have been received.	Existing
Fargo Traffic Signals, FM Signals	Roadway Signal Control	6	The field element shall return traffic signal controller operational status to the center.	Existing
Fargo Traffic Signals, FM Signals	Roadway Signal Control	7	The field element shall return traffic signal controller fault data to the center.	Existing
Fargo Traffic Signals, FM Signals	Roadway Signal Control	8	The field element shall report current transit priority status to the center.	Existing
Fargo Traffic Signals, FM Signals, MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Preemption	1	The field element shall respond to signal preemption requests from emergency vehicles.	Existing
Fargo Traffic Signals, MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Preemption	3	The field element shall send the preemption request to the signal controller to immediately preempt the signal for the requested direction.	Existing
Fargo Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	15	The field element shall receive requests for emergency vehicle signal preemption.	Existing
FM Cameras, Fargo Cameras	Roadway Basic Surveillance	2	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
FM Cameras, Fargo Cameras	Roadway Basic Surveillance	4	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Cameras, Fargo Cameras	Roadway Basic Surveillance	5	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing
FM Data Warehouse	Archive Data Repository	1	The center shall collect data from centers.	Existing
FM Data Warehouse	Archive Data Repository	2	The center shall collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data; e.g., time range of entries, number of entries; or a sample of the data (e. g. a thumbnail).	Existing
FM Data Warehouse	Archive Data Repository	4	The center shall perform quality checks on collected data.	Existing
FM Data Warehouse	Archive Data Repository	5	The center shall notify the system operator of errors related to data collection, analysis and archival.	Existing
FM Data Warehouse	Archive Data Repository	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.	Planned
FM Data Warehouse	Archive Data Repository	8	The center shall collect data from data distribution systems and other data sources.	Planned
FM Data Warehouse	Archive Data Repository	9	The center shall respond to requests from the administrator interface function to manage center-sourced data collection.	Planned

Element Name	Functional Object	Requirement #	Requirement	Status
FM DMS	Roadway Traffic Information Dissemination	1	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
FM DMS	Roadway Traffic Information Dissemination	2	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
FM DMS	Roadway Traffic Information Dissemination	3	The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing
FM DMS	Roadway Traffic Information Dissemination	4	The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Existing
FM Emergency Management	Emergency Evacuation Support	1	The center shall manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.	Existing
FM Emergency Management	Emergency Evacuation Support	10	The center shall monitor the progress of the reentry process.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Emergency Management	Emergency Evacuation Support	2	The center shall develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.	Existing
FM Emergency Management	Emergency Evacuation Support	4	The center shall coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.	Existing
FM Emergency Management	Emergency Evacuation Support	5	The center shall provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.	Existing
FM Emergency Management	Emergency Evacuation Support	6	The center shall request resources from transit agencies as needed to support the evacuation.	Existing
FM Emergency Management	Emergency Evacuation Support	7	The center shall request 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.	Planned
FM Emergency Management	Emergency Evacuation Support	8	The center shall provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.	Existing
FM Emergency Management	Emergency Evacuation Support	9	The center shall monitor the progress or status of the evacuation once it begins and exchange tactical plans, prepared during the incident, with allied agencies.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Emergency Management	Emergency Incident Command	1	The center shall provide tactical decision support, resource coordination, and communications integration for first responders to support local management of an incident.	Existing
FM Emergency Management	Emergency Incident Command	2	The center shall provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.	Existing
FM Emergency Management	Emergency Incident Command	3	The center shall track and maintain resource information and action plans pertaining to the incident command.	Existing
FM Emergency Management	Emergency Incident Command	4	The center shall share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.	Existing
FM Emergency Management	Emergency Incident Command	5	The center shall assess the status of responding emergency vehicles as part of an incident command.	Existing
FM Emergency Management	Emergency Response Management	1	The center shall provide strategic emergency response capabilities provided by an Emergency Operations Center for large-scale incidents and disasters.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Emergency Management	Emergency Response Management	10	The center shall provide the capability to request transit resource availability from transit centers for use during disaster and evacuation operations.	Existing
FM Emergency Management	Emergency Response Management	12	The center shall provide information to the media concerning the status of an emergency response.	Existing
FM Emergency Management	Emergency Response Management	16	The center shall provide the capability to communicate information about emergency situations to local population through the Emergency Telecommunications System.	Existing
FM Emergency Management	Emergency Response Management	2	The center shall manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.	Existing
FM Emergency Management	Emergency Response Management	4	The center shall develop, coordinate with other agencies, and store emergency response plans.	Existing
FM Emergency Management	Emergency Response Management	6	The center shall allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.	Existing
FM Emergency Management	Emergency Response Management	7	The center shall receive event scheduling information from Event Promoters.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Emergency Management	Emergency Response Management	9	The center shall provide the capability to remotely control and monitor CCTV systems normally operated by a traffic management center.	Planned
FM Emergency Management	Emergency Routing	4	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
FM Emergency Management	Emergency Routing	6	The center shall track current emergency vehicle location and status along with other emergency vehicle characteristics.	Existing
FM Emergency Vehicles	EV On-Board En Route Support	6	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
FM Emergency Vehicles	EV On-Board En Route Support	7	The emergency vehicle shall send patient status information to the care facility along with a request for further information.	Existing
FM Emergency Vehicles, County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	1	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing
FM Emergency Vehicles, County Sheriff Vehicles, Fargo PD Vehicles	EV On-Board En Route Support	5	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM FAST Anti-icing Systems	Roadway Automated Treatment	1	The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Existing
FM FAST Anti-icing Systems	Roadway Automated Treatment	2	The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Existing
FM FAST Anti-icing Systems	Roadway Automated Treatment	3	The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	Existing
FM FAST Anti-icing Systems	Roadway Automated Treatment	4	The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	Existing
FM Maintenance and Construction Management	MCM Incident Management	2	The maintenance center shall exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, etc.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Maintenance and Construction Management	MCM Incident Management	3	The maintenance center shall exchange incident and threat information with emergency management centers as well as traffic management centers; including notification of existence of incident and expected severity, location, time and nature of incident.	Existing
FM Maintenance and Construction Management	MCM Incident Management	4	The maintenance center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing
FM Maintenance and Construction Management	MCM Incident Management	5	The maintenance center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers.	Existing
FM Maintenance and Construction Management	MCM Incident Management	6	The maintenance center shall exchange road network status assessment information with emergency management and traffic management centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Maintenance and Construction Management	MCM Incident Management	7	The maintenance center shall provide work zone activities affecting the road network during traffic incidents including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits.	Existing
FM Maintenance and Construction Management	MCM Incident Management	8	The maintenance center shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management.	Existing
FM Maintenance and Construction Management	MCM Roadway Maintenance	2	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	Existing
FM Maintenance and Construction Management	MCM Roadway Maintenance	4	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 #	Requirement	Status
FM Maintenance and Construction Management	MCM Roadway Maintenance	8	The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	Existing
FM Maintenance and Construction Management	MCM Roadway Maintenance	9	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
FM Maintenance and Construction Management	MCM Vehicle Tracking	1	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
FM Maintenance and Construction Management	MCM Vehicle Tracking	2	The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.	Existing
FM Maintenance and Construction Management	MCM Winter Maintenance Management	1	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Maintenance and Construction Management	MCM Winter Maintenance Management	3	The center shall provide status information about scheduled winter maintenance activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, and the media.	Existing
FM Maintenance and Construction Management	MCM Winter Maintenance Management	6	The center shall collect real-time information on the state of the regional transportation system from other centers including current traffic and road conditions, weather conditions, special event and incident information and use the collected information to support winter maintenance operations.	Existing
FM Maintenance and Construction Management	MCM Winter Maintenance Management	7	The center shall dispatch and route winter maintenance vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Maintenance and Construction Management	MCM Winter Maintenance Management	8	The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
FM Maintenance and Construction Management	MCM Winter Maintenance Management	9	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing
FM Maintenance and Construction Management	MCM Work Zone Management	3	The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information centers, and the media.	Existing
FM Maintenance and Construction Management	MCM Work Zone Management	4	The center shall control traffic in work zones by providing remote control of dynamic message signs, highway advisory radio systems, gates, and barriers located in or near the work zone.	Existing
FM Maintenance Vehicles	MCV Vehicle Location Tracking	1	The maintenance and construction vehicle shall track its current location.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Maintenance Vehicles	MCV Vehicle Location Tracking	2	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Existing
FM Maintenance Vehicles	MCV Winter Maintenance	1	The maintenance and construction vehicle shall track the vehicle's location and status of safety systems on-board the winter maintenance vehicle.	Existing
FM Maintenance Vehicles	MCV Winter Maintenance	3	The maintenance and construction vehicle shall monitor winter maintenance materials information including remaining quantity and current application rate of materials on the vehicle.	Existing
FM Maintenance Vehicles	MCV Winter Maintenance	4	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
FM Rail Crossing Equipment	Roadway Standard Rail Crossing	1	The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	Existing
FM Rail Crossing Equipment	Roadway Standard Rail Crossing	2	The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the traffic management center.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Rail Crossing Equipment	Roadway Standard Rail Crossing	4	The field element shall receive track status from the rail wayside equipment that can be passed on to the traffic management center. This may include the current status of the tracks and whether a train is approaching.	Existing
FM Rail Crossing Equipment	Roadway Standard Rail Crossing	6	The field element shall control the dynamic message signs (DMS) in the vicinity of a highway-rail intersection (HRI) to advise drivers, cyclists, and pedestrians of approaching trains.	Existing
FM Rail Crossing Equipment	Roadway Standard Rail Crossing	7	The field element shall close the highway-rail intersection (HRI) when a train is approaching using gates, lights/signs, barriers, and traffic control signals.	Existing
FM Rail Crossing Equipment	Roadway Standard Rail Crossing	8	The field element shall support the integrated control of adjacent traffic signals to clear an area in advance of an approaching train and to manage traffic around the intersection.	Existing
FM Signals, Fargo Traffic Signals	Roadway Signal Control	4	The field element shall report the current signal control information to the center.	Existing
FM Signals, Fargo Traffic Signals	Roadway Signal Control	5	The field element shall report current preemption status to the center.	Existing
FM Signals, Fargo Traffic Signals, MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	1	The field element shall control traffic signals under center control.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Signals, Fargo Traffic Signals, MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	2	The field element shall respond to pedestrian crossing requests by accommodating the pedestrian crossing.	Existing
FM Speed Warning Devices	Roadway Speed Monitoring and Warning	3	If the speed detected by vehicle speed sensors is determined to be excessive, the field element shall provide a safe speed advisory to passing drivers via a driver information system (such as portable messages signs, field to vehicle communications to in-vehicle signing systems, etc.).	Existing
FM Speed Warning Devices, Fargo Traffic Sensors	Roadway Speed Monitoring and Warning	1	The field element shall include sensors to detect vehicle speeds, under traffic or maintenance center control.	Existing
FM Traffic Operations	Center Data Collection			
FM Traffic Operations	TMC Basic Surveillance	1	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing
FM Traffic Operations	TMC Basic Surveillance	2	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Planned
FM Traffic Operations	TMC Basic Surveillance	4	The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Traffic Operations	TMC Basic Surveillance	6	The center shall maintain a database of surveillance equipment and sensors and associated data (including the roadway on which they are located, the type of data collected, and the ownership of each).	Existing
FM Traffic Operations	TMC Basic Surveillance	7	The center shall remotely control devices to detect traffic.	Existing
FM Traffic Operations	TMC Data Collection	1	The center shall collect traffic management data such as operational data, event logs, etc.	Existing
FM Traffic Operations	TMC Data Collection	3	The traffic management center shall receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.	Existing
FM Traffic Operations	TMC Data Collection	4	The traffic management center shall produce sample products of the data available.	Existing
FM Traffic Operations	TMC Evacuation Support	1	The center shall coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc.	Existing
FM Traffic Operations	TMC Evacuation Support	2	The center shall support requests from emergency management centers to preempt the current traffic control strategy, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems to support evacuation traffic control plans.	Planned

Element Name	Functional Object	Requirement #	Requirement	Status
FM Traffic Operations	TMC Evacuation Support	3	The center shall coordinate evacuation information and controls with other traffic management centers.	Existing
FM Traffic Operations	TMC Evacuation Support	4	The center shall coordinate execution of evacuation strategies with emergency management centers - including activities such as setting closures and detours, establishing routes, updating areas to be evacuated, timing the process, etc.	Existing
FM Traffic Operations	TMC Evacuation Support	5	The center shall provide road network conditions and traffic images to support evacuations.	Existing
FM Traffic Operations	TMC Signal Control	1	The center shall remotely control traffic signal controllers.	Existing
FM Traffic Operations	TMC Signal Control	10	The center shall adjust signal timing in respond to a signal prioritization, signal preemption, pedestrian call, multi-modal crossing activation, or other requests for right-of-way.	Existing
FM Traffic Operations	TMC Signal Control	14	The center shall support requests from emergency management centers to provide responding emergency vehicles with signal preemption.	Existing
FM Traffic Operations	TMC Signal Control	15	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements at or near signalized intersections.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Traffic Operations	TMC Signal Control	16	The center shall maintain a database of traffic sensors and associated data (including the roadway on which they are located, the type of data collected, and the ownership of each).	Existing
FM Traffic Operations	TMC Signal Control	3	The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Existing
FM Traffic Operations	TMC Signal Control	4	The center shall collect traffic signal controller fault data from the field.	Existing
FM Traffic Operations	TMC Signal Control	5	The center shall manage (define, store and modify) control plans to coordinate signalized intersections, to be engaged at the direction of center personnel or according to a daily schedule.	Existing
FM Traffic Operations	TMC Signal Control	6	The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Planned
FM Traffic Operations	TMC Signal Control	7	The center shall manage boundaries of the control sections used within the signal system.	Planned
FM Traffic Operations	TMC Signal Control	8	The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Existing
FM Traffic Operations	TMC Signal Control	9	The center shall implement control plans to coordinate signalized intersections based on data from sensors and connected vehicles.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
FM Traffic Operations	TMC Traffic Network Performance Evaluation	1	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center to support overall network performance evaluations.	Existing
FM Traffic Operations	TMC Traffic Network Performance Evaluation	4	The center shall exchange information with transit management centers including details current transit routes, the level of service on each route, and the progress of individual vehicles along their routes for use in forecasting demand and estimating current transportation network performance.	Planned
FM Traffic Operations	TMC Traffic Network Performance Evaluation	5	The center shall exchange traffic information with other traffic management centers, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.	Planned
FM Traffic Operations	TMC Traffic Network Performance Evaluation	6	The center shall provide an interface to the archive data repository to enable the operator to retrieve historical operating data for use in planning to predict future traffic patterns and conditions.	Planned
FM Traffic Operations	TMC Traffic Network Performance Evaluation	7	This center shall use the collected information to measure overall current and forecast network performance and predict travel demand patterns.	Planned

Element Name	Functional Object	Requirement #	Requirement	Status
MAT Kiosks	Transit Stop Information Services	1	The public interface for travelers shall collect and provide real-time travel-related information at transit stops, multi-modal transfer points, and other public transportation areas.	Existing
MAT Kiosks	Transit Stop Information Services	2	The public interface for travelers shall collect and present to the transit traveler information on transit routes, schedules, and real-time schedule adherence.	Existing
MAT Vehicles	Transit Vehicle On-Board Fare Management	1	The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Existing
MAT Vehicles	Transit Vehicle On-Board Fare Management	9	The transit vehicle shall provide fare statistics data to the center.	Existing
MAT Vehicles	Transit Vehicle On-Board Information Services	2	The transit vehicle shall broadcast advisories about the imminent arrival of the transit vehicle at the next stop via an on-board automated annunciation system.	Existing
MAT Vehicles	Transit Vehicle On-Board Information Services	3	The transit vehicle shall support input and output forms that are suitable for travelers with physical disabilities.	Existing
MAT Vehicles	Transit Vehicle On-Board Maintenance	1	The transit vehicle shall collect and process vehicle mileage data available to sensors on-board.	Existing
MAT Vehicles	Transit Vehicle On-Board Maintenance	2	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

Element Name	Functional Object	Requirement #	Requirement	Status
MAT Vehicles	Transit Vehicle On-Board Maintenance	3	The transit vehicle shall transmit vehicle maintenance data to the center to be used for scheduling future vehicle maintenance.	Planned
MAT Vehicles	Transit Vehicle On-Board Trip Monitoring	1	The transit vehicle shall track the current location of the transit vehicle.	Existing
MAT Vehicles	Transit Vehicle Passenger Counting	1	The transit vehicle shall count passengers boarding and alighting.	Planned
MAT Vehicles	Transit Vehicle Passenger Counting	2	The passenger counts shall be related to location to support association of passenger counts with routes, route segments, or bus stops.	Planned
MAT Vehicles	Transit Vehicle Passenger Counting	3	The passenger counts shall be timestamped so that ridership can be measured by time of day and day of week.	Planned
MAT Vehicles	Transit Vehicle Security	1	The transit vehicle shall perform video and audio surveillance inside of transit vehicles and output raw video or audio data for either local monitoring (for processing or direct output to the transit vehicle operator), remote monitoring or for local storage (e.g., in an event recorder).	Existing
MAT Vehicles	Transit Vehicle Signal Priority	2	The transit vehicle shall send priority requests to traffic signal controllers at intersections, pedestrian crossings, and multimodal crossings on the roads (surface streets) and freeway (ramp controls) network that enable a transit vehicle schedule deviation to be corrected.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
MATBus	Transit Center Data Collection	1	The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	Existing
MATBus	Transit Center Fixed-Route Operations	3	The center shall generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	Planned
MATBus	Transit Center Fixed-Route Operations	4	The center shall dispatch fixed route or flexible route transit vehicles.	Existing
MATBus	Transit Center Fixed-Route Operations	5	The center shall collect transit operational data for use in the generation of routes and schedules.	Existing
MATBus	Transit Center Fixed-Route Operations	6	The center shall provide instructions or corrective actions to the transit vehicle operators based upon operational needs.	Existing
MATBus	Transit Center Fixed-Route Operations	9	The center shall exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.	Planned
MATBus	Transit Center Information Services	1	The center shall provide travelers using public transportation with traffic and advisory information upon request. Such information may include transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, and special events.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
MATBus	Transit Center Passenger Counting	1	The center shall collect passenger count information from each transit vehicle.	Existing
MATBus	Transit Center Passenger Counting	2	The center shall calculate transit ridership data by route, route segment, transit stop, time of day, and day of week based on the collected passenger count information.	Existing
MATBus	Transit Center Security	1	The center shall monitor transit vehicle operational data to determine if the transit vehicle is off-route and assess whether a security incident is occurring.	Existing
MATBus	Transit Center Security	5	The center shall receive information pertaining to a wide-area alert such as weather alerts, disaster situations, or child abductions. This information may come from Emergency Management or from other Alerting and Advisory Systems.	Planned
MATBus	Transit Center Security	7	The center shall coordinate the response to security incidents involving transit with other agencies including Emergency Management, other transit agencies, media, traffic management, and traveler information service providers.	Existing
MATBus	Transit Center Vehicle Assignment	1	The center shall assign individual transit vehicles to transit blocks.	Existing
MATBus	Transit Center Vehicle Tracking	1	The center shall monitor the locations of all transit vehicles within its network.	Existing
MATBus	Transit Center Vehicle Tracking	2	The center shall determine adherence of transit vehicles to their assigned schedule.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
MATBus	Transit Center Vehicle Tracking	3	The center shall provide transit operational data to traveler information service providers.	Existing
MATBus	Transit Evacuation Support	1	The center shall manage the use of transit resources to support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency.	Existing
MATBus	Transit Garage Maintenance	1	The center shall collect operational and maintenance data from transit vehicles.	Existing
MATBus	Transit Garage Maintenance	2	The center shall monitor the condition of a transit vehicle to analyze brake, drive train, sensors, fuel, steering, tire, processor, communications equipment, and transit vehicle mileage to identify mileage based maintenance, out-of-specification or imminent failure conditions.	Existing
MATBus	Transit Garage Maintenance	3	The center shall generate transit vehicle maintenance schedules that identify the maintenance or repair to be performed and when the work is to be done.	Existing
MATBus	Transit Garage Maintenance	8	The center shall provide transit operations personnel with the capability to update transit vehicle maintenance information and receive reports on all transit vehicle operations data.	Existing
MnDOT D4 Maintenance, NDDOT Fargo Maintenance	ITS Security Support			

Element Name	Functional Object	Requirement #	Requirement	Status
MnDOT D4 Maintenance, NDDOT Fargo Maintenance	MCM Automated Treatment System Control	1	The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Existing
MnDOT D4 Maintenance, NDDOT Fargo Maintenance	MCM Automated Treatment System Control	2	The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Existing
MnDOT D4 Maintenance, NDDOT Fargo Maintenance	MCM Automated Treatment System Control	3	The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Existing
MnDOT D4 Maintenance, NDDOT Fargo Maintenance	MCM Automated Treatment System Control	4	The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Existing
MnDOT D4 Maintenance, NDDOT Fargo Maintenance	MCM Automated Treatment System Control	5	The center shall accept requests for automated roadway treatment system activation from center personnel.	Existing
MnDOT D4 TOC	TMC Traffic Information Dissemination	2	The center shall remotely control 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.	Existing
MnDOT D4 TOC	TMC Traffic Information Dissemination	20	The center should collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Planned

Element Name	Functional Object	Requirement #	Requirement	Status
MnDOT D4 TOC	TMC Traffic Information Dissemination	21	The center should collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Planned
MnDOT D4 TOC	TMC Traffic Information Dissemination	22	The center should provide traffic information in both data stream and graphical display.	Planned
MnDOT D4 TOC	TMC Traffic Information Dissemination	23	The center will distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, parking facilities, and traveler information providers.	Planned
MnDOT D4 TOC, MnTOC, Moorhead TOC	TMC Regional Traffic Management	3	The center will exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Planned
MnDOT D4 TOC, MnTOC, Moorhead TOC	TMC Regional Traffic Management	4	The center will exchange traffic control information with other traffic management centers to support remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	Planned
MnDOT D4 TOC, NDDOT TOC	TMC Traffic Information Dissemination	1	The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	Existing
MnDOT D4 TOC, NDDOT TOC	TMC Traffic Information Dissemination	6	The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, parking facilities, and traveler information providers.	Planned

Element Name	Functional Object	Requirement #	Requirement	Status
MnDOT D4 Traffic Signals	Roadway Signal Control	15	The field element shall receive requests for emergency vehicle signal preemption.	Planned
MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	10	The field element shall receive request for transit vehicle signal priority.	Existing
MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	19	The field element should report the current signal control information to the center.	Existing
MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	20	The field element should return traffic signal controller operational status to the center.	Existing
MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	21	The field element should return traffic signal controller fault data to the center.	Existing
MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Control	22	The field element should report current transit priority status to the center.	Existing
MnDOT D4 Traffic Signals, Moorhead Traffic Signals	Roadway Signal Preemption	4	The field element should inform the controlling center when preemption requests have been received.	Existing
MSP DL District, RRRDC	Emergency Dispatch	1	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
MSP DL District, RRRDC	Emergency Dispatch	2	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
MSP DL District, RRRDC	Emergency Dispatch	3	The center shall relay location and incident details to the responding vehicles.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
MSP DL District, RRRDC	Emergency Dispatch	4	The center shall track the location and status of emergency vehicles responding to an emergency based on information from the emergency vehicle.	Existing
MSP DL District, RRRDC	Emergency Dispatch	5	The center shall store and maintain the emergency service responses in an action log.	Existing
MSP DL District, RRRDC	Emergency Dispatch	6	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
MSP DL District, RRRDC	Emergency Dispatch	7	The center shall receive traffic images to support dispatch of emergency vehicles.	Planned
MSP DL District, RRRDC	Emergency Dispatch	8	The center shall provide the capability to request remote control of traffic surveillance devices.	Planned
NDDOT TOC	TMC Traffic Information Dissemination	3	The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Existing
NDDOT TOC	TMC Traffic Information Dissemination	4	The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
NDDOT TOC	TMC Traffic Information Dissemination	5	The center shall retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), and the definition of the road network itself.	Planned
NDDOT TOC	TMC Traffic Metering	1	The center shall remotely control systems to manage use of the freeways, including ramp, interchange, and mainline metering.	Planned
NDDOT TOC, West Fargo TOC	TMC Regional Traffic Management	1	The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Planned
NDDOT Traffic Signals, West Fargo TOC Signals	Roadway Signal Control			
RRRDC	Emergency Call-Taking	1	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

Element Name	Functional Object	Requirement #	Requirement	Status
RRRDC	Emergency Call-Taking	10	The emergency call-taking center shall update the incident information log once the emergency system operator has verified the incident.	Existing
RRRDC	Emergency Call-Taking	2	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
RRRDC	Emergency Call-Taking	3	The emergency call-taking center shall receive emergency call information from vehicles and present the possible incident information to the emergency system operator.	Existing
RRRDC	Emergency Call-Taking	5	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
RRRDC	Emergency Call-Taking	6	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
RRRDC	Emergency Call-Taking	8	The emergency call-taking center shall send a request for remote control of Closed-circuit Television (CCTV) systems from a traffic management center in order to verify the reported incident.	Planned

Element Name	Functional Object	Requirement #	Requirement	Status
RRRDC	Emergency Call-Taking	9	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
RRRDC	Emergency Data Collection	1	The center shall collect emergency service data, emergency vehicle management data, emergency vehicle data, sensor and surveillance data, threat data, and incident data.	Existing
RRRDC	Emergency Data Collection	2	The emergency management center shall assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.	Existing
RRRDC	Emergency Data Collection	3	The center shall receive and respond to requests from ITS Archives for either a catalog of the emergency management data or for the data itself.	Planned