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GRAND FORKS-EAST GRAND FORKS REGIONAL ITS ARCHITECTURE UPDATE

Version 5.0

Final Report
September 2024

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NDSU

UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

Grand Forks-East Grand Forks Regional ITS Architecture Version 5.0

The information contained in this report was obtained through extensive input from various stakeholders in the Grand Forks-East Grand Forks region. The contents of the report were written by a research team from the Advanced Traffic Analysis Center of the Upper Great Plains Transportation Institute at North Dakota State University which facilitated the development of the Regional Architecture.

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

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ACRONYMS

AVL	Automated Vehicle Location
CAT	Cities Area Transit
CCTV	Closed Circuit Television
Dist	District
DMS	Dynamic Message Sign
DOT	Department of Transportation
EAS	Emergency Alert System
EGF	East Grand Forks
EOC	Emergency Operations Center
EV	Emergency Vehicle
FD	Fire Department
FHWA	Federal Highway Administration
GF	Grand Forks
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
MCO	Maintenance and Construction Operations
MDSS	Maintenance Decision Support System
MnDOT	Minnesota Department of Transportation
MPO	Metropolitan Planning Organization
MSP	Minnesota State Patrol
PIC	Public Information Center, City of Grand Forks
NDDOT	North Dakota Department of Transportation
NDHP	North Dakota Highway Patrol
PD	Police Department
PW	Public Works
RA	Regional Architecture
TOC	Traffic Operations Center

Standards

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

Service Packages

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

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EXECUTIVE SUMMARY

The Grand Forks-East Grand Forks Regional Intelligent Transportation Systems (ITS) Architecture was developed under the leadership of the Grand Forks-East Grand Forks Metropolitan Planning Organization (GF-EGF MPO). This architecture has been updated three times since its original development—in 2008, 2014, and 2019. The goal of the GF-EGF regional architecture is to guide the implementation of ITS systems in the region and to coordinate funding, deployment, information sharing, and operations of ITS technologies. The main ITS goal areas for the GF-EGF region include enhanced traveler safety, effective traffic and transit management, coordinated incident management, and improved traveler information. The RA development considered a 15-year planning horizon.

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 Grand Forks-East Grand Forks MPO to support the RA development and maintenance.

This version of the Regional Architecture (RA) is the fifth iteration in a maintenance process that aims to keep the architecture up-to-date by FHWA guidelines and to reflect the most current ITS developments in the region. It is based on the National Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT 9.2).

The GF-EGF region continues to experience increased economic and cultural activity, serving as a business and cultural center for the rural surrounding areas. Therefore, an efficient transportation system is crucial for supporting the mobility needs of individuals and businesses in the region.

The geographical boundaries used to develop the GF-EGF RA were based on the metropolitan boundaries for the GF-EGF MPO. Major jurisdictions include:

- City of Grand Forks, North Dakota
- City of East Grand Forks, Minnesota
- Grand Forks County, North Dakota
- Polk County, Minnesota

In addition to these jurisdictions, the RA recognizes interfaces with statewide architectures in North Dakota and Minnesota. Therefore, the North Dakota Department of Transportation (NDDOT) and the Minnesota Department of Transportation (MnDOT) participated in the RA development.

The RA development was guided by various regional stakeholders who own and operate ITS in the GF-EGF region and included:

- MPO planning staff

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

A system inventory was updated to account for existing and planned ITS systems. Most of these systems may be classified into the following service areas: traffic and travel management, maintenance and construction management, emergency management, and transit 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 and input from regional stakeholders. The National ITS Architecture was used to map these services and to develop service packages in support of these services. A total of 30 Service Packages including service package instances were identified for the GF-EGF area comprising the agencies, devices, and information flows needed to achieve each ITS service.

The service 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 potential information flows, access sharing, and funding partnerships, potential agency agreements were identified. The format for each agreement includes the purpose, entities included and items covered. Three potential agreements were identified for the GF-EGF region, including network surveillance, incident management, and emergency routing.

1.0 INTRODUCTION

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

The Grand Forks-East Grand Forks Regional Intelligent Transportation Systems Architecture was prepared under the leadership of the Grand Forks-East Grand Forks Metropolitan Transportation Organization (GF-EGF MPO). The goal of the GF-EGF regional architecture (RA) is to guide the implementation of ITS systems in the GF-EGF area and coordinate funding, deployment, information sharing, and operations of ITS in the region. The main ITS goal areas for the GF-EGF area include enhanced traveler safety, effective traffic and transit management, coordinated incident management, and efficient roadway system maintenance. A 5-year planning horizon was considered in the RA development.

The development and current update of the RA was 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 2008, 2014, and 2019.

1.1 Report Organization

The GF-EGF RA Report is organized into several main sections to facilitate the report 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 GF-EGF region. It also discusses the regional architecture (RA) scope, providing a high-level outline of the range of ITS services and systems used.

2.1 Geographical Boundaries

The geographical areas in the GF-EGF RA primarily consisted of the GF-EGF MPO's metropolitan boundaries. Major jurisdictions within the region include the following:

1. City of Grand Forks, North Dakota
2. City of East Grand Forks, Minnesota
3. Grand Forks County, North Dakota
4. Polk County, Minnesota

In addition, the North Dakota Department of Transportation (NDDOT) is responsible for operating and maintaining the state highway system within North Dakota, including sections of Interstate Highway I-29 and U.S. 2. The NDDOT also has an agreement with Grand Forks for operating traffic signals located on the state system. Similarly, the Minnesota Department of Transportation (MnDOT) is responsible for traffic signal operations in East Grand Forks and for maintenance and operation on the Minnesota state system.

2.2 Scope of the RA

The scope of the GF-EGF 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
 - d. Highway-rail intersection
2. Public Transportation Management
 - a. Fleet management (real-time information)
 - b. Automated Passenger and Fare Management
3. Incident Management
 - a. Incident response coordination (integrated communications)
4. Information Management
 - a. Data archival and analysis services
5. Maintenance and Construction Management
 - a. Winter maintenance
 - b. Fleet management

3.0 STAKEHOLDERS

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

Table 3.1: List of Stakeholders

Stakeholder Name	Stakeholder Description
Altru Ambulance	GF-EGF area ambulance service
ATAC	Advanced Traffic Analysis Center
CAT	Cities Area Transit (CAT)
East Grand Forks	City of East Grand Forks, MN
EGF FD	East Grand Forks Fire Department
EGF PD	East Grand Forks Police Department
EGF PW	East Grand Forks Public Works
GF EM	Grand Forks County Emergency Department
GF Engineering	GF engineering agencies
GF Event Venues	Alerus Center, Ralph Engelstad Arena, other venues
GF FD	Grand Forks Fire Department
GF PD	Grand Forks Police Department
GF PW	Grand Forks Public Works
GF-EGF EM Group	GF-EGF Emergency Management Group
GF-EGF Maintenance Group	GF-EGF Maintenance and Construction Management Group
Grand Forks	City of Grand Forks, ND
Grand Forks County	Grand Forks County, ND
MnDOT Dist 2	Minnesota DOT District 2, Bemidji.
MSP	Minnesota State Patrol Crookston
ND Department of Emergency Services	North Dakota Department of Emergency Services
NDDOT GF District	NDDOT Grand Forks district
NDHP	North Dakota Highway Patrol
Other ambulance services	Other ambulance service that use the same CAD system in the regions. Some examples are Northwood, Michigan, Larry Moore etc.
Polk County	Polk County, MN

Additionally, RA stakeholder groups were utilized to simplify services when many agencies from the same specialty area participate in performing a service. Two stakeholder groups were created in the emergency management area and maintenance and construction areas.

Table 3.2: Stakeholders Group

Stakeholder Group	Group Members
GF-EGF Emergency Management Group	Altru Ambulance
	EGF FD
	EGF PD
	GF EM
	GF FD
	GF PD
	Grand Forks County
	MSP
	ND Department of Emergency Services
	NDHP
	Other ambulance services
Polk County	
GF-EGF Maintenance and Construction Management Group	EGF PW
	GF PW
	Grand Forks County
	MnDOT Dist 2
	NDDOT GF District
	Polk County

4.0 SYSTEM INVENTORY

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

To facilitate the inventory process, the types of systems included in the inventory were defined using the National ITS Architecture. Systems were categorized into existing or planned, with planned referring to systems, components, or services that have been identified for future deployment in the region.

Using the Physical Architecture, four types of entities were identified for the GF-EGF region:

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

These entities are explained in greater detail in the following subsections. Section 4.5 summarizes ITS inventory in the GF-EGF region for each stakeholder.

4.1 GF-EGF 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 GF-EGF area Physical Architecture is shown in Figure 1.

4.1.1 Traffic Management Center

The Traffic Management Center (subsystem) monitors and controls traffic and the road network. It communicates with the Roadway Subsystem to monitor and manage traffic flow and monitor the condition of the roadway, surrounding environmental conditions, and field equipment status. Traffic management activities within the GF-EGF area are concentrated in the main corridors in the area. They primarily include arterial traffic control and managing event traffic for the Alerus Center. The specific traffic management systems within the GF-EGF area classified by agency are discussed in the next section.

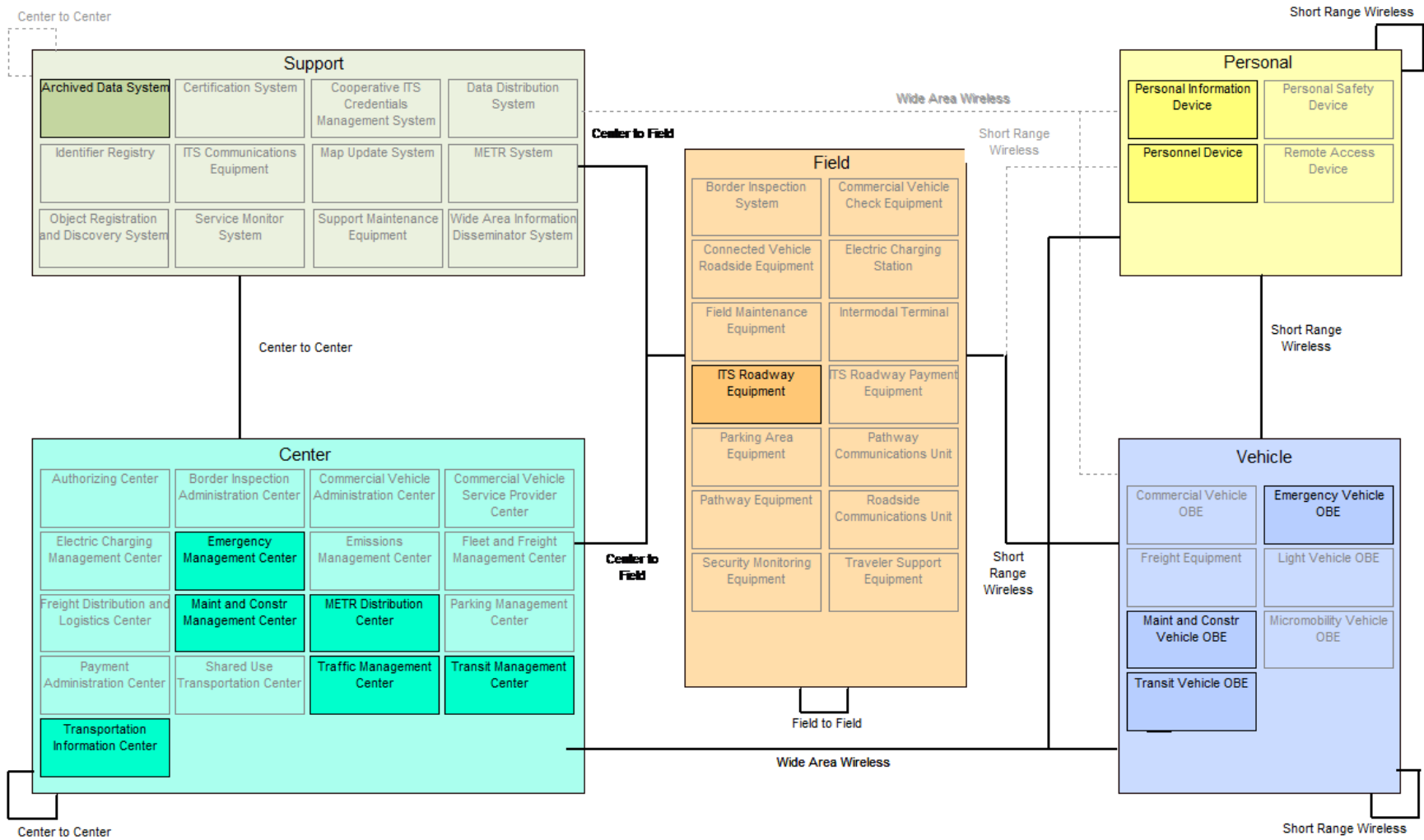


Figure 1. Grand Forks-East Grand Forks Physical Architecture

City of Grand Forks Traffic Signal System

The City of Grand Forks operates a state-of-the-art traffic signal control system with several coordinated corridors and 72 actuated traffic signals. These signals are equipped with fiber and wireless communication capabilities. The city uses the Centrac software for centralized signal control and management. Most intersections are supported by video detection through a vision camera system, which facilitates traffic monitoring and detailed data collection. Additionally, cameras enhance capacity at signalized intersections near the Alerus Center and Ralph Engelstad Arena by accurately detecting vehicle entry and exit. These signals primarily manage lane usage for turning traffic during event control plans.

MnDOT Traffic Signal System

MNDOT plans to install two cameras in East Grand Forks downtown traffic signals in the near future. The networking for these cameras will be done using a modem. The system will be designed to share all information, including incident details, road network conditions, traffic images, device control requests, data, and status updates with MnDOT and East Grand Forks TOC.

4.1.2 Emergency Management Center

Emergency management and 9-1-1 dispatch functions for the City of Grand Forks and Grand Forks County are performed through the Public Safety Answering Point (PSAP). They provide radio communications for Grand Forks Fire and Police, Grand Forks County Sheriff's Office, UND Police, Altru Ambulance, and all rural fire departments. The PSAP dispatch center also provides emergency medical pre-arrival instructions to callers. Dispatch and 9-1-1 services in East Grand Forks are provided by the police department, while the Polk County Sheriff's Office provides those services for Polk County. County emergency management centers in Grand Forks and Polk counties are activated when needed for large-scale incidents.

4.1.3 Maintenance and Construction Management Center

Several entities handle Maintenance and Construction Management (MCM) in the Grand Forks-East Grand Forks (GF-EGF) area. These include Grand Forks Public Works, East Grand Forks Public Works, the North Dakota Department of Transportation (NDDOT), and the Minnesota Department of Transportation (MnDOT). Except for East Grand Forks, all these agencies have varying levels of vehicle tracking capabilities and use Automated Vehicle Location (AVL) technologies. Both MnDOT and NDDOT utilize their own Maintenance Decision Support Systems (MDSS) software for maintenance work on state roads, while cities use separate management software systems. The Grand Forks County and Polk County Highway Departments perform maintenance activities on county roads and highways without access to a management system.

4.1.4 Information Service Provider

Functions associated with an Information Service Provider (ISP) are handled through multiple GF-EGF regional agencies. Grand Forks has a Public Information Center (PIC) which serves as a resource for citizens, city departments, city council, and the mayor. The PIC administers the City's website and interfaces daily with media outlets to provide public information. The NDDOT handles traveler information statewide using 511 and a traveler information web page. The NDDOT Grand Forks District and MnDOT District 2 controls a number of DMS which are used to warn drivers of incidents and weather related road conditions. The GF Police Department also uses their portable DMS to provide travelers with incident and detour information.

4.1.5 Transit Management Center

The Cities Area Transit (CAT) provides public transportation services for the Grand Forks-East Grand Forks (GF-EGF) metropolitan area, operating fixed routes and demand response routes in both cities. CAT employs a sophisticated management system that offers dispatch, routing, and fare management capabilities, including revenue analysis, passenger data analysis, and GPS bus location tracking. The Automated Vehicle Location (AVL) functionality allows for location-specific transit signal priority and automated audible and visual stop announcements. The new facility can wirelessly download data from each transit vehicle. Additionally, the transit center plans to introduce mobile ticketing to offer passengers flexible ticketing options. The facility also features a rainwater collection system, aligning with the metropolitan transportation plan's goals of reducing and/or eliminating negative impacts on environmental resources.

4.1.6 Archived Data Management Center

Only Grand Forks Engineering and CAT currently can collect data from ITS sensors. Grand Forks engineering department provides access to ATAC for their signal timing and traffic sensors to synthesize and archive.

4.2 GF-EGF Field Devices

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

4.2.1 NDDOT Field Devices

1. Sensors
 - a. Weather
 - i. RWIS and Surface sensors located on I-29 in Grand Forks
2. Warning/advisory devices
 - b. DMS along I-29 and US-2

4.2.2 City of Grand Forks Field Devices

1. Sensors
 - a. Traffic
 - i. Video traffic detectors
 - ii. Loop detectors
2. Control devices
 - a. Traffic signal controllers
 - b. Electronic lane use signs
3. Warning/advisory devices
 - a. DMS along I-29 and US-2

4.2.3 City of East Grand Forks/MnDOT Field Devices

1. Sensors
 - a. Traffic
 - i. Loop detectors
2. Control devices
 - b. Traffic signal controllers

4.2.4 City of Grand Forks Police Department Field Devices

1. Warning/advisory devices
 - a. Three portable DMS

4.2.5 MnDOT District 2 Field Devices

1. Warning/advisory devices
 - b. One permanent DMS board

4.3 GF-EGF Vehicles

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

1. Emergency Vehicle for GF-EGF area
 - a. Fire (signal preemption)
 - b. Law enforcement (AVL)
 - c. Ambulance (signal preemption)
2. Transit Vehicle
 - a. CAT buses with electronic fare box, AVL capabilities, and transit signal priority (TSP)
3. MCO vehicles for NDDOT and Grand Forks
 - a. Snowplows equipped with AVL and atmospheric and operational sensors

4.4 GF-EGF Communication Infrastructure

Below is a brief description of existing and planned communication infrastructure in the GF-EGF 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 GF-EGF RA is implemented.

1. Fiber
 - a. Arterial network (Grand Forks)
2. Phone drops (dial-up)
 - a. East Grand Forks traffic signals
3. Wireless/cellular
 - a. Some of Grand Forks traffic signals
 - b. GFPD portable DMS

4.5 Summary of GF-EGF Inventory

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
Archived Data User System	Archived Data User System' represents the systems users employ to access archived data. The general interface provided allows a broad range of users (e.g. planners, researchers, analysts, operators) and their systems (e.g. databases, models, analytical tools, user interface devices) to acquire data and analyses results from the archive.	Existing	ATAC	Develops, Manages, Owns
CAT Drivers	CAT bus drivers	Existing	CAT	
CAT Information Provider	An architecture element to represent the transit traveler information function performed within CAT.	Existing	CAT	Owns
CAT Operations Center	Cities Area Transit dispatch center	Existing	CAT	Owns
CAT System Operators	CAT dispatch and operations personnel	Existing	CAT	
CAT 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. This element is designated for both physical card and mobile ticketing systems. By September 2024, this will be identified as CAT Pass.	Existing	CAT	Owns
CAT 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.	Existing	CAT	Owns

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
Driver	The 'Driver' represents the person that operates a vehicle on the roadway. Included are operators of private, transit, commercial, and emergency vehicles where the interactions are not particular to the type of vehicle (e.g., interactions supporting vehicle safety applications). The Driver originates driver requests and receives driver information that reflects the interactions which might be useful to all drivers, regardless of vehicle classification. Information and interactions which are unique to drivers of a specific vehicle type (e.g., fleet interactions with transit, commercial, or emergency vehicle drivers) are covered by separate objects.	Existing		
EGF Dispatch	An architecture element representing 9-1-1 call taking and dispatch in East Grand Forks covering services provided by EGF Police and Fire Departments Dispatch along with Polk County Dispatch Center.	Existing	GF EM	Owns
EGF PW Operations Center	East Grand Forks public works operations center	Existing	EGF PW	Owns
Emergency Personnel	Emergency Personnel' represents personnel that are responsible for police, fire, emergency medical services, towing, service patrols, and other special response team (e.g., hazardous material clean-up) activities at an incident site. These personnel are associated with the Emergency Vehicle during dispatch to the incident site, but often work independently of the Emergency Vehicle while providing their incident response services.	Existing	GF-EGF EM Group	

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
Emergency Personnel Device	Emergency Personnel Device' represents devices used by emergency personnel in the field. The devices would include body cameras or smartphones (and their peripherals) that can be used by emergency personnel to provide images or video as well as send or receive data regarding the incident. The devices could also be used for incident scene safety messages to the personnel.	Existing	GF-EGF EM Group	Owns
Emergency System Operator	Emergency System Operator' represents the public safety personnel that monitor emergency requests, (including those from the E911 Operator) and set up pre-defined responses to be executed by an emergency management system. The operator may also override predefined responses where it is observed that they are not achieving the desired result. This also includes dispatchers who manage an emergency fleet (police, fire, ambulance, HAZMAT, etc.) or higher order emergency managers who provide response coordination during emergencies.	Existing	GF-EGF EM Group	
Event Promoters	Alerus Center, Ralph Engelstad Arena, other venues	Existing	GF Event Venues	Owns
GF County Maintenance	Grand Forks County Maintenance Operations Center	Existing	Grand Forks County	Owns

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
GF County Maintenance Vehicles	<p>The 'Maint and Constr Vehicle OBE' resides in a maintenance, construction, or other specialized service vehicle or equipment and provides the processing, storage, and communications functions necessary to support highway maintenance and construction. All types of maintenance and construction vehicles are covered, including heavy equipment and supervisory vehicles. The MCV OBE provides two-way communications between drivers/operators and dispatchers and maintains and communicates current location and status information. A wide range of operational status is monitored, measured, and made available, depending on the specific type of vehicle or equipment. A snow plow for example, would monitor whether the plow is up or down and material usage information. The Maint and Constr Vehicle OBE may also contain capabilities to monitor vehicle systems to support maintenance of the vehicle itself and include sensors that monitor environmental conditions such as road condition and surface weather information. This can include a diverse set of mobile environmental sensing platforms, including wheeled vehicles and any other vehicle that collects and reports environmental information. A separate 'Vehicle OBE' physical object supports the general vehicle safety and driver information capabilities that apply to all vehicles, including maintenance and construction vehicles. The Maint and Constr Vehicle OBE supplements these general capabilities with capabilities that are specific to maintenance and construction vehicles.</p>	Existing	Grand Forks County	Owns

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
GF PD DMS	Grand Forks Police Department portable Dynamic Message Signs	Existing	GF PD	Owens
GF PIC	City of Grand Forks Public Information Center	Existing	Grand Forks	Owens
GF PSAP	Grand Forks County Public Safety Answering Point	Existing	GF EM	Owens
GF PW Operations Center	Grand Forks public works operations center	Existing	GF PW	Owens
GF PW Vehicles	Grand Forks public works vehicles	Existing	GF PW	Owens
GF Rail Detection and Information System	A system that detects rail signal preemption at specific roadway-rail intersections and provide information to travelers so they can take alternate routes.	Existing	GF Engineering	Owens
GF TOC	Grand Forks Traffic Operations Center	Existing	GF Engineering	Owens
GF TOC Field Devices	Grand Forks area traffic sensors and control devices including signals owned and maintained by NDDOT but operated by Grand Forks TOC.	Existing	GF Engineering	Owens
GF Traffic Operations Personnel	Traffic Operations Personnel' represents the people that operate a traffic management center. These personnel interact with traffic control systems, traffic surveillance systems, incident management systems, work zone management systems, and travel demand management systems. They provide operator data and command inputs to direct system operations to varying degrees depending on the type of system and the deployment scenario.	Existing	GF Engineering	
GF-EGF Emergency Management	A single architecture element representing emergency agencies in the region including dispatchers, law enforcement, and emergency responders.	Existing	GF-EGF EM Group	Owens

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
GF-EGF Emergency Vehicles	A single architecture element representing emergency vehicles used by law enforcement and emergency responders in the GF-EGF region.	Existing	GF-EGF EM Group	Owens
GF-EGF Maintenance	A single architecture element representing maintenance management agencies in the GF-EGF region including the cities, counties, and both state DOTs. The single element simplifies architecture flows while individual agencies are referred to when needed.	Existing	GF-EGF Maintenance Group	Owens
GF-EGF Maintenance Vehicles	A single architecture element representing maintenance and construction vehicles used by Grand Forks and East Grand Forks public works departments, Grand Forks and Polk counties, NDDOT GF District, and MnDOT D2.	Existing	GF-EGF Maintenance Group	Owens
Government Reporting Systems	Government Reporting Systems' represents the system and associated personnel that prepare the inputs to support the various local, state, and federal government transportation data reporting requirements (e.g. Highway Performance Monitoring System, Fatality Analysis Reporting System) using data collected by ITS systems. It represents a system interface that provides access to the archived data relevant to these reports. In most cases, this system will combine data collected from ITS archives with data from non-ITS sources to assemble the required information.	Planned		

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
Location and Time Data Source	The 'Location and Time Data Source' provides accurate position information. While a Global Positioning System (GPS) Receiver is the most common implementation, this physical object represents any technology that provides a position fix in three dimensions and time with sufficient accuracy.	Existing		
Maint and Constr Center Personnel	<p>An ITS element representing maintenance and construction personnel from agencies in GF-EGF.</p> <p>The people that directly interface with a Maintenance and Construction Management Center. These personnel interact with fleet dispatch and management systems, road maintenance systems, incident management systems, work plan scheduling systems, and work zone management systems. They provide operator data and command inputs to direct system operations to varying degrees depending on the type of system and the deployment scenario.</p>	Existing	GF-EGF Maintenance Group	
Maint and Constr Vehicle Operator	<p>Maintenance and construction vehicle operators in GF-EGF.</p> <p>The operator of maintenance, construction, or other specialized service vehicles or equipment. Represents the maintenance and construction vehicle operators. The operator provides input specific to maintenance</p>	Existing	GF-EGF Maintenance Group	

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
	and construction vehicle operations, including the status of maintenance actions. Information provided to the operator includes dispatch requests and maintenance and construction actions to be performed.			
Media	This element designates print, digital and virtual media (social media).	Existing		
MnDOT D2 Field Devices	Mn/DOT District 2 sensors, traffic signals, and DMS.	Existing	MnDOT Dist 2	Owens
MnDOT D2 Office	Mn/DOT District 2 Traffic Operations Center	Existing	MnDOT Dist 2	Owens
MNDOT D2 Traffic Operations Personnel	<p>Traffic operations personnel in MnDOT District 2 responsible for signal operations in East Grand Forks.</p> <p>'Traffic Operations Personnel' represents the people that operate a traffic management center. These personnel interact with traffic control systems, traffic surveillance systems, incident management systems, work zone management systems, and travel demand management systems. They provide operator data and command inputs to direct system operations to varying degrees depending on the type of system and the deployment scenario.</p>	Existing	MnDOT Dist 2	
MSP District 3200	Minnesota State Patrol District serving the Northwestern counties of Minnesota including Polk.	Existing	MSP	Owens

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
NDDOT Field Devices	ITS Roadway Equipment' represents the ITS equipment that is distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway itself. This physical object includes traffic detectors, environmental sensors, traffic signals, highway advisory radios, dynamic message signs, CCTV cameras and video image processing systems, grade crossing warning systems, and ramp metering systems. Lane management systems and barrier systems that control access to transportation infrastructure such as roadways, bridges and tunnels are also included. This object also provides environmental monitoring including sensors that measure road conditions, surface weather, and vehicle emissions. Work zone systems including work zone surveillance, traffic control, driver warning, and work crew safety systems are also included.	Existing	NDDOT GF District	Owns
NDDOT GF District Office	NDDOT District maintenance and construction and freeway operations.	Existing	NDDOT GF District	Owns
NDHP Grand Forks	North Dakota Highway Patrol - Grand Forks District	Existing	NDHP	Owns
Personal Information Device	The 'Personal Information Device' provides the capability for travelers to receive formatted traveler information wherever they are. Capabilities include traveler information, trip planning, and route guidance. Frequently a smart phone, the Personal Information Device provides travelers with the capability to receive route planning and other personally focused transportation services from the	Existing		

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
	infrastructure in the field, at home, at work, or while en-route. Personal Information Devices may operate independently or may be linked with connected vehicle on-board equipment.			
State Radio	ND State Radio	Existing	ND Department of Emergency Services	Owns
Traveler	The 'Traveler' represents any individual who uses transportation services. The interfaces to the traveler provide general pre-trip and en-route information supporting trip planning, personal guidance, and requests for assistance in an emergency that are relevant to all transportation system users. It also represents users of a public transportation system and addresses interfaces these users have within a transit vehicle or at transit facilities such as roadside stops and transit centers.	Existing		
Wayside Equipment	'Wayside Equipment' represents train interface equipment (usually) maintained and operated by the railroad and (usually) physically located at or near a grade crossing. It is a source and destination for information for, or about, approaching trains and their crews (e.g. the time at which the train will arrive and the time it will take to clear a crossing, crossing status or warnings, etc.). Generally one wayside	Existing		

Element Name	Element Description	Element Status	Stakeholder	Stakeholder Role
	equipment interface would be associated with one highway rail intersection. However, multiple crossings may be controlled using information based on data from one wayside equipment interface.			
Weather Service System	The 'Weather Service System' provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service, private sector providers, and various research organizations. The interface provides formatted weather data products suitable for on-line processing and integration with other ITS data products as well as Doppler radar images, satellite images, severe storm warnings, and other products that are formatted for presentation to various ITS users.	Existing		

5.0 SERVICE PACKAGES

This section describes the ITS services selected for the GF-EGF area. These services were identified from previous ITS planning efforts and from stakeholders' input throughout the RA development and update process.

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
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.	Existing	Archived Data User System, CAT Operations Center, GF TOC, GF TOC Field Devices, GF-EGF Emergency Management , GF-EGF Maintenance
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	Planned	Archived Data User System, CAT Operations Center, GF TOC, Government

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		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.		Reporting Systems
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.	Existing	GF-EGF Maintenance, GF-EGF Maintenance Vehicles, Location and Time Data Source
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.	Existing	GF PW Operations Center, GF PW Vehicles, Maint and Constr Center Personnel, Maint and Constr

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
				Vehicle Operator
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.	Existing	CAT Operations Center, GF PIC, GF TOC, GF-EGF Emergency Management, GF-EGF Maintenance, GF-EGF Maintenance Vehicles, Maint and Constr Center Personnel, Maint and Constr Vehicle Operator, Media,

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
				Weather Service System
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.	Existing	GF-EGF Maintenance, GF-EGF Maintenance Vehicles, Maint and Constr Center Personnel, Maint and Constr Vehicle Operator, Weather Service System

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
MC06	Work Zone Management	<p>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.</p>	Existing	<p>CAT Operations Center, GF PIC, GF TOC, GF- EGF Emergency Management , GF-EGF Maintenance, GF-EGF Maintenance Vehicles, Maint and Constr Center Personnel, Maint and Constr Vehicle Operator, Media</p>

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
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.	Existing	CAT Operations Center, GF PIC, GF TOC, GF-EGF Emergency Management, GF-EGF Maintenance, Maint and Constr Center Personnel, Media
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	Existing	CAT Operations Center, GF PSAP, GF TOC, GF-EGF Emergency Vehicles, Location and Time Data Source, NDHP Grand Forks,

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.		Weather Service System
PS01	Emergency Call-Taking and Dispatch in EGF	--Instance of PS01-- 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.	Existing	EGF Dispatch, GF-EGF Emergency Vehicles, MSP District 3200
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	Existing	Emergency Personnel, Emergency Personnel Device, Emergency System Operator, GF-EGF

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		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.		Emergency Management , GF-EGF Emergency Vehicles
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.	Existing	GF TOC, GF TOC Field Devices, GF-EGF Emergency Vehicles, MnDOT D2 Field Devices
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	Existing	EGF Dispatch, GF PSAP, MSP District 3200, NDHP Grand Forks, Personal Information Device, State Radio, Traveler

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		<p>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.</p>		

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
PS12	Disaster Response and Recovery	<p>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).</p> <p>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.</p> <p>The service package identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this service package, the Emergency Management Center represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the</p>	Existing	CAT Operations Center, CAT System Operators, Emergency System Operator, GF TOC, GF Traffic Operations Personnel, GF-EGF Emergency Management, GF-EGF Maintenance, Maint and Constr Center Personnel, MnDOT D2 Office, MSP District 3200, NDDOT GF District

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		<p>Emergency Management Center and the other centers provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this service package supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities.</p> <p>This service package builds on the basic traffic incident response service that is provided by TM08, the Traffic Incident Management service package. This service package addresses the additional complexities and coordination requirements that are associated with the most severe incidents that warrant an extraordinary response from outside the local jurisdictions and require special measures such as the activation of one or more emergency operations centers. Many users of ARC-IT will want to consider both TM08 and this service package since every region is concerned with both day-to-day management of traffic-related incidents and occasional management of disasters that require extraordinary response.</p>		Office, State Radio

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
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.	Existing	CAT Operations Center, CAT Vehicles, Location and Time Data Source
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.	Existing	CAT Drivers, CAT Information Provider, CAT Operations Center, CAT System Operators, CAT Vehicles
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	Existing	CAT Drivers, CAT Information Provider, CAT Operations Center, CAT System

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		schedule and dispatch or modify the route of an in-service vehicle by matching compatible trips together. TI06 covers other shared use transportation options.		Operators, CAT Vehicles, Personal Information Device, Traveler
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).	Existing	CAT Operations Center, CAT System Operators, CAT Traveler Card, CAT Vehicles
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	Existing	CAT Drivers, CAT Operations Center, CAT System Operators, CAT Vehicles

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		<p>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).</p> <p>Most of the surveillance and sensor data that is collected by this service package may be monitored by either the Emergency Management Center or the Transit Management Center, providing two possible approaches to implementing this service package. This service package also supports remote transit vehicle disabling and transit vehicle operator authentication by the Transit Management Center.</p>		
PT06	Transit Fleet Management	<p>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.</p>	Existing	CAT Operations Center, CAT System Operators, CAT Vehicles

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
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.	Existing	CAT Information Provider, CAT Operations Center, CAT Vehicles, Media, Personal Information Device, Traveler
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.	Existing	CAT Operations Center, CAT Vehicles, GF TOC Field Devices
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	Existing	GF TOC, GF TOC Field Devices, MnDOT D2 Field Devices, MnDOT D2 Office, NDDOT

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		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.		Field Devices, NDDOT GF District Office
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 strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the TM07-Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.	Existing	Driver, GF TOC, GF TOC Field Devices, GF Traffic Operations Personnel
TM03	Traffic Signal Control in EGF	--Instance of TM03-- 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	Planned	Driver, MnDOT D2 Field Devices, MnDOT D2 Office, MNDOT D2 Traffic

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		<p>package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the TM07-Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.</p>		Operations Personnel
TM06	Traffic Information Dissemination	<p>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.</p>	Existing	Driver, GF TOC, GF TOC Field Devices, MnDOT D2 Field Devices, MnDOT D2 Office, NDDOT GF District Office

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
TM07	Regional Traffic Management	<p>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.</p>	Planned	GF TOC, GF Traffic Operations Personnel, MnDOT D2 Office
TM08	Traffic Incident Management System	<p>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</p>	Existing	CAT Operations Center, GF PIC, GF PSAP, GF TOC, GF TOC Field Devices, GF-EGF

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
		<p>appropriate response. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination service package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information service packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel. This service package is closely related with the Public Safety service packages, which focus on services that support first responders. In particular, local management of the incident using an incident command system is covered by PS02.</p>		<p>Emergency Management , GF-EGF Maintenance, Media, NDDOT Field Devices, NDHP Grand Forks</p>

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
TM12	Dynamic Roadway Warning	<p>This service package includes systems that dynamically warn drivers and other road users of hazards on a roadway. Such hazards include roadway weather conditions, road surface conditions, traffic conditions including queues, obstacles or animals in the roadway and any other transient event that can be sensed. These dynamic roadway warning systems can alert approaching drivers and other road users via warning signs, flashing lights, in-vehicle messages, etc. Such systems can increase the safety of a roadway by reducing the occurrence of incidents. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.</p> <p>Speed warnings that consider the limitations of a given vehicle for the geometry of the roadway (e.g., rollover risk for tall vehicles) are not included in this service package but are covered by the TM17 – Speed Warning and Enforcement service package.</p> <p>Roadway warning systems, especially queue warning systems are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as TM20-Variable Speed Limits and TM22-Dynamic Lane Management and Shoulder Use).</p>	Existing	Driver, GF Rail Detection and Information System, GF TOC, GF TOC Field Devices, NDDOT Field Devices, NDDOT GF District Office

Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
TM13	Standard Railroad Grade Crossing	<p>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.</p>	Existing	Driver, GF TOC, GF TOC Field Devices, Wayside Equipment

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 GF-EGF RA. The operational concept outlines these roles and responsibilities for specific scenarios, e.g., traffic incidents, major winter storms, floods, etc. In addition to providing a snapshot of how things are done for a certain scenario, the operational concept explores additional integration opportunities in the region with particular focus on stakeholder involvement.

6.1 Operational Roles and Responsibilities

Stakeholder	RR Description	RR Status
Altru Ambulance	<ul style="list-style-type: none"> Coordinate with other emergency management agencies in GF-EGF. Provide emergency medical services in GF-EGF. 	Existing
ATAC	<ul style="list-style-type: none"> Process the data and archive., Secure connection to the GF Engineering database to access the traffic signal data. Use traffic count and speed data from signalized intersections. 	Existing
CAT	<ul style="list-style-type: none"> Provide dynamic transit (demand response) services in GF-EGF area. Provide transit fixed route operations for the GF-EGF area. Collect transit data, Provide evacuation and sheltering services. 	Existing
CAT, GF-EGF EM Group	<ul style="list-style-type: none"> Provide data for archival 	Planned
EGF FD	<ul style="list-style-type: none"> Respond to incidents in EGF, Coordinate with other emergency management agencies in GF-EGF 	Existing
EGF PD	<ul style="list-style-type: none"> Dispatch law enforcement in EGF. Coordinate with other GF-EGF emergency management agencies, Respond to incidents in EGF. 	Existing

Stakeholder	RR Description	RR Status
EGF PW	<ul style="list-style-type: none"> • EGF city system road maintenance. • Winter maintenance (snow plow operations, sanding, anti icing) in EGF. • Track and monitor maintenance vehicles. 	Existing
GF EM	<ul style="list-style-type: none"> • Coordinate wide area alert., Coordinate incident responses. 	Existing
GF Engineering	<ul style="list-style-type: none"> • Coordinate with MnDOT Dist 2/EGF 	Planned
GF Engineering	<ul style="list-style-type: none"> • Operate TOC. • Provide data for archival. • Collect traffic data, Design, operate, and maintain signal control in GF. 	Existing
GF Event Venues	<ul style="list-style-type: none"> • Provide event information to GF-EGF agencies. 	Existing
GF FD	<ul style="list-style-type: none"> • Coordinate with other emergency management agencies in GF-EGF. 	Planned
GF FD	<ul style="list-style-type: none"> • Respond to incidents in GF 	Existing
GF PD	<ul style="list-style-type: none"> • Coordinate with other emergency management agencies in GF-EGF, Respond to incidents in GF 	Existing
GF PW	<ul style="list-style-type: none"> • Winter maintenance (snow plow operations, sanding, anti-icing) in GF. • Track and monitor maintenance vehicles. • GF city system road maintenance. 	Existing
GF-EGF EM Group	<ul style="list-style-type: none"> • Collect emergency response data, Respond to incidents. • Coordinate with other emergency management agencies 	Existing
GF-EGF Maintenance Group	<ul style="list-style-type: none"> • Collect maintenance performance data. • Provide data for archival. 	Planned

Stakeholder	RR Description	RR Status
GF-EGF Maintenance Group	<ul style="list-style-type: none"> • Provide maintenance resources during incidents and emergencies • Coordinate with emergency management agencies in GF-EGF 	Existing
Grand Forks	<ul style="list-style-type: none"> • Provide PSAP 9-1-1 and dispatch services in GF city and county. 	Existing
Grand Forks County	<ul style="list-style-type: none"> • Winter maintenance (snow plow operations, sanding, anti-icing) in GF county. • Track and monitor maintenance vehicles. • GF county system road maintenance 	Existing
MnDOT Dist 2	<ul style="list-style-type: none"> • Coordinate with GF TOC 	Planned
MnDOT Dist 2	<ul style="list-style-type: none"> • Winter maintenance (snow plow operations, sanding, anti-icing) on MN state system • MN state system road maintenance. • Track and monitor maintenance vehicles. • Design, operate, and maintain signal control in EGF. 	Existing
MSP	<ul style="list-style-type: none"> • Provide dispatch and communications for MSP. • Respond to incidents on Minnesota state system. 	Existing
ND Department of Emergency Services	<ul style="list-style-type: none"> • Provide dispatch and communications for NDHP 	Existing
NDDOT GF District	<ul style="list-style-type: none"> • Track and monitor maintenance vehicles. • ND state system road maintenance. • Winter maintenance (snow plow operations, sanding, anti-icing) in ND state system. 	Existing
NDHP	<ul style="list-style-type: none"> • Respond to incidents on ND state system. 	Planned

Stakeholder	RR Description	RR Status
Other ambulance services	<ul style="list-style-type: none"> • Coordinate with other emergency management agencies in GF-EGF. • Provide emergency medical services in remote part of GF-EGF. 	Planned
Polk County	<ul style="list-style-type: none"> • Coordinate with other emergency management agencies in GF-EGF 	Planned
Polk County	<ul style="list-style-type: none"> • Provide PSAP 9-1-1 and dispatch services in EGF. • Track and monitor maintenance vehicles. • Polk County system road maintenance. • Winter maintenance (snow plow operations, sanding, anti-icing) in Polk county. 	Existing
Valley Bus Service	<ul style="list-style-type: none"> • Provide evacuation and sheltering services 	Existing

7.0 AGREEMENTS

This section will briefly outline potential agreements needed to support the GF-EGF RA. The process of identifying needed agreements relied on the service packages to identify potential roles and responsibilities and 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 to finalize 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 summarizes potential agreements in the GF-EGF region. The table provides the following information for each agreement:

1. Area
 - a. The service area where the agreement is needed
2. Purpose
 - 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

Area	Purpose	Stakeholders	Issues
Network Surveillance	Share data	GF Engineering EGF Engineering NDDOT-Grand Forks Dist.	Access to sensors. Access to databases. Access to networks.
Incident Management	Incident/special event traffic response	GF PD EGF PD NDHP MSP GF Engineering EGF Engineering NDDOT GF District MnDOT District 2 CAT	Communication links. Response protocols.
Emergency Routing	Metro-wide pre-emption	GF Engineering EGF Engineering MnDOT District 2	Hardware compatibility.
Regional Traffic Management	Signal coordination between GF and EGF	GF Engineering MnDOT District 2	Field to field communication. Data sharing.
Snow and Ice Removal	Snow and ice removal on state roads through city boundaries.	EGF PW MnDOT District 2	Identification of area boundary.
Emergency Service Aid	Provide additional support or required services as needed	EGF FD GF FD	Communication links.

8.0 FUNCTIONAL REQUIREMENTS

This section discusses detailed functional requirements for the user services and service packages identified for the GF-EGF 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.

The functional requirements are listed in the table below. The table contains the following columns with the headings described as follows:

1. Element Name: the element from GF-EGF inventory (section 4.5)
2. Functional Object: element mapping to the national ITS architecture
3. Requirement number
4. Requirement: The purpose an element will serve by functioning properly.
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:

Element Name	Functional Object	Number	Requirement	Status
CAT Information Provider	TIC Data Collection	4	The center shall collect, process, and store transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information.	Existing
CAT Information Provider	TIC Interactive Traveler Information	3	The center shall disseminate customized transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travelers upon request.	Existing
CAT Information Provider	TIC Trip Planning	1	The center shall provide the capability to provide specific pre-trip and en route directions to travelers (and drivers), including costs, arrival times, and transfer points.	Planned

9.0 ITS STANDARDS

This section will identify applicable ITS Standards identified for the GF-EGF 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 information in the table are arranged in the following columns:

- SDO: standard development organization
- Standard Number: ID number of the document containing the standard
- Standard Title
- Element: the relevant GF-EGF architecture element

SDO	Standard Number	Standard Title	Element Name
Advanced Traffic Controller Joint Committee	ITE ATC 5201	Advanced Transportation Controller	GF PD DMS, GF Rail Detection and Information System, GF TOC Field Devices, MnDOT D2 Field Devices, NDDOT Field Devices
Advanced Traffic Controller Joint Committee	ITE ATC 5202	Model 2070 Controller Standard	GF PD DMS, GF Rail Detection and Information System, GF TOC Field Devices, MnDOT D2 Field Devices, NDDOT Field Devices
Advanced Traffic Controller Joint Committee	ITE ATC 5301	Intelligent Transportation System Standard Specification for Roadside Cabinets	GF PD DMS, GF Rail Detection and Information System, GF TOC Field Devices, MnDOT D2 Field Devices, NDDOT Field Devices
Advanced Traffic Controller Joint Committee	ITE ATC 5401	Application Programming Interface Standard for the Advanced Transportation Controller	GF PD DMS, GF Rail Detection and Information System, GF TOC Field Devices, MnDOT D2 Field Devices, NDDOT Field Devices
International Organization for Standardization	ISO 21217	Intelligent transport systems -- Communications access for land mobiles (CALM) -- Architecture	Archived Data User System, CAT Information Provider, CAT Operations Center, CAT Vehicles, EGF Dispatch, EGF PW Operations Center, Emergency Personnel Device, GF County Maintenance, GF County Maintenance Vehicles, GF PD DMS, GF PIC, GF PSAP, GF PW Operations Center, GF PW Vehicles, GF Rail Detection and Information System, GF TOC, GF TOC Field Devices, GF

SDO	Standard Number	Standard Title	Element Name
			Transportation Data Archival, GF-EGF Emergency Management, GF-EGF Emergency Vehicles, GF-EGF Maintenance, GF-EGF Maintenance Vehicles, MnDOT D2 Field Devices, MnDOT D2 Office, MSP District 3200, NDDOT Field Devices, NDDOT GF District Office, Personal Information Device, State Radio
National Electrical Manufacturers Association	NEMA TS 5	Portable Traffic Signal Systems (PTSS) Standard	GF PD DMS, GF Rail Detection and Information System, GF TOC Field Devices, MnDOT D2 Field Devices, NDDOT Field Devices
National Electrical Manufacturers Association	NEMA TS 8	Cyber and Physical Security for Intelligent Transportation Systems	EGF Dispatch, EGF PW Operations Center, GF County Maintenance, GF PD DMS, GF PSAP, GF PW Operations Center, GF Rail Detection and Information System, GF TOC, GF TOC Field Devices, GF Transportation Data Archival, GF-EGF Emergency Management, GF-EGF Maintenance, MnDOT D2 Field Devices, MnDOT D2 Office, MSP District 3200, NDDOT Field Devices, NDDOT GF District Office, State Radio
National Electrical Manufacturers Association	NEMA TS2	Traffic Controller Assemblies with NTCIP Requirements	GF PD DMS, GF Rail Detection and Information System, GF TOC Field Devices, MnDOT D2 Field Devices, NDDOT Field Devices
National Electrical Manufacturers Association	NEMA TS4	Hardware Standards for Dynamic Message Signs (DMS) With NTCIP Requirements	GF PD DMS, GF Rail Detection and Information System, GF TOC Field Devices, MnDOT D2 Field Devices, NDDOT Field Devices
National Institute for Standards and Technology	NIST FIPS PUB 140-2	Security Requirements for Cryptographic Modules	Archived Data User System, CAT Information Provider, CAT Operations Center, CAT Vehicles, EGF Dispatch, EGF PW Operations Center, Emergency Personnel Device, GF County Maintenance, GF County Maintenance Vehicles, GF PD DMS, GF PIC, GF PSAP,

SDO	Standard Number	Standard Title	Element Name
			GF PW Operations Center, GF PW Vehicles, GF Rail Detection and Information System, GF TOC, GF TOC Field Devices, GF Transportation Data Archival, GF-EGF Emergency Management, GF-EGF Emergency Vehicles, GF-EGF Maintenance, GF-EGF Maintenance Vehicles, MnDOT D2 Field Devices, MnDOT D2 Office, MSP District 3200, NDDOT Field Devices, NDDOT GF District Office, Personal Information Device, State Radio

10.0 PLANNING ASPECTS

10.1 Planning and the Regional ITS Architecture

This section ties service packages from the RA to goals and objectives identified in the MPO’s Metropolitan Transportation Plan 2050 for transit development, Street and Highway Plan.

Goal: Performance Measures

Description: Performance measurement is a crosscutting activity throughout all the identified goals in order to set measures designed to serve as a benchmark to evaluate and quantify progress.

Associated Service Package:

DM01: ITS Data Warehouse

DM02: Performance Monitoring

Goal: Economic Vitality

Description: Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency.

Objectives:

Name	Description	Source	Service Package
Community Connectivity by providing transit access	Provide transit service within 1/4 mile of residential areas and to major activity and employment centers	Metropolitan Transportation Plan 2050: GF-EGF Transit Development Plan	PT02: Transit Fixed-Route Operations, PT03: Dynamic Transit Operations

Goal: Safety

Description: Increase the safety of the transportation system for motorized and non-motorized uses.

Objectives:

Name	Description	Source	Service Package
Reduce vehicular crashes	Reduce the number and rate of vehicular crashes by supporting an emergency response system.	Metropolitan Transportation Plan 2050	PS02: Emergency Response, PS03: Emergency Vehicle Preemption
Reduce fatal and incapacitating crashes	Reduce the number and rate of fatal and incapacitating crashes, and support statewide Vision Zero initiatives by supporting the emergency response system.	Metropolitan Transportation Plan 2050	PS02: Emergency Response, PS03: Emergency Vehicle Preemption

Goal: Security

Description: Increase transportation system security for motorized and non-motorized uses.

Objectives:

Name	Description	Source	Service Package
Street and Highway Security	Implement transportation improvements that enhance system resiliency	Metropolitan Transportation Plan 2050	TM01: Infrastructure-Based Traffic Surveillance
Transportation User Security	Leverage emerging transportation technologies to improve the multimodal system's operations	Metropolitan Transportation Plan 2050	PT05: Transit Security

Goal: Connected and Accessible

Description: Increase accessibility and mobility for people and freight. Facilitates high degrees of accessibility for system users by providing connections to the destinations they want to go.

Objectives:

Name	Description	Source	Service Package
Transit ridership	Shift ridership from demand response to fixed-route system through improved information availability and service quality.	Metropolitan Transportation Plan 2050: GF-EGF Transit Development Plan	PT02: Transit Fixed-Route Operations, PT03: Dynamic Transit Operations, PT08: Transit Traveler Information
Fixed Route and Dynamic Transit Demand	Manage system demand between fixed-route and demand response system through eligibility screening and better coordination with demand users and human services agencies	Metropolitan Transportation Plan 2050: GF-EGF Transit Development Plan	PT02: Transit Fixed-Route Operations, PT03: Dynamic Transit Operations

Goal: System Preservation

Description: Emphasize the preservation of the existing transportation system.

Objectives:

Name	Description	Source	Service Package
Asset maintenance	Identify financial and human resources to support the maintenance of critical transportation facilities	Metropolitan Transportation Plan 2050	MC02: Maintenance and Construction Vehicle Maintenance
Transit fleet maintenance	Maintain and manage the condition of transit assets,	Metropolitan Transportation Plan 2050	PT06: Transit Fleet Management

Name	Description	Source	Service Package
	including vehicles, equipment, and transit facilities.		

Goal: Resiliency and Reliability

Description: Improve transportation system resiliency and reliability and reduce or mitigate stormwater impacts to surface transportation.

Objectives:

Name	Description	Source	Service Package
Peak hour congestion	Limit recurring peak hour congestion	Metropolitan Transportation Plan 2050	TM03: Traffic Signal Control, TM03: Traffic Signal Control in EGF, TM07: Regional Traffic Management, TM12: Dynamic Roadway Warning
Reduce or Mitigate Stormwater Impacts	Reduce street and highway system vulnerability to snow and stormwater.	Metropolitan Transportation Plan 2050	MC04: Winter Maintenance
Improve transit travel time	Implement service and infrastructure improvements that improve travel time and reliability (service that is regularly on-time for riders)	Metropolitan Transportation Plan 2050: GF-EGF Transit Development Plan	PT01: Transit Vehicle Tracking, PT08: Transit Traveler Information

10.2 Regional ITS Architecture Maintenance

The Grand Forks-East Grand Forks MPO maintains and updates the GF-EGF Regional ITS Architecture. It is envisioned that the updates will be conducted every year or as needed upon deploying major ITS projects in the area. The updates will account for any changes to existing systems, regional needs and priorities, and changes in the National ITS Architecture. However, it is suggested that the practice of project architecture development be implemented with any existing or planned ITS-related project for the region and included in the regional architecture regularly.

APPENDIX-A

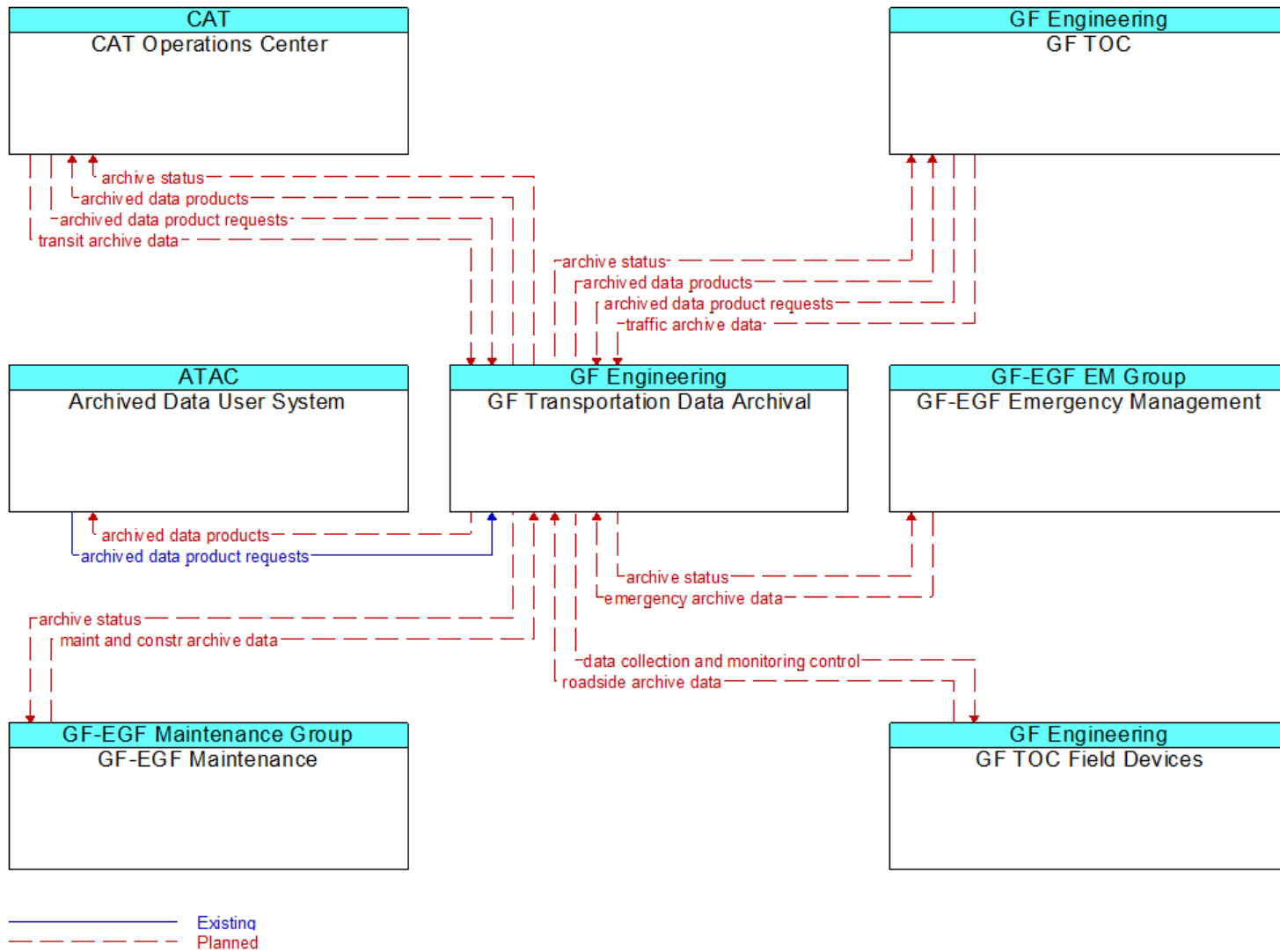
GRAND FORKS-EAST GRAND FORKS SERVICE PACKAGES AND INFORMATION FLOWS

The Service Package Diagrams are available electronically at:

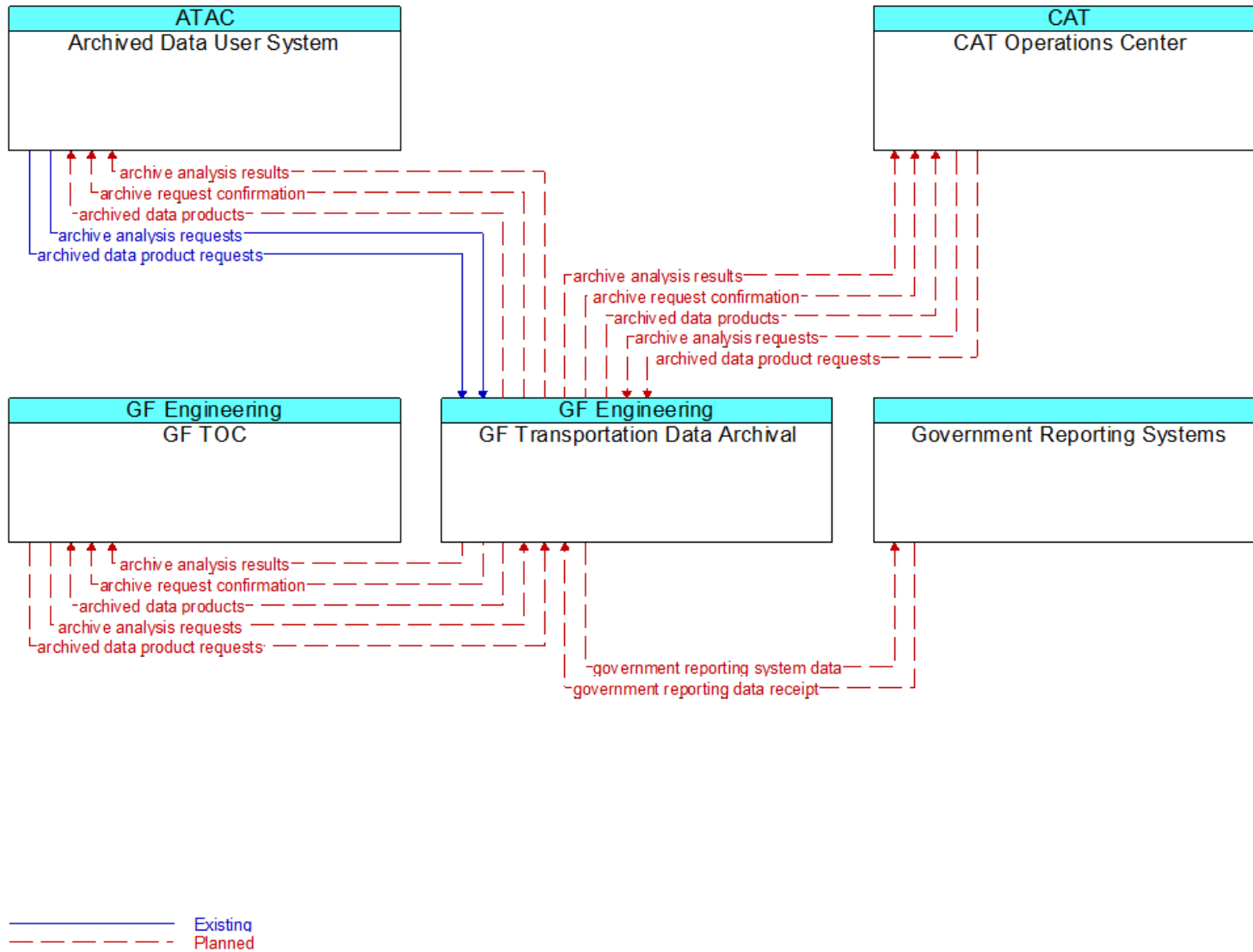
<http://www.atacenter.org/regional/grandforks>

Viewing electronically will allow for zooming and panning which is required for the diagram's readability.

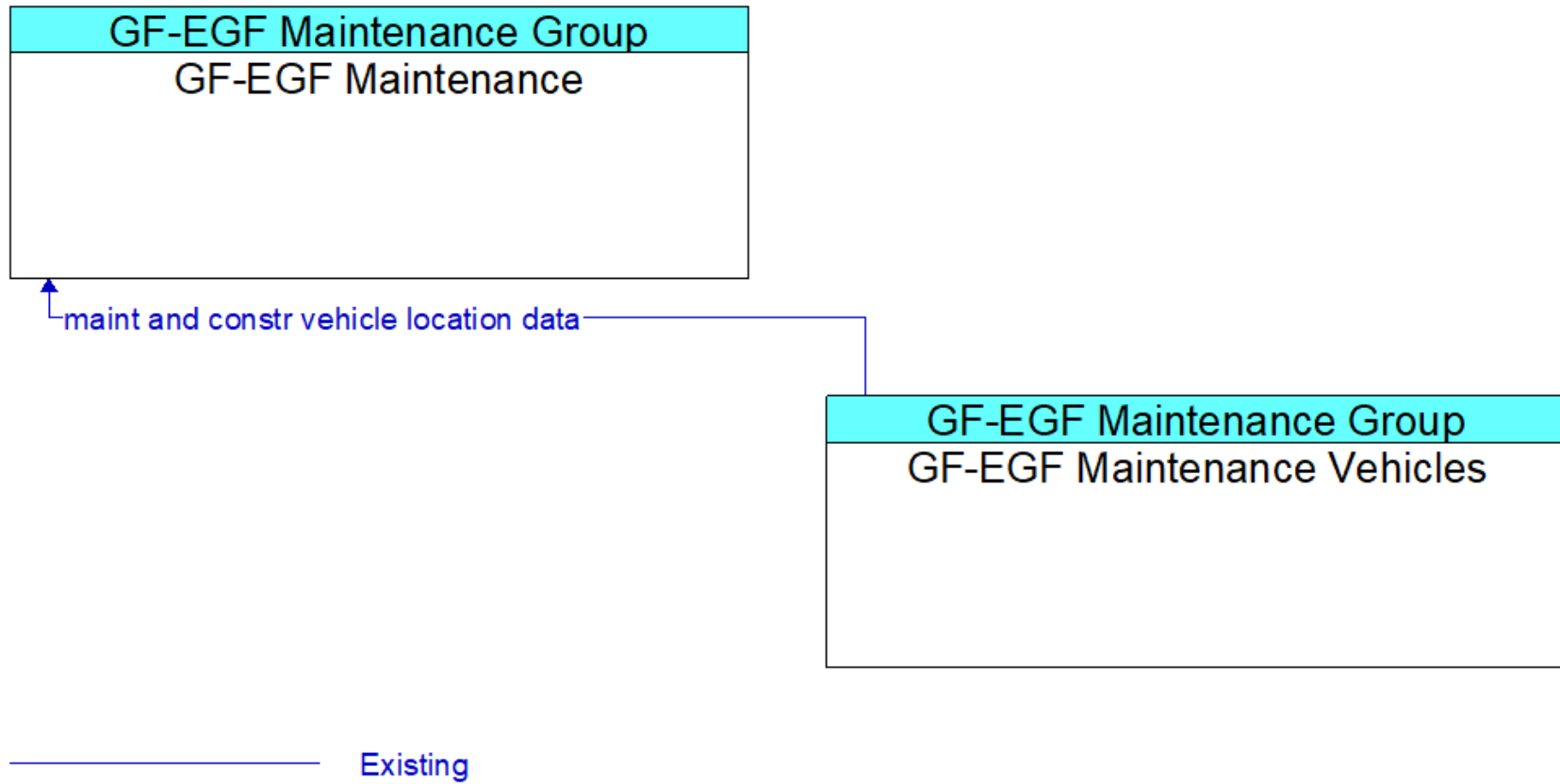
DM01 ITS Data Warehouse



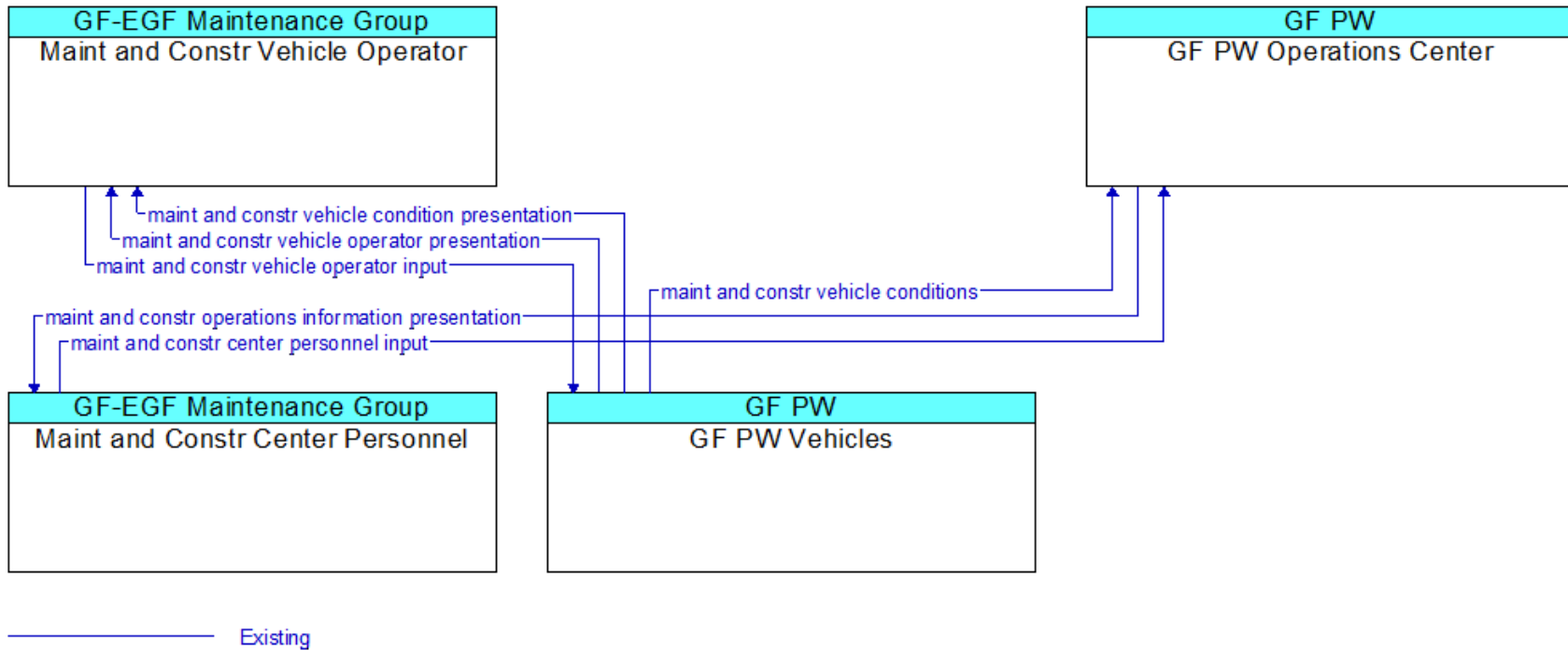
DM02 Performance Monitoring



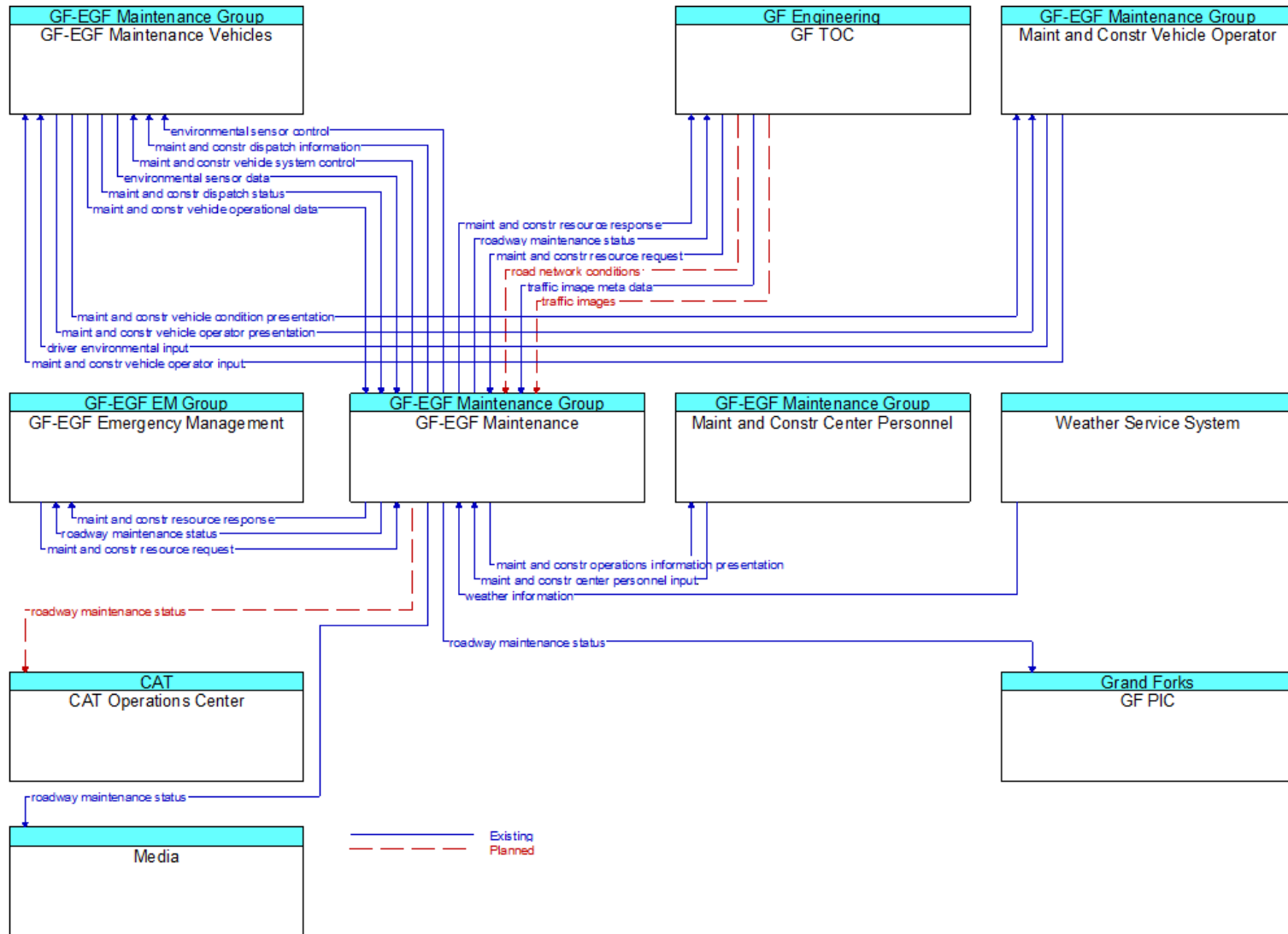
MC01 Maintenance and Construction Vehicle and Equipment Tracking



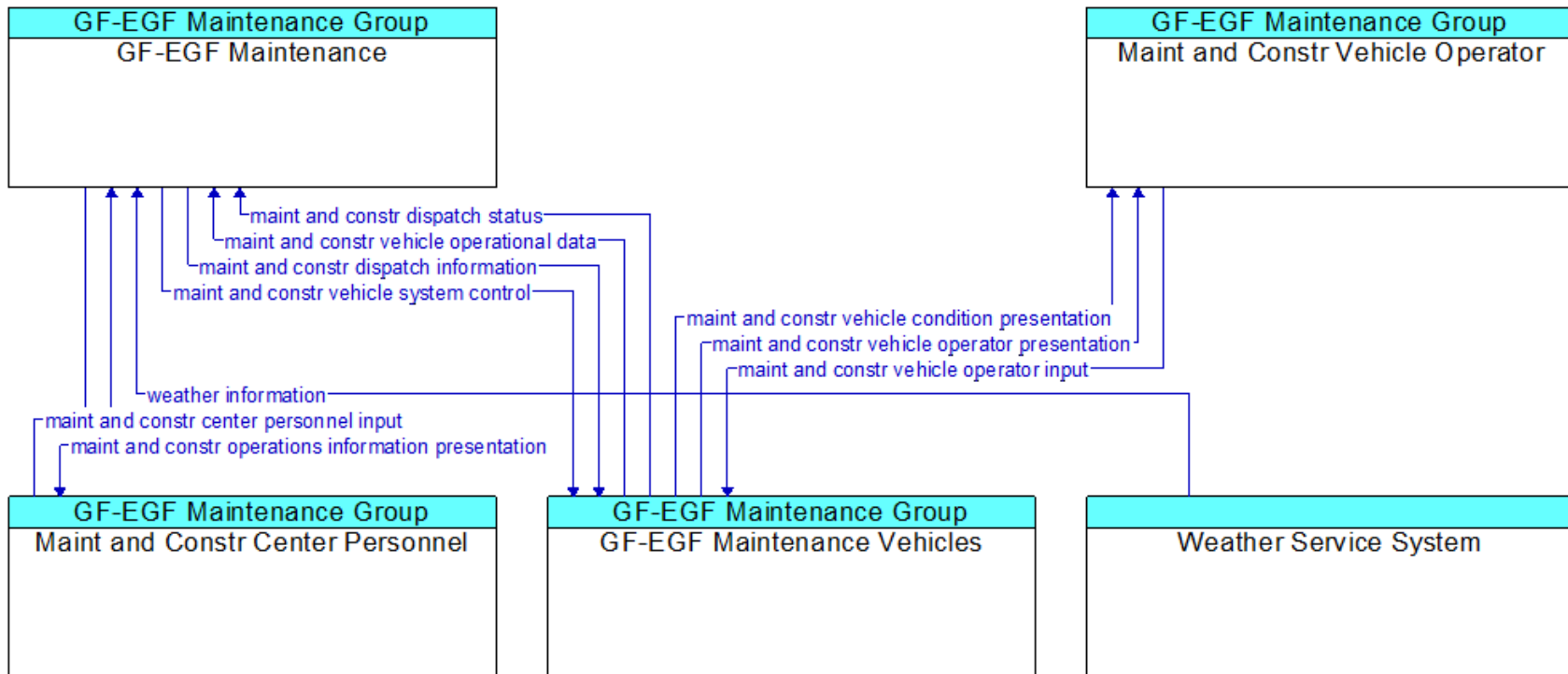
MC02 Maintenance and Construction Vehicle Maintenance



MC04 Winter Maintenance

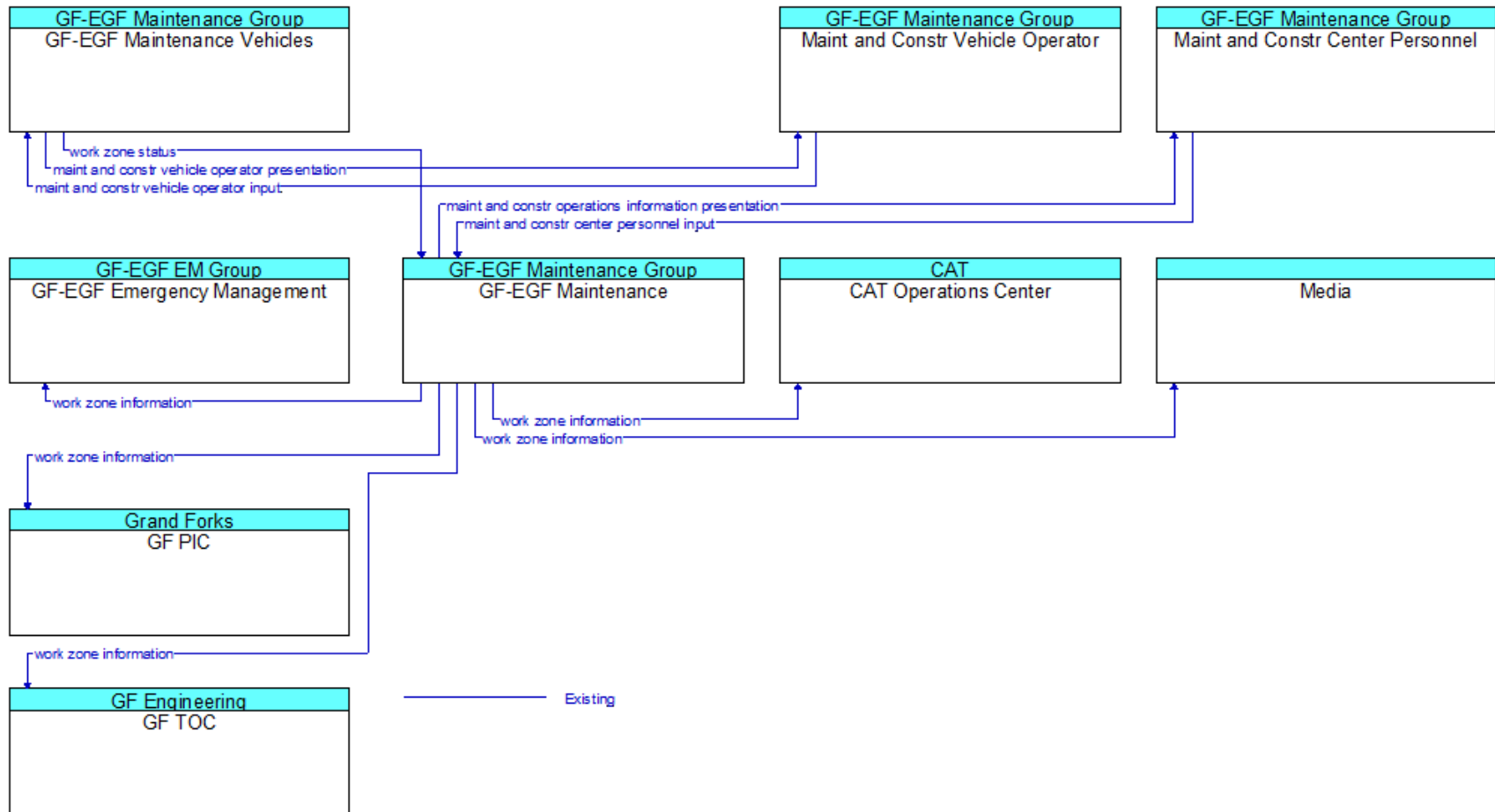


MC05 Roadway Maintenance and Construction

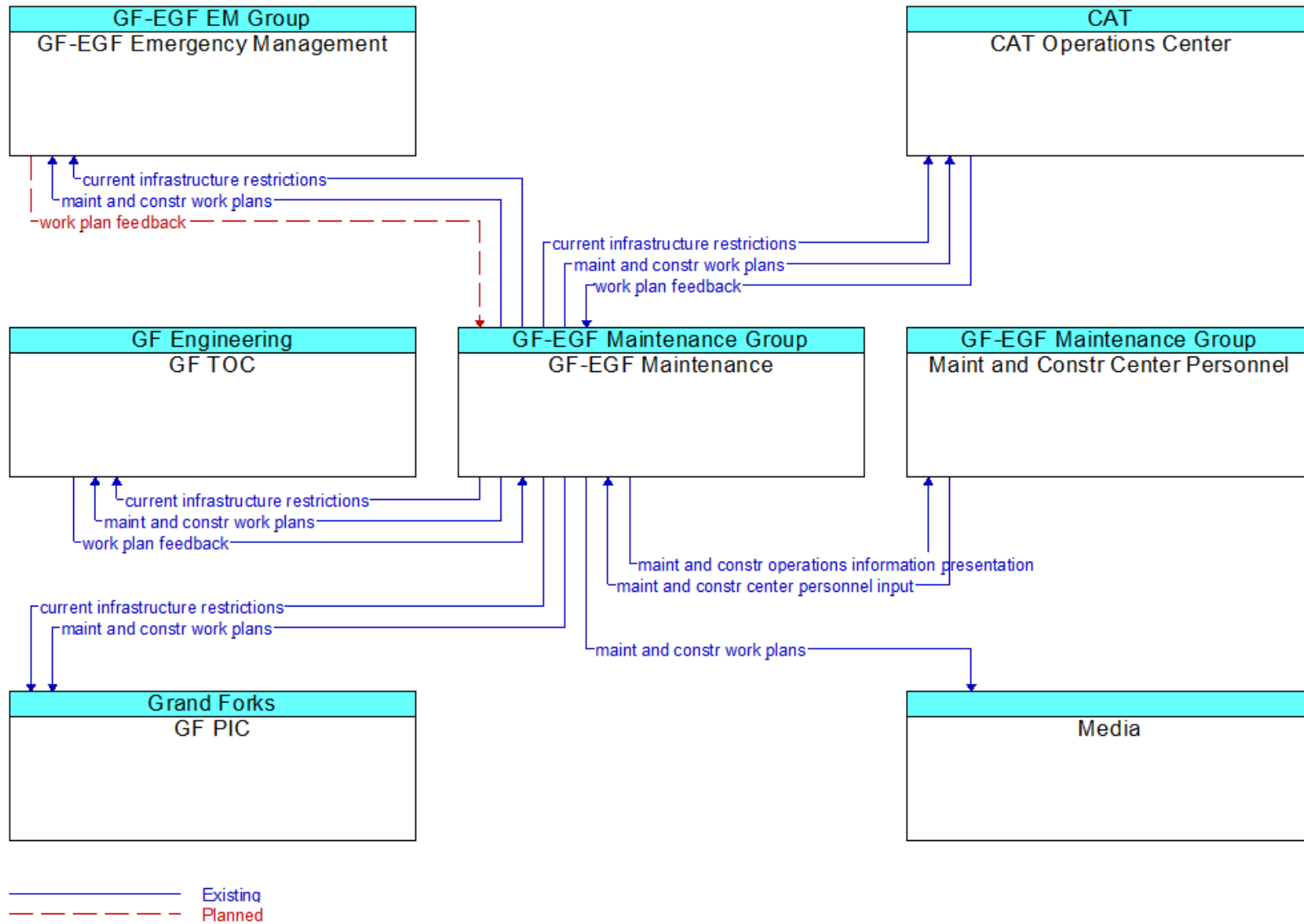


Existing

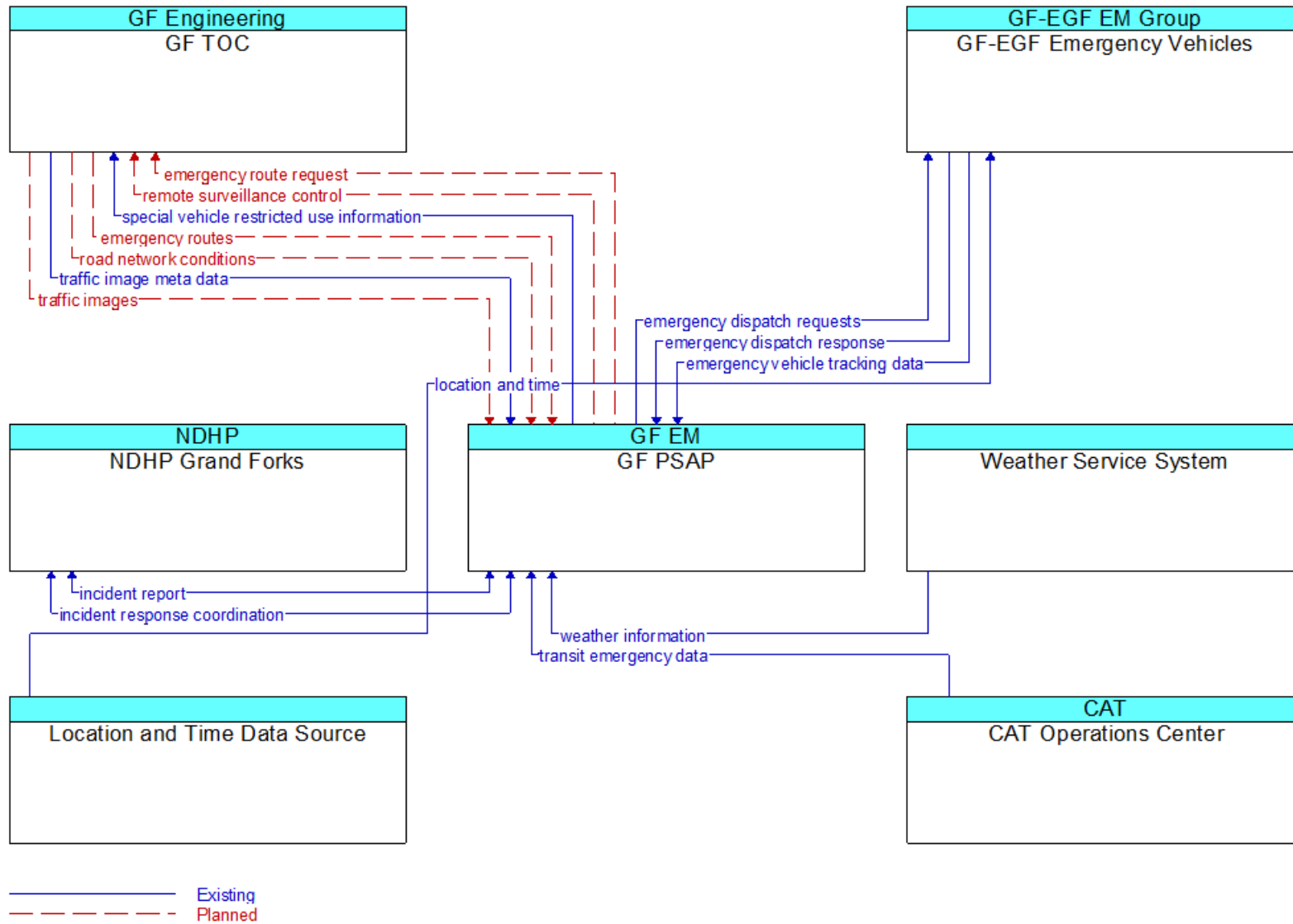
MC06 Work Zone Management



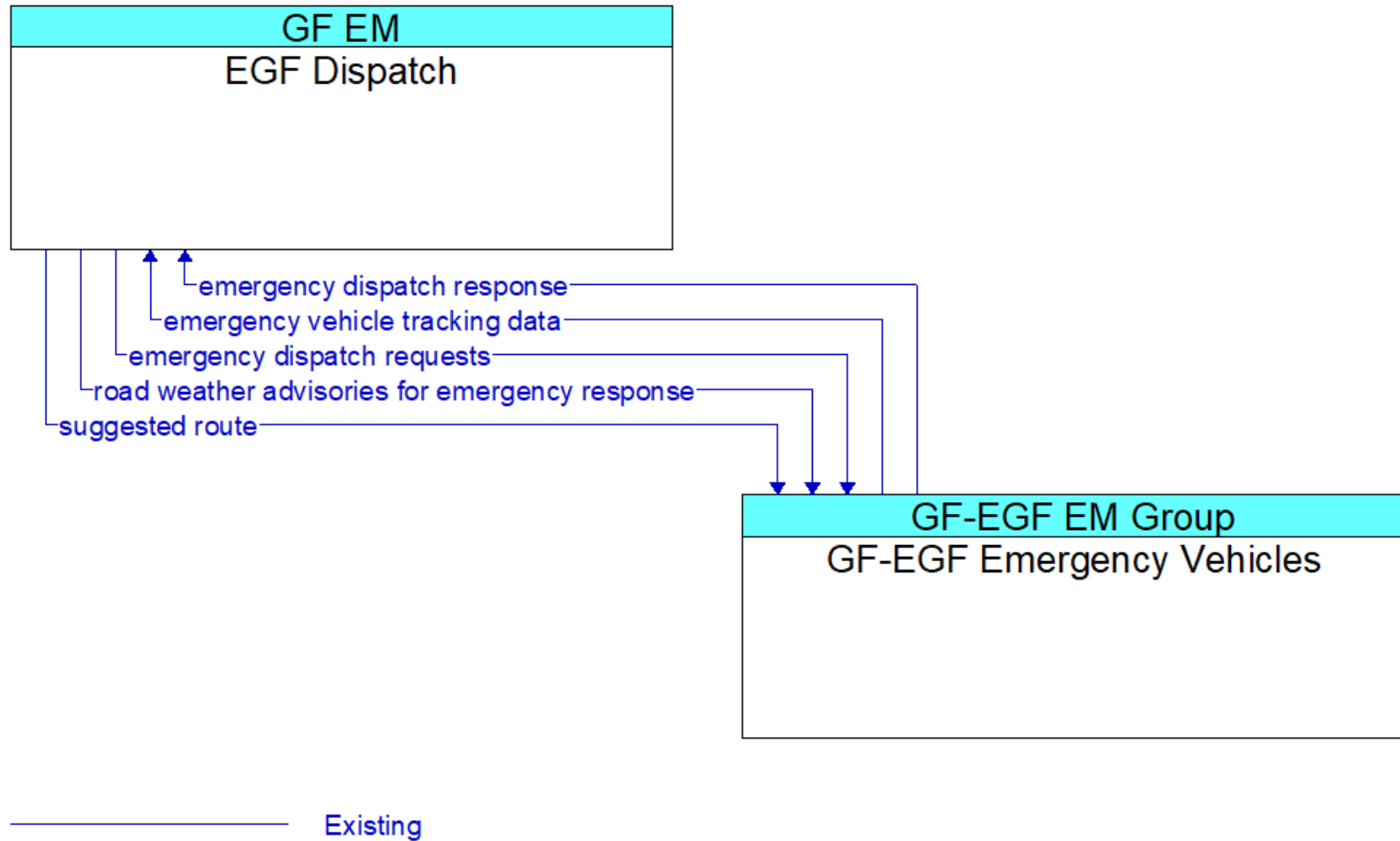
MC08 Maintenance and Construction Activity Coordination



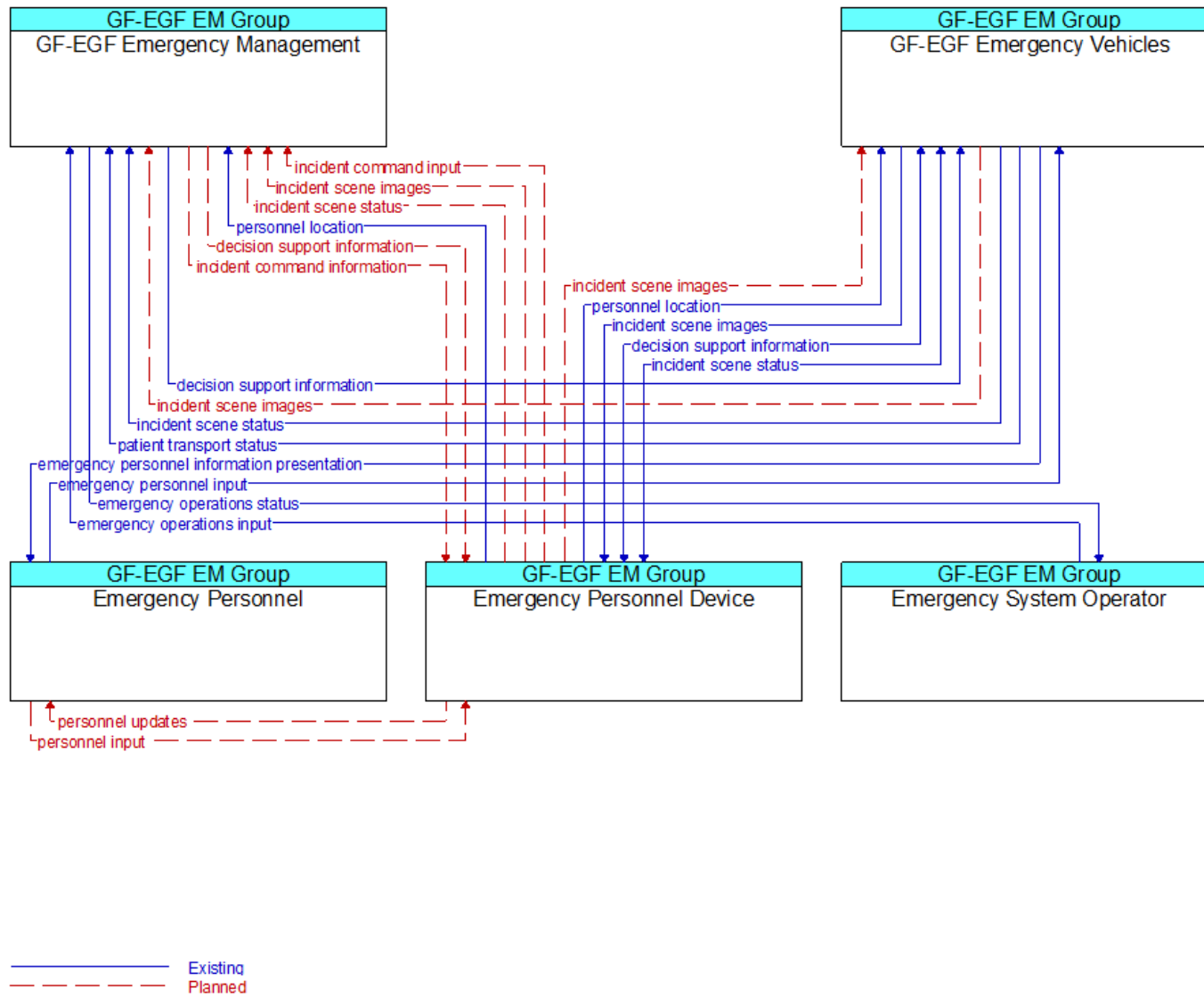
PS01 Emergency Call-Taking and Dispatch



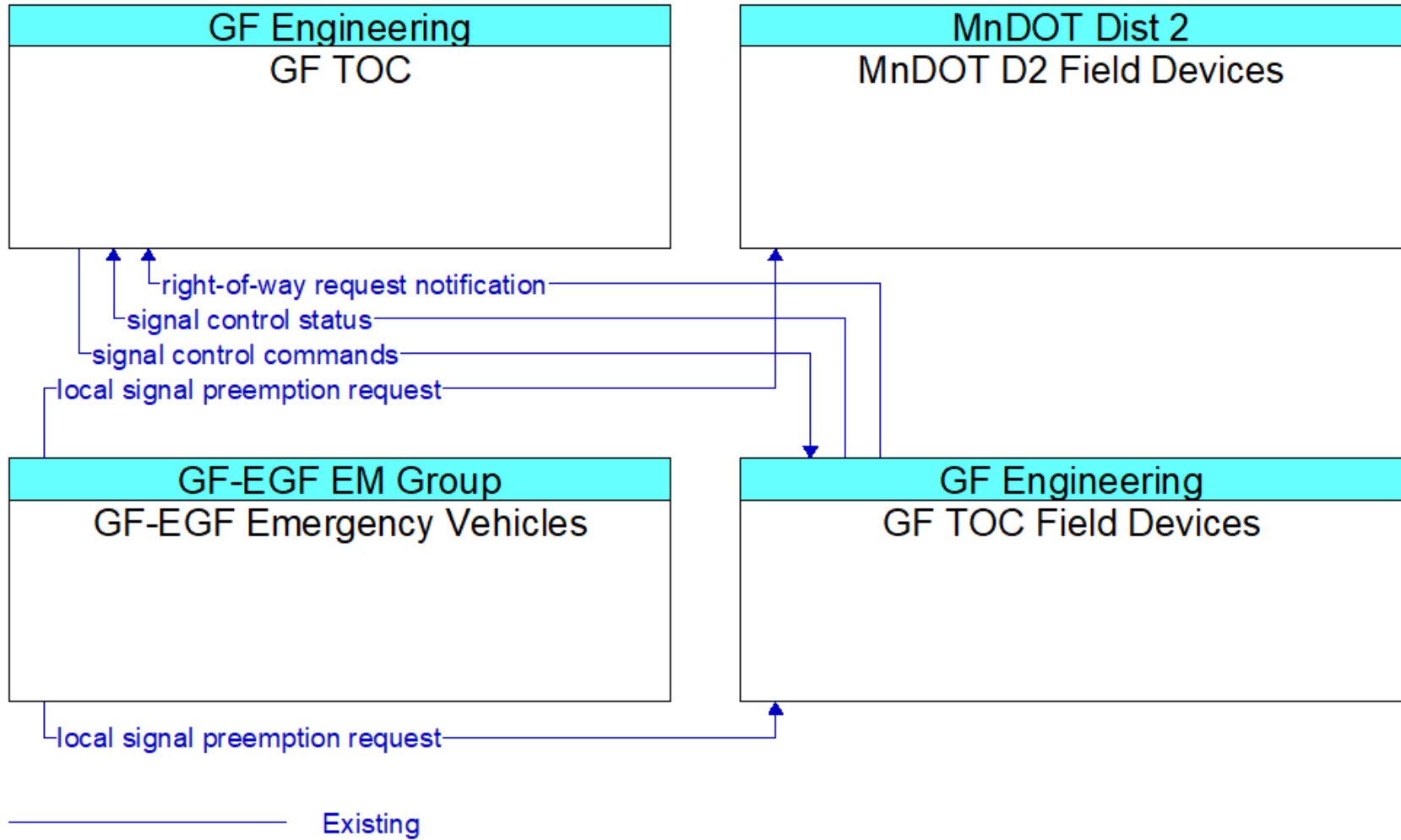
PS01 Emergency Call-Taking and Dispatch in EGF



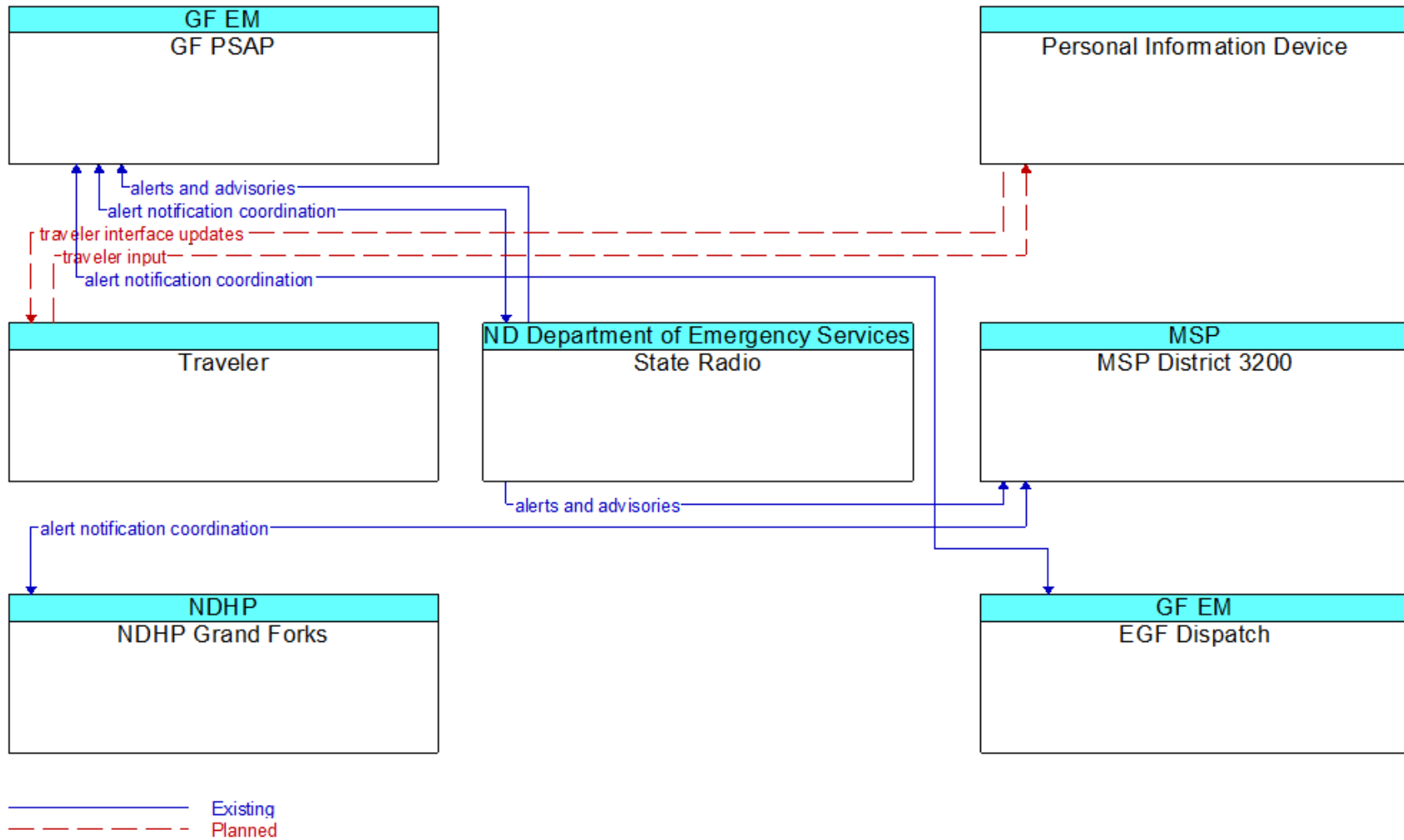
PS02 Emergency Response



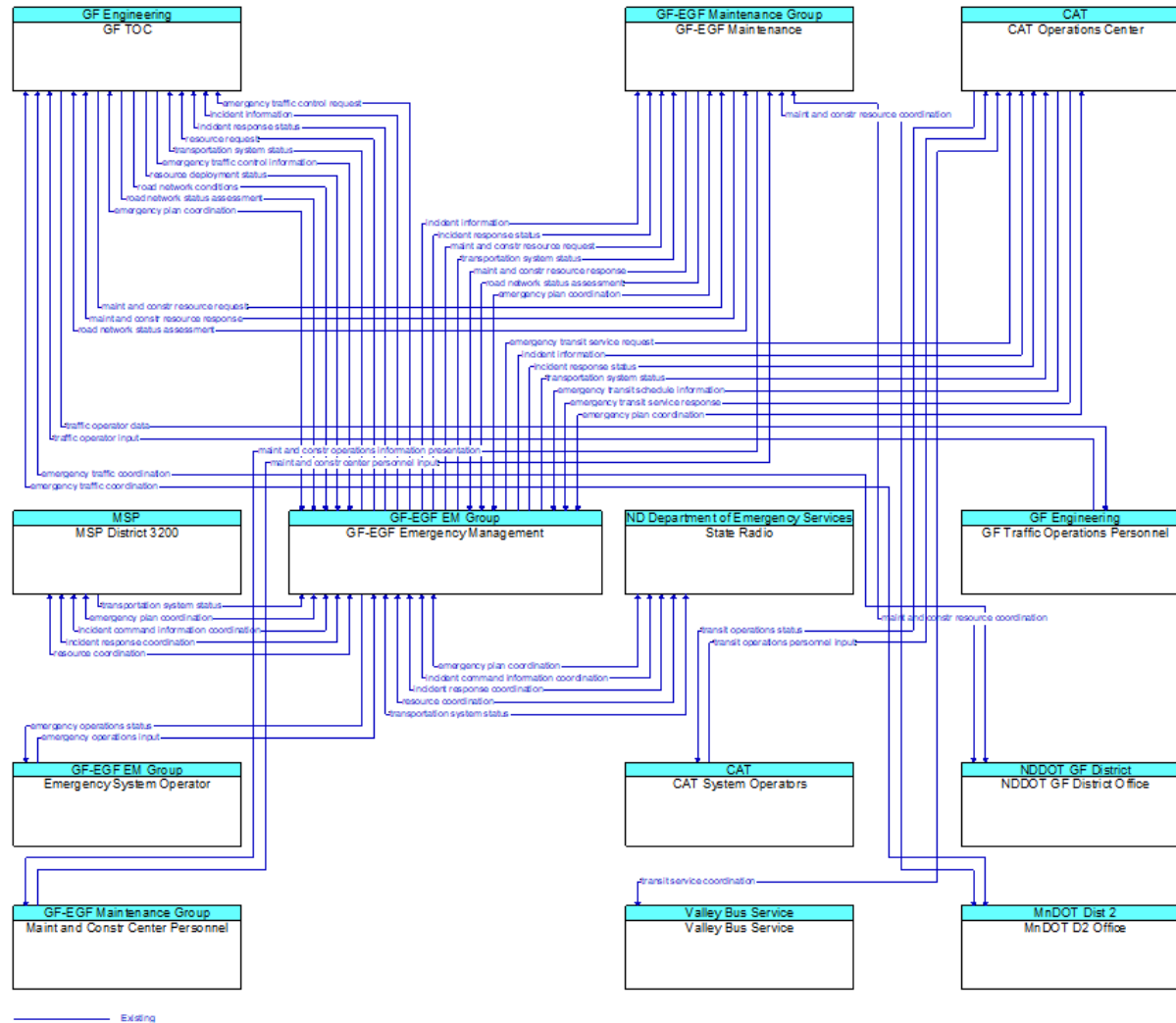
PS03 Emergency Vehicle Preemption



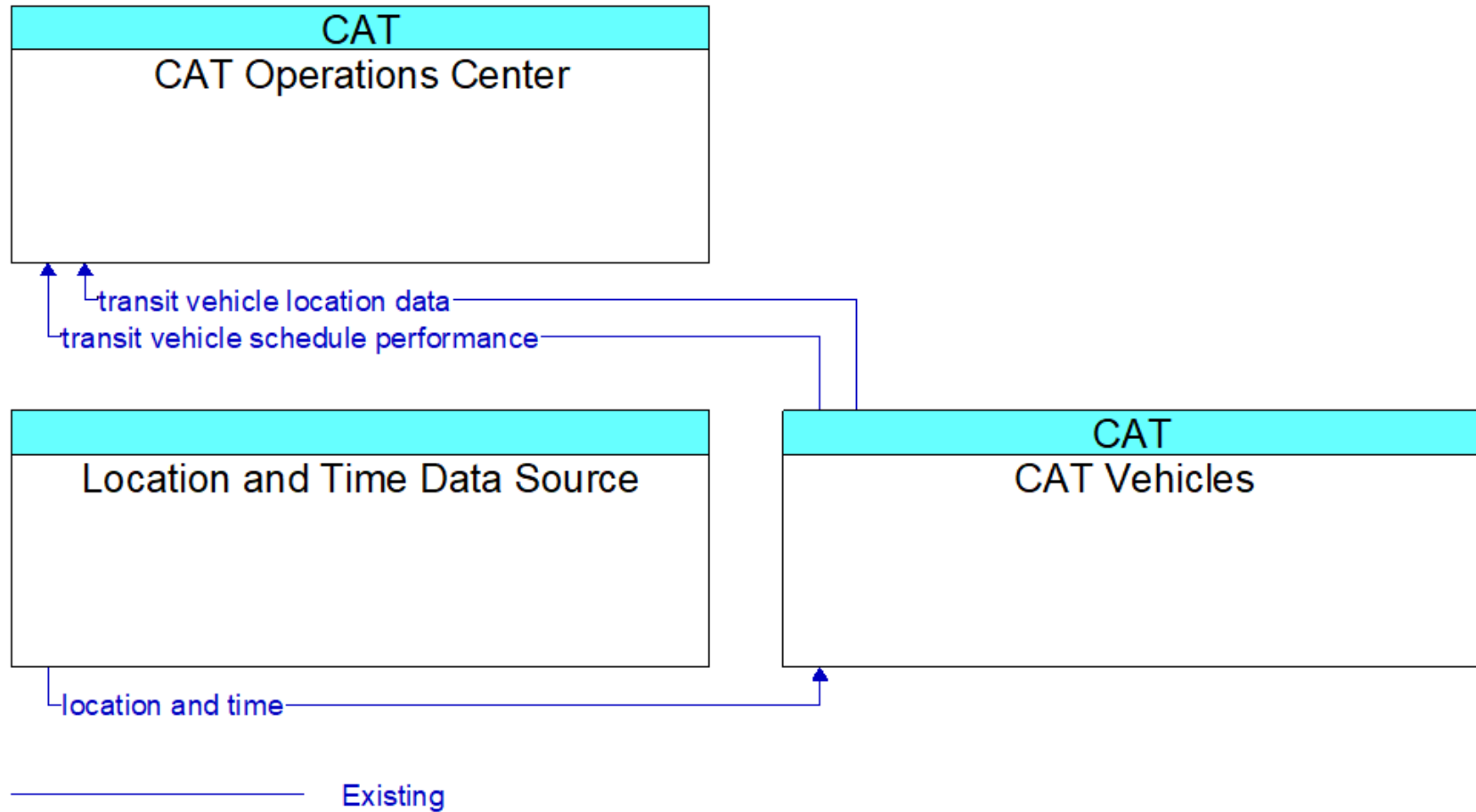
PS10 Wide-Area Alert



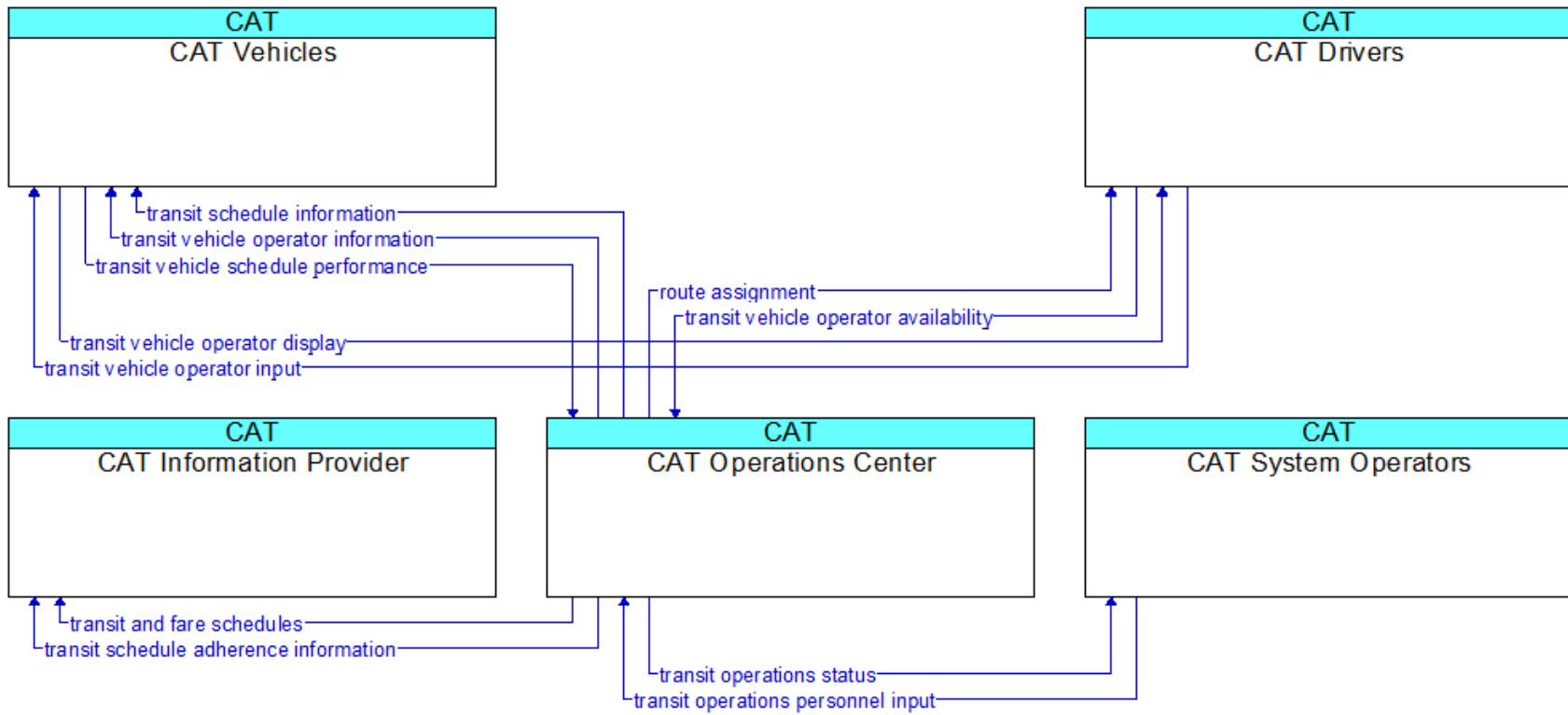
PS12 Disaster Response and Recovery



PT01 Transit Vehicle Tracking

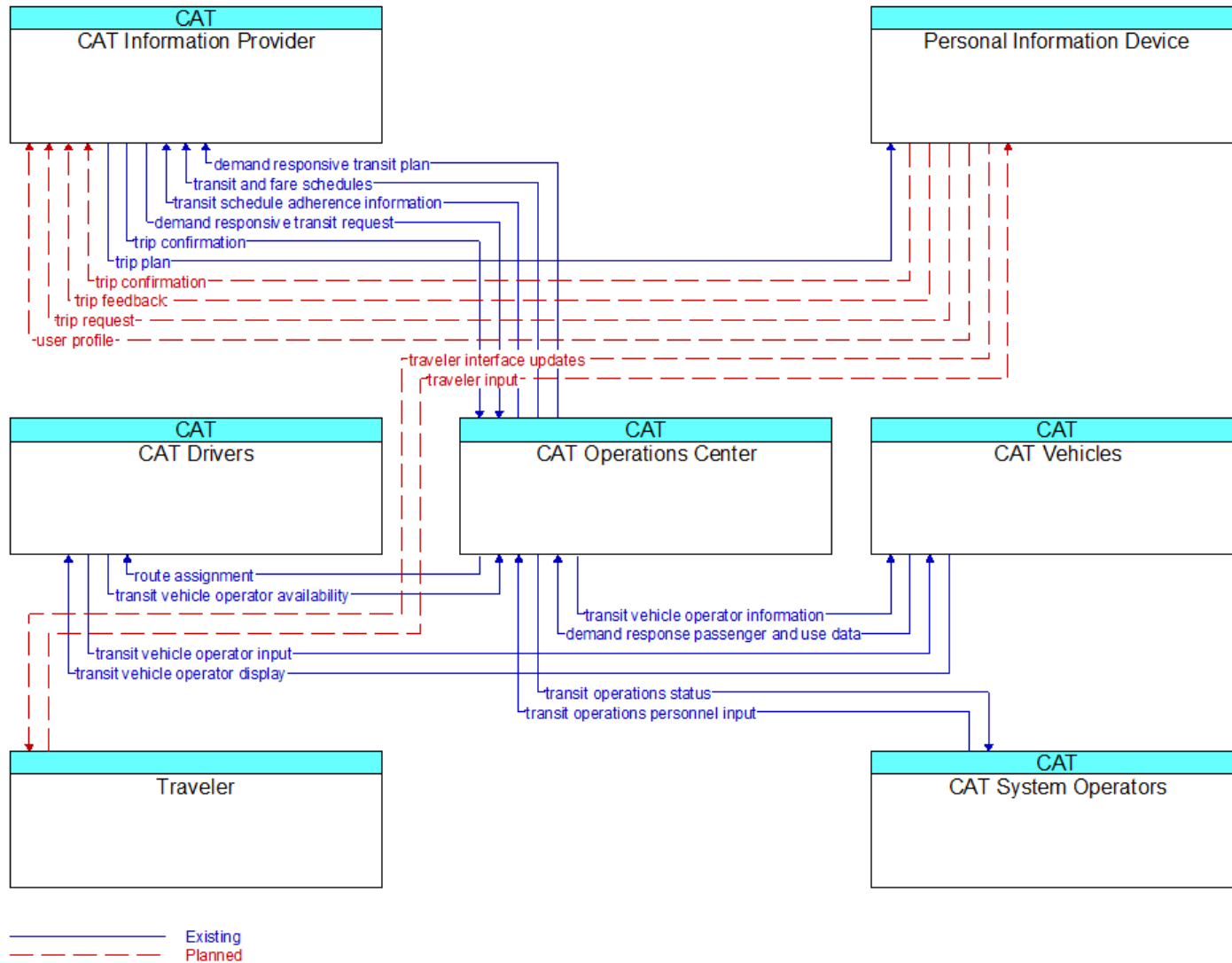


PT02 Transit Fixed-Route Operations

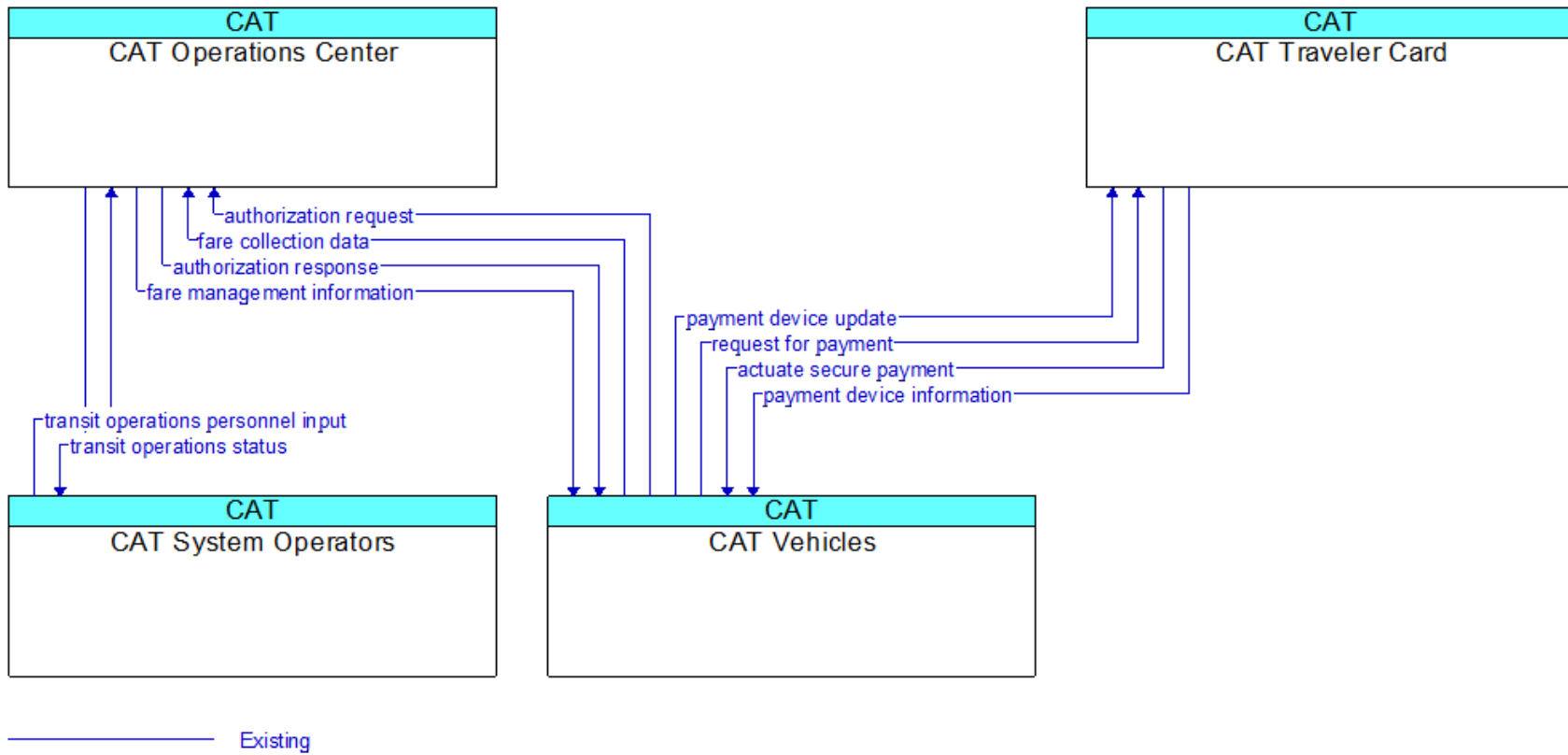


Existing

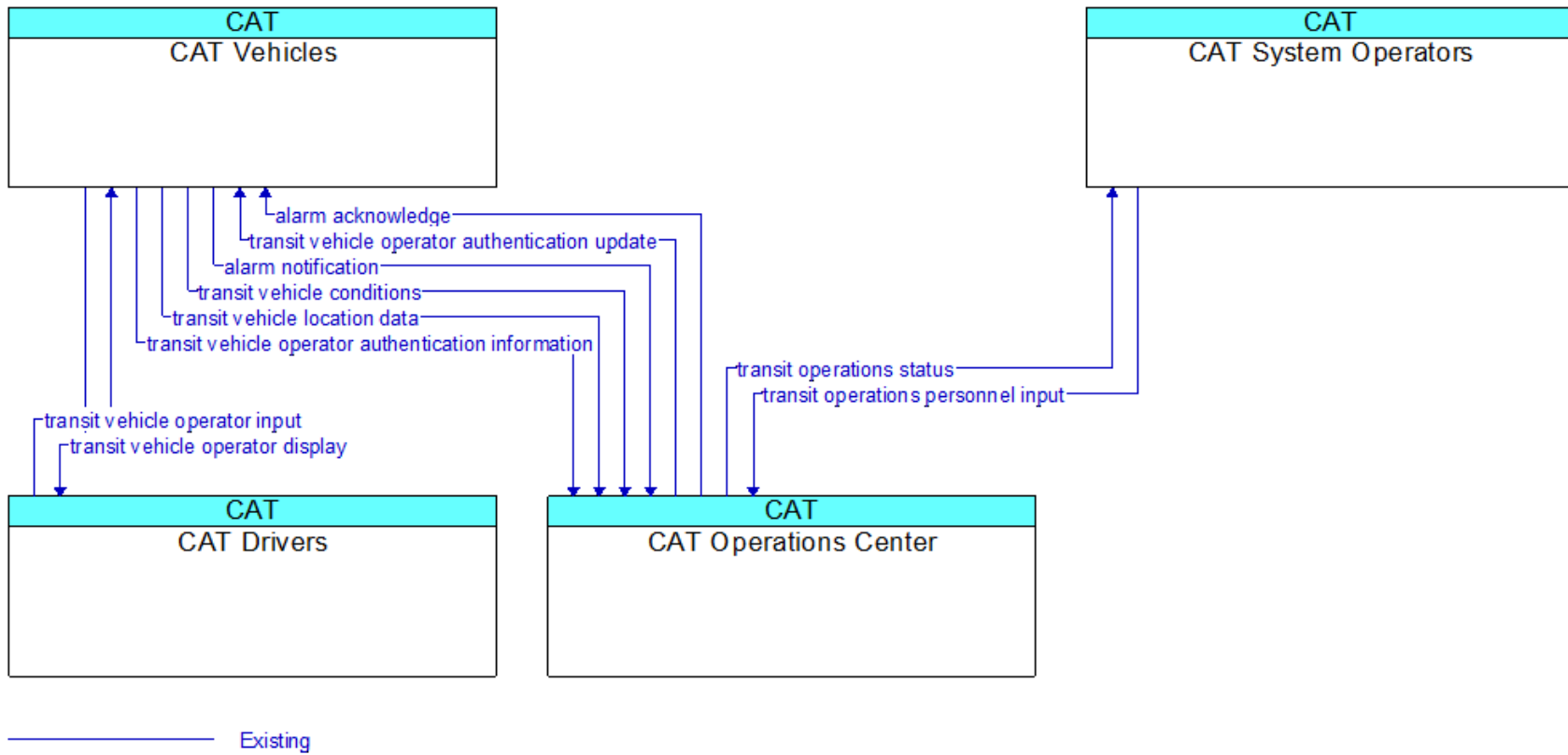
PT03 Dynamic Transit Operations



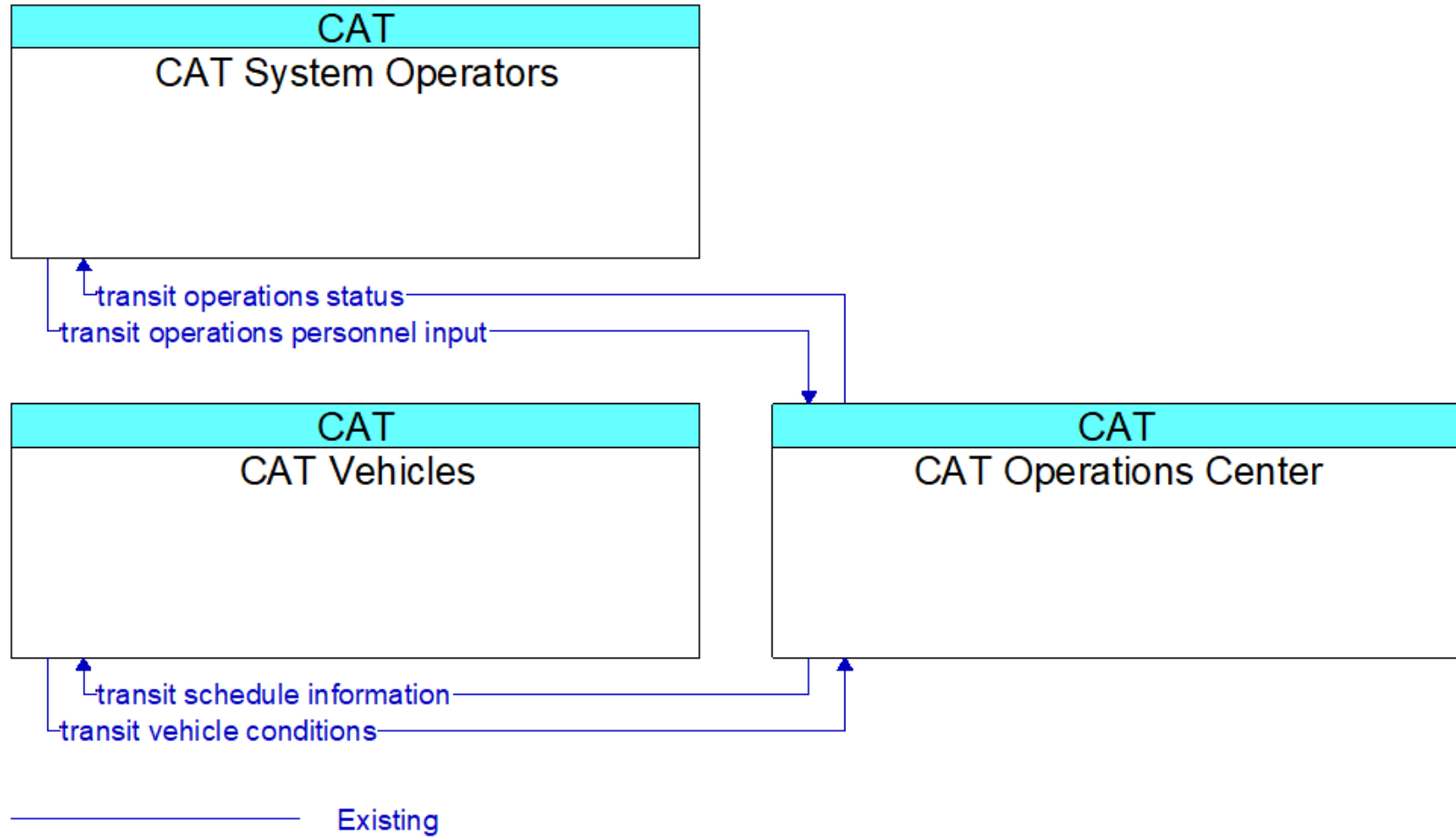
PT04 Transit Fare Collection Management



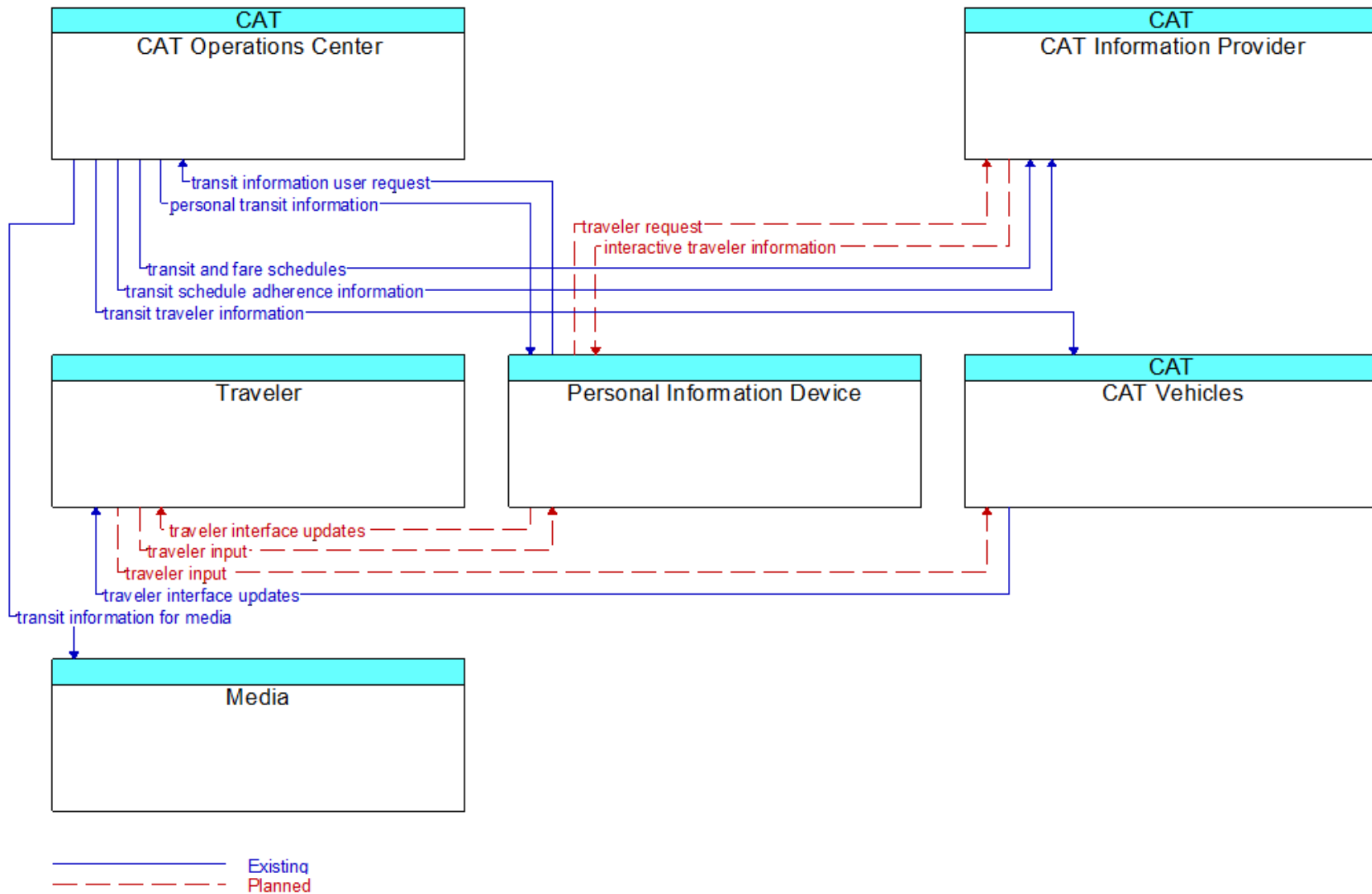
PT05 Transit Security



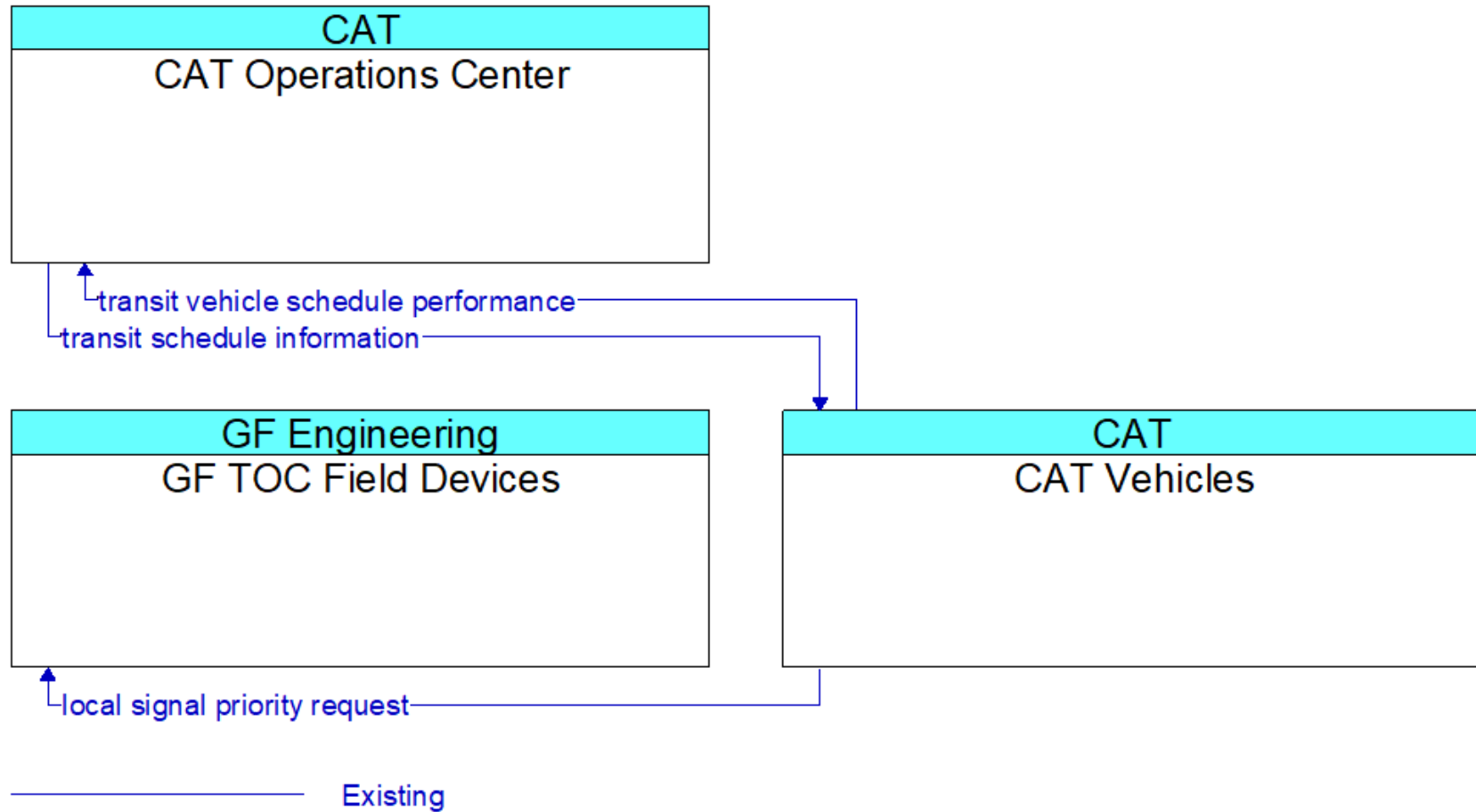
PT06 Transit Fleet Management



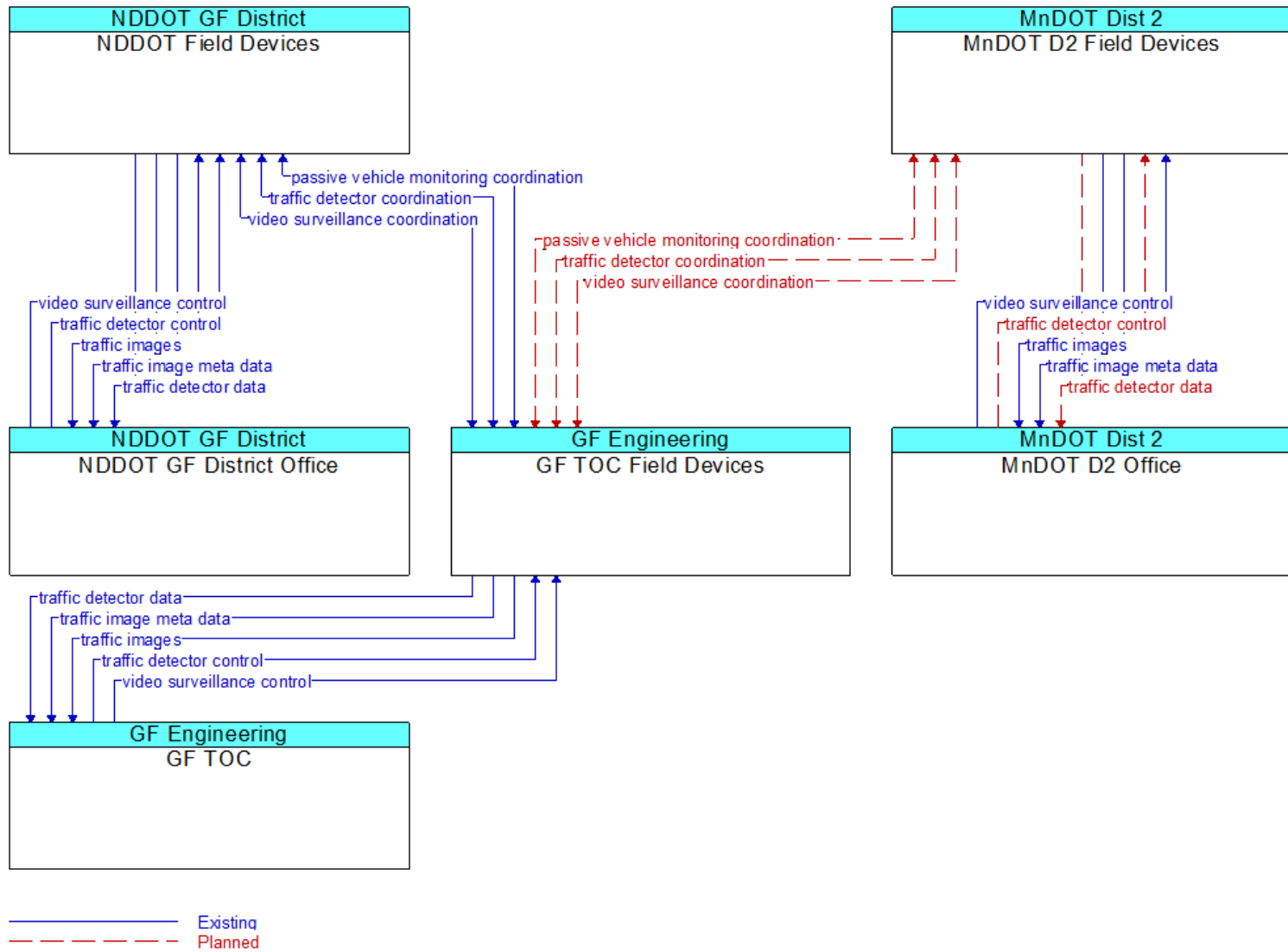
PT08 Transit Traveler Information



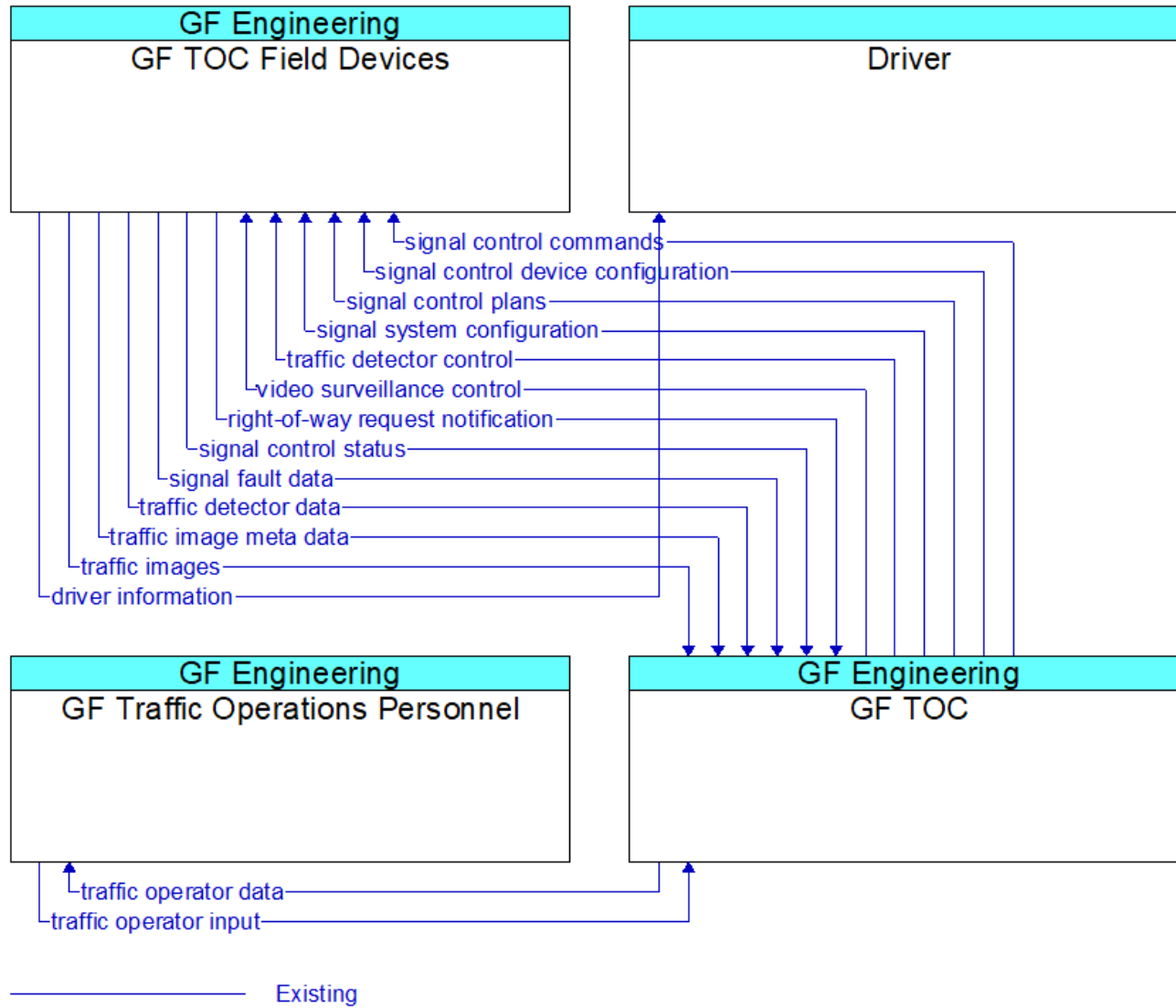
PT09 Transit Signal Priority



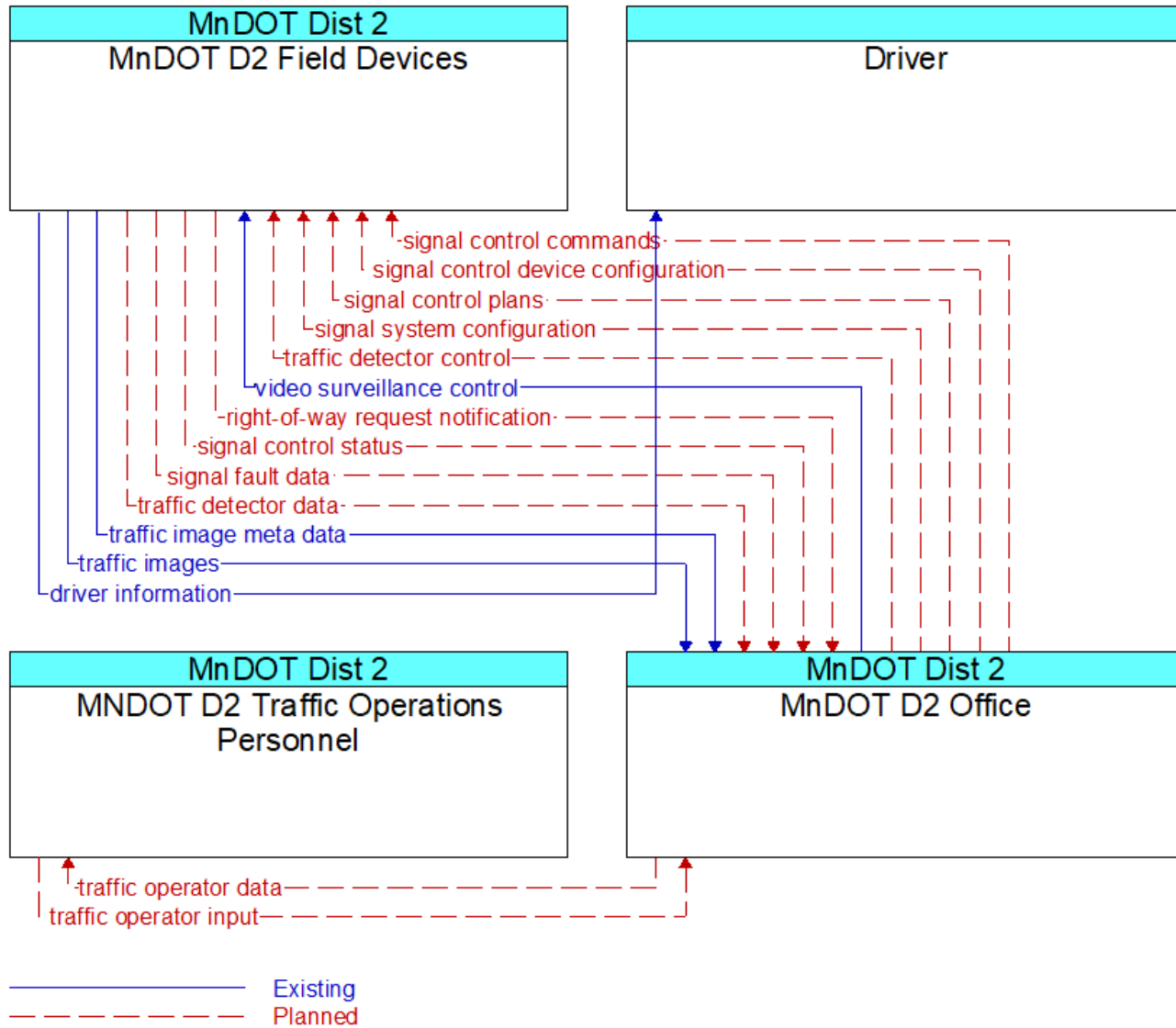
TM01 Infrastructure-Based Traffic Surveillance



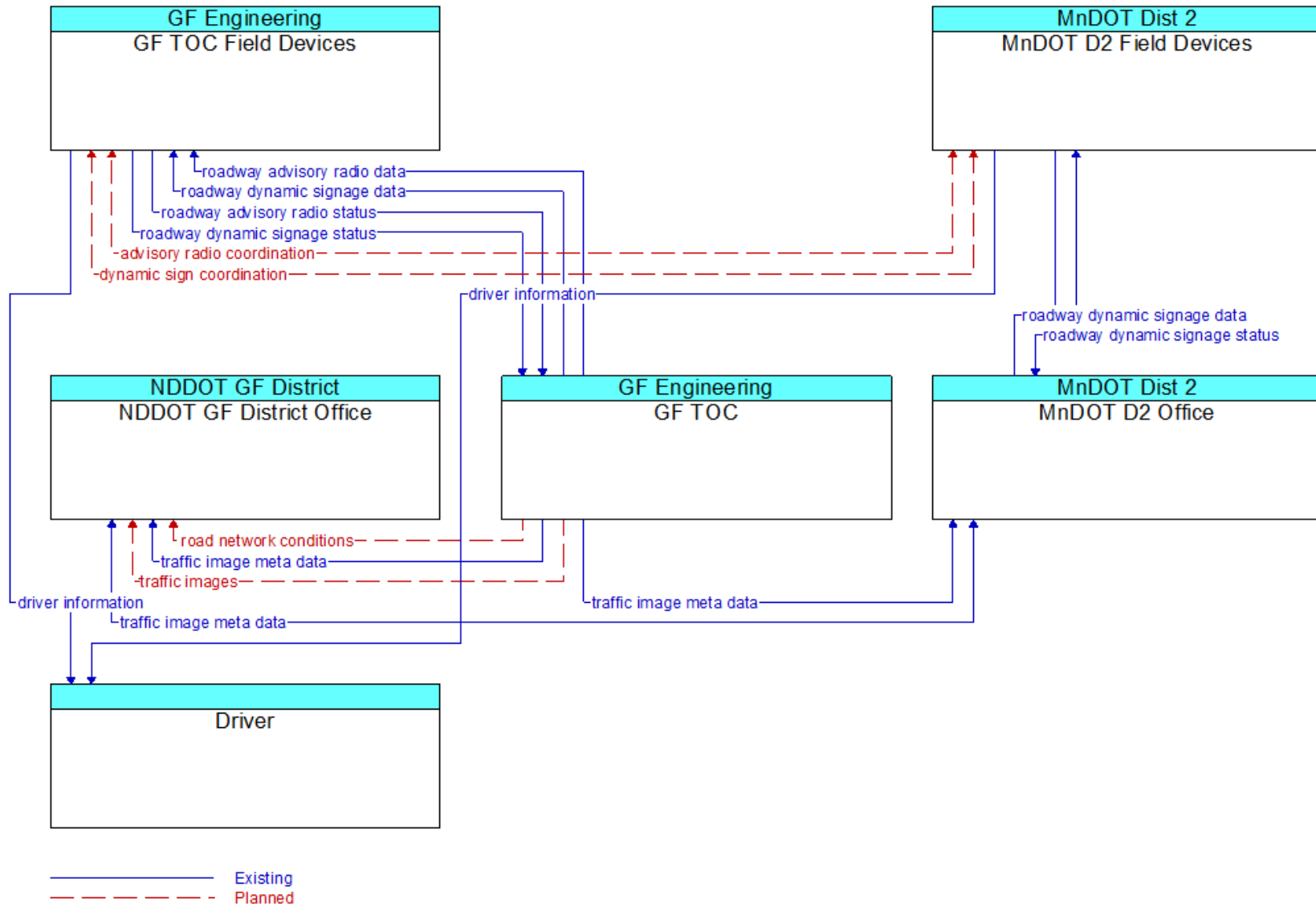
TM03 Traffic Signal Control



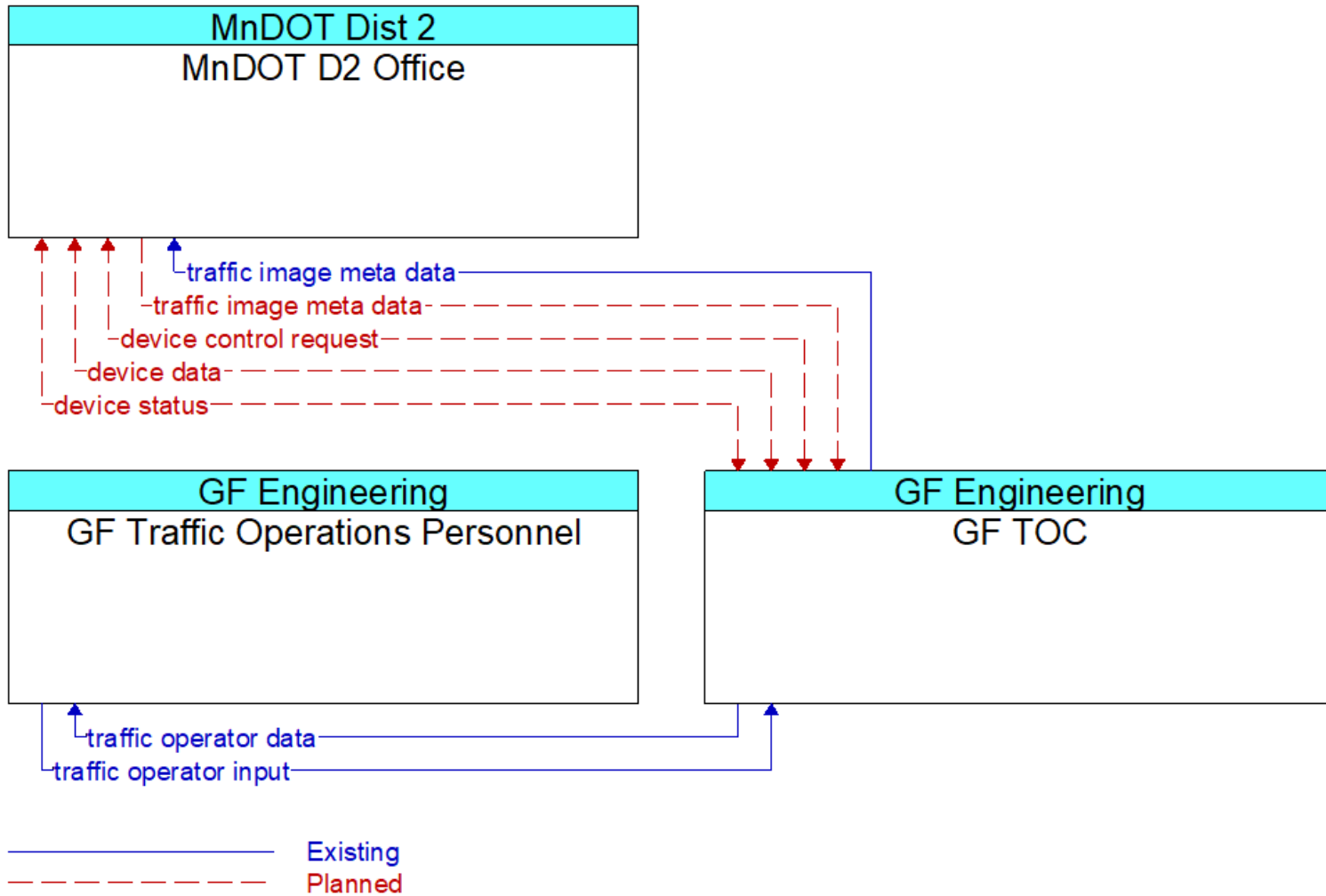
TM03 Traffic Signal Control in EGF



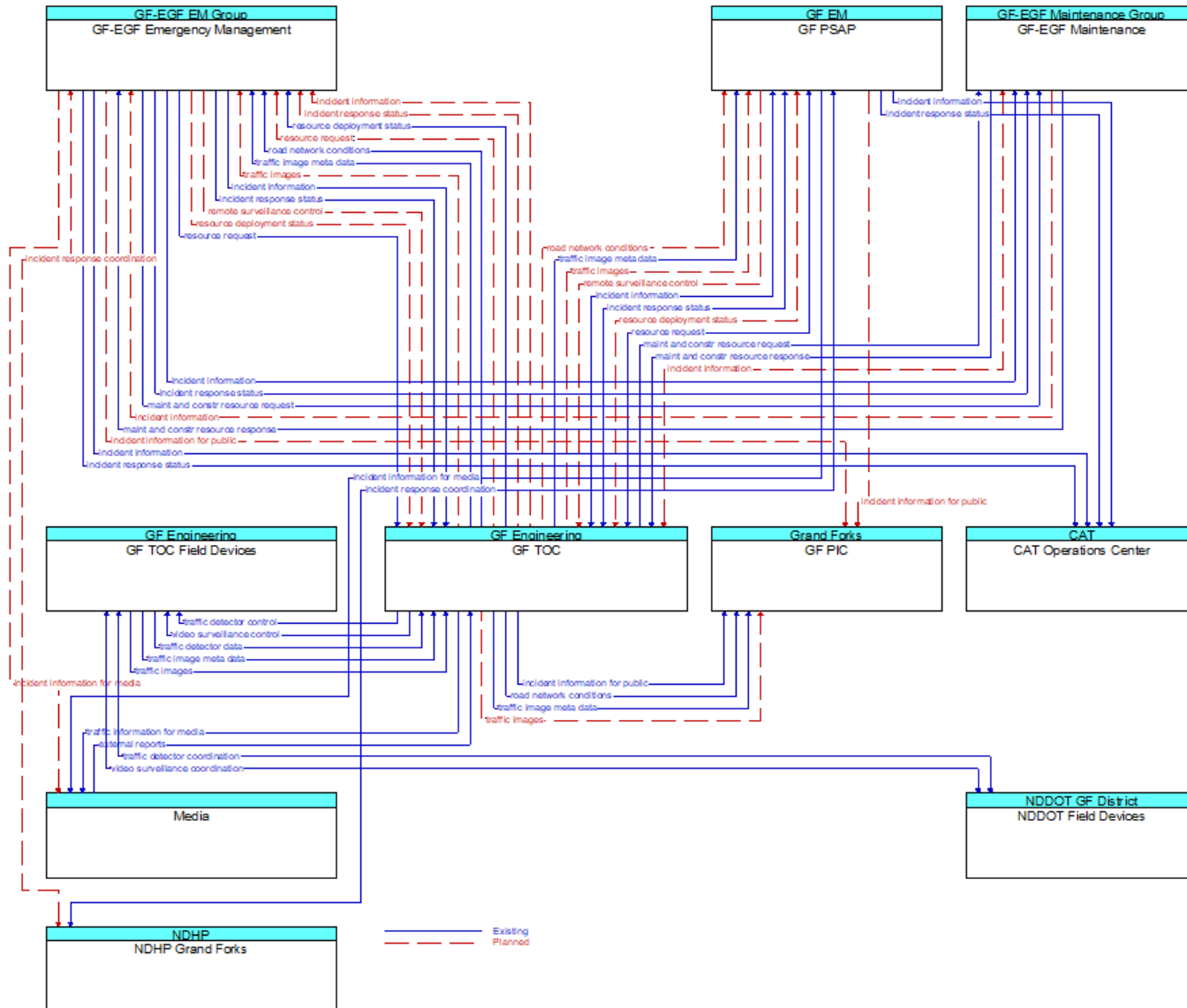
TM06 Traffic Information Dissemination



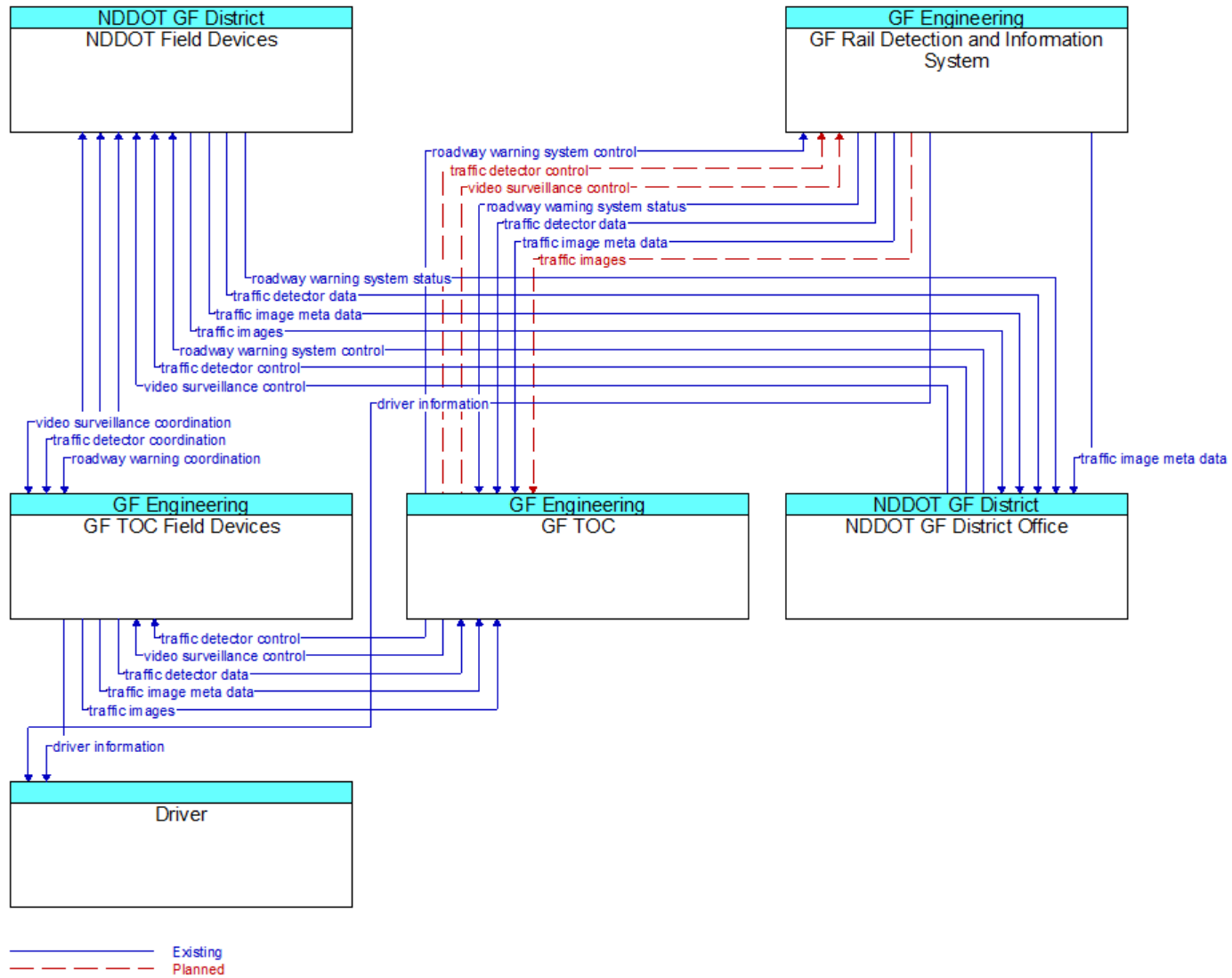
TM07 Regional Traffic Management



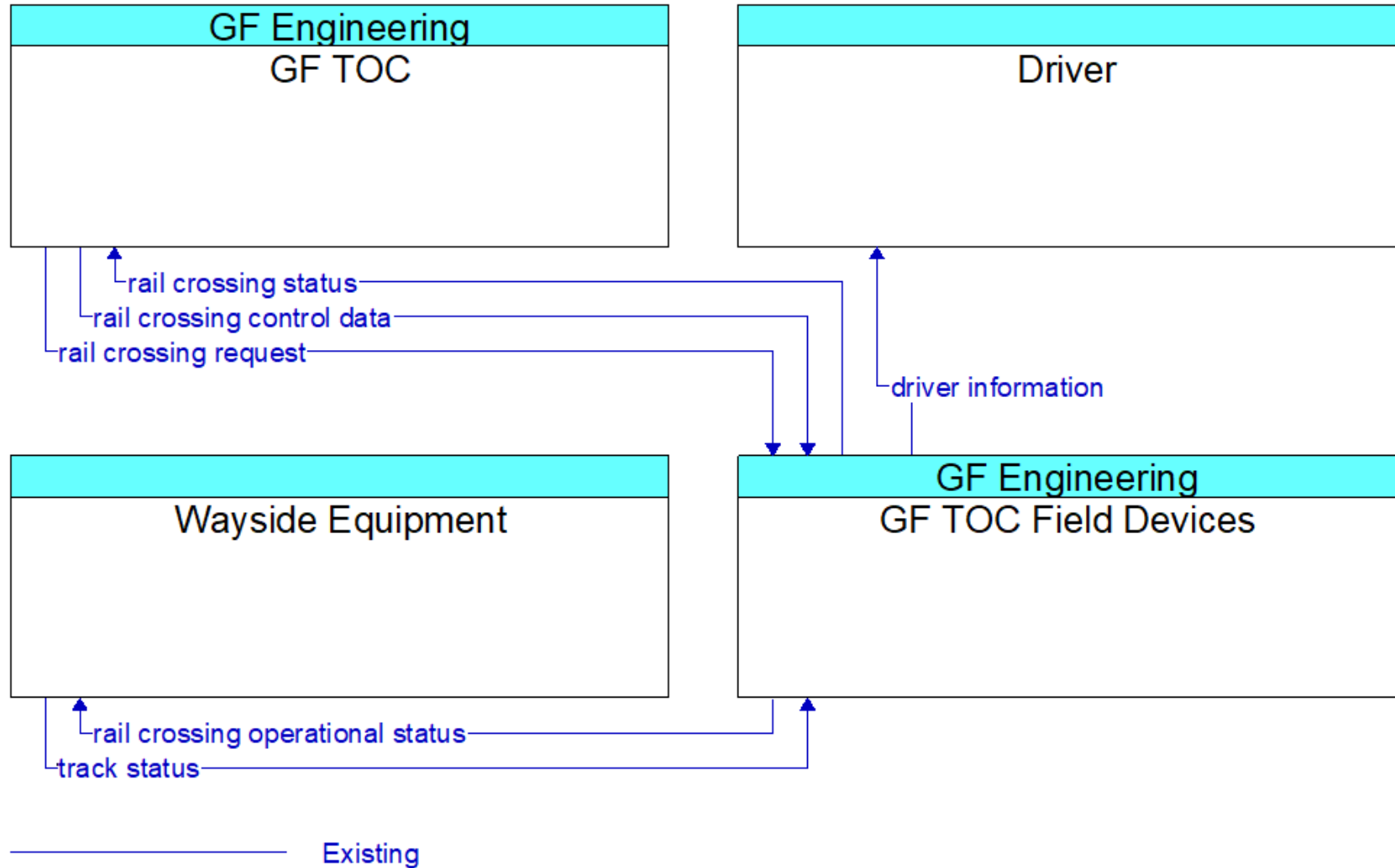
TM08 Traffic Incident Management System



TM12 Dynamic Roadway Warning



TM13 Standard Railroad Grade Crossing



APPENDIX B

FUNCTIONAL REQUIREMENTS

Element Name	Functional Object	Number	Requirement	Status
CAT Information Provider	TIC Data Collection	4	The center shall collect, process, and store transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information.	Existing
CAT Information Provider	TIC Interactive Traveler Information	3	The center shall disseminate customized transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travelers upon request.	Existing
CAT Information Provider	TIC Trip Planning	1	The center shall provide the capability to provide specific pre-trip and en route directions to travelers (and drivers), including costs, arrival times, and transfer points.	Planned
CAT Information Provider	TIC Trip Planning	12	The center shall use the preferences and constraints specified by the traveler in the trip request to select the most appropriate mode of transport.	Planned
CAT Information Provider	TIC Trip Planning	13	The center shall provide the capability for the traveler to confirm the proposed trip plan.	Planned
CAT Information Provider	TIC Trip Planning	7	The center shall generate route plans based on transit services, including fares, schedules, and requirements for travelers with special needs.	Planned
CAT Operations Center	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

Element Name	Functional Object	Number	Requirement	Status
CAT Operations Center	Transit Center Data Collection	3	The center shall receive and respond to requests from ITS Archives for either a catalog of the transit data or for the data itself.	Planned
CAT Operations Center	Transit Center Data Collection	4	The transit management center shall produce sample products of the data available.	Existing
CAT Operations Center	Transit Center Fare Management	4	The center shall support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.	Existing
CAT Operations Center	Transit Center Fare Management	6	The center shall process requests for transit fares to be paid in advance.	Existing
CAT Operations Center	Transit Center Fare Management	7	The center shall maintain a list of invalid traveler credit identities or bad tag lists that can be forwarded to transit vehicles and transit stops or stations.	Existing
CAT Operations Center	Transit Center Fixed-Route Operations	11	The center shall provide an interface to the archive data repository to enable the operator to retrieve historical operating data for use in planning transit routes and schedules.	Planned
CAT Operations Center	Transit Center Fixed-Route Operations	3	The center shall generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	Existing
CAT Operations Center	Transit Center Fixed-Route Operations	4	The center shall dispatch fixed route or flexible route transit vehicles.	Existing
CAT Operations Center	Transit Center Fixed-Route Operations	5	The center shall collect transit operational data for use in the generation of routes and schedules.	Existing
CAT Operations Center	Transit Center Fixed-Route Operations	6	The center shall provide instructions or corrective actions to the transit vehicle operators based upon operational needs.	Existing

Element Name	Functional Object	Number	Requirement	Status
CAT Operations Center	Transit Center Fixed-Route Operations	7	The center shall manage large deviations of individual transit vehicles, deviations in rural areas, and deviations of large numbers of vehicles.	Existing
CAT Operations Center	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
CAT Operations Center	Transit Center Vehicle Tracking	1	The center shall monitor the locations of all transit vehicles within its network.	Existing
CAT Operations Center	Transit Center Vehicle Tracking	2	The center shall determine adherence of transit vehicles to their assigned schedule.	Existing
CAT 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
CAT Vehicles	Transit Vehicle On-Board Fare Management	9	The transit vehicle shall provide fare statistics data to the center.	Existing
CAT 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
CAT 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
CAT Vehicles	Transit Vehicle On-Board Maintenance	1	The transit vehicle shall collect and process vehicle mileage data available to sensors on-board.	Existing

Element Name	Functional Object	Number	Requirement	Status
CAT 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
CAT 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.	Existing
CAT Vehicles	Transit Vehicle On-Board Paratransit Operations	2	The transit vehicle shall receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.	Existing
CAT Vehicles	Transit Vehicle On-Board Paratransit Operations	3	The transit vehicle shall provide the transit vehicle operator instructions about the demand responsive or flexible-route transit schedule that has been confirmed from the center.	Existing
CAT Vehicles	Transit Vehicle On-Board Paratransit Operations	4	The transit vehicle shall provide the capability to log passenger boardings and alightings and make passenger use data available to the transit center.	Existing
CAT Vehicles	Transit Vehicle On-Board Trip Monitoring	1	The transit vehicle shall track the current location of the transit vehicle.	Existing
CAT Vehicles	Transit Vehicle On-Board Trip Monitoring	3	The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Existing
CAT Vehicles	Transit Vehicle On-Board Trip Monitoring	4	The transit vehicle shall record transit trip monitoring data including operational status information such as doors open/closed, running times, etc.	Existing
CAT Vehicles	Transit Vehicle On-	5	The transit vehicle shall send the transit vehicle trip monitoring data	Existing

Element Name	Functional Object	Number	Requirement	Status
	Board Trip Monitoring		to center-based trip monitoring functions.	
CAT 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
CAT 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
CAT Vehicles	Transit Vehicle Signal Priority	4	The transit vehicle shall prevent a priority request from being sent when the transit vehicle cannot use the priority (e.g., when the transit vehicle makes a passenger stop on the approach to an intersection).	Not Applicable
EGF Dispatch, GF PSAP	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
EGF Dispatch, GF PSAP	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
EGF Dispatch, GF PSAP	Emergency Call-Taking	2	The emergency call-taking center shall receive emergency call information from 911 services and present the possible incident	Existing

Element Name	Functional Object	Number	Requirement	Status
			information to the emergency system operator.	
EGF Dispatch, GF PSAP	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
EGF Dispatch, GF PSAP	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
EGF Dispatch, GF PSAP	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
EGF Dispatch, GF PSAP	Emergency Routing	1	The center shall collect current traffic and road condition information for emergency vehicle route calculation.	Not Applicable
EGF Dispatch, GF PSAP	Emergency Routing	4	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
EGF Dispatch, GF PSAP, MSP District 3200, State Radio	Emergency Dispatch	1	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
EGF Dispatch, GF PSAP, MSP District 3200, State Radio	Emergency Dispatch	2	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing

Element Name	Functional Object	Number	Requirement	Status
EGF Dispatch, GF PSAP, MSP District 3200, State Radio	Emergency Dispatch	3	The center shall relay location and incident details to the responding vehicles.	Existing
EGF Dispatch, GF PSAP, MSP District 3200, State Radio	Emergency Dispatch	6	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
EGF PW Operations Center	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.	Not Applicable
EGF PW Operations Center	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.	Not Applicable
EGF PW Operations Center	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.	Not Applicable
EGF PW Operations	MCM Winter	9	The center shall provide dispatch instructions for vehicle operators	Existing

Element Name	Functional Object	Number	Requirement	Status
Center, GF PW Operations Center, MnDOT D2 Office, NDDOT GF District Office	Maintenance Management		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.	
GF PIC	TIC Traveler Information Broadcast	1	The center shall disseminate traffic and highway condition information to travelers, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.	Existing
GF PIC	TIC Traveler Information Broadcast	2	The center shall disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.	Existing
GF PSAP	Emergency Routing	6	The center shall track current emergency vehicle location and status along with other emergency vehicle characteristics.	Existing
GF PW Operations Center, MnDOT D2 Office, NDDOT GF District Office	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
GF PW Operations Center, MnDOT D2 Office, NDDOT GF	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	Number	Requirement	Status
District Office				
GF PW Operations Center, MnDOT D2 Office, NDDOT GF District Office	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
GF PW Vehicles	MCV Vehicle System Monitoring and Diagnostics	1	The maintenance and construction vehicle shall collect vehicle diagnostics and operating status data from the maintenance vehicle platform including engine temperature, mileage, tire wear, brake wear, belt wear, and other operational status measures as well as the status of maintenance and construction-specific systems on the vehicle.	Existing
GF PW Vehicles	MCV Vehicle System Monitoring and Diagnostics	3	The maintenance and construction vehicle shall send the vehicle diagnostic and safety information to an equipment repair facility.	Not Applicable
GF Rail Detection and Information System	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.	Not Applicable
GF TOC	Center Field Equipment Management	1	The center shall collect the status and fault data from field equipment, such as traffic, infrastructure, and environmental sensors, highway advisory radio	Not Applicable

Element Name	Functional Object	Number	Requirement	Status
			and dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, short range communications equipment, security sensors and surveillance equipment, etc..	
GF TOC	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
GF TOC	TMC Basic Surveillance	2	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Planned
GF TOC	TMC Basic Surveillance	5	The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing
GF TOC	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
GF TOC	TMC Basic Surveillance	7	The center shall remotely control devices to detect traffic.	Existing
GF TOC	TMC Data Collection	1	The center shall collect traffic management data such as operational data, event logs, etc.	Existing
GF TOC	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.	Planned

Element Name	Functional Object	Number	Requirement	Status
GF TOC	TMC Dynamic Lane Management and Shoulder Use	1	The center shall remotely monitor and control dynamically managed travel lanes.	Existing
GF TOC	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
GF TOC	TMC Signal Control	17	The center shall remotely control devices to detect traffic in the vicinity of traffic signals.	Existing
GF TOC	TMC Signal Control	2	The center shall accept notifications of pedestrian calls.	Existing
GF TOC	TMC Signal Control	3	The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Existing
GF TOC	TMC Signal Control	6	The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Existing
GF TOC	TMC Signal Control	7	The center shall manage boundaries of the control sections used within the signal system.	Existing
GF TOC	TMC Signal Control	8	The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Existing
GF TOC	TMC Standard Rail Crossing Management	1	The center shall collect highway-rail intersection (HRI) equipment operational status including both the current state or mode of operation and the current equipment condition.	Existing
GF TOC Field Devices	Field System Monitoring	1	The field device shall monitor the operating conditions of itself and other field devices under its control	Existing

Element Name	Functional Object	Number	Requirement	Status
	and Diagnostics		in order to determine if any operational problems are occurring.	
GF TOC Field Devices	Field System Monitoring and Diagnostics	2	The field device shall perform diagnostic tests in order to determine operational issues with itself or other field devices under its control.	Existing
GF TOC Field Devices	Field System Monitoring and Diagnostics	3	The field device shall provide the status data and diagnostic information to field personnel.	Existing
GF TOC Field Devices	Field System Monitoring and Diagnostics	4	The field device shall provide the status data and diagnostic information to remote centers.	Existing
GF TOC Field Devices	Roadway Basic Surveillance	1	The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.	Existing
GF TOC Field Devices	Roadway Basic Surveillance	2	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
GF TOC Field Devices	Roadway Basic Surveillance	4	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing
GF TOC Field Devices	Roadway Basic Surveillance	5	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing
GF TOC Field Devices	Roadway Data Collection	1	The field element shall collect traffic, road, and environmental conditions information.	Not Applicable
GF TOC Field Devices	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	Not Applicable

Element Name	Functional Object	Number	Requirement	Status
			information to a center for archival.	
GF TOC Field Devices	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
GF TOC Field Devices	Roadway Dynamic Lane Management and Shoulder Use	3	The field element shall receive lane management control information from the controlling center.	Existing
GF TOC Field Devices	Roadway Dynamic Lane Management and Shoulder Use	4	The field element shall provide guidance and information to drivers regarding current lane configuration and status.	Existing
GF TOC Field Devices	Roadway Field Device Support	1	The field element shall monitor the operational status of field devices and detects and reports fault conditions.	Existing
GF TOC Field Devices	Roadway Field Device Support	2	The field element shall detect and report any fault conditions with the equipment being monitored back to its controlling center.	Existing
GF TOC Field Devices	Roadway Field Device Support	3	The field element shall provide the capability for field personnel to locally control and configure this equipment.	Existing
GF TOC Field Devices	Roadway Field Device Support	4	The field element shall support an interface with field support equipment to accept installation of updates or configuration of field operations.	Existing
GF TOC Field Devices	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

Element Name	Functional Object	Number	Requirement	Status
GF TOC Field Devices	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
GF TOC Field Devices	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
GF TOC Field Devices	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
GF TOC Field Devices	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
GF TOC Field Devices, MnDOT D2 Field Devices	Roadway Signal Control	1	The field element shall control traffic signals under center control.	Existing
GF TOC Field Devices, MnDOT D2 Field Devices	Roadway Signal Control	6	The field element shall return traffic signal controller operational status to the center.	Existing
GF TOC Field Devices, MnDOT D2	Roadway Signal Control	7	The field element shall return traffic signal controller fault data to the center.	Existing

Element Name	Functional Object	Number	Requirement	Status
Field Devices				
GF TOC Field Devices, MnDOT D2 Field Devices	Roadway Signal Preemption	1	The field element shall respond to signal preemption requests from emergency vehicles.	Existing
GF TOC, MnDOT D2 Office	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
GF TOC, MnDOT D2 Office	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
GF TOC, MnDOT D2 Office	TMC Signal Control	1	The center shall remotely control traffic signal controllers.	Existing
GF TOC, MnDOT D2 Office	TMC Signal Control	4	The center shall collect traffic signal controller fault data from the field.	Existing
GF TOC, MnDOT D2 Office	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
GF-EGF Emergency Vehicles	EV On-Board En Route Support	1	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing
GF-EGF Emergency 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	Existing

Element Name	Functional Object	Number	Requirement	Status
			emergency management and dispatch.	
GF-EGF Emergency 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
GF-EGF Emergency 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.	Existing
GF-EGF Emergency 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
GF-EGF 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
GF-EGF 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
GF-EGF Maintenance	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
GF-EGF Maintenance	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	Existing

Element Name	Functional Object	Number	Requirement	Status
			involve coordination with traffic management centers and other maintenance centers.	
GF-EGF Maintenance	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
GF-EGF Maintenance	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
GF-EGF Maintenance	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
GF-EGF Maintenance	MCM Incident Management	9	The maintenance center shall receive evacuation information including evacuation zones, evacuation times, and reentry times from emergency operation centers.	Existing
GF-EGF Maintenance	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

Element Name	Functional Object	Number	Requirement	Status
GF-EGF Maintenance	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
GF-EGF Maintenance	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
GF-EGF Maintenance	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
GF-EGF Maintenance	MCM Work Activity Coordination	1	The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.	Existing
GF-EGF Maintenance	MCM Work Activity Coordination	2	The center shall provide status information about scheduled maintenance and construction activities including anticipated closures and impact to the roadway, alternate routes,	Existing

Element Name	Functional Object	Number	Requirement	Status
			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, multimodal transportation providers, rail operations, and the media.	
GF-EGF Maintenance	MCM Work Activity Coordination	5	The Center shall provide road infrastructure restriction information to other Centers.	Existing
GF-EGF Maintenance Vehicles	MCV Roadway Maintenance and Construction	1	The maintenance and construction vehicle shall track the location and status of safety systems on-board the vehicle.	Existing
GF-EGF Maintenance Vehicles	MCV Roadway Maintenance and Construction	3	The maintenance and construction vehicle shall monitor materials information including remaining quantity and current application rate of materials on the vehicle.	Planned
GF-EGF Maintenance Vehicles	MCV Roadway Maintenance and Construction	5	The maintenance and construction vehicle shall send operational data to the center including the operational state of the maintenance equipment (e.g., blade up/down, spreader pattern), types and quantities of materials used for construction and maintenance activities, and a record of the actual work performed.	Planned
GF-EGF 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
GF-EGF 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

Element Name	Functional Object	Number	Requirement	Status
GF-EGF Maintenance Vehicles	MCV Work Zone Support	1	The maintenance and construction vehicle shall monitor, operate, and control work zone devices located at or alongside the roadway. The devices operated on board the vehicle include driver information devices (e.g. dynamic message signs) and work zone intrusion detection and alert devices.	Existing
GF-EGF Maintenance Vehicles	MCV Work Zone Support	3	The maintenance and construction vehicle shall collect inputs from field personnel and from work zone devices on-board the maintenance and construction vehicle and send them to the controlling center.	Existing
GF-EGF Maintenance Vehicles	MCV Work Zone Support	4	The maintenance and construction vehicle shall provide work zone information, including lane closures and reduced speed to oncoming traffic via direct warning signals or in-vehicle signage functions.	Not Applicable
GF-EGF Maintenance Vehicles, GF PW Vehicles	MCV Vehicle Location Tracking	1	The maintenance and construction vehicle shall track its current location.	Existing
GF-EGF Maintenance Vehicles, GF PW Vehicles	MCV Vehicle Location Tracking	2	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Existing
MnDOT D2 Office, EGF PW Operations Center, GF County Maintenance, GF PW Operations Center, NDDOT GF	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	Number	Requirement	Status
District Office				
MnDOT D2 Office, EGF PW Operations Center, GF County Maintenance, GF PW Operations Center, NDDOT GF District Office	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
MnDOT D2 Office, GF PW Operations Center	MCM Winter Maintenance Management	5	The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for the scheduling of winter maintenance activities.	Existing
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	MCM Maintenance Decision Support	1	The center shall provide the center personnel with tailored external information, including weather or road condition observations, forecasted weather information or road conditions, current usage of treatments and materials, available resources, equipment and vehicle availability, road network information, and source reliability information.	Existing
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	MCM Maintenance Decision Support	3	The center shall provide an interface to the center personnel to input control parameters for the decision support process and receive decisions or information presentation.	Existing

Element Name	Functional Object	Number	Requirement	Status
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	MCM Maintenance Decision Support	4	The center shall provide dispatch information to maintenance and construction vehicles based on the outputs of the decision support system, including recommended roadway treatment actions.	Existing
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	MCM Vehicle Maintenance Management	1	The center shall collect and analyze vehicle diagnostics information from maintenance and construction vehicles. The information includes engine temperature, mileage, tire wear, brake wear, belt wear, and any warnings or alarms concerning the operational condition of the vehicle and ancillary equipment.	Existing
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	MCM Vehicle Maintenance Management	2	The center shall exchange information with equipment repair facilities including status and history of repairs concerning maintenance and construction vehicles. This information includes vehicle status and diagnostic information, vehicle utilization, and coordination of when vehicles will be available for preventative and corrective maintenance.	Existing
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	MCM Vehicle Maintenance Management	3	The center shall schedule preventive and corrective vehicle maintenance with the equipment repair facility based on fleet health reports, maintenance records, vehicle utilization and vehicle availability schedules.	Existing
MnDOT D2 Office, GF PW Operations Center,	MCM Vehicle Tracking	1	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing

Element Name	Functional Object	Number	Requirement	Status
NDDOT GF District Office				
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	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
MnDOT D2 Office, GF PW Operations Center, NDDOT GF District Office	MCM Winter Maintenance Management	11	The center shall assess the current status of all winter maintenance activities, including actual work activities performed, current locations and operational conditions of vehicles, materials and equipment inventories, field equipment status, environmental information, etc.	Existing
MnDOT D2 Office, NDDOT GF District Office	MCM Winter Maintenance Management	2	The center shall exchange information with administrative systems to support the planning and scheduling of winter maintenance activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract administration.	Existing
Personal Information Device	Personal Traveler Information Reception	1	The personal traveler interface shall receive traffic information from a center and present it to the traveler.	Not Applicable
Personal Information Device	Personal Traveler Information Reception	2	The personal traveler interface shall receive transit information from a center and present it to the traveler.	Existing

Element Name	Functional Object	Number	Requirement	Status
Personal Information Device	Personal Traveler Information Reception	5	The personal traveler interface shall receive broadcast wide-area alerts and present it to the traveler.	Existing