



Grand Forks - East Grand Forks

METROPOLITAN  
PLANNING ORGANIZATION

255 N 4<sup>th</sup> St - Grand Forks, ND 58206  
(701) 746-2660

600 DeMers Ave - East Grand Forks, MN 56721  
(218) 773-0124

[www.theforksmo.org](http://www.theforksmo.org)

---

# Grand Forks-East Grand Forks Regional ITS Architecture Update

## Version 4.0

### Final Report

---

April 2020

**NDSU**

UPPER GREAT PLAINS TRANSPORTATION INSTITUTE  
ADVANCED TRAFFIC ANALYSIS CENTER

# **Grand Forks-East Grand Forks Regional ITS Architecture Version 4.0**

Final Report

April 2020

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.

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

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

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

Dept. 2880 – PO Box 6050  
NDSU – Fargo, ND 58108  
Tel 701-231-8058  
[www.ugpti.org](http://www.ugpti.org) - [www.atacenter.org](http://www.atacenter.org)

# 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

# TABLE OF CONTENTS

<b>Executive Summary</b> .....	<b>i</b>
<b>1.0 Introduction</b> .....	<b>1</b>
1.1 Report Organization.....	1
<b>2.0 Region and Scope</b> .....	<b>2</b>
2.1 Geographical Boundaries.....	2
2.2 Scope of the RA .....	2
<b>3.0 Stakeholders</b> .....	<b>3</b>
<b>4.0 System inventory</b> .....	<b>5</b>
4.1 GF-EGF Centers .....	5
4.1.1 Traffic Management Center.....	5
4.1.2 Emergency Management Center.....	7
4.1.3 Maintenance and Construction Management Center.....	7
4.1.4 Information Service Provider.....	7
4.1.5 Transit Management Center.....	8
4.1.6 Archived Data Management Center.....	8
4.2 GF-EGF Field Devices .....	8
4.2.1 NDDOT Field Devices .....	8
4.2.2 City of Grand Forks Field Devices .....	8
4.2.3 City of East Grand Forks/MnDOT Field Devices .....	8
4.2.3 City of Grand Forks Police Department Field Devices .....	9
4.3 GF-EGF Vehicles.....	9
4.4 GF-EGF Communication Infrastructure.....	9
4.5 Summary of GF-EGF Inventory .....	10
<b>5.0 Service Packages</b> .....	<b>19</b>
<b>6.0 Operational Concept</b> .....	<b>29</b>
6.1 Operational Roles and Responsibilities .....	30
<b>7.0 Agreements</b> .....	<b>33</b>
<b>8.0 Functional requirements</b> .....	<b>35</b>
<b>9.0 ITS Standards</b> .....	<b>36</b>
<b>10.0 Planning Aspects</b> .....	<b>38</b>
10.1 Planning and the Regional ITS Architecture .....	38
10.2 Regional ITS Architecture Maintenance .....	40
<b>Appendix-A</b>	
<b>Grand Forks-East Grand Forks Service Packages And Information Flows</b> .....	<b>41</b>
<b>Appendix-B</b>	
<b>Functional Requirements</b> .....	<b>70</b>

# EXECUTIVE SUMMARY

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

The 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 for supporting the RA development and maintenance.

This version of the RA is the fourth iteration in a maintenance process that aims to keep the architecture up-to-date in accordance with FHWA guidelines and to continue to reflect the most current ITS picture in the region. This version of the RA is based on the national Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT 8.3).

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 mobility needs of individuals and businesses in the region.

The geographical boundaries used for purposes of developing 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. The majority of these systems may be classified into the following service areas: traffic and travel management, maintenance and construction management, and transit management. The inventory identified systems and their functions by agency and jurisdiction.

ITS user services for the region were initially identified from previous ITS planning efforts as well as input from regional stakeholders. The National ITS Architecture was used to map these services and to develop service packages in support of these services. A total of 28 Service Packages 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 summarizes the results of the regional Intelligent Transportation architecture development for the Grand Forks-East Grand Forks Area. Intelligent Transportation Systems (ITS) refer to integrated applications of sensing, communications, computer processing, and electronics to enhance the transportation systems. The regional architecture (RA) provides a tool to guide future ITS planning, define system requirements, coordinate agency roles and integrate functions across jurisdictional lines.

The 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 maintenance of the roadway system. A 15-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 and 2014.

## 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 in order to access the architecture and make changes or future updates.

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

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

### 2.1 Geographical Boundaries

The geographical areas included 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 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.

Name	Description
Altru Ambulance	GF-EGF area ambulance service
CAT	Cities Area Transit (CAT)
Dietrich - Grand Forks	School bus and charter bus provider in the Grand Forks area.
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 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
Polk County	Polk County, MN

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

<b>Stakeholder Group</b>	<b>Group Members</b>
GF-EGF Emergency Management Group	Altru Ambulance
	EGF FD
	EGF PD
	GF FD
	GF PD
	Grand Forks County
	MSP
	ND Department of Emergency Services
	NDHP
	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 for the RA update.

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

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

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

These entities are explained in greater details in the following subsections. Section 4.5 shows a summary of 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 into 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.

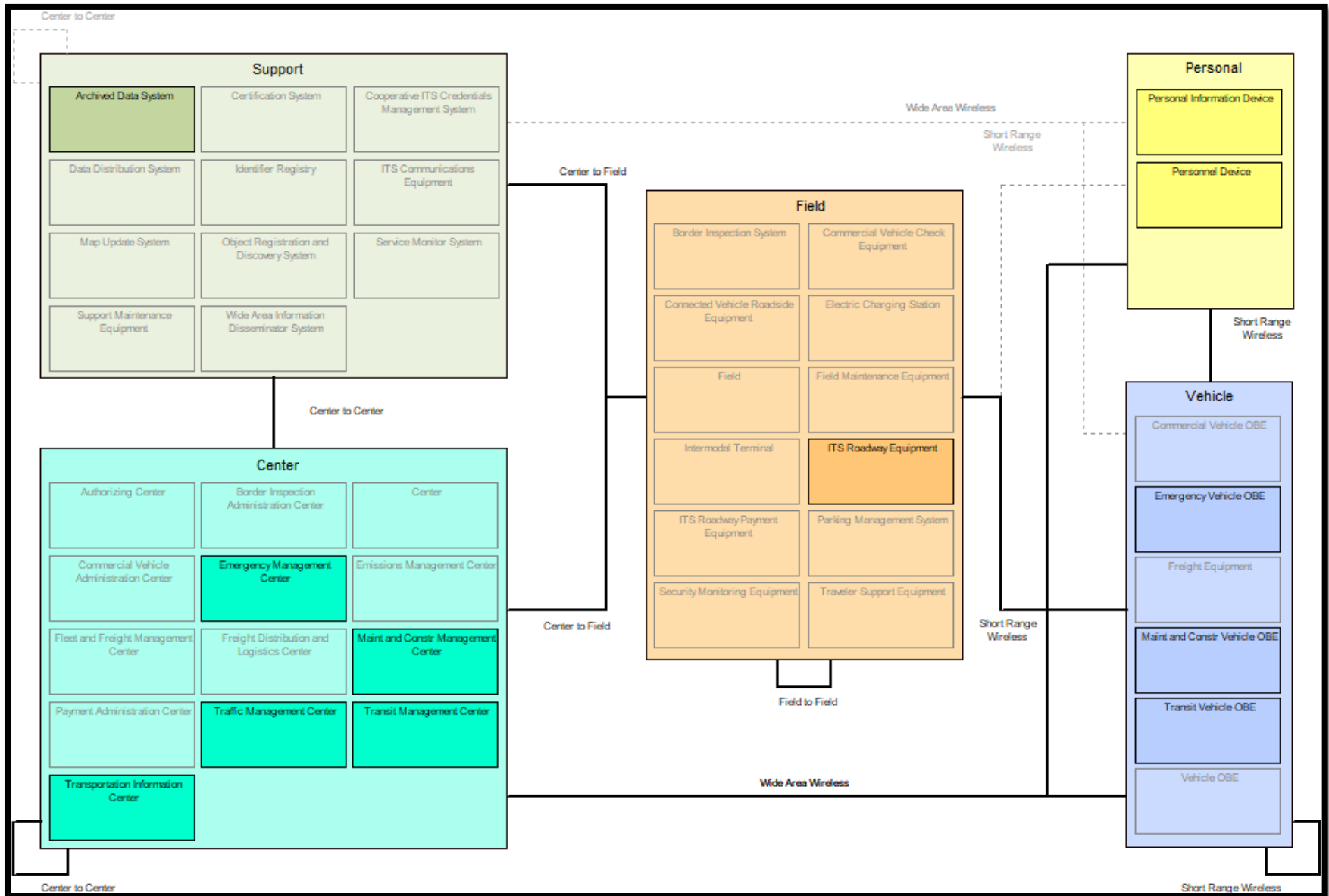


Figure 1. Grand Forks-East Grand Forks Physical Architecture

### City of Grand Forks Traffic Signal System

The City of Grand Forks maintains a modern traffic signal control system with several coordinated corridors. All signals, except for the downtown area, have communication capabilities using fiber, twisted pair, and wireless communications. A centralized signal control system utilizing the Centrac software is used for the control and management of the city's signals. The city's majority of intersections are supported by video detection, which enables traffic monitoring and detailed traffic data collection. In addition, the City of Grand Forks operates electronic lane control signs to increase capacity at signalized intersections in the Alerus Center vicinity. These signs primarily control lane usage for turning traffic during event traffic control plans.

#### **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 instruction to callers. Dispatch and 9-1-1 services in East Grand Forks are provided by the police department while 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**

Currently, there are several entities that handle Maintenance and Construction Management (MCM) in the GF-EGF area, including: Grand Forks Public Works, East Grand Forks Public Works, NDDOT, and MnDOT. These agencies are incrementally adding fleet management capabilities, and using Automated Vehicle Location (AVL) technologies. Additionally, Grand Forks and Polk County Highway Departments perform maintenance activities on county roads and highways.

#### **4.1.4 Information Service Provider**

Functions associated with an Information Service Provider (ISP) are currently handled through multiple agencies in the GF-EGF region. 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 at the statewide level 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 GF-EGF metropolitan area. CAT operates fixed routes in Grand Forks and East Grand Forks. CAT uses a sophisticated management system that provides dispatch, routing, fare management, including revenue analysis, passenger data analysis, and GPS bus location. The AVL functionality allows for location specific transit signal priority and automated audible and visual stop announcements.

#### **4.1.6 Archived Data Management Center**

Only Grand Forks Engineering and CAT currently have the ability to collect data from ITS sensors. However, as more ITS devices are deployed, it is expected that data archival functions will be coordinated region-wide.

### **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
  - b. Traffic signal controllers
  - c. Electronic lane use signs

#### **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

#### **4.3 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	Architecture Mapping	Stakeholder
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.	Archived Data User System	
CAT Drivers	CAT bus drivers	Transit Vehicle Operator	CAT
CAT Information Provider	An architecture element to represent the transit traveler information function performed within CAT.	Transportation Information Center	CAT
CAT Operations Center	Cities Area Transit dispatch center	Archived Data User System, Transit Management Center	CAT
CAT System Operators	CAT dispatch and operations personnel	Transit Operations Personnel	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.	Payment Device, Traveler Card	CAT
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.	Transit Vehicle OBE	CAT
Dietrich Bus Service		Other Transit Management Centers	Dietrich - Grand Forks



<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
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.	Driver	
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.	Emergency Management Center	GF-EGF EM Group
EGF PW Operations Center	East Grand Forks public works operations center	Maint and Constr Management Center	EGF PW
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.	Emergency Personnel	GF-EGF EM Group
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.	Personnel Device	GF-EGF EM Group

<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
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.	Emergency System Operator	GF-EGF EM Group
Event Promoters	Alerus Center, Ralph Engelstad Arena, other venues	Event Promoter System	GF Event Venue
GF County Maintenance	Grand Forks County Maintenance Operations Center	Maint and Constr Management Center	Grand Forks County

<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
GF County Maintenance Vehicles	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.	Maint and Constr Vehicle OBE	Grand Forks County
GF PD DMS	Grand Forks Police Department portable Dynamic Message Signs	ITS Roadway Equipment	GF PD
GF PIC	City of Grand Forks Public Information Center	Transportation Information Center	Grand Forks
GF PSAP	Grand Forks County Public Safety Answering Point	Emergency Management Center	Grand Forks
GF PW Operations Center	Grand Forks public works operations center	Maint and Constr Management Center	GF PW
GF PW Vehicles	Grand Forks public works vehicles	Maint and Constr Vehicle OBE	GF PW

<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
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.	ITS Roadway Equipment	GF Engineering
GF TOC	Grand Forks Traffic Operations Center	Archived Data User System, Traffic Management Center	GF Engineering
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.	ITS Roadway Equipment	GF Engineering
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.	Traffic Operations Personnel	GF Engineering
GF Transportation Data Archival	Archival center for transportation data, initially this will house traffic counts but other data could be warehoused there including transit data, incident data, etc. Currently data from different agencies is housed in separate databases.	Archived Data System	GF Engineering
GF-EGF Emergency Management	A single architecture element representing emergency agencies in the region including dispatchers, law enforcement, and emergency responders.	Emergency Management Center	GF-EGF EM Group
GF-EGF Emergency Vehicles	A single architecture element representing emergency vehicles used by law enforcement and emergency responders in the GF-EGF region.	Emergency Vehicle OBE	GF-EGF EM Group
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.	Maint and Constr Management Center	GF-EGF Maintenance Group
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.	Maint and Constr Vehicle OBE	GF-EGF Maintenance Group

<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
Government Reporting Systems	'Government Reporting Systems' represents the system and associated personnel that prepare the inputs to support the various local, state, and federal government transportation data reporting requirements (e.g. Highway Performance Monitoring System, Fatality Analysis Reporting System) using data collected by ITS systems. It represents a system interface that provides access to the archived data relevant to these reports. In most cases, this system will combine data collected from ITS archives with data from non-ITS sources to assemble the required information.	Government Reporting Systems	
Maint and Constr Center Personnel	An ITS element representing maintenance and construction personnel from agencies in GF-EGF. 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.	Maint and Constr Center Personnel	GF-EGF Maintenance Group
Maint and Constr Vehicle Operator	Maintenance and construction vehicle operators in GF-EGF. 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 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.	Maint and Constr Vehicle Operator	GF-EGF Maintenance Group
Media		Media	
MnDOT D2 Field Devices	Mn/DOT District 2 sensors, traffic signals, and DMS.	ITS Roadway Equipment	MnDOT Dist 2
MnDOT D2 Office	Mn/DOT District 2 Traffic Operations Center	Maint and Constr Management Center, Other Maint and Constr Mgmt Centers, Other Traffic Management Centers, Traffic Management Center	MnDOT Dist 2

<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
MNDOT D2 Traffic Operations Personnel	Traffic operations personnel in MnDOT District 2 responsible for signal operations in East Grand Forks. '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.	Traffic Operations Personnel	MnDOT Dist 2
MSP District 3200	Minnesota State Patrol District serving the Northwestern counties of Minnesota including Polk.	Other Emergency Management Centers	MSP
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.	ITS Roadway Equipment	NDDOT GF District
NDDOT GF District Office	NDDOT District maintenance and construction and freeway operations.	Maint and Constr Management Center, Other Maint and Constr Mgmt Centers, Other Traffic Management Centers, Traffic Management Center	NDDOT GF District
NDHP Grand Forks	North Dakota Highway Patrol - Grand Forks District	Other Emergency Management Centers	NDHP

<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
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 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.	Personal Information Device	
State Radio	ND State Radio	Alerting and Advisory System, Emergency Management Center, Other Emergency Management Centers	ND Department of Emergency Services
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.	Traveler	
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 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.	Wayside Equipment	

<b>Element Name</b>	<b>Element Description</b>	<b>Architecture Mapping</b>	<b>Stakeholder</b>
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.	Weather Service System	



## 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.

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

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

### DM01: ITS Data Warehouse (Planned)

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

GF-EGF: Data collection and archival efforts are performed within separate agencies as part of their day to day functions, notably City of GF Traffic and CAT have extensive data collection efforts. There is not an entity in the region tasked with data warehousing function.

### DM02: Performance Monitoring (Planned)

National architecture description: The Performance Monitoring service package uses information collected from detectors and sensors, connected vehicles, and operational data feeds from centers to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g.

environmental data and infrastructure conditions monitoring data. Additional data are collected including accident data, road condition data, road closures and other operational decisions to provide context for measured transportation performance and additional safety and mobility-related measures. More complex performance measures may be derived from the collected data.

GF-EGF: The data currently collected and archived in DM01 is used by agencies for operational improvements (e.g. adjusting traffic signal timing). There are no region wide performance measures and monitoring established at this time.

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

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

GF-EGF: Automated vehicle location (AVL) technologies for vehicle tracking are utilized on the maintenance fleet of several area agencies including City of GF Public Works, NDDOT, and MnDOT.

MC02: Maintenance and Construction Vehicle Maintenance (Existing)

National architecture description: This service package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle and equipment maintenance.

GF-EGF: Several maintenance agencies in the region utilize software systems to help manage some maintenance aspects of their fleet of vehicles. Such systems are in use by City of GF Public Works, NDDOT, and MnDOT.

MC04: Winter Maintenance (Existing)

National architecture description: 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.

GF-EGF: All maintenance agencies in the region perform winter road maintenance. NDDOT and MnDOT both have statewide maintenance decision support systems (MDSS) that the local districts utilize to determine the appropriate snow and ice control response. GF Public Works utilizes an MDSS product from Iteris named ClearPath Weather.

#### MC05: Roadway Maintenance and Construction (Existing)

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

GF-EGG: All maintenance agencies in the region perform roadway maintenance and construction functions.

#### MC06: Work Zone Management (Existing)

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

GF-EGF: Depending on the project, these activities are either performed by local agencies or contractors, and sometimes by both.

#### MC08: Maintenance and Construction Activity Coordination (Existing)

National architecture description: 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.

GF-EGF: Maintenance and construction activities are coordinated through the dissemination of information by the City of GF Public Information Center.

#### PS01: Emergency Call-Taking and Dispatch (Existing)

National architecture description: This service package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel. This service package also provides information to support dynamic routing of

emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle routing. The Emergency Management Center provides routing information based on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.

GF-EGF: This service is handled by several agencies in the region and can be summarized as follows:

- GF PSAP: Call taking and dispatch for the Police and Fire Department in GF, Sheriff Department in GF county, Altru Ambulance in GF and EGF.
- Polk County: 9-1-1 call taking in EGF and Polk county, dispatch for Polk County Sheriff Department.
- EGF Police Department: Dispatch for EGF police officers.

#### PS02: Emergency Response (Existing)

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

GF-EGF: This service is performed by all emergency responders in the region.

#### PS03: Emergency Vehicle Preemption (Existing)

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

GF-EGF: City of GF signals have GPS based and optical systems for preemption. Signals in EGF currently use a sonic system that is activated by the sound of sirens, the preemption system will potentially be updated to match GF in an upcoming signal system update project.

#### PS12: Disaster Response and Recovery (Existing)

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

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

The service package identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this service package, the Emergency Management Center represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Center and the other centers provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this service package supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities.

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

GF-EGF: Agencies in the region have decades of experience responding to large scale events in the form of river flooding and have detailed and coordinated plans in place.

#### PT01: Transit Vehicle Tracking (Existing)

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

GF-EGF: CAT has AVL on both fixed route and dynamic transit vehicles.

#### PT02: Transit Fixed-Route Operations (Existing)

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

GF-EGF: CAT provides fixed route service and utilizes a central software system to manage operations.

#### PT03: Dynamic Transit Operations (Existing)

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

GF-EGF: CAT offers dial-a-ride service and utilizes a software system to manage operations.

#### PT04: Transit Fare Collection Management (Existing)

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

GF-EGF: CAT uses electronic fare boxes that allow payment through a variety of methods including smart card and a smartphone mobile application. The fare box system comes with central software to manage fare collection. With the new transit facility, data can be downloaded wirelessly from the busses as they enter the garage.

#### PT05: Transit Security (Existing)

National architecture description: This service package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment performs surveillance and sensor monitoring in order to identify potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and

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

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

GF-EGF: CAT has video and audio surveillance onboard all their vehicles. The recordings are utilized for incident resolution and CAT will be able to download recordings wirelessly in the new transit facility.

#### PT06: Transit Fleet Management (Existing)

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

GF-EGF: CAT utilizes a software system that handles scheduling of routine maintenance and maintenance based on diagnostics data from the vehicle.

#### PT08: Transit Traveler Information (Existing)

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

GF-EGF: In addition to electronic signs, CAT uses the web to provide real-time schedule information.

#### PT09: Transit Signal Priority (Existing)

National architecture description: 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.

GF-EGF: CAT fixed route vehicles are equipped with emitters to activate transit signal priority.

#### TM01: Infrastructure-Based Traffic Surveillance (Existing)

National architecture description: This service package includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Center). The data generated by this service package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.

GF-EGF: City of GF Traffic signal and camera detection systems are setup for data collection.

#### TM03: Traffic Signal Control (Existing)

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

GF-EGF: City of GF Traffic operates a traffic operations center (TOC) for managing the city's traffic signals.

#### TM07: Regional Traffic Management (Planned)

National architecture description: 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.

GF-EGF: regional coordination between GF and EGF signals is planned utilizing clock synchronization. Further coordination efforts can be explored once MnDOT’s signals in EGF are updated and interconnected.

#### TM08: Traffic Incident Management System (Existing)

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

GF-EGF: Traffic and emergency response agencies have plans and mutual aid agreements for coordinating incident response.

### TM12: Dynamic Roadway Warning (Existing)

National architecture description: This service package includes systems that dynamically warn drivers approaching 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 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.

GF-EGF: This service package covers the usage for flashing beacon signs that inform travelers when certain highway-rail intersections in the city have been preempted by rail activity.

### TM13: Standard Railroad Grade Crossing (Existing)

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

GF-EGF: The majority of rail crossings in the area are equipped with wayside detection that activates gates and warning systems in addition to preempting signalized intersections.

## 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.

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

The set of service packages for the GF-EGF area was the vehicle used for facilitating the operational concept development. Using Service Package graphics, stakeholders were able to identify their roles for given events, current links with other stakeholders, and additional links and/or coordination that could be achieved.

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

The following section outlines the roles and responsibilities of stakeholders in the GF-EGF RA.

## 6.1 Operational Roles and Responsibilities

Stakeholder	Role
GF-EGF MPO	Maintain the RA Create policies for RA use Monitor RA use for change triggers
Altru Ambulance	Coordinate with other emergency management agencies in GF-EGF Provide emergency medical services in GF-EGF
CAT	Provide evacuation and sheltering services Provide transit fixed route operations for the GF-EGF area Provide dynamic transit (demand response) services in GF-EGF area Collect transit data Provide data for archival
Dietrich – Grand Forks	Provide evacuation and sheltering services
EGF FD	Respond to incidents in EGF Coordinate with other emergency management agencies in GF-EGF
EGF PD	Dispatch law enforcement in EGF Respond to incidents in EGF Coordinate with other GF-EGF emergency management agencies
EGF PW	EGF city system road maintenance Winter maintenance (snow plow operations, sanding, anti icing) in EGF
GF Engineering	Coordinate with MnDOT Dist 2/EGF Design, operate, and maintain signal control in GF Operate TOC Collect traffic data Provide data for archival
GF Event Venues	Provide event information to GF-EGF agencies
GF FD	Respond to incidents in GF Coordinate with other emergency management agencies in GF-EGF

GF PD	Coordinate with other emergency management agencies in GF-EGF Respond to incidents in GF
GF PW	GF city system road maintenance Winter maintenance (snow plow operations, sanding, anti icing) in GF
GF-EGF EM Group	Coordinate with other emergency management agencies Collect emergency response data Provide data for archival Respond to incidents
GF-EGF Maintenance Group	Collect maintenance performance data, Provide data for archival, Provide maintenance resources during incidents and emergencies, Coordinate with emergency management agencies in GF-EGF
Grand Forks	Provide PSAP 9-1-1 and dispatch services in GF city and county
Grand Forks County	GF county system road maintenance Winter maintenance (snow plow operations, sanding, anti icing) in GF county
MnDOT Dist 2	Coordinate with GF TOC, Design, operate, and maintain signal control in EGF MN state system road maintenance Winter maintenance (snow plow operations, sanding, anti icing) on MN state system
MSP	Provide dispatch and communications for MSP troopers Respond to incidents on Minnesota state system
ND Department of Emergency Services	Provide dispatch and communications for NDHP
NDDOT GF District	Winter maintenance (snow plow operations, sanding, anti icing) in ND state system ND state system road maintenance
NDHP	Respond to incidents on ND state system

Polk County	Polk county system road maintenance Winter maintenance (snow plow operations, sanding, anti icing) in Polk county Provide PSAP 9-1-1 and dispatch services in EGF Coordinate with other emergency management agencies in GF-EGF
-------------	--

## 7.0 AGREEMENTS

This section briefly outlines 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 as well as interfaces. Anytime agencies shared operations of a system or shared formal access to system control and data, a potential agreement was flagged. Discussions with stakeholders helped 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 shows a summary of 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



## 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
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	Requirement #	Requirement	Status
CAT Information Provider	TIC Data Collection	04	The center shall collect, process, and store transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information.	Existing
	TIC Interactive Traveler Information	03	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
	TIC Trip Planning	01	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
		07	The center shall generate route plans based on transit services, including fares, schedules, and requirements for travelers with special needs.	Planned
		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
		13	The center shall provide the capability for the traveler to confirm the proposed trip plan.	Planned

## 9.0 ITS STANDARDS

This section identifies 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 following table shows applicable standards for the GF-EGF RA based on RAD-IT output. The information in the table is arranged in the following columns:

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

<b>SDO</b>	<b>Document ID</b>	<b>Standard Title</b>	<b>Element</b>
Institute of Transportation Engineers	ITE ATC 5201	Advanced Transportation Controller (ATC)	GF Rail Detection and Information System
Institute of Transportation Engineers	ITE ATC 5201	Advanced Transportation Controller (ATC)	GF TOC Field Devices
Institute of Transportation Engineers	ITE ATC 5201	Advanced Transportation Controller (ATC)	MnDOT D2 Field Devices
Institute of Transportation Engineers	ITE ATC 5202	Model 2070 Controller Standard	GF Rail Detection and Information System
Institute of Transportation Engineers	ITE ATC 5202	Model 2070 Controller Standard	GF TOC Field Devices
Institute of Transportation Engineers	ITE ATC 5202	Model 2070 Controller Standard	MnDOT D2 Field Devices
Institute of Transportation Engineers	ITE ATC API	Application Programming Interface (API) Standard for the Advanced Transportation Controller (ATC)	GF Rail Detection and Information System
Institute of Transportation Engineers	ITE ATC API	Application Programming Interface (API) Standard for the Advanced Transportation Controller (ATC)	GF TOC Field Devices
Institute of Transportation Engineers	ITE ATC API	Application Programming Interface (API) Standard for the Advanced Transportation Controller (ATC)	MnDOT D2 Field Devices

<b>SDO</b>	<b>Document ID</b>	<b>Standard Title</b>	<b>Element</b>
Institute of Transportation Engineers	ITE ITS Cabinet	ITS 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
National Electrical Manufacturers Association	NEMA TS 2	Traffic Controller Assemblies with NTCIP Requirements	GF Rail Detection and Information System
National Electrical Manufacturers Association	NEMA TS 2	Traffic Controller Assemblies with NTCIP Requirements	GF TOC Field Devices
National Electrical Manufacturers Association	NEMA TS 2	Traffic Controller Assemblies with NTCIP Requirements	MnDOT D2 Field Devices
National Electrical Manufacturers Association	NEMA TS 4	Hardware Standards for Dynamic Message Signs (DMS) with NTCIP Requirements	GF TOC Field Devices
National Electrical Manufacturers Association	NEMA TS 8	Cyber and Physical Security for Intelligent Transportation Systems (ITS)	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 (ITS)	GF TOC
National Electrical Manufacturers Association	NEMA TS 8	Cyber and Physical Security for Intelligent Transportation Systems (ITS)	MnDOT D2 Office

## 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.

#### **Goal 1: Economic Vitality**

*Goal statement:* Support the economic vitality through enhancing the economic competitiveness of the metropolitan area by giving people access to jobs, and education services as well as giving business access to markets.

Objective 5: Provide transit service within ¼ mile of residential areas and to major activity and employment centers.

*Associated Service Packages:*

PT02: Transit Fixed-Route Operations

PT03: Dynamic Transit Operations

#### **Goal 2. Security**

*Goal statement:* Increase security of the transportation system for motorized and non-motorized uses.

Objective 1: Identify and maintain security of critical street and highway system assets. Identify and maintain security of critical street and highway system assets.

*Associated Service Packages:*

TM01: Infrastructure-Based Traffic Surveillance

Objective 2: Support state and regional emergency, evacuation, and security plans.

*Associated Service Packages:*

PS12: Disaster Response and Recovery

Objective 5: Identify and implement programs to improve the security for both the users and the existing bicycle and pedestrian facilities.

*Associated Service Packages:*

PT05: Transit Security

#### **Goal 3. Accessibility and Mobility**

*Goal Statement:* Increase the accessibility and mobility options for people and freight by providing more transportation choices.

Objective 1: Mitigate excessive travel delays.

Objective 2: Maintain an acceptable level of service for all streets and intersections during peak hours.

*Associated Service Packages:*

TM03: Traffic Signal Control

TM07: Regional Traffic Management

Objective 4: Increase ridership on the Fixed Route system through improved information availability and service quality.

Objective 5: Manage system demand between Fixed Route and Demand Response system through eligibility screening and better coordination with hand demand users.

Objective 6: Operate 40 percent of fixed routes at 30-minute headways.

Objective 7: Encourage transit travel time to be competitive with auto, no more than three times auto travel.

*Associated Service Packages:*

PT01: Transit Vehicle Tracking

PT02: Transit Fixed-Route Operations

PT03: Dynamic Transit Operations

PT08: Transit Traveler Information

PT09: Transit Signal Priority

**Goal 4. Environment/Energy/Quality of Life**

*Goal statement:* Protect and enhance the environment, promote energy conservation, and improve quality of life by valuing the unique qualities of all communities – whether urban, suburban, or rural.

Objective 1: Avoid, minimize, and/or mitigate adverse social, environmental, and economic impacts resulting from existing or new transportation facilities.

*Associated Service Packages:*

MC05: Roadway Maintenance and Construction

MC06: Work Zone Management

MC08: Maintenance and Construction Activity Coordination

Objective 3: Maintain and improve regional air quality.

*Associated Service Packages:*

TM03: Traffic Signal Control

PT02: Transit Fixed-Route Operations

**Goal 6. Efficient System Management**

*Goal statement:* Promote efficient system management and operation by increasing collaboration among federal, state, local government to better target investments and improve accountability.

Objective 3: Cooperate across jurisdictional boundaries to create an integrated transportation network.

*Associated Service Packages:*

TM07: Regional Traffic Management

### **Goal 7. System Preservation**

*Goal statement:* Emphasize the preservation of the existing transportation system by first targeting federal funds towards existing infrastructure to spur revitalization, promote urban landscapes and protect rural landscapes.

Objective 4: Ensure daily transit operations without interruption for fleet maintenance or repair.

*Associated Service Packages:*

PT06: Transit Fleet Management

### **Goal 8. Safety**

*Goal statement:* Increase safety of the transportation system for motorized and non-motorized uses.

Objective 29: Increase the safety and security of the transportation system for motorized and non-motorized users.

*Associated Service Packages:*

PS03: Emergency Vehicle Preemption

### **Goal 9. Resiliency and Reliability**

*Goal statement:* Improve resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation.

Objective 1: Reduce street and highway system vulnerability to snow and storm water

*Associated Service Packages:*

MC04: Winter Maintenance

### **Performance Measures**

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

DM01: ITS Data Warehouse

DM02: Performance Monitoring

## **10.2 Regional ITS Architecture Maintenance**

The Grand Forks-East Grand Forks MPO is responsible for maintaining and updating the GF-EGF Regional ITS Architecture. It is envisioned that the updates will be conducted every 5 years or as needed upon the deployment of major ITS projects in the area. The updates will account for any changes to existing systems, as well as changes to regional needs and priorities, and changes in the National ITS Architecture.

# **APPENDIX-A**

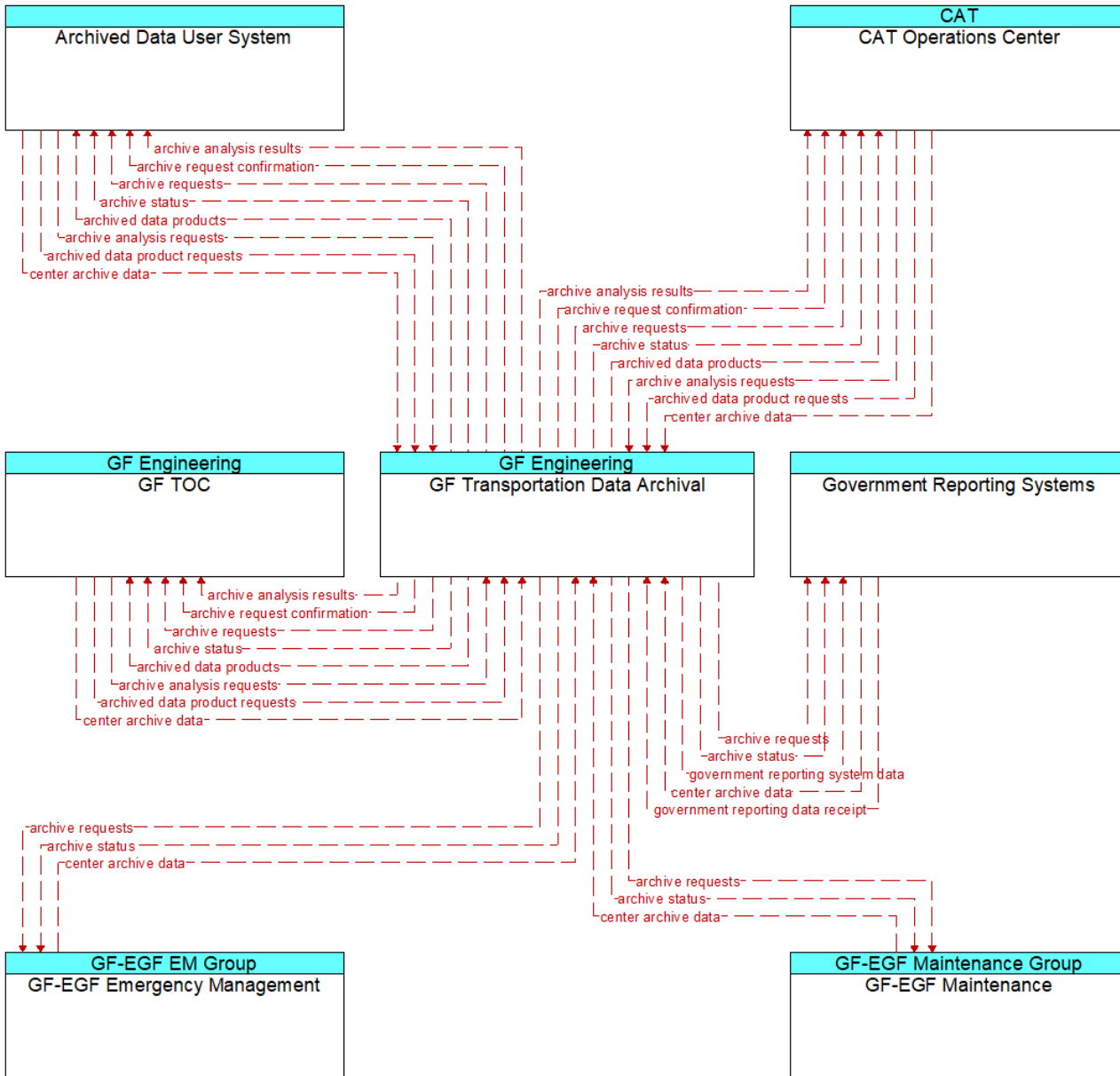
## **GRAND FORKS-EAST GRAND FORKS SERVICE PACKAGES AND INFORMATION FLOWS**

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 diagrams readability.

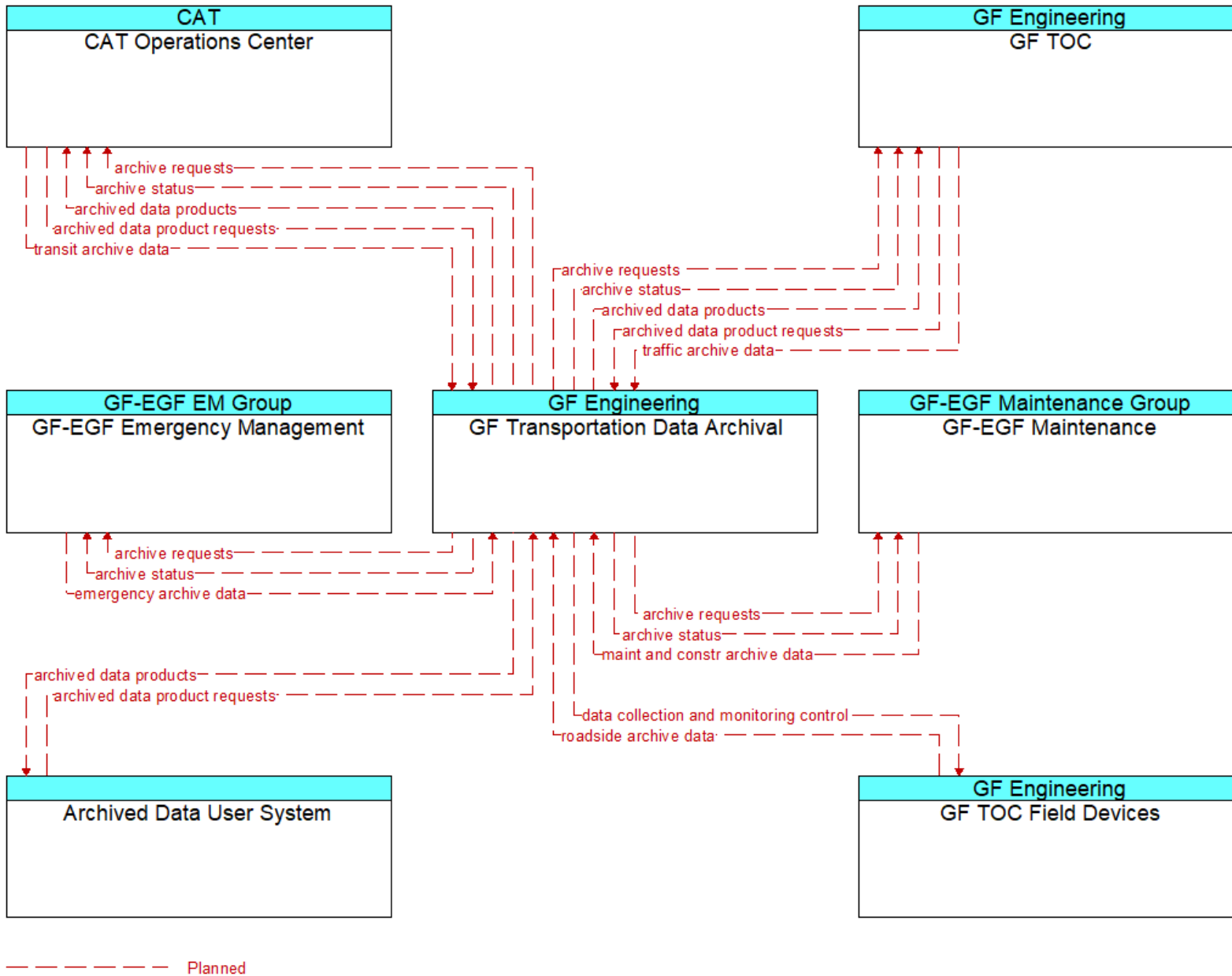
# DM01 ITS Data Warehouse



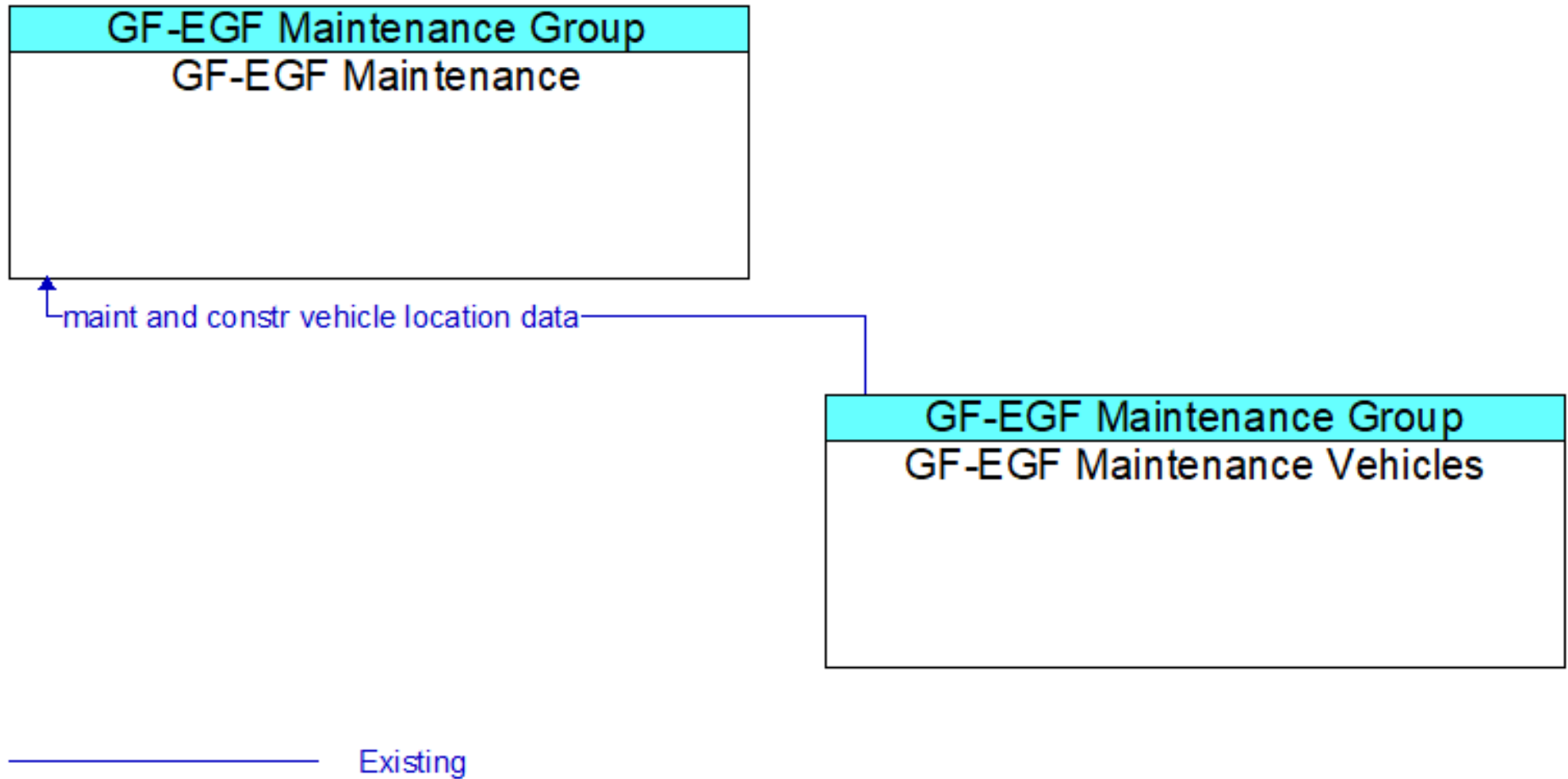
----- Planned



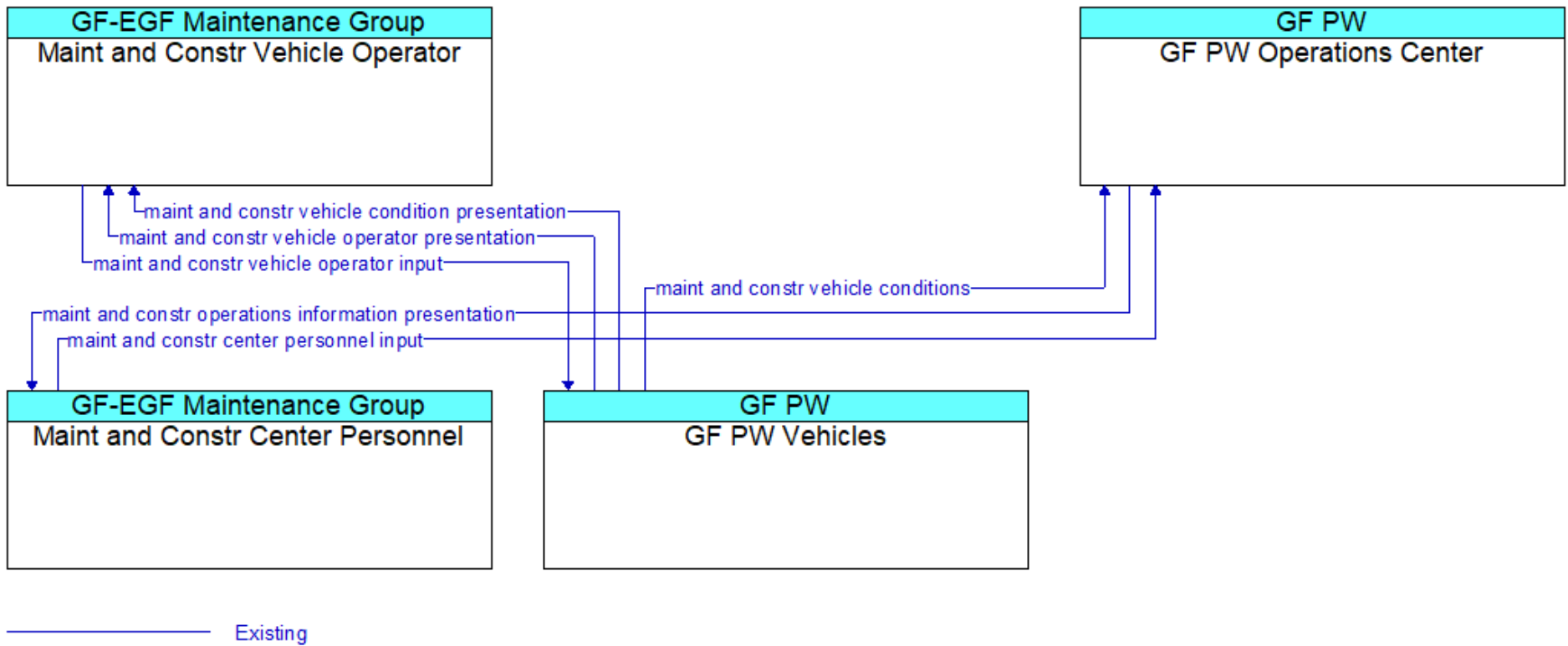
## DM02 Performance Monitoring



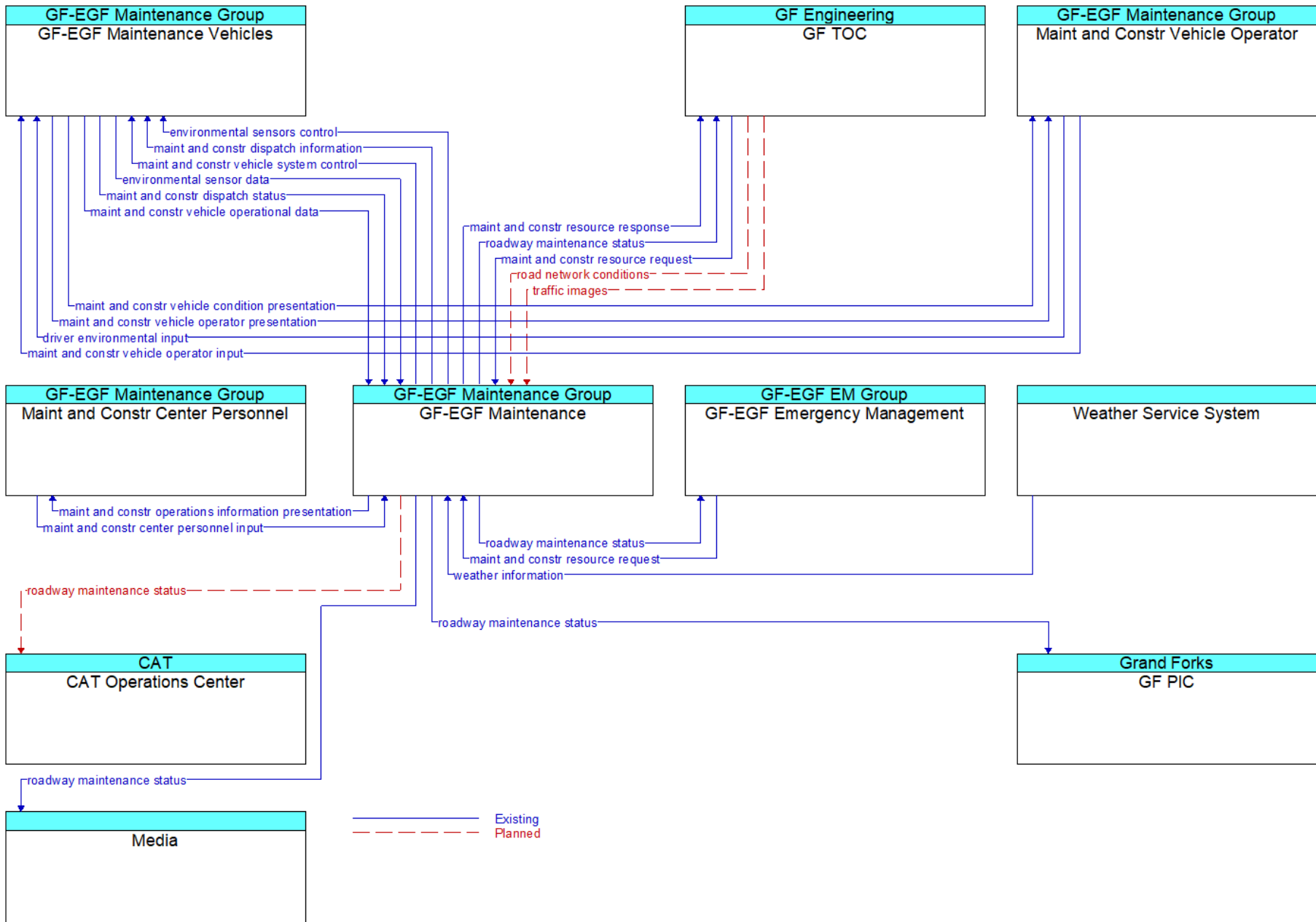
## MC01 Maintenance and Construction Vehicle and Equipment Tracking



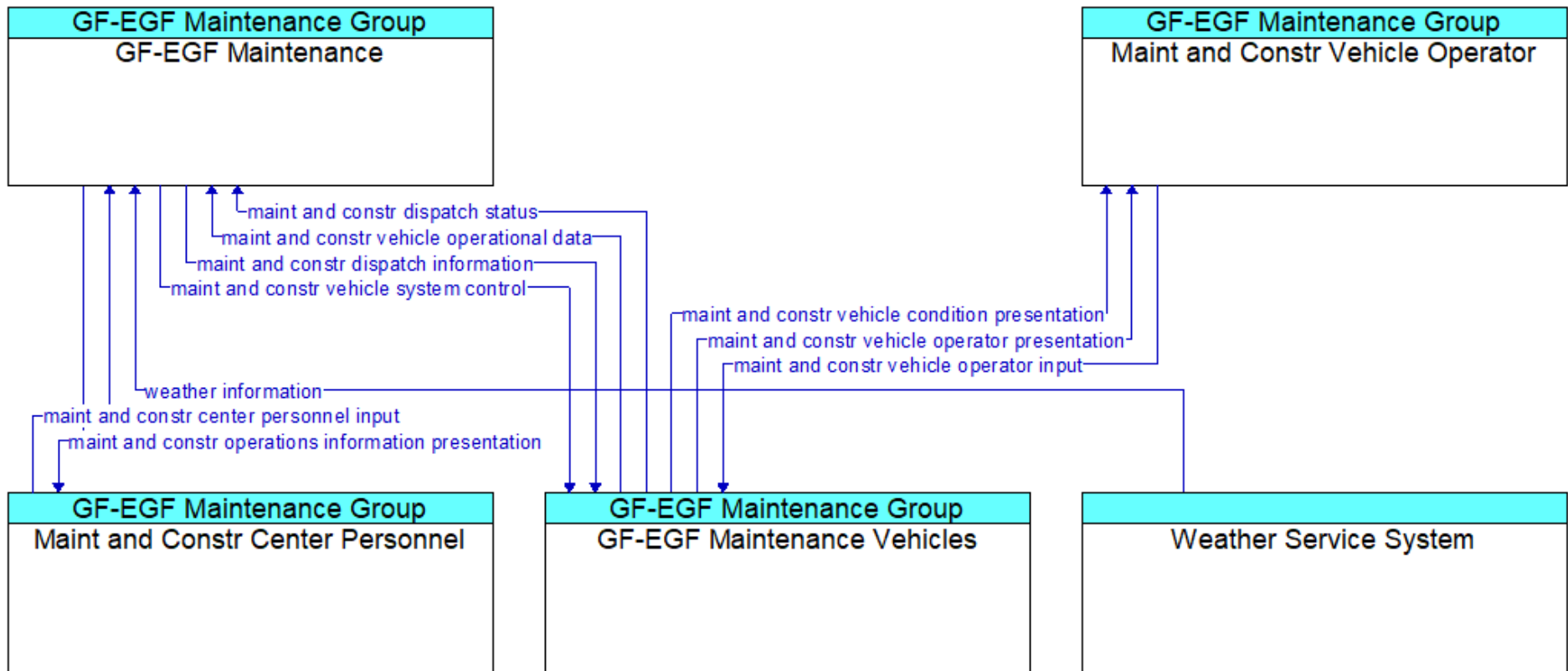
## MC01 Maintenance and Construction Vehicle Maintenance



# MC04 Winter Maintenance

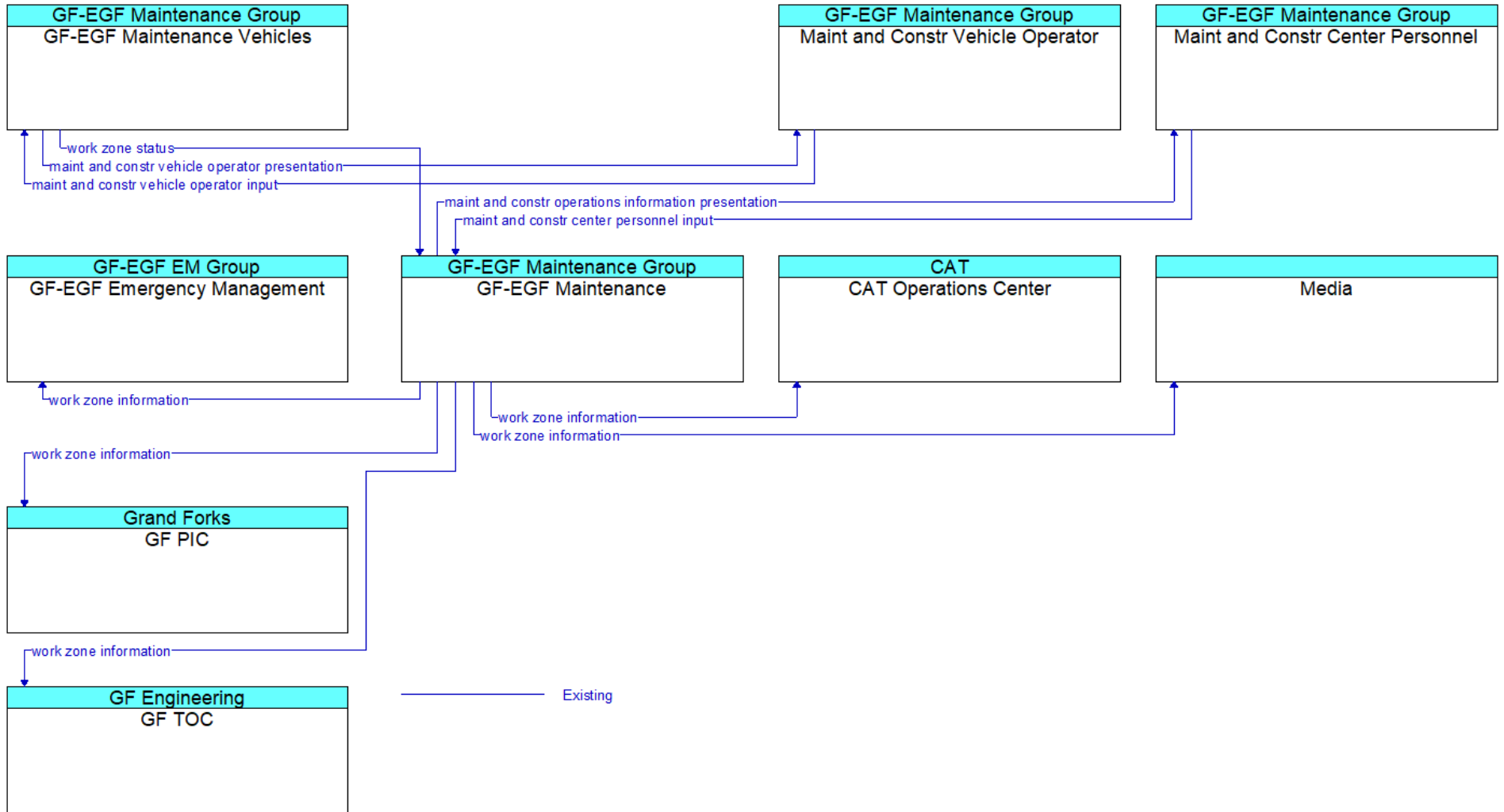


## MC05 Roadway Maintenance and Construction

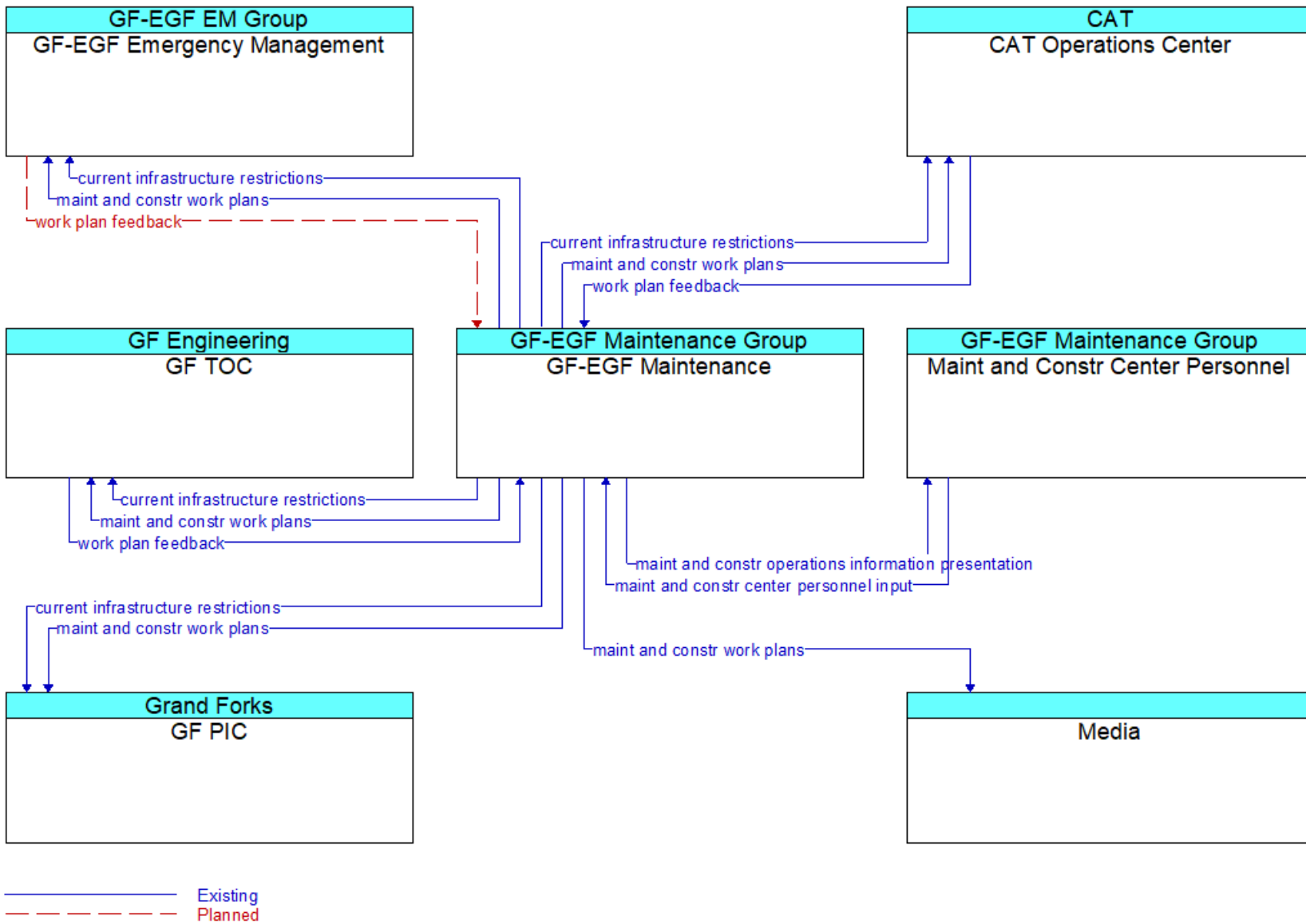


Existing

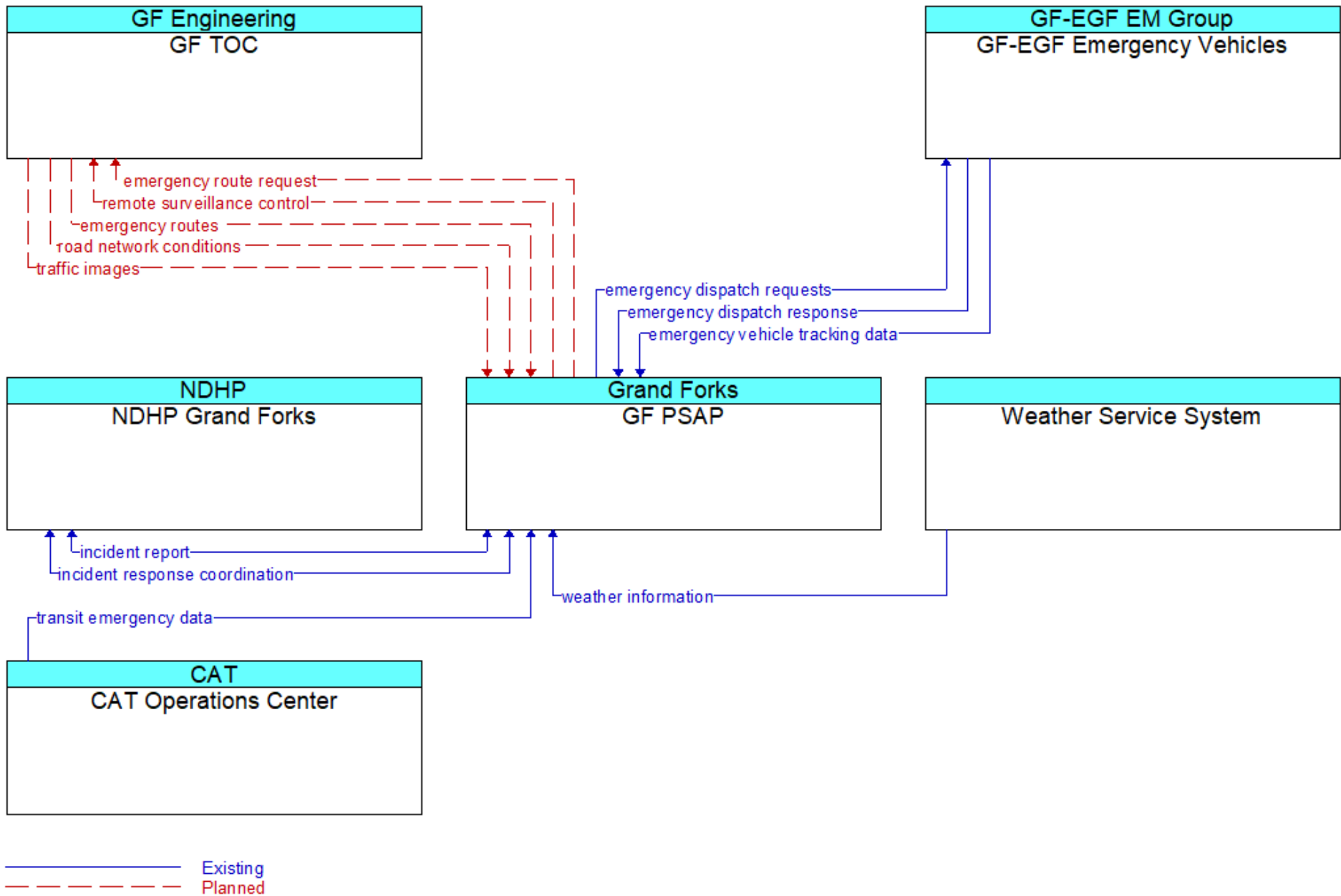
## MC06 Work Zone Management



## MC08 Maintenance and Construction Activity Coordination

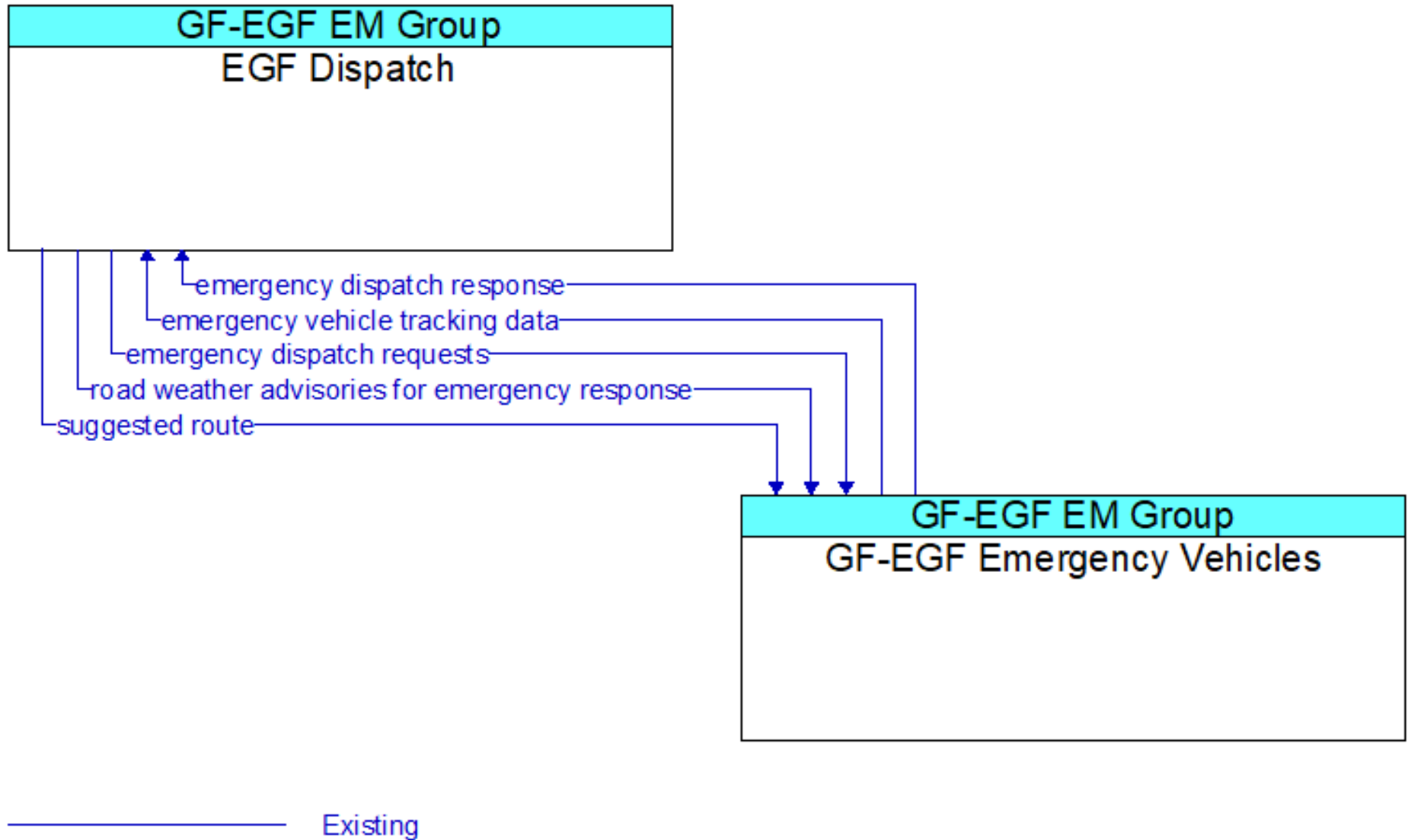


## PS01 Emergency Call-Taking and Dispatch

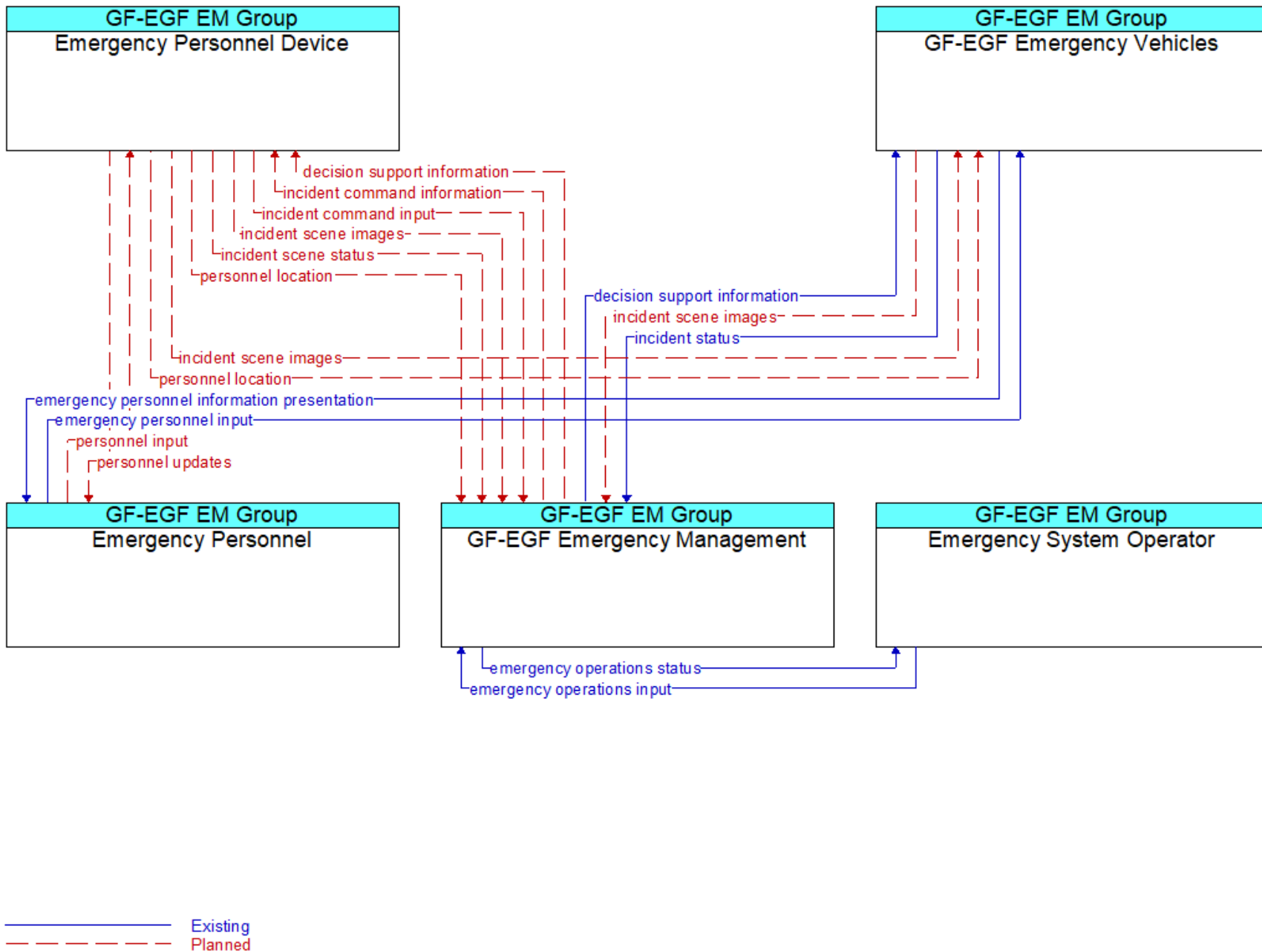




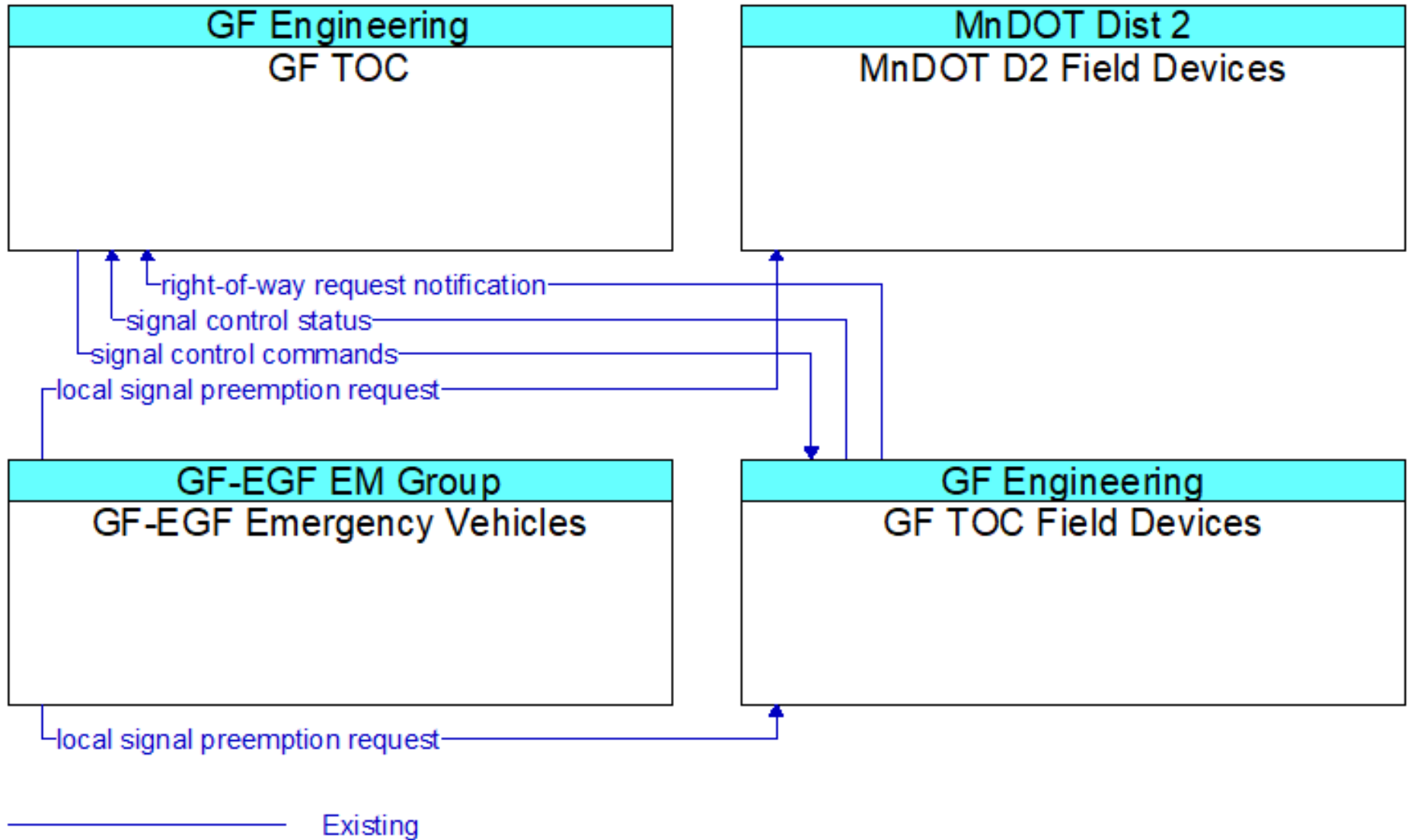
## PS01 Emergency Call-Taking and Dispatch in EGF



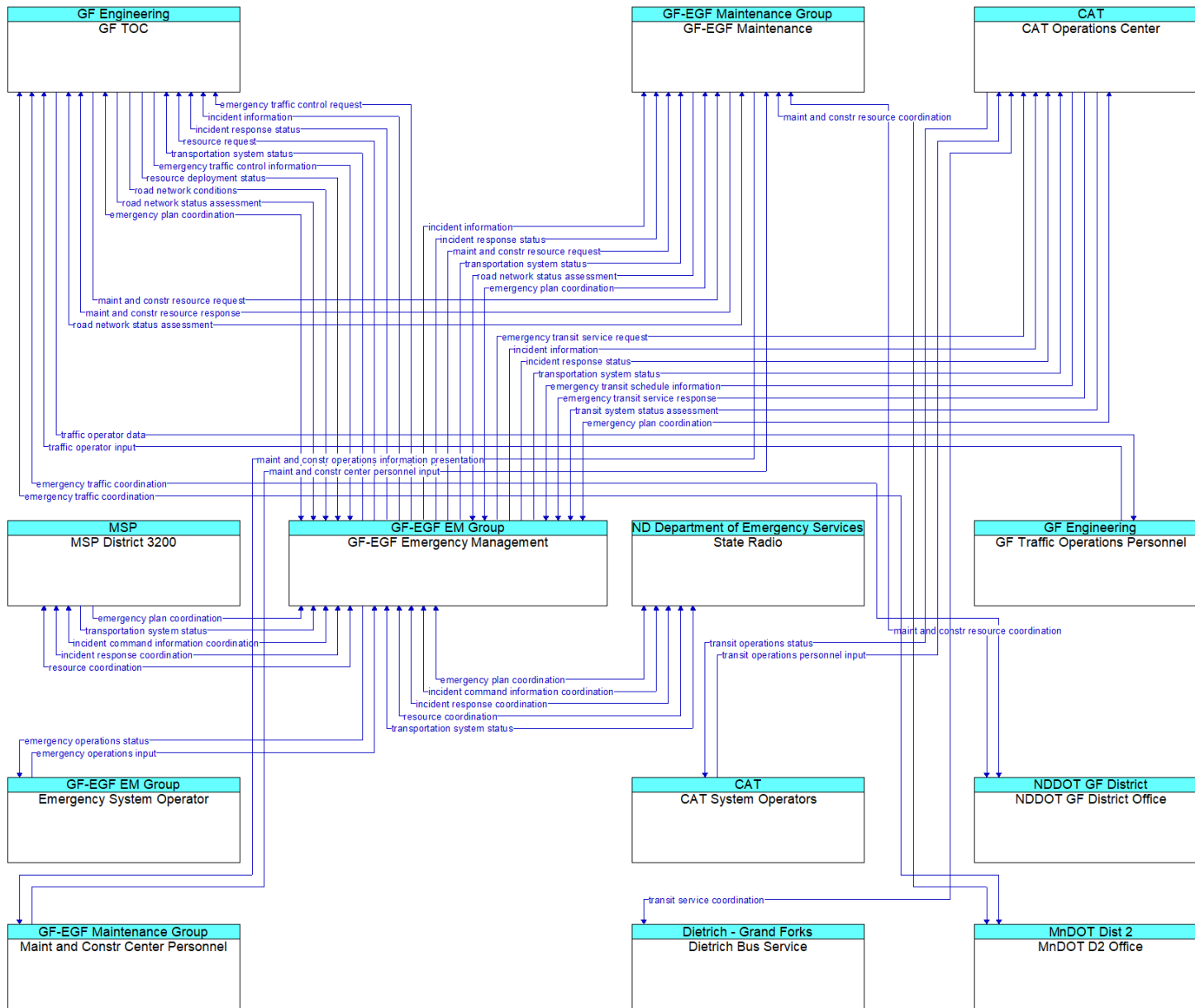
## PS02 Emergency Response



### PS03 Emergency Vehicle Preemption

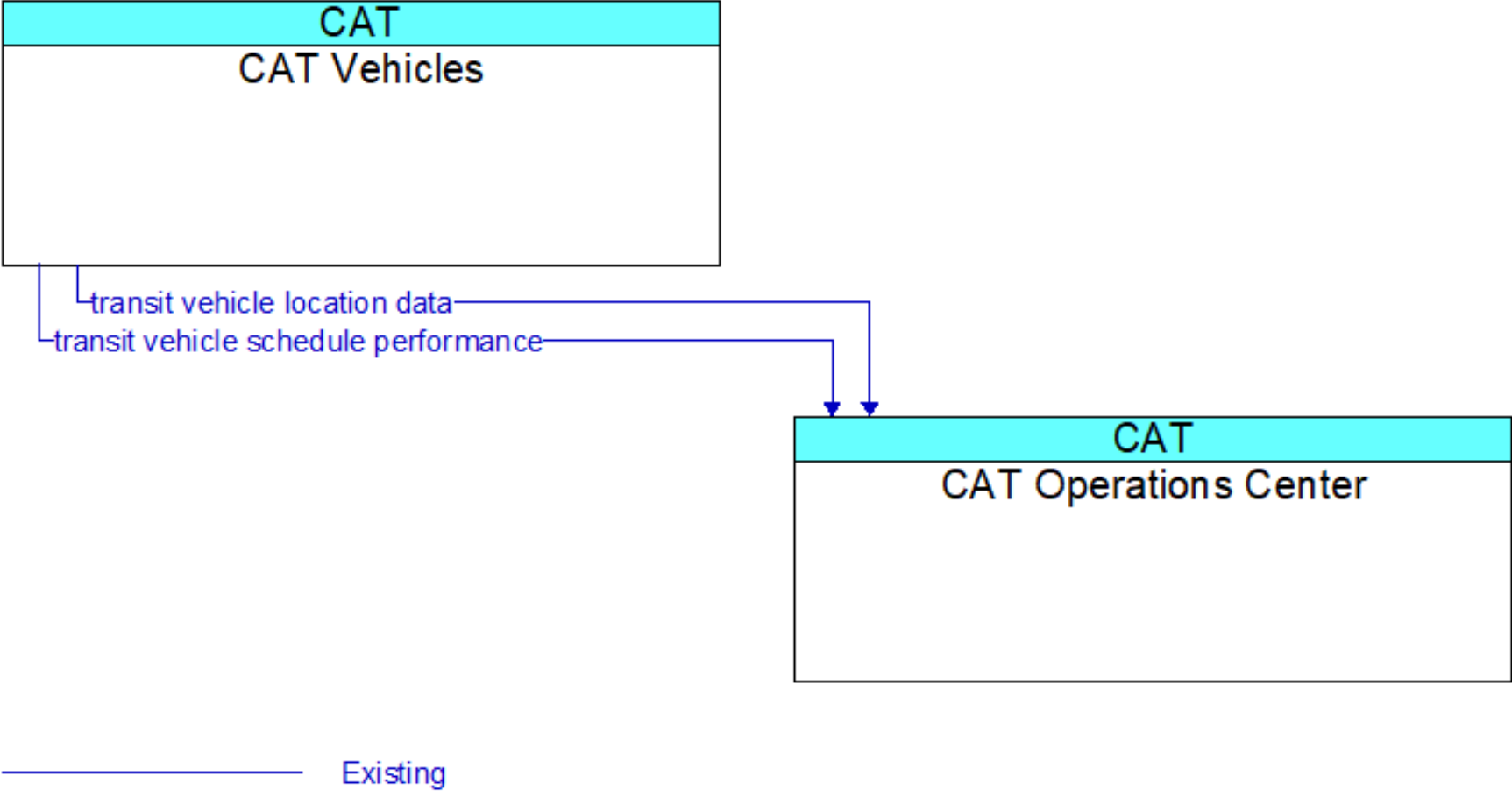


# PS12 Disaster Response and Recovery

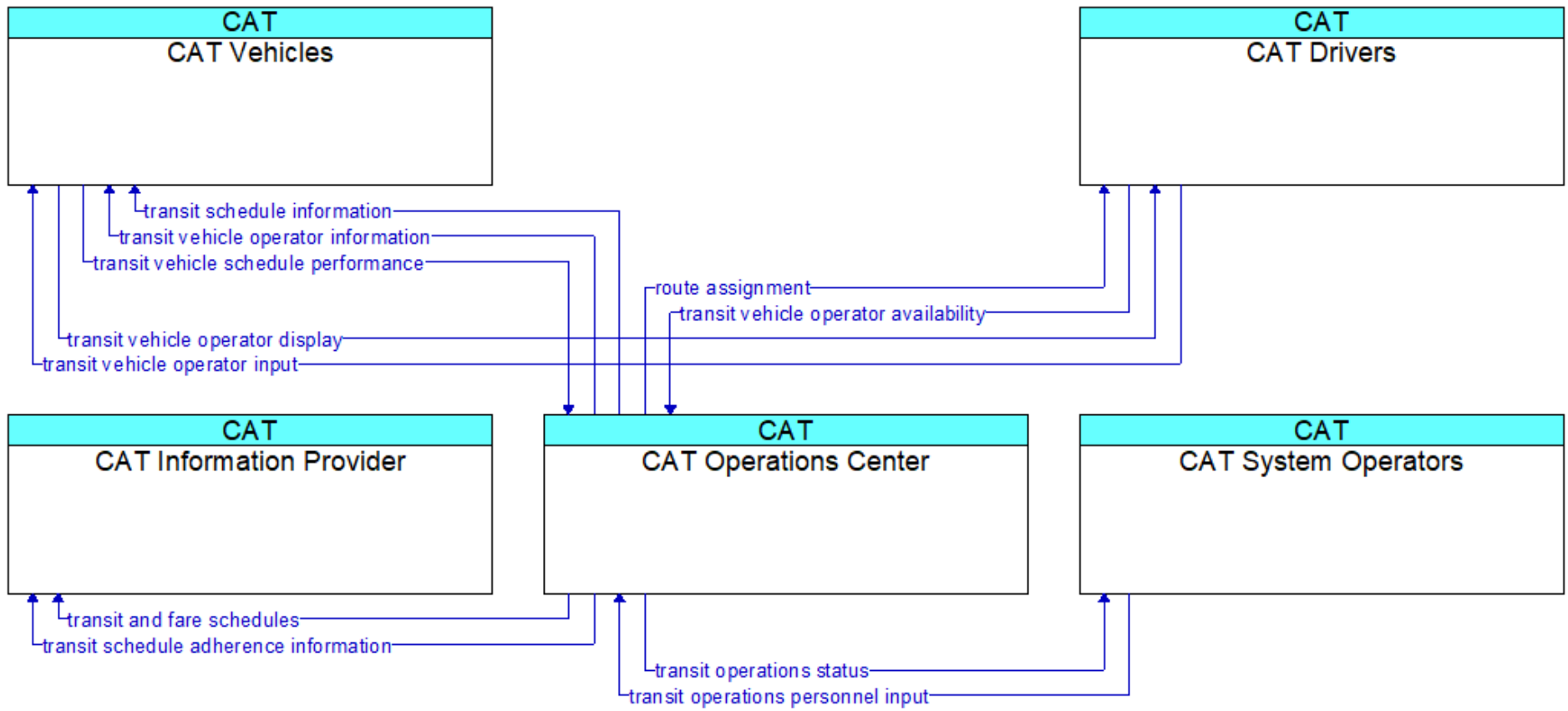


Existing

**PT01 Transit Vehicle Tracking**

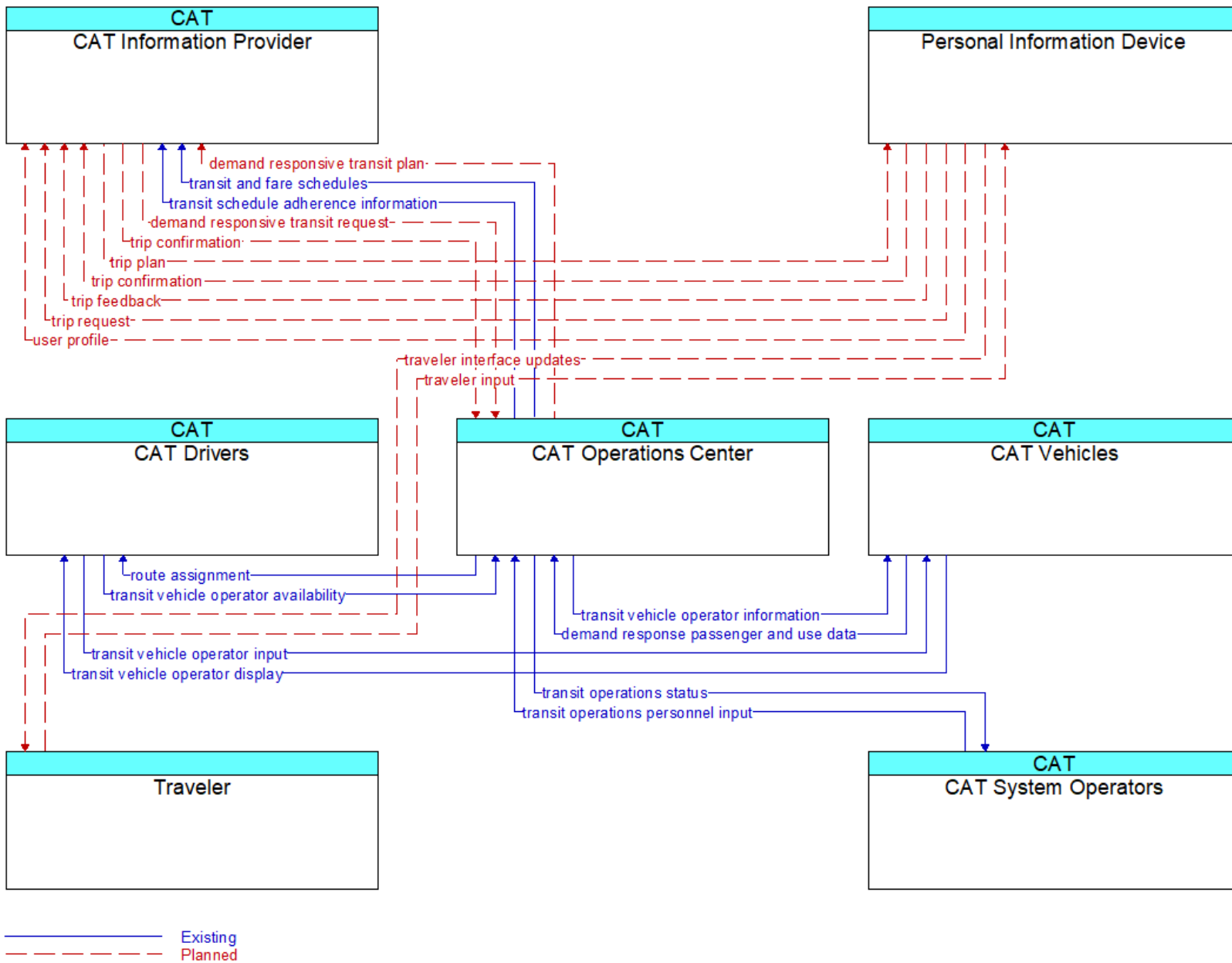


## PT02 Transit Fixed-Route Operations

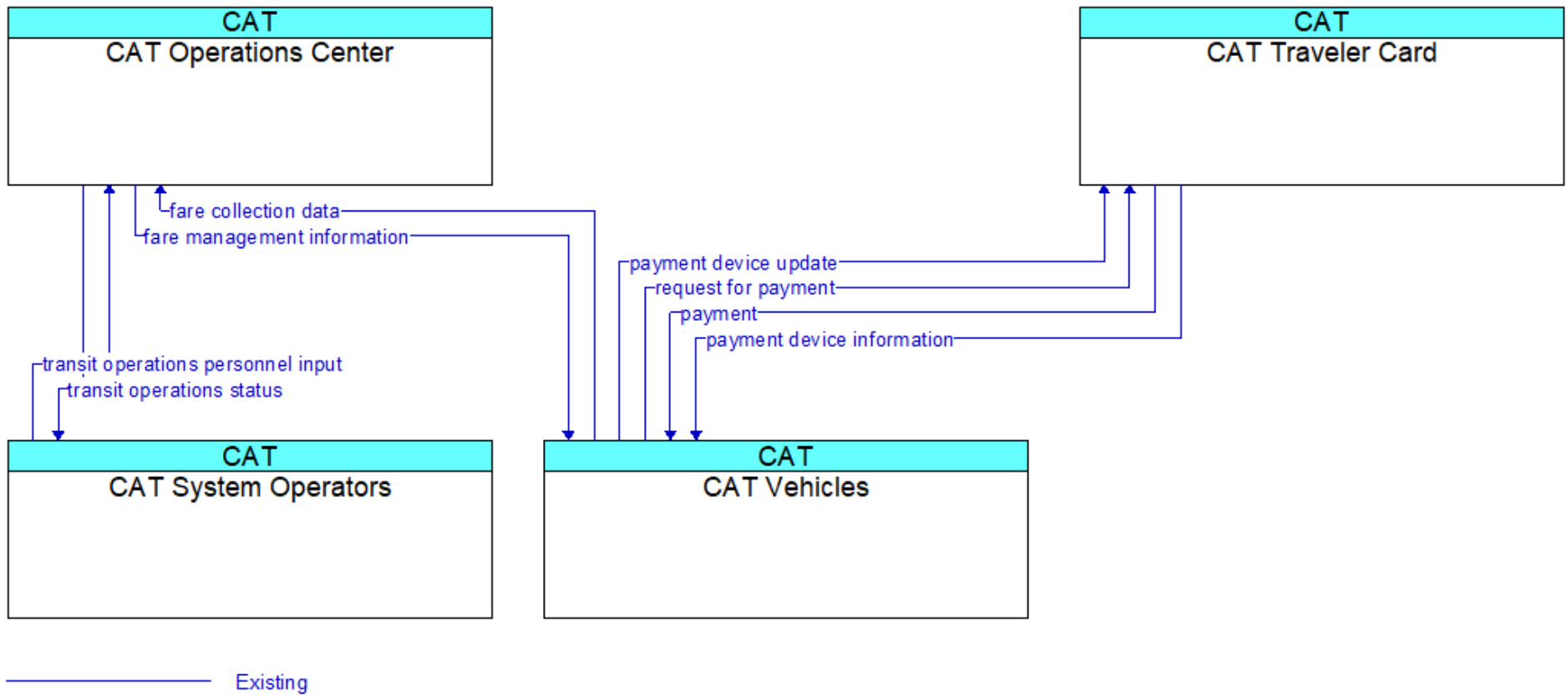


Existing

## PT03 Dynamic Transit Operations

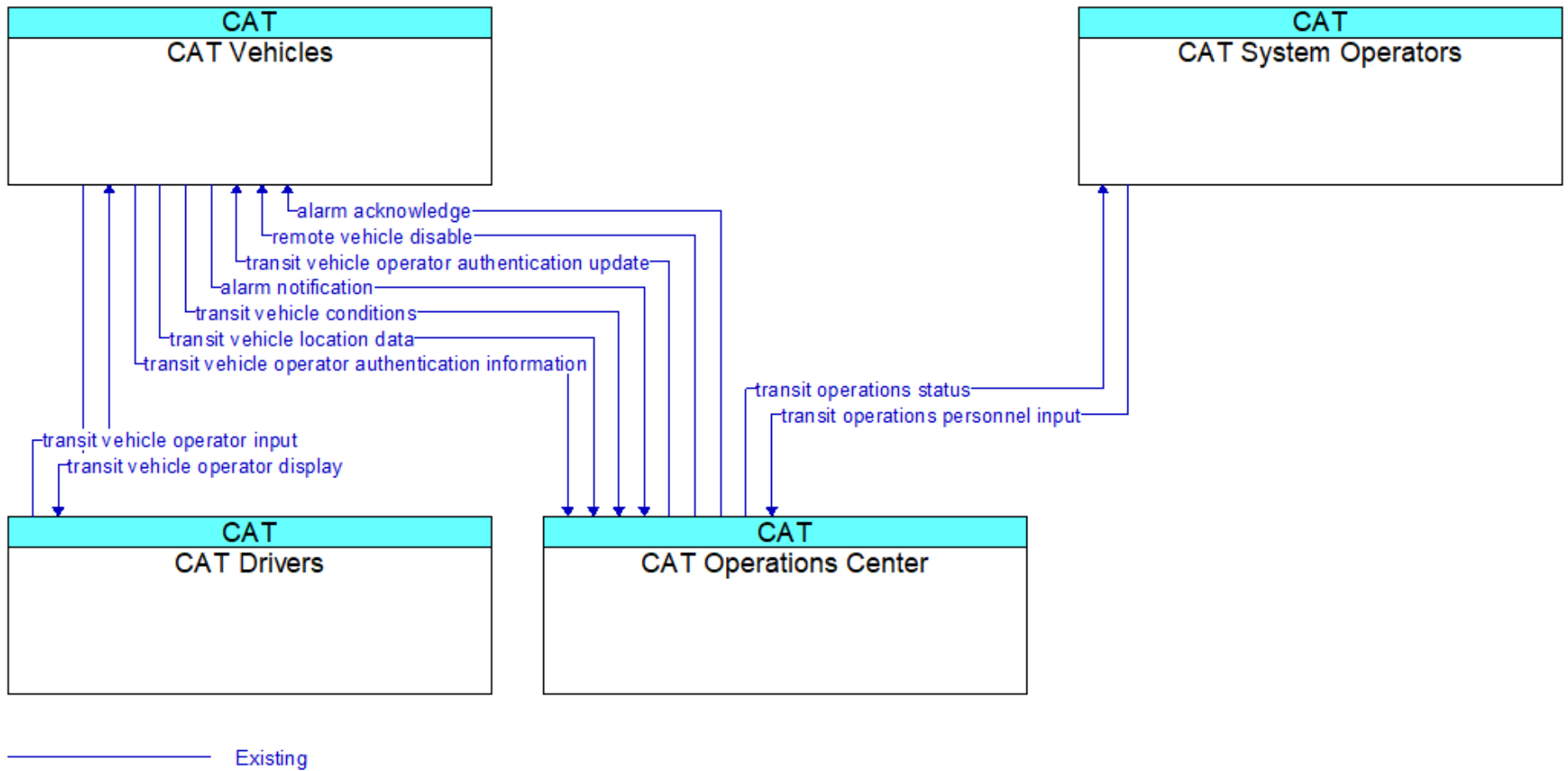


## PT04 Transit Fare Collection Management

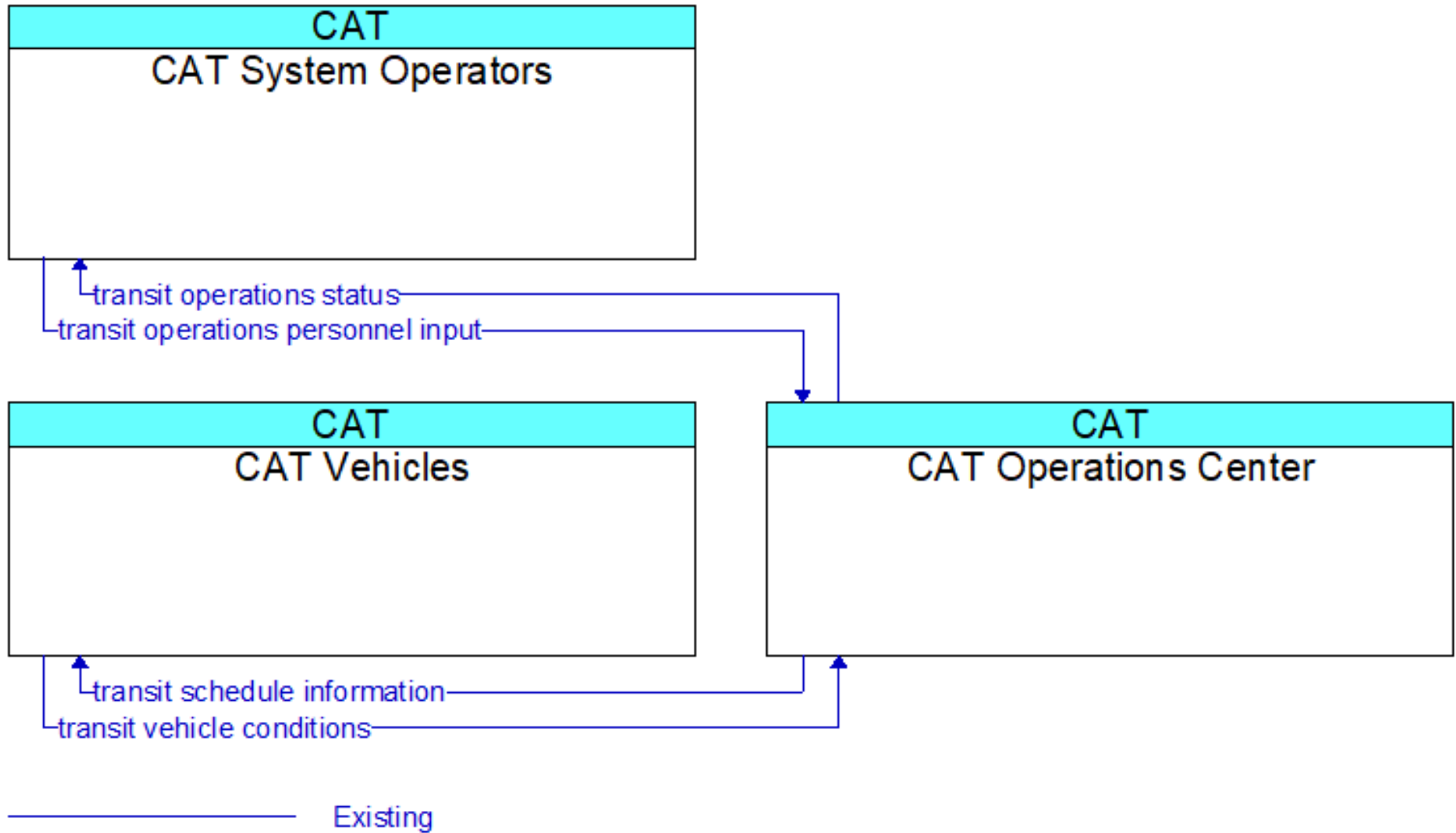




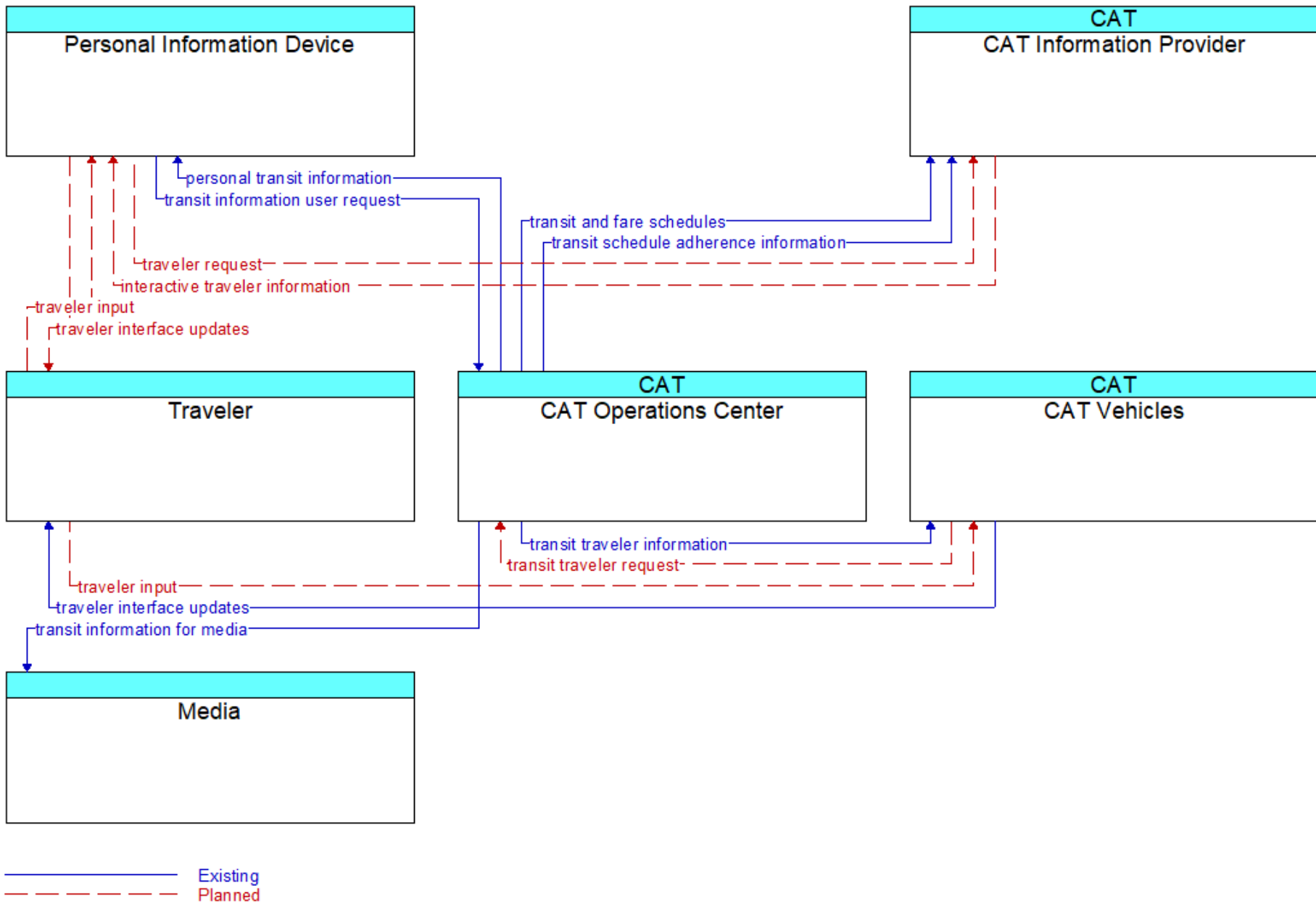
## PT05 Transit Security



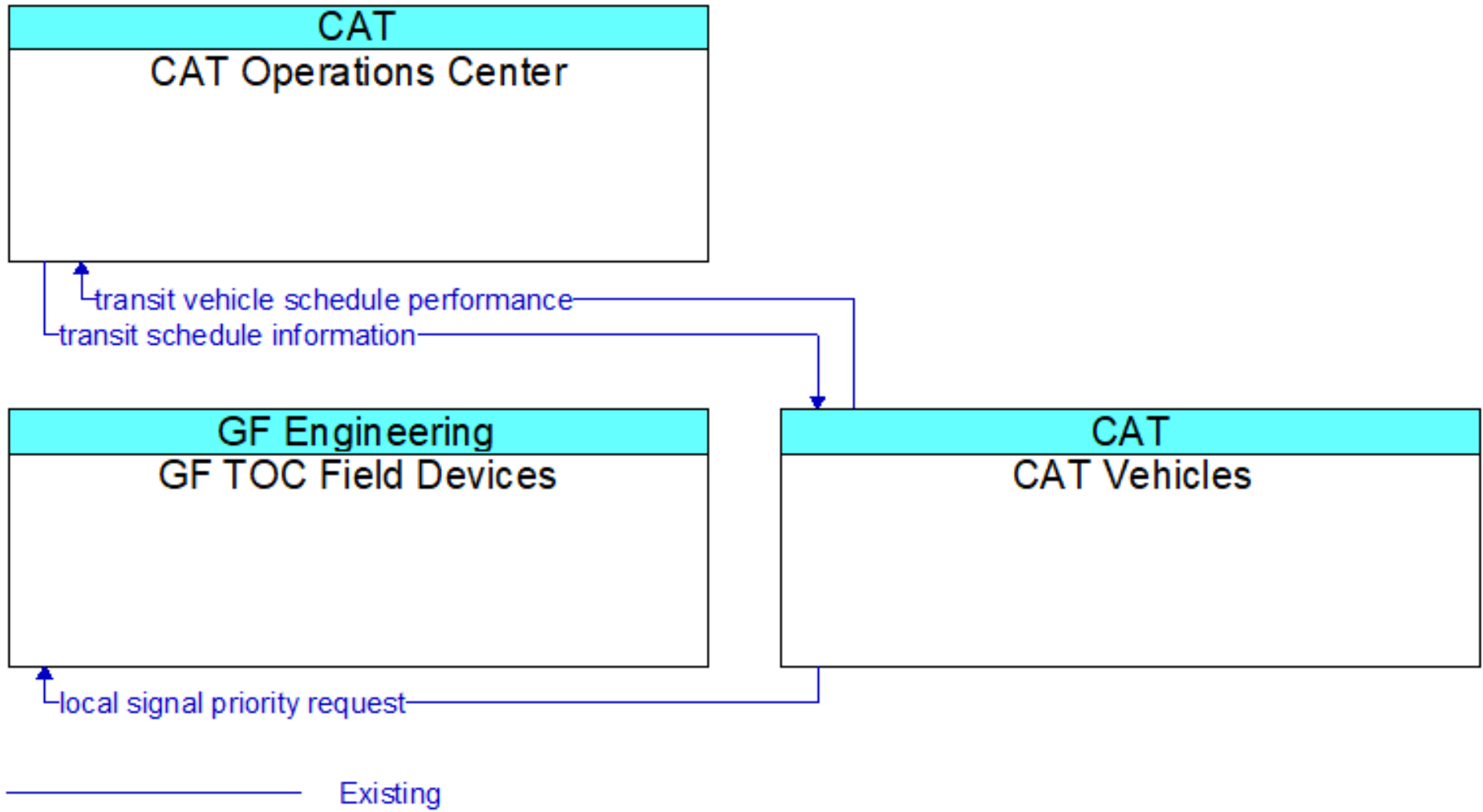
## PT06 Transit Fleet Management



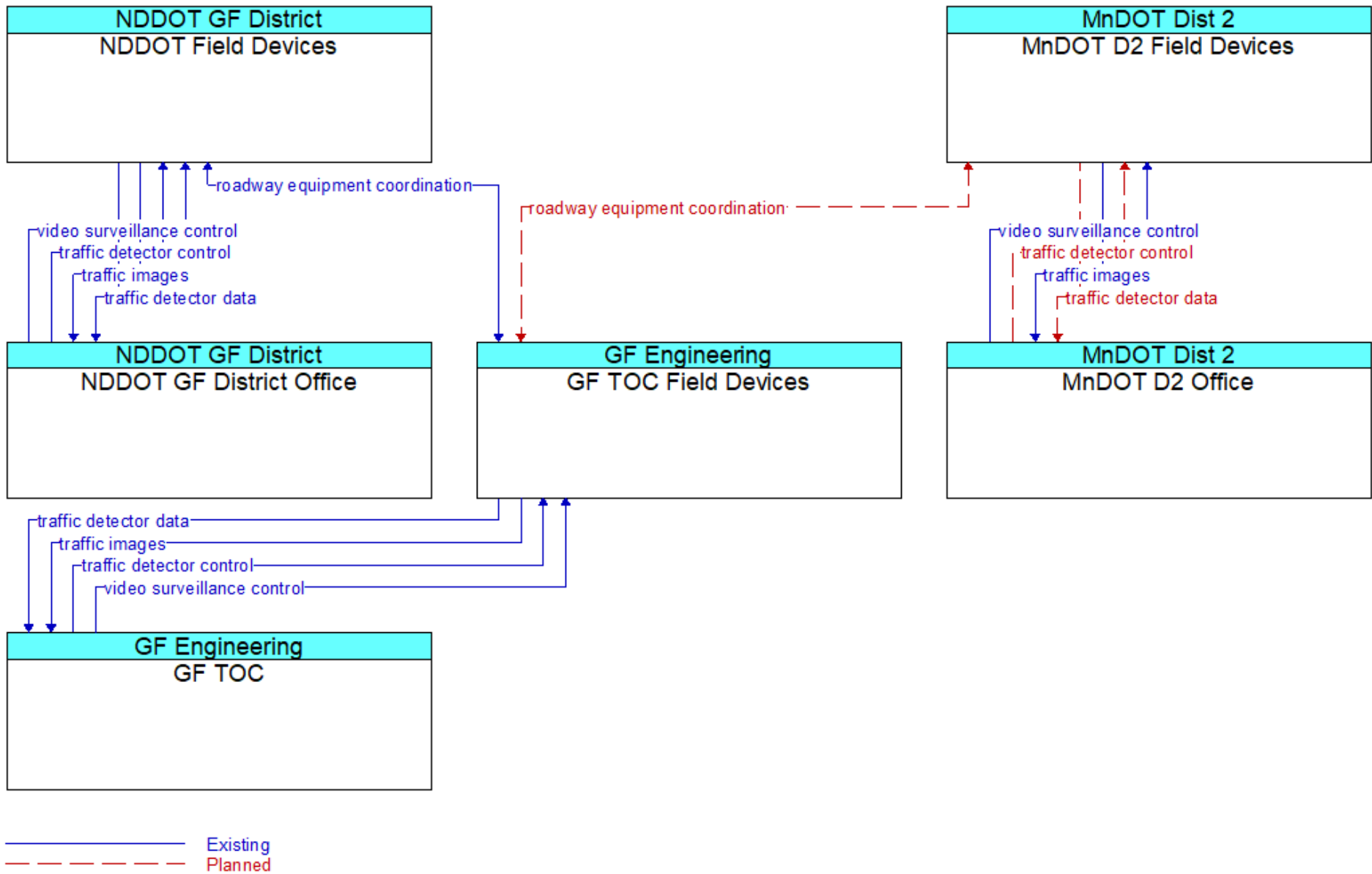
## PT08 Transit Traveler Information



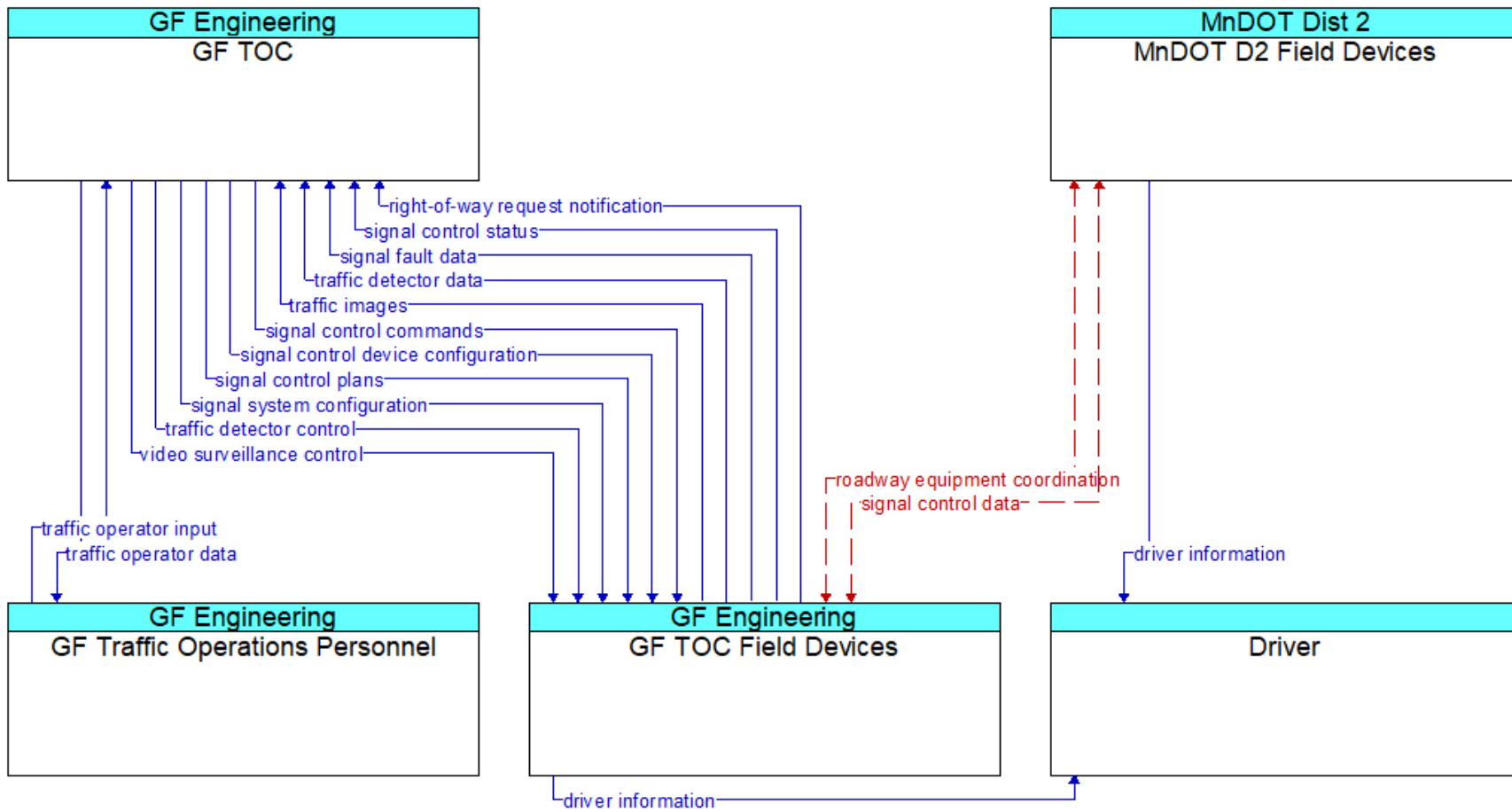
## PT09 Transit Signal Priority



## TM01 Infrastructure-Based Traffic Surveillance

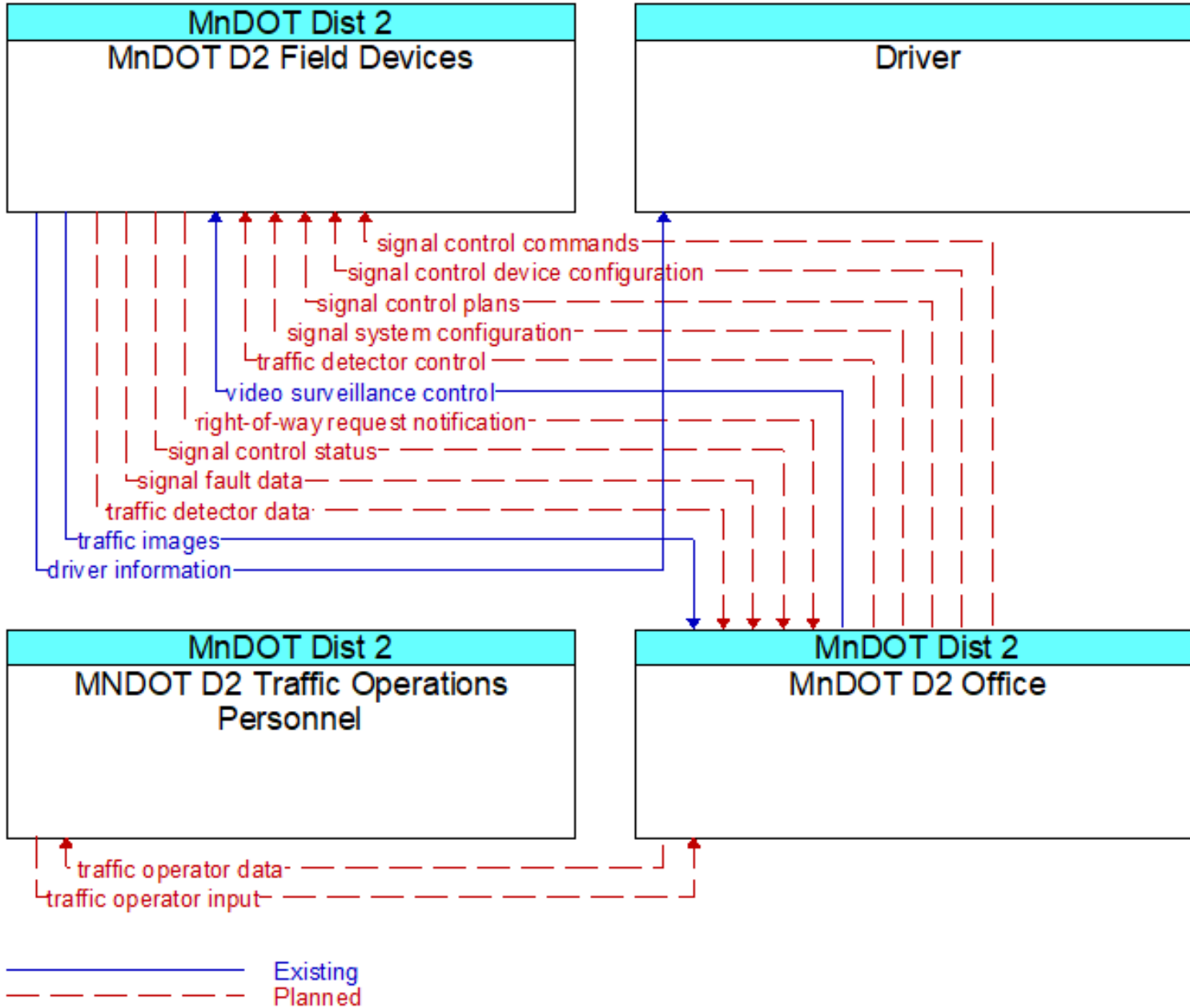


## TM03 Traffic Signal Control

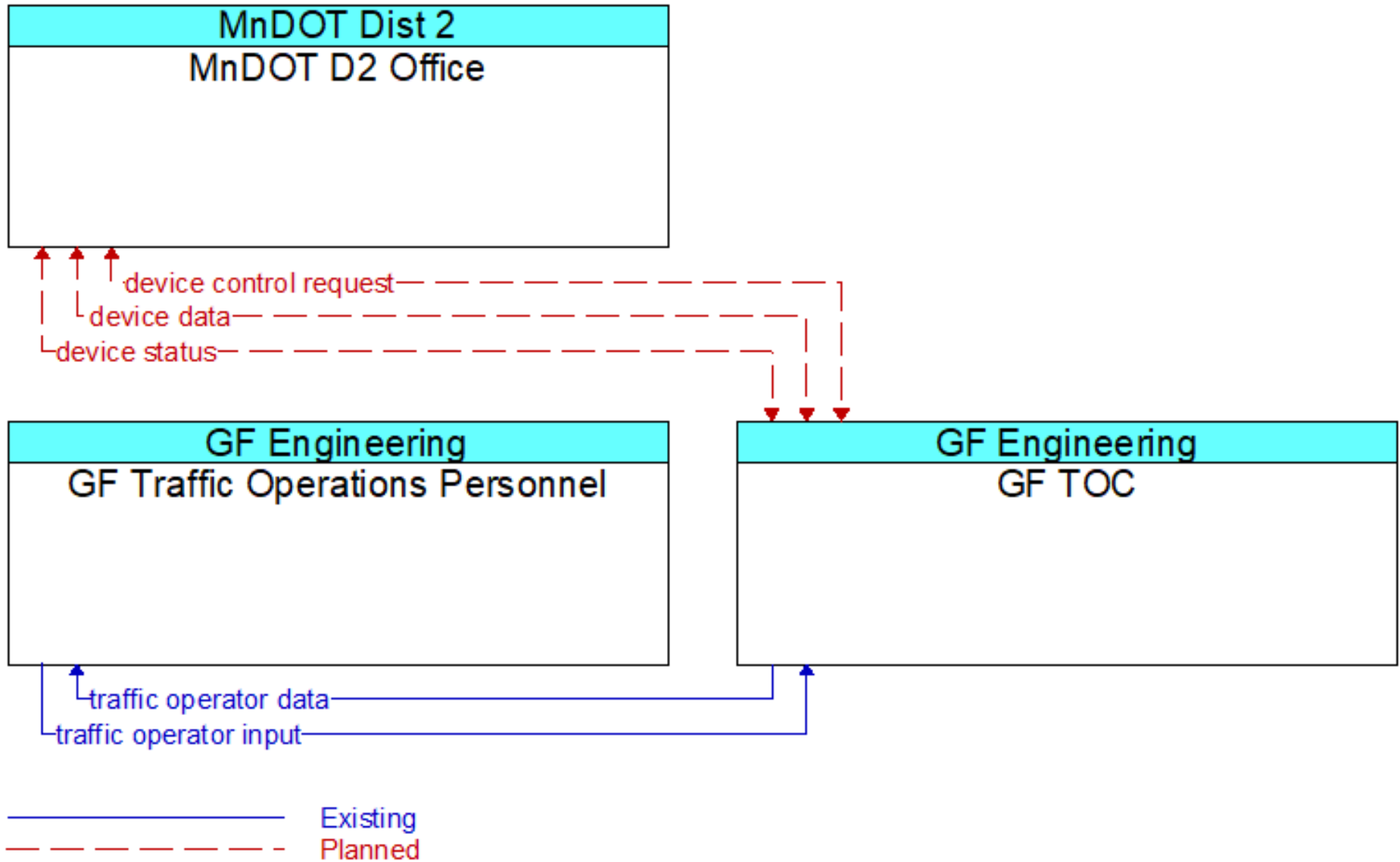


————— Existing  
- - - - - Planned

### TM03 Traffic Signal Control in EGF

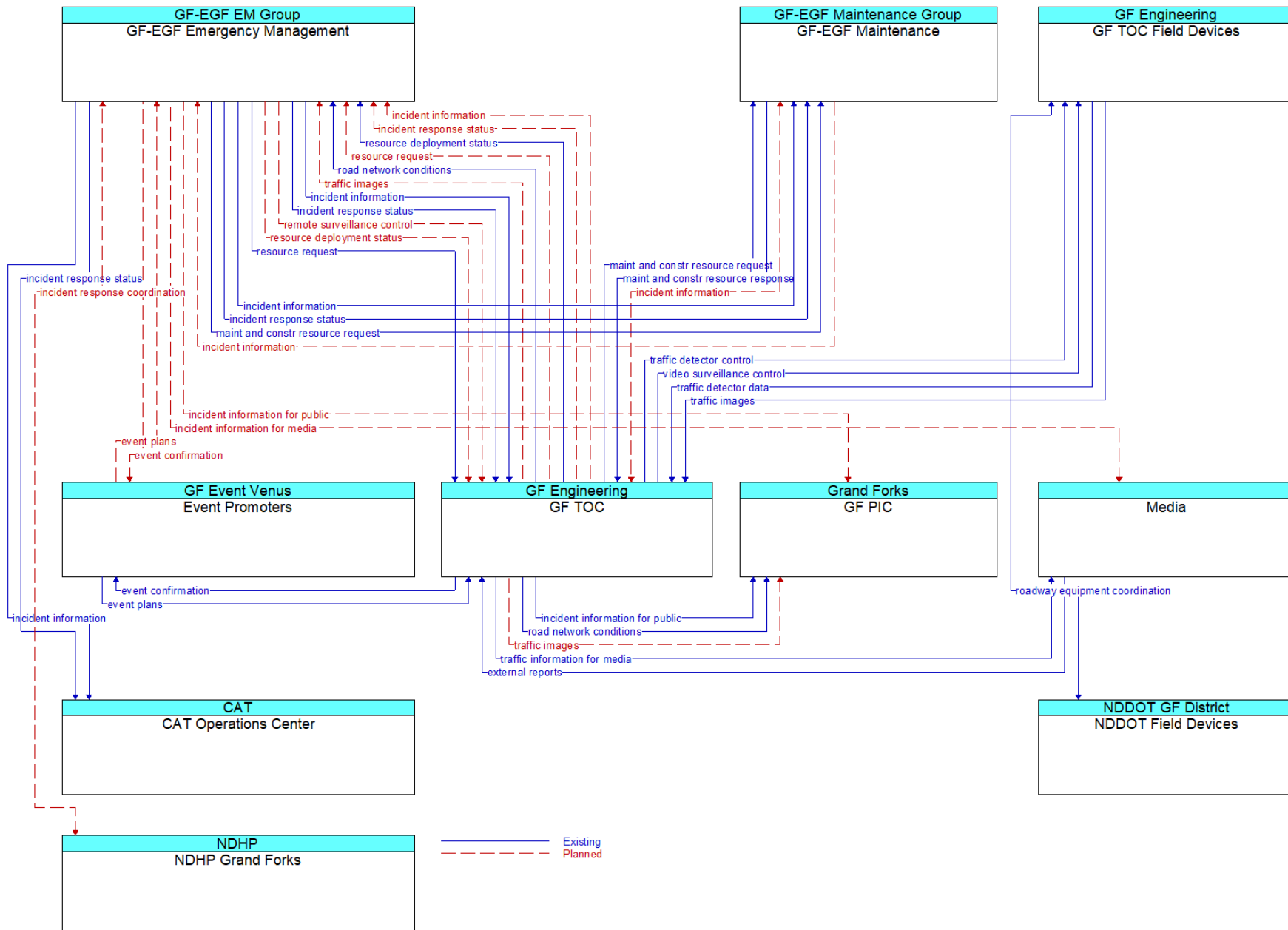


## TM07 Regional Traffic Management

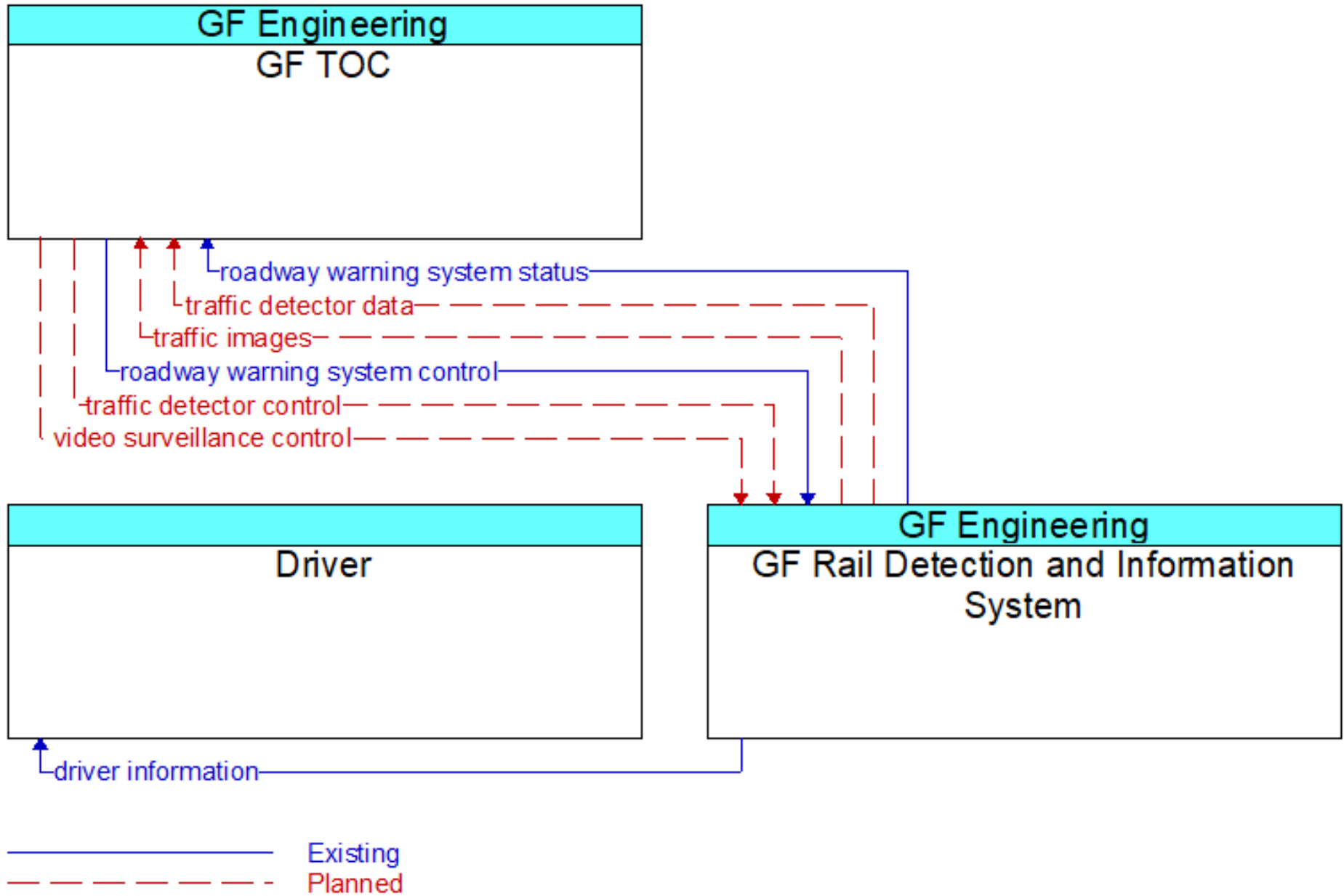




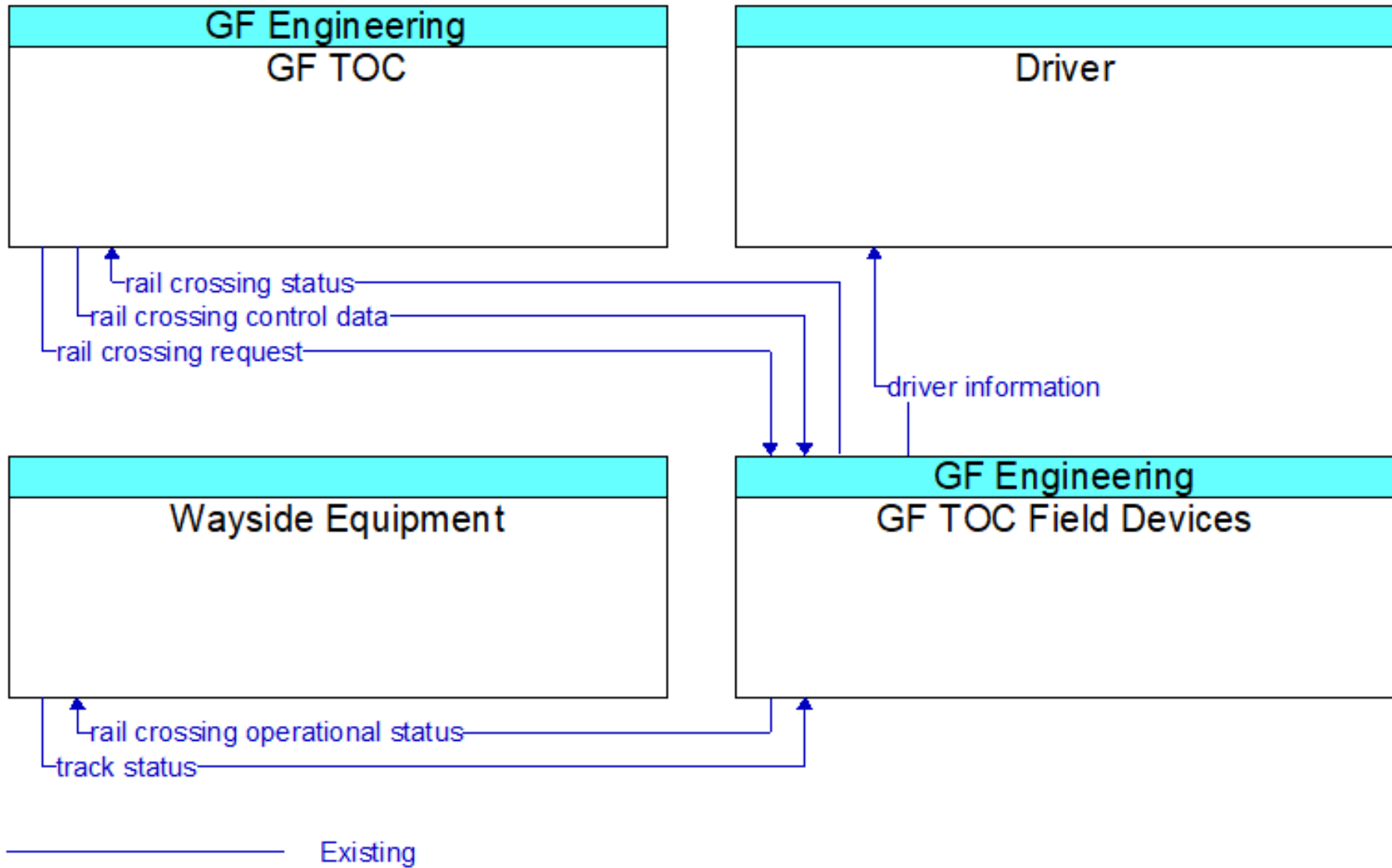
# TM08 Traffic Incident Management System



# TM12 Dynamic Roadway Warning



TM13 Standard Railroad Grade Crossing



**APPENDIX-B**  
**FUNCTIONAL REQUIREMENTS**

Element Name	Functional Object	Requirement #	Requirement	Status
Archived Data User System	Center Data Collection	01	The center shall collect transportation data such as traffic operational data, transit data, vehicle data, weather data, freight data, event logs, etc. and make it available for ITS Archives upon request.	Planned
		02	The center shall assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.	Planned
		03	The center shall receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.	Planned
CAT Information Provider	TIC Data Collection	04	The center shall collect, process, and store transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information.	Existing
	TIC Interactive Traveler Information	03	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
	TIC Trip Planning	01	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
		07	The center shall generate route plans based on transit services, including fares, schedules, and requirements for travelers with special needs.	Planned
		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
		13	The center shall provide the capability for the traveler to confirm the proposed trip plan.	Planned
CAT Operations Center	Transit Center Data Collection	01	The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	Existing
		03	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
		04	The center shall be able to produce sample products of the data available.	Existing
	Transit Center Fare Management	04	The center shall support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.	Existing
		06	The center shall process requests for transit fares to be paid in advance.	Existing
CAT Operations Center	Transit Center Fare Management	07	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
	Transit Center Fixed-Route Operations	03	The center shall be able to generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	Existing
		04	The center shall dispatch fixed route or flexible route transit vehicles.	Existing
		05	The center shall collect transit operational data for use in the generation of routes and schedules.	Existing
		06	The center shall provide instructions or corrective actions to the transit vehicle operators based upon operational needs.	Existing
		07	The center shall manage large deviations of individual transit vehicles, deviations in rural areas, and deviations of large numbers of vehicles.	Existing
		09	The center shall exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.	Planned
		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

Element Name	Functional Object	Requirement #	Requirement	Status	
	Transit Center Vehicle Tracking	01	The center shall monitor the locations of all transit vehicles within its network.	Existing	
		02	The center shall determine adherence of transit vehicles to their assigned schedule.	Existing	
CAT Vehicles	Transit Vehicle On-Board Fare Management	01	The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Existing	
		09	The transit vehicle shall provide fare statistics data to the center.	Existing	
	Transit Vehicle On-Board Information Services	02	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	
		03	The transit vehicle shall support input and output forms that are suitable for travelers with physical disabilities.	Existing	
	Transit Vehicle On-Board Maintenance	01	The transit vehicle shall collect and process vehicle mileage data available to sensors on-board.	Existing	
		02	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	03	The transit vehicle shall transmit vehicle maintenance data to the center to be used for scheduling future vehicle maintenance.	Existing	
	Transit Vehicle On-Board Paratransit Operations	02	The transit vehicle shall receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.	Existing	
		03	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	
		04	The transit vehicle shall provide the capability to log passenger boardings and alightings and make passenger use data available to the transit center.	Existing	
	Transit Vehicle On-Board Trip Monitoring	01	The transit vehicle shall track the current location of the transit vehicle.	Existing	
		03	The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Existing	
		04	The transit vehicle shall record transit trip monitoring data including operational status information such as doors open/closed, running times, etc.	Existing	
		05	The transit vehicle shall send the transit vehicle trip monitoring data to center-based trip monitoring functions.	Existing	
	Transit Vehicle Security	01	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	
	Transit Vehicle Signal Priority	02	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	
	EGF Dispatch	Emergency Call-Taking	01	The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
			02	The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
			05	The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status	
EGF Dispatch	Emergency Call-Taking	06	The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing	
		09	The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing	
		10	The center shall update the incident information log once the emergency system operator has verified the incident.	Existing	
	Emergency Dispatch	01	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing	
		02	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing	
		03	The center shall relay location and incident details to the responding vehicles.	Existing	
		06	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing	
	Emergency Routing	04	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing	
	EGF PW Operations Center	MCM Winter Maintenance Management	01	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
			03	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
09			The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing	
12			The center shall dispatch and route winter maintenance vehicle drivers.	Existing	
13			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. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing	
GF County Maintenance			MCM Winter Maintenance Management	01	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.
GF County Maintenance	MCM Winter Maintenance Management	03	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	
		12	The center shall dispatch and route winter maintenance vehicle drivers.	Existing	
		13	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. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing	
GF PIC	TIC Traveler Information Broadcast	01	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	

Element Name	Functional Object	Requirement #	Requirement	Status
		02	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 Call-Taking	01	The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
		02	The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
		05	The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing
		06	The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
		09	The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
		10	The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
	Emergency Dispatch	01	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
		02	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
GF PSAP	Emergency Dispatch	03	The center shall relay location and incident details to the responding vehicles.	Existing
		06	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing
	Emergency Routing	04	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing
		06	The center shall track current emergency vehicle location and status along with other emergency vehicle characteristics.	Existing
GF PW Operations Center	MCM Maintenance Decision Support	01	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
		03	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
		04	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
	MCM Vehicle Maintenance Management	01	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
		02	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
		03	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



Element Name	Functional Object	Requirement #	Requirement	Status
	MCM Vehicle Tracking	01	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
		02	The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.	Existing
GF PW Operations Center	MCM Winter Maintenance Management	01	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
		03	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
		05	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
		06	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
		07	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
		08	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
		09	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing
		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
GF PW Vehicles	MCV Vehicle Location Tracking	01	The maintenance and construction vehicle shall track its current location.	Existing
		02	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Existing
GF PW Vehicles	MCV Vehicle System Monitoring and Diagnostics	01	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 Rail Detection and Information System	Roadway Standard Rail Crossing	11	The field element shall activate the flashing beacons on the (rail crossing is blocked) static sign in the vicinity of a highway-rail intersection (HRI) to advise drivers, cyclists, and pedestrians of approaching trains.	Existing
GF TOC	Center Data Collection	06	The center shall collect transportation data such as traffic operational data, event logs, etc. and make it available for ITS Archives upon request.	Planned
	Center Field Equipment Management	06	The center shall collect the status and fault data from field equipment, such as traffic, cameras, traffic signals and surveillance equipment, etc..	Existing

Element Name	Functional Object	Requirement #	Requirement	Status	
	TMC Basic Surveillance	01	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing	
		02	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Planned	
		05	The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing	
		06	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	
		07	The center shall remotely control devices to detect traffic.	Existing	
	TMC Data Collection	01	The center shall collect traffic management data such as operational data, event logs, etc.	Existing	
		03	The center shall receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.	Planned	
	TMC Dynamic Lane Management and Shoulder Use	01	The center shall remotely monitor and control dynamically managed travel lanes.	Existing	
	TMC Regional Traffic Management	01	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	TMC Regional Traffic Management	02	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
		TMC Signal Control	01	The center shall remotely control traffic signal controllers.	Existing
02			The center shall accept notifications of pedestrian calls.	Existing	
03			The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Existing	
04			The center shall collect traffic signal controller fault data from the field.	Existing	
05			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	
06			The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Existing	
07			The center shall manage boundaries of the control sections used within the signal system.	Existing	
08			The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Existing	
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	
17		The center shall remotely control devices to detect traffic in the vicinity of traffic signals.	Existing		
TMC Standard Rail Crossing Management	01	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 and Diagnostics	01	The field device shall be able to monitor the operating conditions of itself and other field devices under its control in order to determine if any operational problems are occurring.	Existing	
		02	The field device shall be able to perform diagnostic tests in order to determine operational issues with itself or other field devices under its control.	Existing	

Element Name	Functional Object	Requirement #	Requirement	Status	
		03	The field device shall be able to provide the status data and diagnostic information to field personnel.	Existing	
		04	The field device shall be able to provide the status data and diagnostic information to remote centers.	Existing	
GF TOC Field Devices	Roadway Basic Surveillance	01	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	
		02	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing	
		04	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing	
		05	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing	
	Roadway Data Collection	03	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	
		04	The field element shall collect traffic data.	Existing	
		05	The field element shall include the sensors and supporting roadside devices that sense, collect, and send traffic data to a center for archival.	Existing	
	Roadway Dynamic Lane Management and Shoulder Use	03	The field element shall receive lane management control information from the controlling center.	Existing	
		04	The field element shall provide guidance and information to drivers regarding current lane configuration and status.	Existing	
	Roadway Field Device Support	01	The field element shall monitor the operational status of field devices and detects and reports fault conditions.	Existing	
		02	The field element shall detect and report any fault conditions with the equipment being monitored back to its controlling center.	Existing	
		03	The field element shall provide the capability for field personnel to locally control and configure this equipment.	Existing	
		04	The field element shall support an interface with field support equipment to accept installation of updates or configuration of field operations.	Existing	
	Roadway Signal Control	01	The field element shall control traffic signals under center control.	Existing	
		06	The field element shall return traffic signal controller operational status to the center.	Existing	
		07	The field element shall return traffic signal controller fault data to the center.	Existing	
	Roadway Signal Preemption	01	The field element shall respond to signal preemption requests from emergency vehicles.	Existing	
	GF TOC Field Devices	Roadway Standard Rail Crossing	01	The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	Existing
			02	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
			04	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
07			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	
08			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	

Element Name	Functional Object	Requirement #	Requirement	Status
GF Transportation Data Archival	Archive Data Repository	01	The center shall collect data from centers.	Planned
		03	The center shall store collected data in an information repository.	Planned
GF-EGF Emergency Vehicles	EV On-Board En Route Support	01	The emergency vehicle, including roadway service patrols, shall track its current location.	Existing
		02	The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Existing
		03	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Existing
		04	The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Existing
		05	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing
		06	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
		07	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	04	The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing
		05	The center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers.	Existing
		06	The 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
		07	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
		08	The 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
		09	The center shall receive evacuation information including evacuation zones, evacuation times, and reentry times from emergency operation centers.	Existing
	MCM Roadway Maintenance	02	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	Existing
		04	The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
		08	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
		09	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	01	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
		02	The center shall provide status information about scheduled maintenance and construction 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, multimodal transportation providers, rail operations, and the media.	Existing
		05	The Center shall provide road infrastructure restriction information to other Centers.	Existing
MnDOT D2 Field Devices	Roadway Signal Control	01	The field element shall control traffic signals under center control.	Existing
		06	The field element shall return traffic signal controller operational status to the center.	Existing
		07	The field element shall return traffic signal controller fault data to the center.	Existing
	Roadway Signal Preemption	01	The field element shall respond to signal preemption requests from emergency vehicles.	Existing
MnDOT D2 Office	MCM Maintenance Decision Support	01	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
		03	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
		04	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
	MCM Vehicle Maintenance Management	01	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	MCM Vehicle Maintenance Management	02	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
		03	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
	MCM Vehicle Tracking	01	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing
		02	The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.	Existing

Element Name	Functional Object	Requirement #	Requirement	Status
	MCM Winter Maintenance Management	01	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
		02	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
		03	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
		05	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
		06	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
		07	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
		MnDOT D2 Office	MCM Winter Maintenance Management	08
09	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.			Existing
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
TMC Regional Traffic Management	01		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
	02		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
TMC Signal Control	01		The center shall remotely control traffic signal controllers.	Existing
	04		The center shall collect traffic signal controller fault data from the field.	Existing
	05		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
MSP District 3200	Emergency Dispatch		01	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.
		02	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	Requirement #	Requirement	Status	
		03	The center shall relay location and incident details to the responding vehicles.	Existing	
		06	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing	
NDDOT GF District Office	MCM Maintenance Decision Support	01	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	
		03	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	
		04	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	
	MCM Vehicle Maintenance Management	01	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	
		02	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	
		03	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	
	MCM Vehicle Tracking	01	The center shall monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.	Existing	
		02	The center shall present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.	Existing	
	MCM Winter Maintenance Management	01	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	
		02	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	
	NDDOT GF District Office	MCM Winter Maintenance Management	03	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
			06	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
			07	The center shall dispatch and route winter maintenance vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing



Element Name	Functional Object	Requirement #	Requirement	Status
		08	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
		09	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing
		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
Personal Information Device	Personal Traveler Information Reception	02	The personal traveler interface shall receive transit information from a center and present it to the traveler.	Existing
		05	The personal traveler interface shall receive wide-area alerts and present it to the traveler.	Existing
State Radio	Emergency Dispatch	01	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
		02	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
		03	The center shall relay location and incident details to the responding vehicles.	Existing
		06	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing