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Grand Forks-East Grand Forks Regional ITS Architecture Update

Version 3.0

Final Report

December 2014

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

Grand Forks-East Grand Forks Regional ITS Architecture Version 3.0

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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.

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ACRONYMS

AVL	Automated Vehicle Location
CAT	Cities Area Transit
CCTV	Closed Circuit Television
Dist	District
DMS	Dynamic Message Sign
DOT	Department of Transportation
EAS	Emergency Alert System
EGF	East Grand Forks
EOC	Emergency Operations Center
EV	Emergency Vehicle
FD	Fire Department
FHWA	Federal Highway Administration
GF	Grand Forks
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
MCO	Maintenance and Construction Operations
MnDOT	Minnesota Department of Transportation
MPO	Metropolitan Planning Organization
MSP	Minnesota State Petrol
NDDOT	North Dakota Department of Transportation
NDHP	North Dakota Highway Patrol
OEM	Office of Emergency Management
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

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

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EXECUTIVE SUMMARY

The 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 twice since the original development, in 2008 and 2014. 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 systems 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 third 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 current version (7.0) of the National ITS Architecture.

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), 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 21 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.

ARCHITECTURE UPDATE SUMMARY

The regional ITS architecture (RA) is a living document that requires regular maintenance to reflect the most up-to-date ITS picture in the region and to continue to meet federal requirements. FHWA architecture conformity rule states that: "The agencies and other stakeholders participating in the development of the regional ITS architecture shall develop and implement procedures and responsibilities for maintaining it, as needs evolve in the region." The GF-EGF MPO has been designated with the role of maintaining and updating the GF-EGF RA as needed. As part of their partnership agreement, ATAC was contracted by the MPO to carry out the update.

Reasons for updating the RA include:

- The planning of major ITS projects
- Changes in the status of major ITS projects
- Changes in the region's stakeholders
- Changes in the region's ITS needs
- Changes in the National ITS Architecture

The GF-EGF RA specified an update cycle of about two years, the original RA development was completed in early 2005. The first update was completed in December 2008, and the current update in December 2014.

This section of the report describes changes in the GF-EGF region as they pertain to ITS function areas. At the end of each functional area is a list of service packages impacted by these changes, please refer to the service packages in Appendix A to see updated service package diagrams with changes in subsystems and information flows. Appropriate changes have been made to corresponding sections in the report body to reflect the updates as well. The architecture consists of two components that are updated in the maintenance process: the architecture Turbo database and the architecture report document. Both files, and the report appendices, are available for download from the GF-EGF RA website:
http://www.atacenter.org/regional/grandforks/

Agency Updates by ITS Service Area

This section summarizes data collected through stakeholder interviews during the architecture maintenance process.

Public Transportation Management (Transit)

Updates

- CAT has upgraded to the RouteMatch management system for fixed route and demand response services.

- CAT now utilizes automated GPS based transit signal priority, the same system is also used for emergency signal preemption on city of Grand Forks signals.

Architecture changes

- APTS02 Transit Fixed Route Operations
- APTS03 Demand Response Transit Operations
- APTS04 Transit Fare Collection and Management
- APTS09 Transit Signal Priority

Traffic Management

Updates

- The city of Grand Forks has upgraded to the Centracs signal system central control software.
- The city of Grand Forks is now collecting data on the majority of interconnected signalized intersections.

Architecture changes

- ATMS03 Surface Street Control
- AD1 ITS Data Mart

Maintenance and Construction Management

Updates

- Area maintenance agencies continue to grow their fleets of maintenance vehicles that are equipped with automated vehicle locations (AVL) technologies and monitoring equipment that includes atmospheric sensors and snow play operating conditions.

Architecture changes

- MC01 Maintenance and Construction Vehicle and Equipment Tracking
- MC06 Winter Maintenance Activities

Emergency Management

Updates

- Area agencies continue work towards coordinated incident response through the MPO's Emergency Management Committee.

Architecture changes

- ATMS08 Traffic Incident Management System

Project Deployment Timeframe Update

The original RA report completed in 2005 identified ITS projects based upon their projected deployment timeframe. Projects targeted for short-term deployment build upon existing arterial traffic management, automated treatment systems for bridges, and transit management systems. For the medium-term, integrated traveler information and coordinated incident response are planned for deployment. Finally, fleet management technologies for transit and maintenance vehicles and integrated traveler information are planned for the long-term deployment time frame. The deployment timeframe was revised in the 2008 architecture update.

Based on the deployment status and discussions with stakeholders in the 2014 update, the revised timeframe status is as follows:

- Short-term projects:
    - Arterial traffic management: connectivity to the majority of signals, state of the art central control software in use, data collection on going. The status in this service area is now fully implemented with an eye towards future enhancements utilizing adaptive signal control.
    - Advanced transit management: a fully implemented fixed route and demand response management system exists now. Future improvements include sharing transit traveler information with riders.
    - Transit fleet management: existing.
- Medium-term projects:
    - Coordinated incident response: the MPO established an Emergency Management Committee with representatives from local law enforcement and emergency responder agencies. This will facilitate moving towards coordinated incident response through coordinating with traffic operators and maintenance management agencies.
    - Uniform emergency signal preemption and transit signal priority between Grand Forks and East Grand Forks. Currently Grand Forks operates an automated preemption and priority system utilizing GPS and AVL technologies while East Grand Forks uses a sonic based system triggered by emergency vehicle sirens.
- Long-term projects:
    - Integrated traveler information: traveler information remains a state level service provided by NDDOT and MnDOT respectively. This long term service area would augment the information from the state systems with urban traveler information with possible integration of transit information into the system.
    - Automated anti-icing treatment systems: this area remains a long term goal.
    - Train detection and notification.

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 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. ATAC has also facilitated two RA updates since 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 Turbo Architecture 7.0 in order to access the architecture and make changes or future updates.

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

2 Scope and Region	Identifies the geographical and architecture scope
3 Stakeholders	Agencies participating in the architecture
4 System Inventory	Existing and planned ITS systems
5 Needs and ITS Services	ITS user services and service packages
6 Operational Concept	Roles and responsibilities of participating agencies
7 Potential Agreements	Regional agreements to facilitate integration
8 Functional Requirements	High-level description of what the systems will do
9 ITS Standards	Brief discussion of applicable ITS standards
10 Sequence of Projects	Time-frame for ITS projects
Appendix-A	Detailed Service Packages/Information Flow Diagrams
Appendix-B	Functional Requirements
Appendix-C	Public Input Process

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 (Figure 1):

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. Automated treatment (anti-icing systems)
    b. Fleet Management

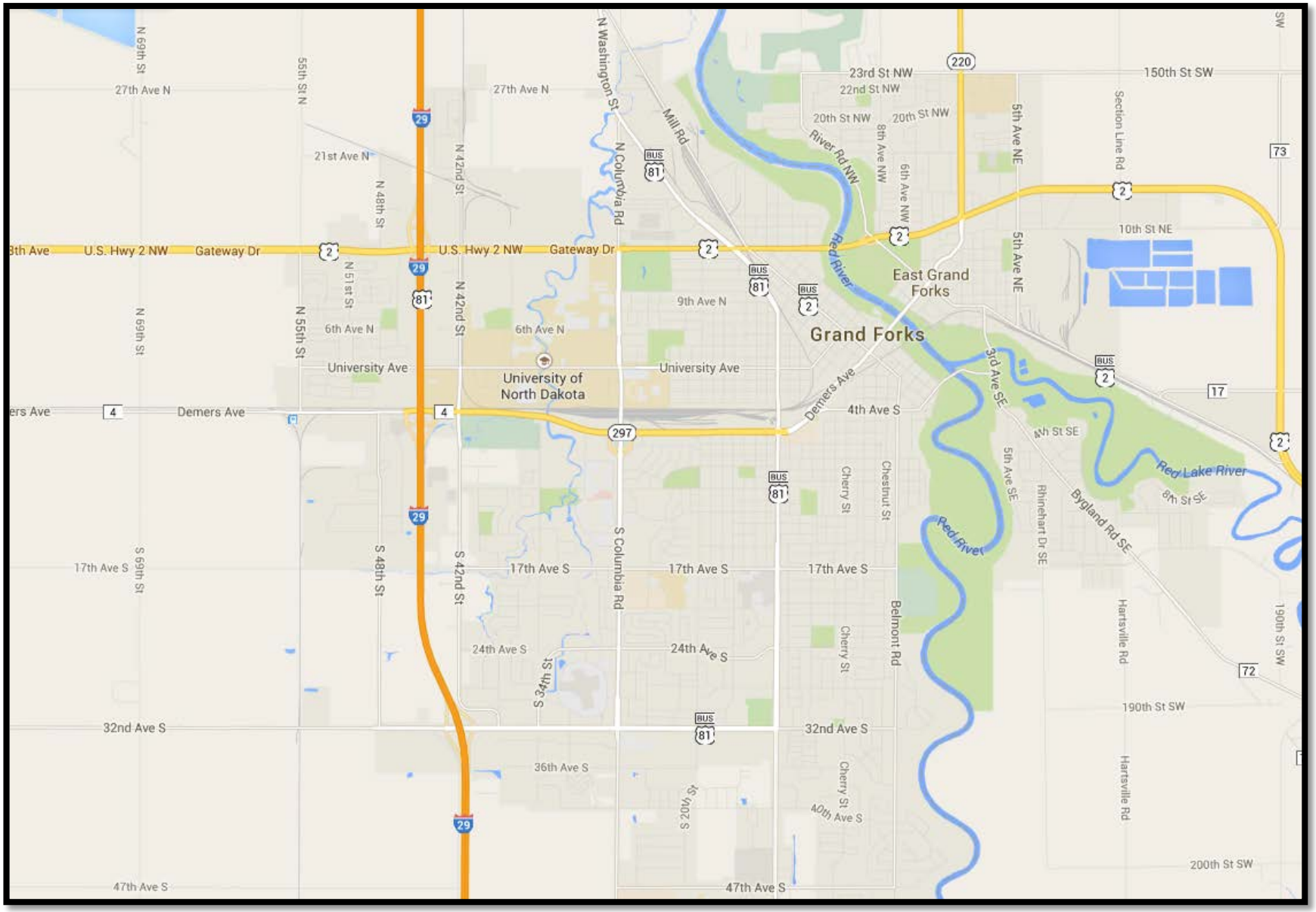


Figure 1. Map of the Grand Forks-East Grand Forks Area (Google)

3.0 STAKEHOLDERS

Stakeholders participating in the development of the GF-EGF RA included transportation, public works, law enforcement, emergency management, transit, and other related agencies. A regional ITS Core Group consisting of agencies who own/operate ITS elements or will do so in the future has the primary role of guiding the RA development.

Table 3.1 Grand Forks - East Grand Forks ITS Stakeholders

Stakeholder	Description	Associated Elements
GF-EGF MPO	Metropolitan Planning Organization	N/A
NDDOT GF District	NDDOT Grand Forks district	NDDOT District Vehicles
		NDDOT District DMS
		NDDOT District Cameras
		NDDOT District Office
EGF PW	East Grand Forks Public Works	EGF PW Operations Center
		EGF PW Field Devices
GF PD	Grand Forks Police Department	GF PD Vehicles
		GF PD DMS
EGF PD	East Grand Forks Police Department	EGF PD Vehicles
		EGF Dispatch Center
CAT	Cities Area Transit (CAT)	CAT Operations Center
		Transit Vehicles
		Traveler Card
		CAT System Operator
		CAT Drivers
MnDOT Dist 2	Minnesota DOT District 2	MnDOT D2 Vehicles
		MnDOT D2 Field Devices
		MnDOT D2 TOC
NDHP	North Dakota Highway Patrol	NDHP Vehicles
MSP	Minnesota State Patrol Crookston	MSP Vehicles
GF PW	Grand Forks Public Works	GF PW Operations Center
		GF PW Vehicles
		GF PW Field Devices
GF Engineering	GF Engineering agencies	GF TOC Field Devices
		GF TOC
Grand Forks	City of Grand Forks	PIC
Grand Forks	City of Grand Forks	PSAP
GF FD	Grand Forks Fire Department	GF FD Vehicles
EGF FD	East Grand Forks Fire Department	EGF FD Vehicles
Altru Ambulance	GF-EGF area ambulance service	Altru Ambulance Vehicles
ND Department of Emergency Services	North Dakota Department of Emergency Services	State Radio
GF Event Venus	Alerus Center, Ralph Engelstad Arena, other venues	Event Promoters

GF and Polk County Sheriffs	County Sheriff Departments	GF County Sheriff Office
		Polk County Sheriff Office
		GF County Sheriff Vehicles
		Polk County Sheriff Vehicles
GF and Polk County Highway Departments	County Highway Departments	GF County Operations Center
		Polk County Operations Center
		GF County Maintenance Vehicles
		Polk County Maintenance Vehicles

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 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 10 possible 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. Out of the 10 possible centers, 6 were found to apply to the GF-EGF RA. A representation of the GF-EGF area Physical Architecture is shown in Figure 2.

4.1.1 Traffic Management Center

The Traffic Management Center (subsystem) monitors and controls traffic and the road network. It communicates with the Roadway Subsystem to monitor and manage traffic flow and monitor the condition of the roadway, surrounding environmental conditions, and field equipment status. 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.

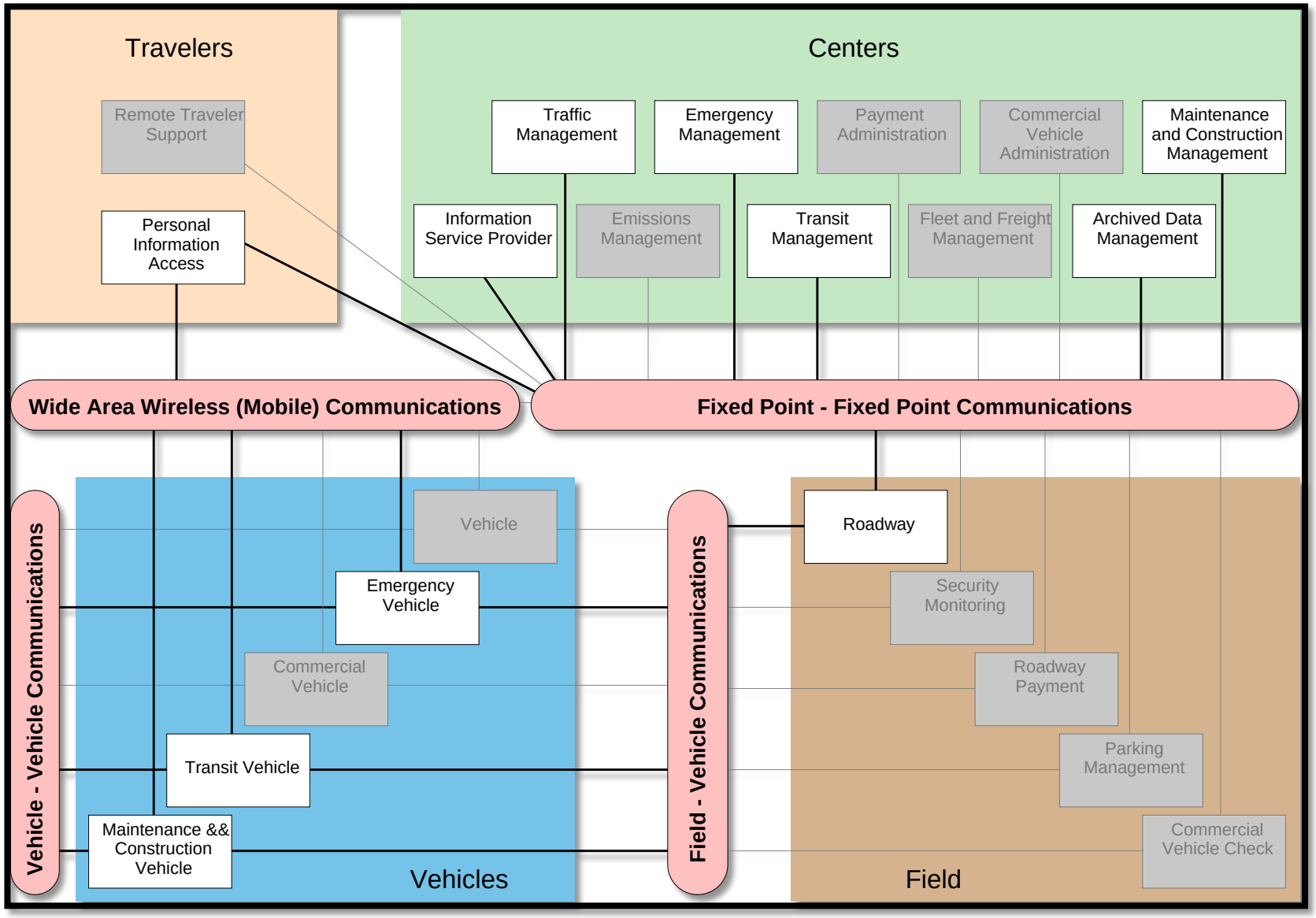


Figure 2. Grand Forks-East Grand Forks Physical Architecture

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 Centracs software. 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 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 preemption 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

4.2.3 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

Entity	ITS Element	Description	Status	Stakeholder
Emergency Management Subsystem	PSAP	Public Safety Answering Point	Existing	Grand Forks
	EGF Dispatch Center	East Grand Forks and Polk County dispatch	Existing	EGF PD
	State Radio	ND State Radio	Existing	ND Department of Emergency Services
	MSP Crookston	Minnesota State Patrol dispatch	Existing	MSP
	GF County Emergency Management	GF County Emergency Management Center	Existing	GF County
	Polk County Emergency Management	Polk County Emergency Management Center	Existing	Polk County
Emergency Vehicle Subsystem	GF FD Vehicles	Grand Forks Fire Department Vehicles	Existing	EGF FD
	EGF PD Vehicles	East Grand Forks Police Department Vehicles	Existing	EGF PD
	EGF FD Vehicles	East Grand Forks Fire Department Vehicles	Existing	EGF FD
	GF Sheriff Vehicles	GF County Sheriff Vehicles	Existing	GF County
	Polk Sheriff Vehicles	Polk County Sheriff Vehicles	Existing	Polk County
	NDHP Vehicles	NDHP vehicles	Existing	NDHP
	MSP Vehicles	Minnesota State Patrol Crookston vehicles	Existing	MSP
	Altru Ambulance Vehicles	Altru ambulance vehicles	Existing	Altru Ambulance
Maintenance and Construction Management Subsystem	GF PW Operations Center	Grand Forks Public Works operations	Existing	GF PW
	NDDOT District Office	NDDOT District maintenance and construction	Existing	NDDOT GF District
	EGF PW Operations Center	East Grand Forks Public Works operations	Existing	EGF PW
	MnDOT D2 Office	MnDOT District 2 Maintenance Operations Center	Existing	MnDOT Dist 2
	GF County Maintenance	GF County Highway Department	Existing	GF County
	Polk County Maintenance	Polk County Highway Department	Existing	Polk County
Maintenance and Construction Vehicle Subsystem	GF PW Vehicles	Grand Forks public works vehicles	Existing	GF PW
	NDDOT District Vehicles	NDDDOT maintenance and construction vehicles	Existing	NDDOT GF District

Maintenance and Construction Vehicle Subsystem	EGF PW Vehicles	East Grand Forks public works vehicles	Planned	EGF PW
	MnDOT D2 Vehicles	MnDOT District 2 maintenance and construction vehicles	Existing	MnDOT Dist 2
	GF County Maintenance Vehicles	GF Country Highway Department Vehicles	Planned	GF County
	Polk County Maintenance Vehicles	Polk County Highway Department Vehicles	Planned	Polk County
Roadway Subsystem	GF TOC Field Devices	Grand Forks area traffic sensors and control devices	Existing	GF Engineering
	GF-EGF Automated Treatment	Fixed automated spray technology for automated anti-icing. Fixed automated spray technology for automated anti-icing.	Planned	GF-EGF Maintenance Group
	NDDOT Cameras	NDDOT District surveillance cameras	Existing	NDDOT GF District
	NDDOT DMS	NDDOT District dynamic message signs	Existing	NDDOT GF District
	MnDOT D2 Field Devices	MnDOT District 2 sensors and control devices	Existing	MnDOT Dist 2
	GF PD DMS	Grand Forks Police dynamic message signs	Existing	GF PD
	GF Rail Detection and Information System	A system that would detect/monitor rail activity at specific roadway-rail intersections and provide information to travelers so they can take alternate routes.	Planned	GF Engineering
Traffic Management	GF TOC	Grand Forks area Traffic Operations Center	Existing	GF Engineering
	NDDOT GF Office	NDDOT GF District Traffic Operations	Existing	NDDOT GF
	MnDOT D2 Office	MnDOT D2 Traffic Operations	Existing	MnDOT D2
Transit Vehicle Subsystem	Transit Vehicles	CAT buses	Existing	CAT
Traveler Card	Traveler Card	CAT fare card	Existing	CAT
Information Service Provider	PIC	Public Information Center	Existing	Grand Forks
Transit Vehicle Operator	CAT Drivers	CAT bus drivers	Existing	CAT
Transit System Operators	CAT System Operator	CAT dispatch and operations personnel	Existing	CAT
Transit Management	CAT Operations Center	Cities Area Transit dispatch center	Existing	CAT
Alerting and Advisory Systems	State Radio	ND State Radio	Existing	ND Department of Emergency Services
Event Promoters	Event Promoters	Alerus Center, Ralph Engelstad Arena, other venues	Existing	GF Event Venus
Driver	Driver	Terminator	Existing	

Media	Media	Terminator	Existing	
Traffic	Traffic	Terminator	Existing	

5.0 NEEDS AND SERVICES

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

5.1 Needs

The ITS needs from the 2008 architecture were revisited and updated accordingly. The stakeholders were extensively involved in updating the status of ITS projects identified in the architecture as well as identifying new projects and applications given their experience over the past few years since the last update.

Transportation needs in the GF-EGF relevant to the RA development may be classified into the following major areas:

1. Improve traffic operations and safety
    a. Peak-period traffic management
    b. Special events traffic management
    c. Work-zone and road construction management
    d. Winter weather impact management
    e. School traffic circulation and safety
2. Enhance traveler information and customer service
3. Enhance transit operations to improve service and increase transit use
4. Coordinate emergency and security management

5.2 Services

ITS services were identified by mapping regional transportation needs to the National ITS Architecture. Stakeholders assisted in customizing potential ITS User Services and corresponding service packages to reflect regional needs. Subsection 5.2.1 provides a summary of the ITS User Services identified for the GF-EGF area, while Subsection 5.2.2 outlines the GF-EGF area's Service Packages.

5.2.1 GF-EGF ITS User Services

1. Travel and Traffic Management

1.1.Pre-trip Travel Information: Assist travelers in making mode choices, travel time estimates, and route decisions prior to trip departure.

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

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

1.7. Incident Management: Detect incidents, formulate response actions, and support initiation and ongoing coordination of response actions.

1.10. Highway Rail Intersection: Control highway and rail traffic in at-grade crossings.

2. Public Transportation Management

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

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

5. Emergency Management

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

7. Information Management

7.1. Archived Data Function: Control the archiving and distribution of ITS data.

8. Maintenance and Construction Management

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

5.2.2 GF-EGF Service Packages

The following service packages were identified for the GF-EGF area in support of needs and services. The descriptions are based on the National ITS Architecture. The status of each service package in the GF-EGF area is also indicated (i.e., existing or planned). An Existing * status indicates the Service Package is not fully deployed. Customized GF-EGF service packages and their Information Flows are shown in more detail in **Appendix A**.

AD1: ITS Data Mart (Planned)

This service package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.

ATMS01: Network Surveillance (Existing)

This service package includes traffic detectors, other surveillance equipment, supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally, such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends

data back to the Traffic Management Subsystem). The data generated by this 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.

ATMS03: Traffic Signal Control (Existing)

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

ATMS06: Traffic Information Dissemination (Existing *)

This service package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, emergency alerts and driver advisories. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media, Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real-time information on road/bridge closures due to maintenance and construction activities to be disseminated.

ATMS08: Traffic Incident Management System (Existing *)

This service package manages both unexpected incidents and planned events so the impact to the transportation network and traveler safety is minimized. It 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 event promoters. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between center subsystems. Incident response also includes presentation of information to affected travelers. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds.

ATMS13: Standard Railroad Grade Crossing (Existing)

This service package manages highway traffic at highway-rail intersections (HRIs) where speeds are below 80 mph, using passive and active warning

systems. Traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated upon notification by wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities.

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

This service package will track the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

MC05: Roadway Automated Treatment (Planned)

This service package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The service package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated.

MC06: Winter Maintenance (Existing)

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.

APTS01: Transit Vehicle Tracking (Existing)

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. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider.

APTS02: Transit Fixed-Route Operations (Existing)

This service package performs vehicle routing and scheduling, as well as automatic operator assignment and system monitoring for fixed-route and flexible-route transit services. This service determines current schedule performance using AVL data and provides information displays at the Transit Management Subsystem.

APTS03: Demand Response Transit Operations

This service package performs automated dispatch and system monitoring for demand responsive transit services. This service performs scheduling activities as well as operator assignment. In addition, this service package performs similar functions to support dynamic features of flexible-route transit services. This package monitors the current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. This service includes the capability for a traveler request for personalized transit services to be made through the Information Service Provider (ISP) Subsystem. The ISP may either be operated by a transit management center or be independently owned and operated by a separate service provider.

APTS04: Transit Fare Collection Management (Existing)

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. Readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem.

APTS05: Transit Security (Existing)

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

APTS06: Transit Fleet Management (Existing)

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 Subsystem. Hardware and software in the Transit Management Subsystem 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.

APTS08: Transit Traveler Information (Planned)

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.

APTS09: Transit Signal Priority (Existing)

This service package determines the need for transit priority on routes and at certain intersections and requests transit vehicle priority at these locations. The signal priority may result from limited local coordination between the transit vehicle and the individual intersection for signal priority or may result from coordination between transit management and traffic management centers. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network.

APTS10: Transit Passenger Counting (Existing)

This service package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.

EM01: Emergency Call-Taking and Dispatch (Existing)

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

EM02: Emergency Routing (Existing)

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

Em06: Wide-Area Alert (Existing)

This service package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in

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

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.

After the service packages were approved by the stakeholders, relevant changes were entered into Turbo Architecture. Turbo was used to generate the operational concept for each Service Package based on National ITS Architecture conventions. The operational concept report generated by Turbo focuses on roles and responsibilities pertaining to system operations and does not include implementation roles.

The following two subsections outline the roles and responsibilities developed for the GF-EGF area. Subsection 6.1 shows implementation roles and responsibilities, arranged by service package. Subsection 6.2 summarizes operational roles and responsibilities, organized by stakeholders.

6.1 Implementation Roles

Service Packages	Stakeholders with Implementation Roles
ITS Data Mart	GF, NDDOT
Network Surveillance	NDDOT, GF, EGF
Traffic Signal Control	GF Engineering, MnDOT
Traffic Information Dissemination	NDDOT, GFPD, PIC
Traffic Incident Management System	NDDOT, MnDOT, GF Engineering, GFPD, CAT
Standard Railroad Grade Crossing	GF Engineering, EGF Engineering, MnDOT
Maint. & Const. Vehicle Tracking	GP Public Works, NDDOT
Roadway Automated Treatment	NDDOT
Winter Maintenance	GF Public Works, EGF Public Works, MnDOT, NDDOT
Transit Vehicle Tracking	CAT
Transit Fixed-Route Operations	CAT
Demand Response Transit Operations	CAT
Transit Fare Collection Management	CAT
Transit Security	CAT, GFPD
Transit Fleet Management	CAT
Transit Traveler Information	CAT
Transit Signal Priority	CAT, GF Engineering
Transit Passenger Counting	CAT
Emergency Call-Taking and Dispatch	GF Police, EGF Police, GF County Sheriff, EGF County Sheriff, NDHP, MSP
Emergency Routing	GF Engineering, EGF Engineering, MnDOT
Wide-Area Alert	GF PD, EGF PD, NDHP, MSP

6.2 Operational Roles and Responsibilities

Responsibility Area	Stakeholder	Role
Architecture Management	GF-EGF MPO	1. Maintain the RA 2. Create policies for RA use 3. Monitor RA use for change triggers
Emergency Management	EGF PD	1. Coordinate with other emergency management 2. Provide 9-1-1 and dispatch services for East Grand Forks and Polk county
	Grand Forks	1. Coordinate with other emergency management 2. Provide 9-1-1 and dispatch services in Grand Forks and GF County
	MSP	1. Coordinate with other emergency management 2. Provide dispatch for MSP
	ND Department of Emergency Services	1. Issue Amber Alerts 2. Provide dispatch for NDHP
Incident Management	Altru Ambulance	Provide ambulance service
	EGF FD	1. Respond to incidents in EGF 2. Respond to incidents in EGF
	EGF PW	Provide resources
	GF FD	1. Respond to incidents in GF 2. Display incident and traffic information to travelers via portable DMS
	GF PW	Provide resources
	Grand Forks	1. Provide dispatch and communications 2. Provide incident information
	MnDOT Dist 2	Provide resources
	MSP	Respond to incidents on Minnesota state system
	ND Department of Emergency Services	Provide dispatch and communications to NDHP
	NDDOT GF District	Provide resources
	NDHP	Respond to incidents on ND state system
	GF County Sheriff	Respond to incidents in GF county

Incident Management	Polk County Sheriff	Respond to incidents in Polk county
	GF and Polk County Emergency Management	Activate emergency management centers in response to large scale incidents when needed
	CAT	Provide resources (vehicles for evacuation)
Maintenance and Construction	EGF PW	1. EGF city system road maintenance 2. Winter maintenance (snow plow operations, sanding, anti icing) in EGF
	GF PW	1. GF city system road maintenance 2. Winter maintenance (snow plow operations, sanding, anti icing) in GF
	MnDOT Dist 2	1. MN state system road maintenance 2. Winter maintenance (snow plow operations, sanding, anti icing) on MN state system
	NDDOT GF District	1. ND state system road maintenance 2. Winter maintenance (snow plow operations, sanding, anti icing) in ND state system
	GF County Highway Department	1. GF county road maintenance 2. Winter maintenance (snow plow operations, sanding, anti icing) on GF county roads
	Polk County Highway Department	1. Polk county road maintenance 2. Winter maintenance (snow plow operations, sanding, anti icing) on Polk county roads
Surface Street Management	GF Engineering	1. Design, operate, and maintain signal control in GF 2. Operate TOC
	MnDOT Dist 2	Design, operate, and maintain signal control in EGF
Transit Services	CAT	Provide transit fixed route and demand response operations for the GF-EGF area

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. Service package
    a. The service package 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

(This space was intentionally left blank)

Service Packages	Purpose	Stakeholders	Issues
ATMS01-Network Surveillance	Share data	GF Engineering EGF Engineering NDDOT-Grand Forks Dist.	Access to sensors Access to databases Access to networks
ATMS08-Traffic 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
EM02-Emergency Routing	Metro-wide pre-emption	GF Engineering EGF Engineering MnDOT District 2	Hardware compatibility

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. Turbo Architecture was used to build the functional requirements and produce a Functional Requirements Report.

The organization of the Functional Requirements Report produced by Turbo may be described as follows:

1. Element: Subsystems or Centers in the regional architecture
2. Entity
3. Functional Area
4. Requirements
5. Status

Due to the length of the Functional Requirements Report, it is included in Appendix B. An example of the information provided in the report is provided below.

Grand Forks-East Grand Forks Regional ITS Architecture (Region)
Element: **CAT Operations Center**
Entity: **Transit Management**
Functional Area: **Transit Vehicle Tracking**
Monitoring transit vehicle locations via interactions with on-board systems. Furnish usurers with real-time transit schedule information and maintain interface with digital map providers.

Requirement: 1 The center shall monitor the locations of all transit vehicles within its network. Existing

Functional Area: **Transit Fixed Route Operations**
Management of fixed route transit operations. Planning, scheduling, and dispatch associated with fixed route transit services. Updates customer service operator systems, and provides current vehicle schedule adherence and optimum scenarios for schedule adjustment.

Requirement: 5 The center shall collect transit operational data for use in the generation of routes and schedules. Existing

Requirement: 9 The center shall exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc. 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 table below shows applicable standards for the GF-EGF RA based on Turbo Architecture output.

Standard Name	Document ID
Traffic Management Data Dictionary and Message Sets for External TMC Communication	ITE TMDD 2.1
NTCIP Center-to-Center Standards Group	NTCIP 1102 NTCIP 1104 NTCIP 2104 NTCIP 2202 NTCIP 2303 NTCIP 2304 NTCIP 2306
NTCIP Center-to-Field Standards Group	NTCIP 1102 NTCIP 1103 NTCIP 2101 NTCIP 2102 NTCIP 2103 NTCIP 2104 NTCIP 2201 NTCIP 2202 NTCIP 2301 NTCIP 2302 NTCIP 2303
Global Object Definitions	NTCIP 1201
Object Definitions for Actuated Traffic Signal Controller Units	NTCIP 1202
Object Definitions for Dynamic Message Signs	NTCIP 1203
Object Definitions for Environmental Sensor Stations & Roadside Weather Information System	NTCIP 1204
Data Collection and Monitoring Devices	NTCIP 1206
Objects for Signal Systems Master	NTCIP 1210
Objects Definitions for Signal Control and Prioritization (SCP)	NTCIP 1211
Standard for Transit Communications Interface Profiles	APTA TCIP-S-001 3.0.0
Dedicated Short Range Communication at 915 MHz Standards Group	ASTM E2158-01 ASTM PS 105-99
Incident Management Standards Group	IEEE 1512 -2006 IEEE 1512.1-2006 IEEE 1512.2-2004

	IEEE 1512.3-2006 IEEE P1512.4
Message Sets for External TMC Communication (MS/ETMCC)	ITE TM 2.01
Advanced Traveler Information Systems (ATIS) General Use Standards Group	SAE J2266 SAE J2354 SAE J2540 SAE J2540/1 SAE J2540/2 SAE J2540/3
Dedicated Short Range Communication at 5.9 GHz Standards Group	ASTM E2213-03 IEEE 1609.1-2006 IEEE 1609.2-2006 IEEE 1609.4-2006 IEEE P1609.3 IEEE P802.11p

10.0 PROJECTS SEQUENCE

This section briefly outlines possible time frame for deployment for selected ITS projects in the GF-EGF area. Service Packages are arranged into short, medium, and long-term deployment categories. It should be noted that not all of the planned services for the GF-EGF area have been fully developed into ITS projects yet. Please note that Service Packages are organized in the same order they appear in the National ITS Architecture.

In the following table, Service Packages are arranged into ongoing (already deployed), short (0-3 years), medium (3-6 years), and long-term (6-15 years) deployment categories.

Service Packages/ITS Project	Time Frame
ITS Data Mart	Short-Medium
Network Surveillance	Ongoing
Surface Street Control	Ongoing
Traffic Information Dissemination	Short
Traffic Incident Management System	Short-Medium
Standard Railroad Grade Crossing	Ongoing
Maintenance Vehicle Tracking	Ongoing
Roadway Automated Treatment	Long
Winter Maintenance	Ongoing
Transit Vehicle Tracking	Ongoing
Transit Fixed-Route Operations	Ongoing
Demand Response Transit Operations	Ongoing
Transit Fare Collection Management	Ongoing
Transit Traveler Information	Short
Transit Security	Ongoing
Transit Fleet Management	Ongoing
Transit Signal Priority	Ongoing
Transit Passenger Counting	Ongoing
Emergency Call-Taking and Dispatch	Ongoing
Emergency Routing	Ongoing
Wide-Area Alert	Ongoing
Unified Emergency Signal Preemption and Transit Signal Priority for GF and EGF	Medium
Train Detection and Notification	Long

10.1 Planning and the Regional ITS Architecture

This section ties service packages from the RA to goals and objectives identified in other MPO planning efforts.

Objective 1. Safety

Description: To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.

Source: Long Range Transportation Plan

Associated Service Packages:

ATMS08: Traffic Incident Management System

ATMS13: Standard Railroad Grade Crossing

Objective 2. Infrastructure Condition

Description: To maintain the highway infrastructure asset system in a state of good repair.

Source: Long Range Transportation Plan

Associated Service Packages:

MC01: Maintenance and Construction Vehicle and Equipment Tracking

MC06: Winter Maintenance

Objective 3. Congestion Reduction

Description: To achieve a significant reduction in congestion

Source: Long Range Transportation Plan

Associated Service Packages:

ATMS01: Network Surveillance

ATMS03: Traffic Signal Control

ATMS13: Standard Railroad Grade Crossing

Objective 4. System Reliability

Description: To improve the efficiency of the surface transportation system

Source: Long Range Transportation Plan

Associated Service Packages:

ATMS01: Network Surveillance

ATMS03: Traffic Signal Control

ATMS06: Traffic Information Dissemination

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 two years if needed or upon the deployment of a major ITS project 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

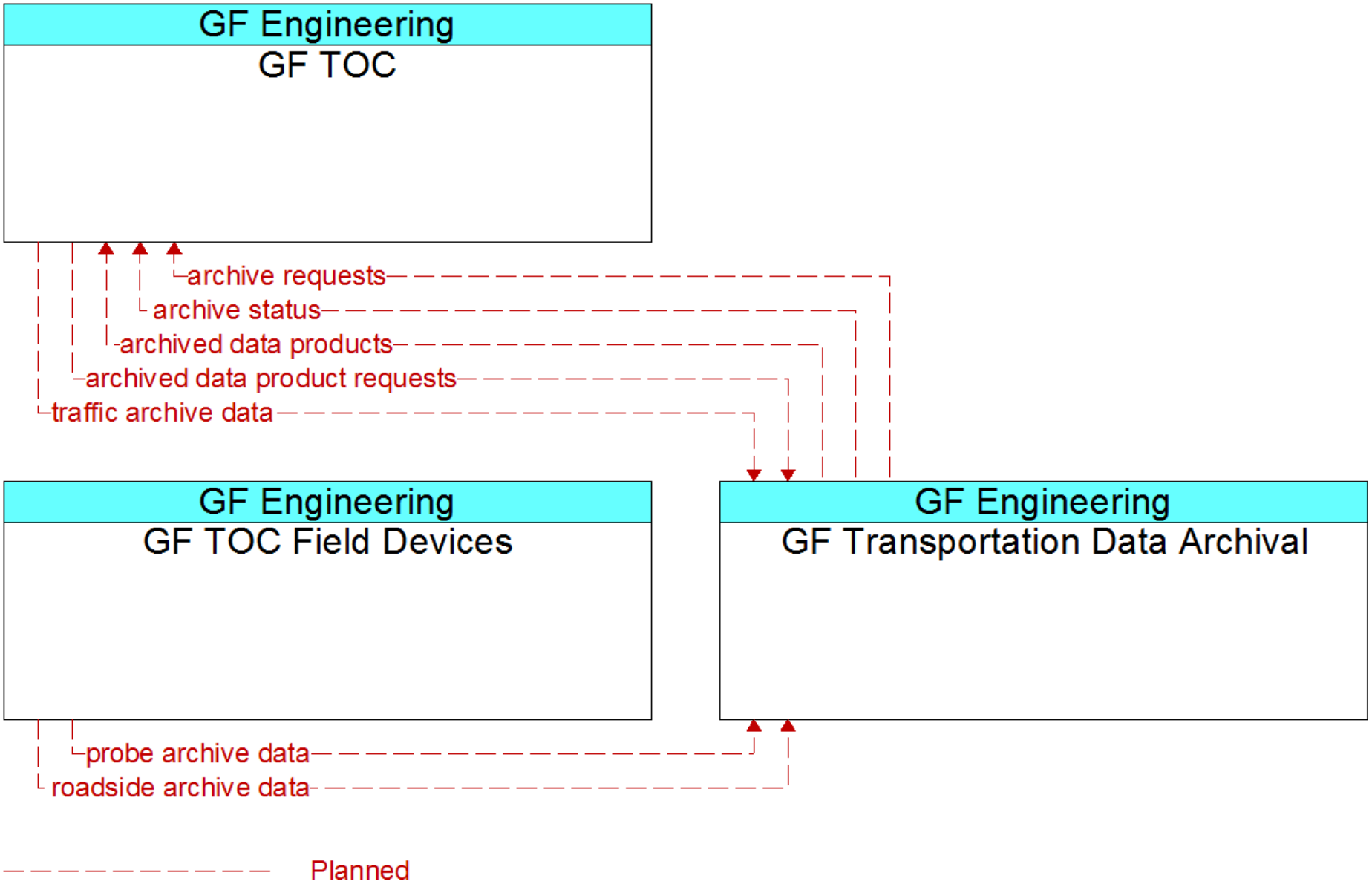
GRAND FORKS-EAST GRAND FORKS SERVICE PACKAGES AND INFORMATION FLOWS

The Service Package Diagrams are available electronically at:

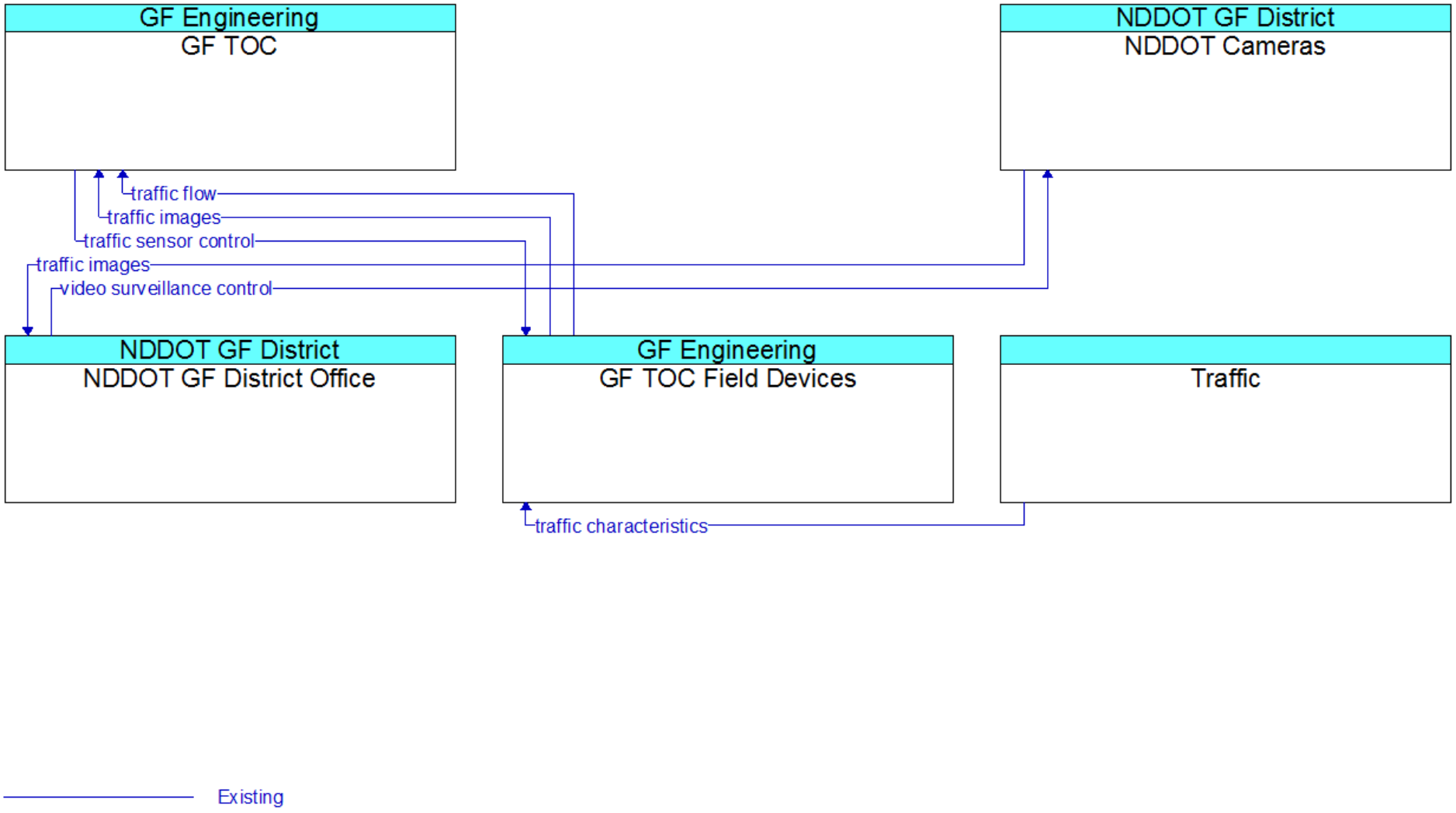
http://www.atacenter.org/regional/grandforks

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

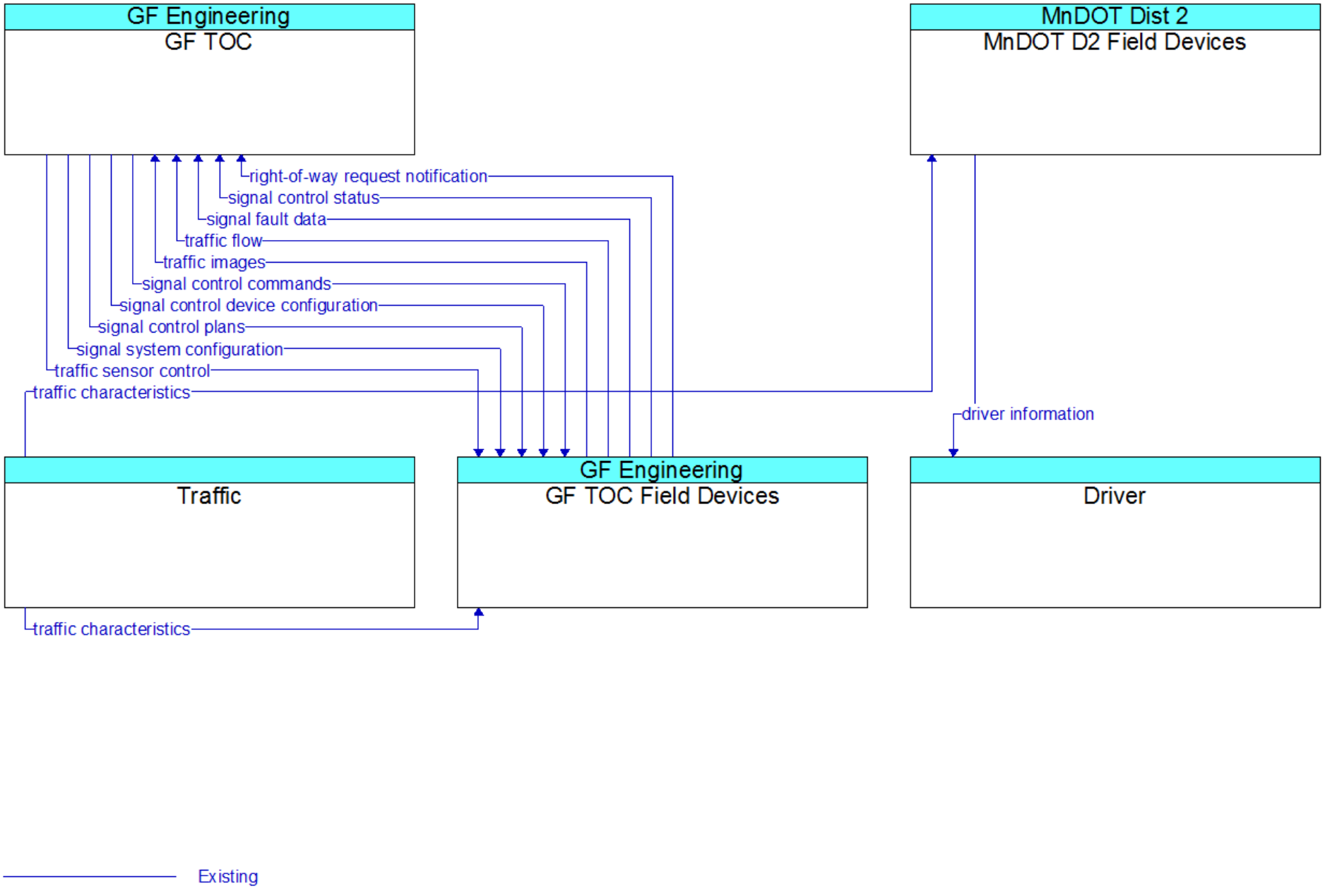
AD1 ITS Data Mart



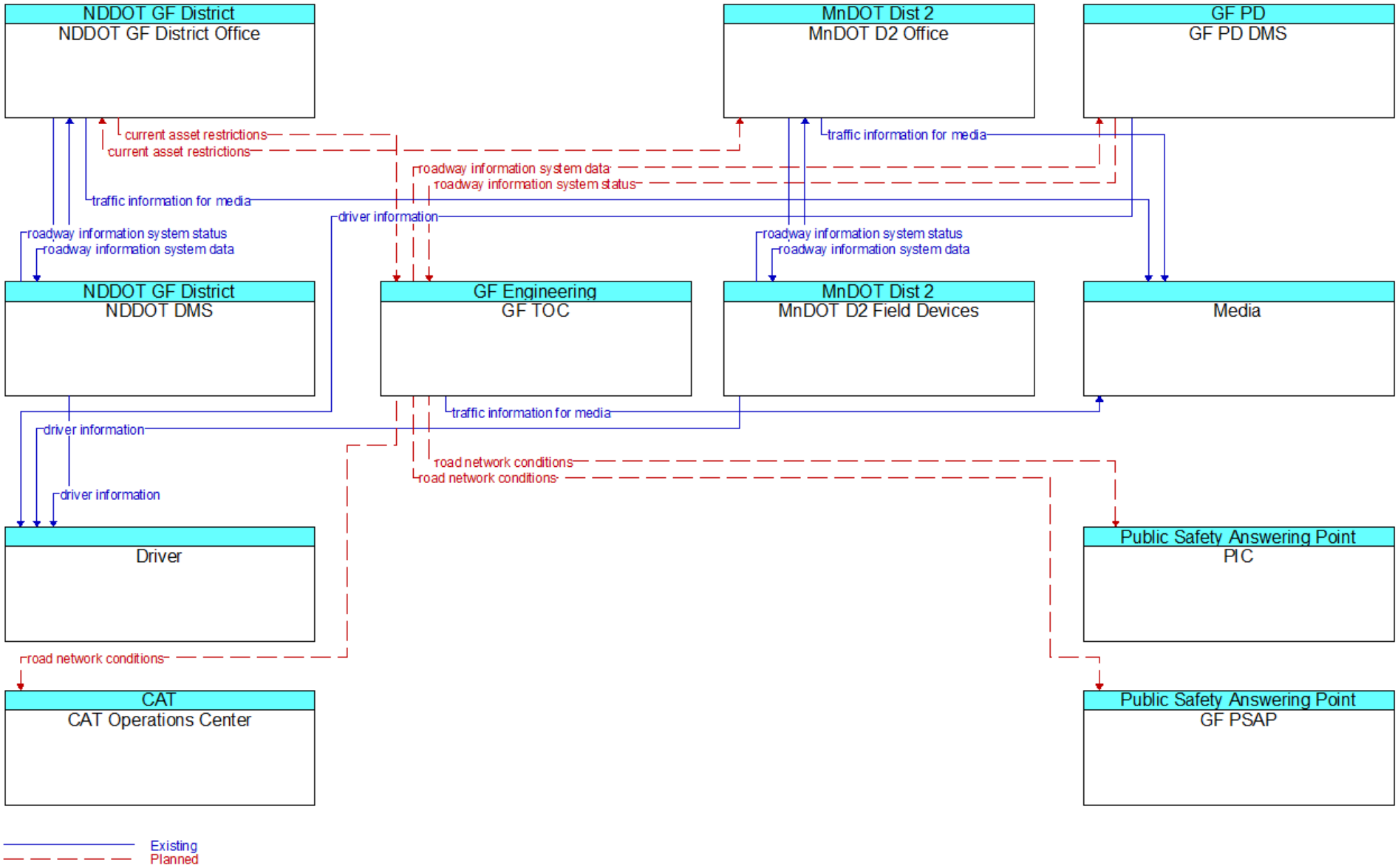
ATMS01 Network Surveillance



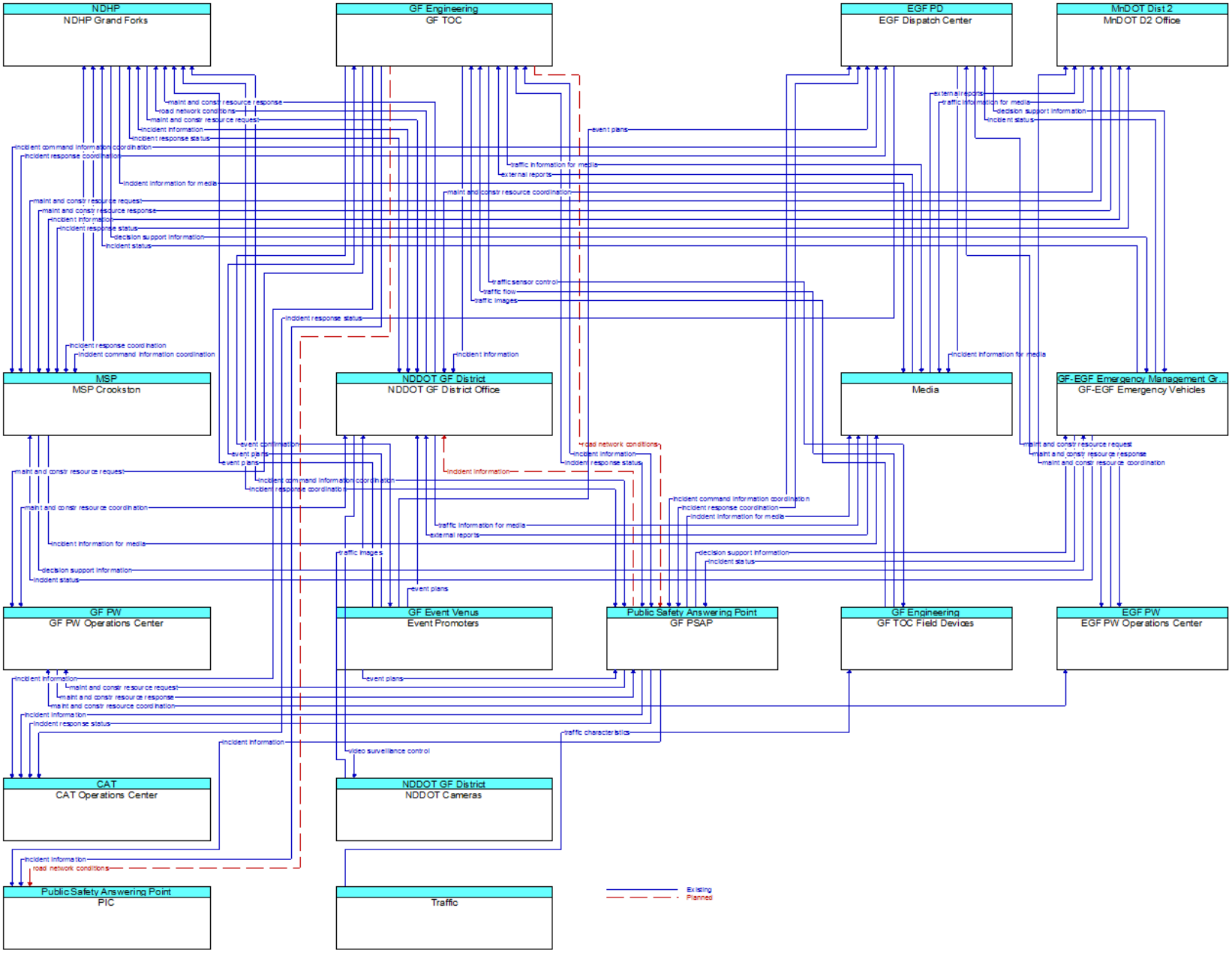
ATMS03 Traffic Signal Control



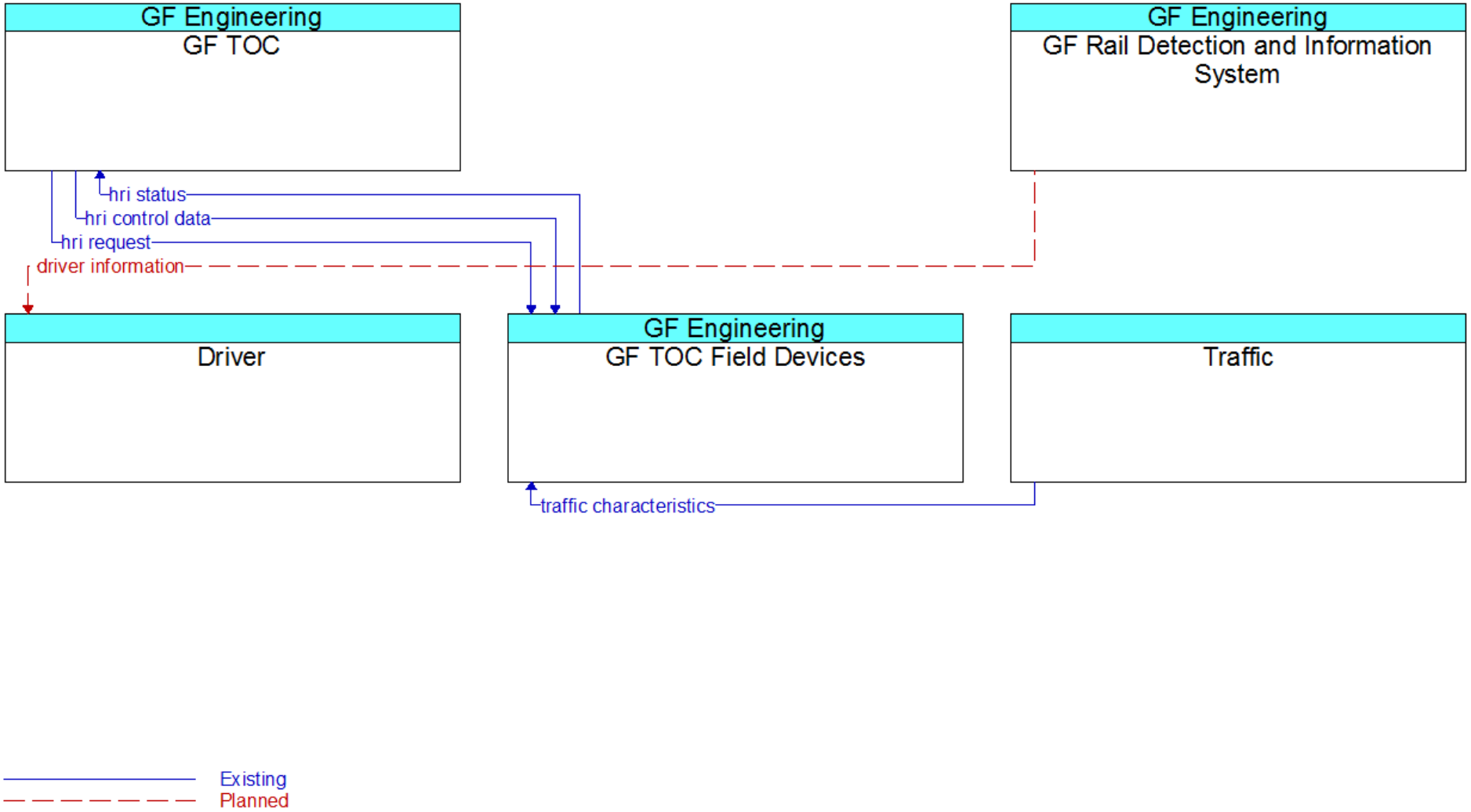
ATMS06 Traffic Information Dissemination



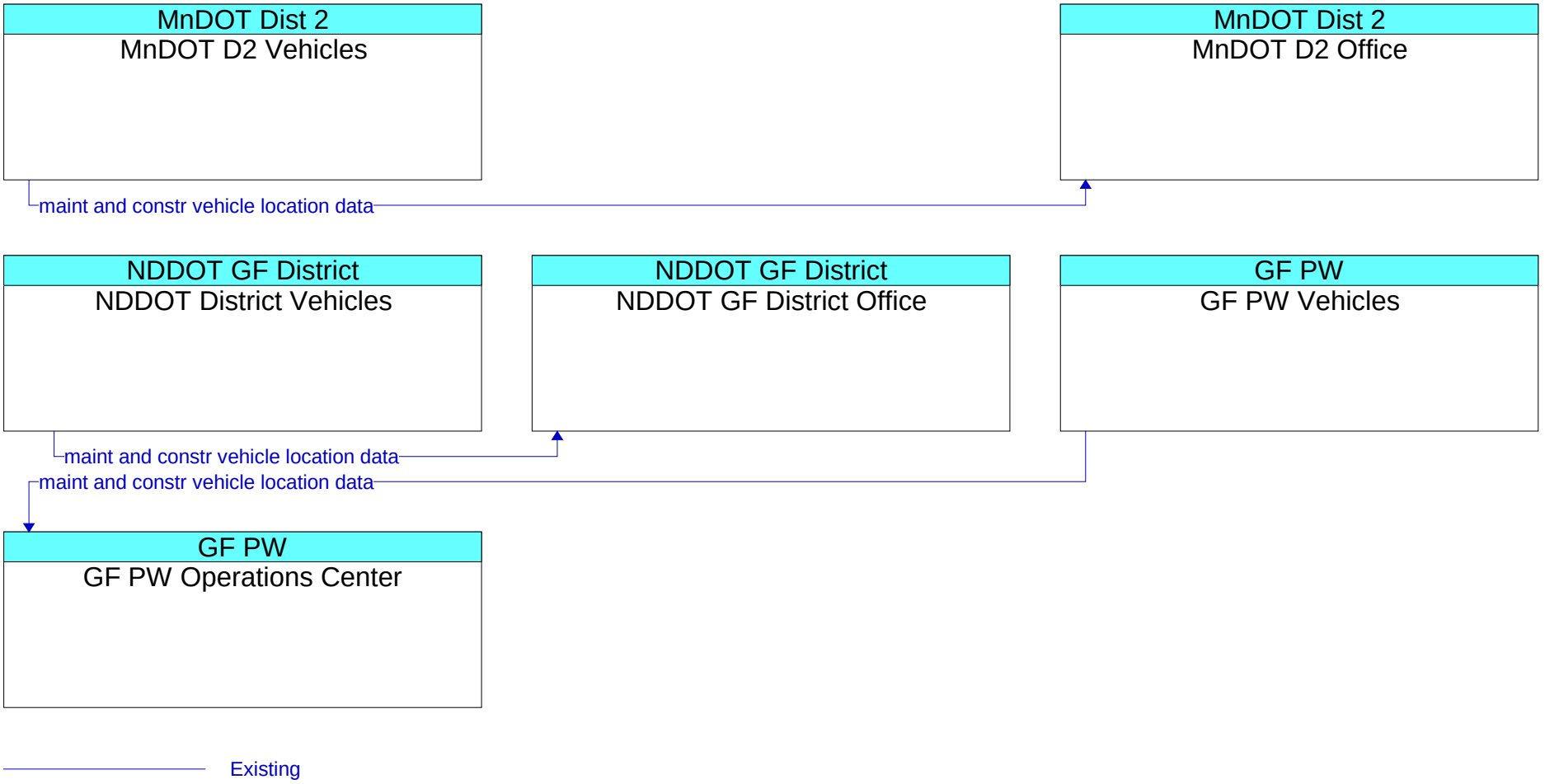
ATMS08 Traffic Incident Management



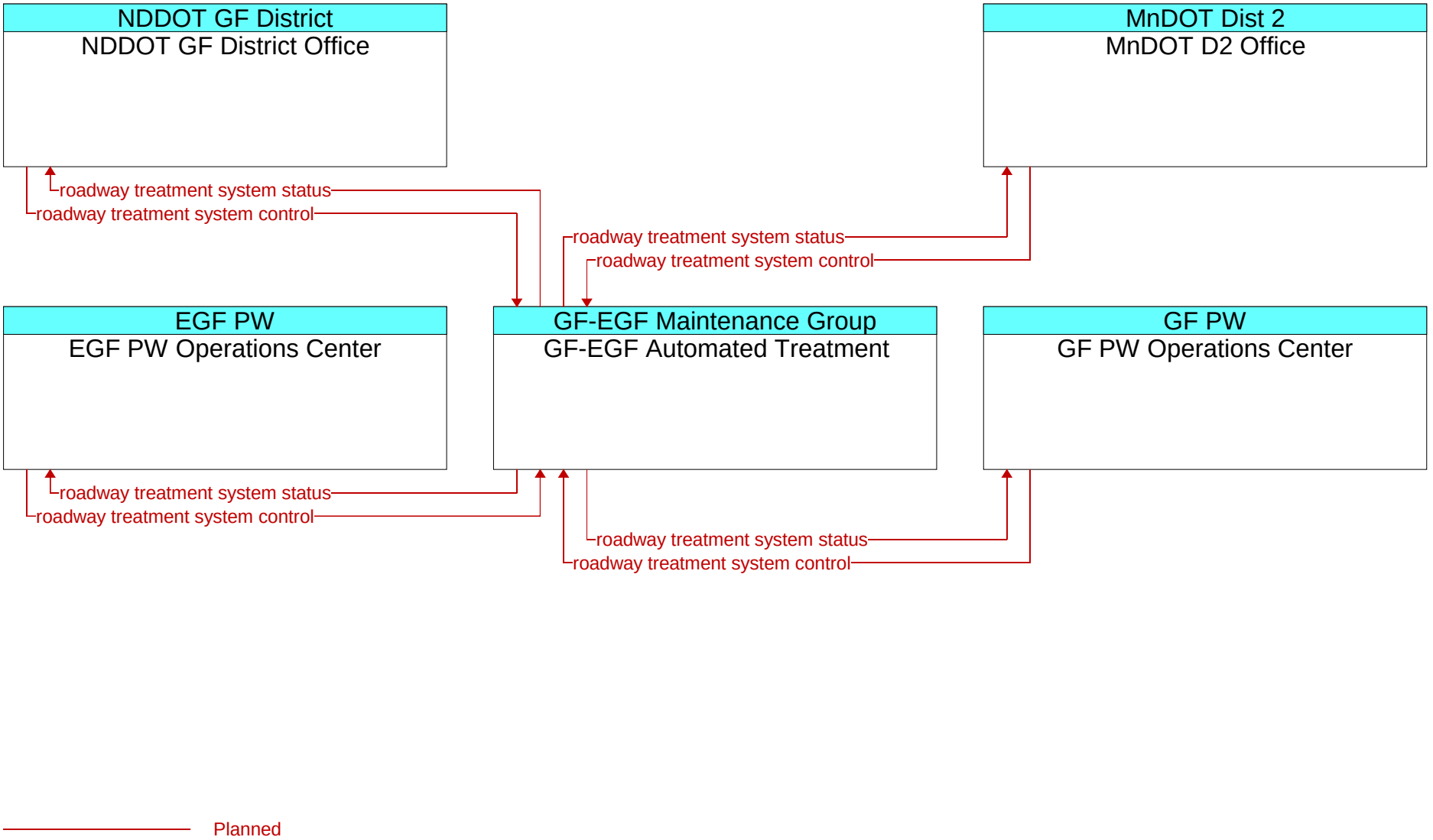
ATMS13 Standard Railroad Grade Crossing



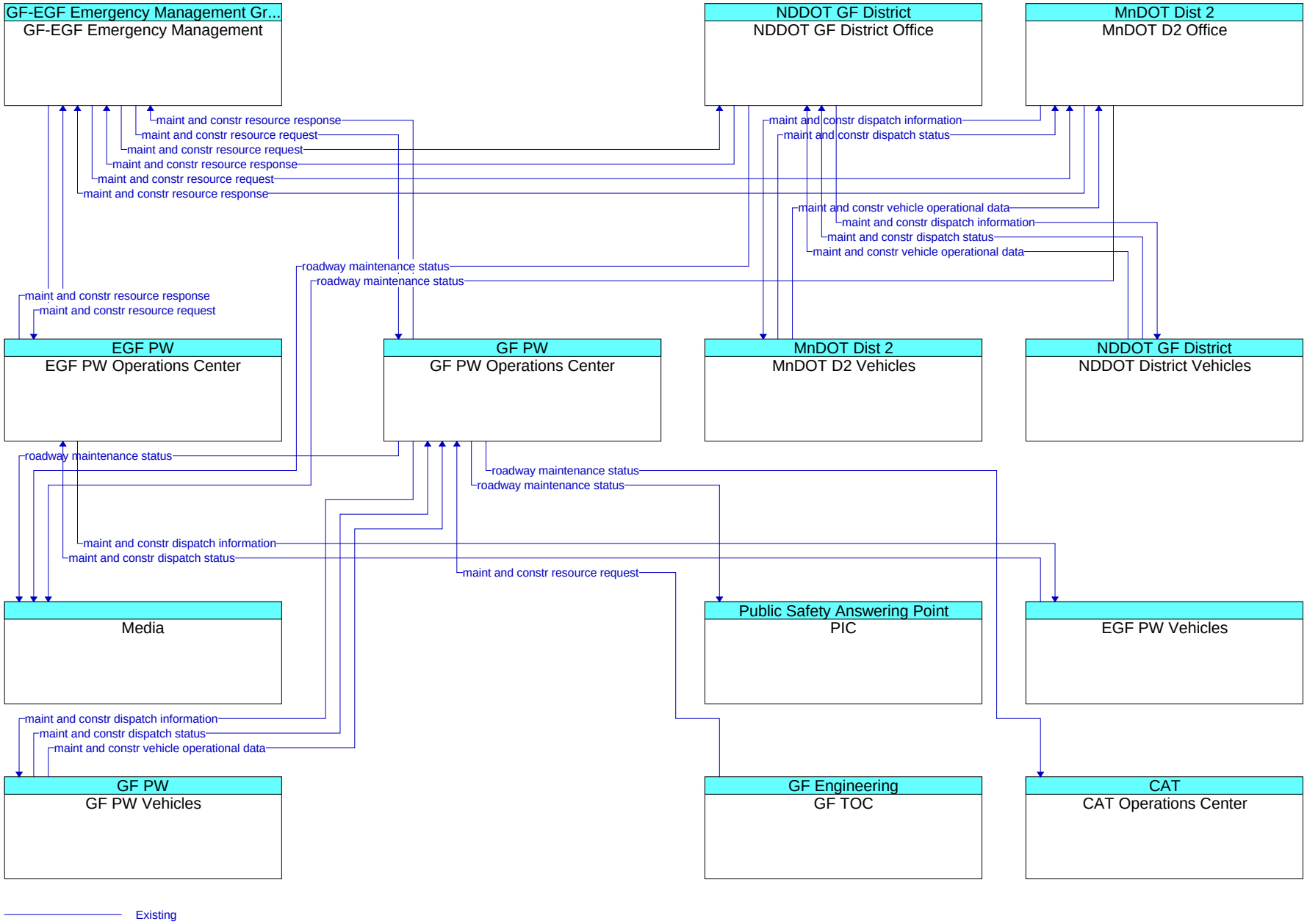
MC01 Maintenance and Construction Vehicle Tracking



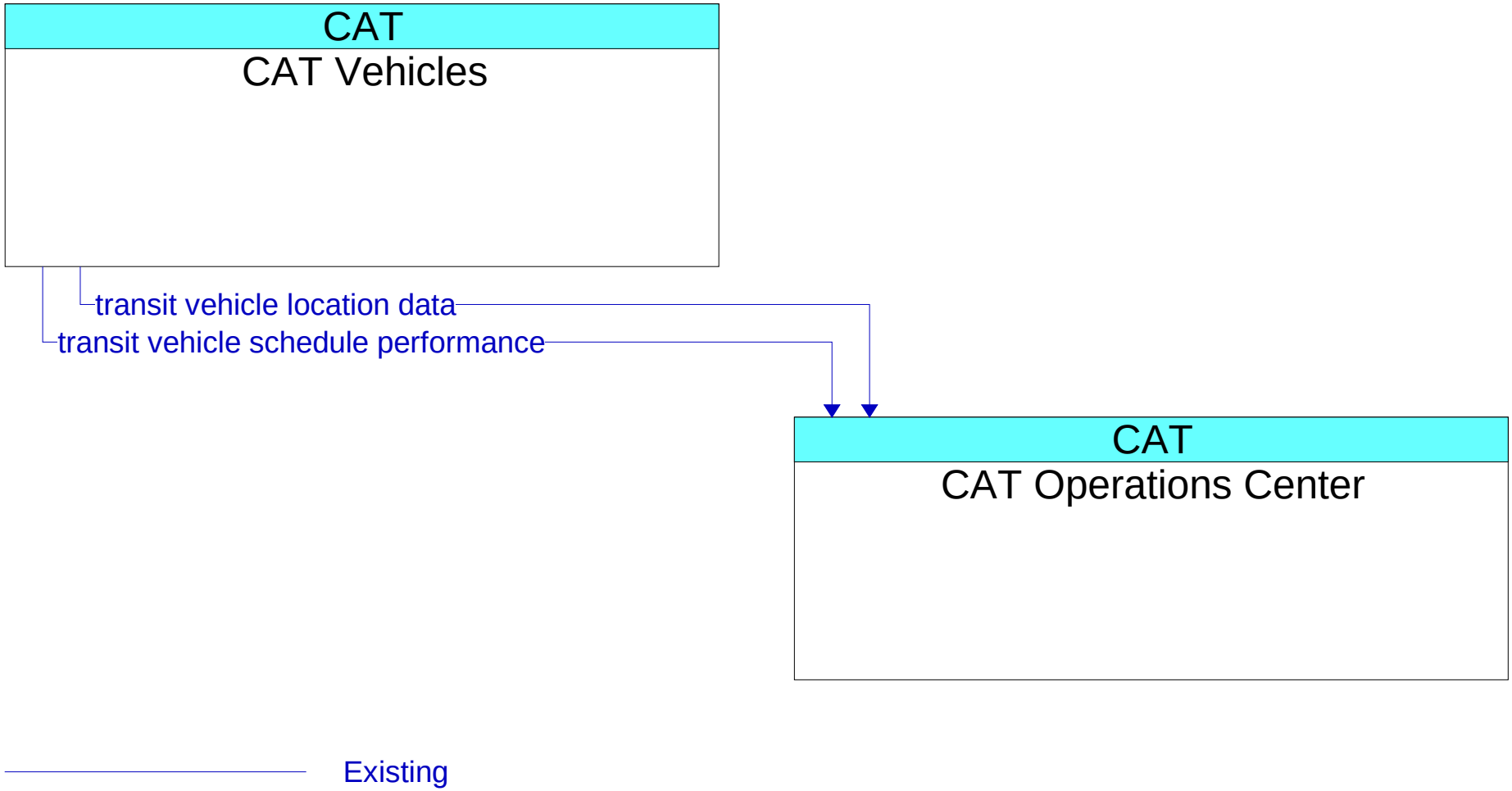
MC05 Roadway Automated Treatment



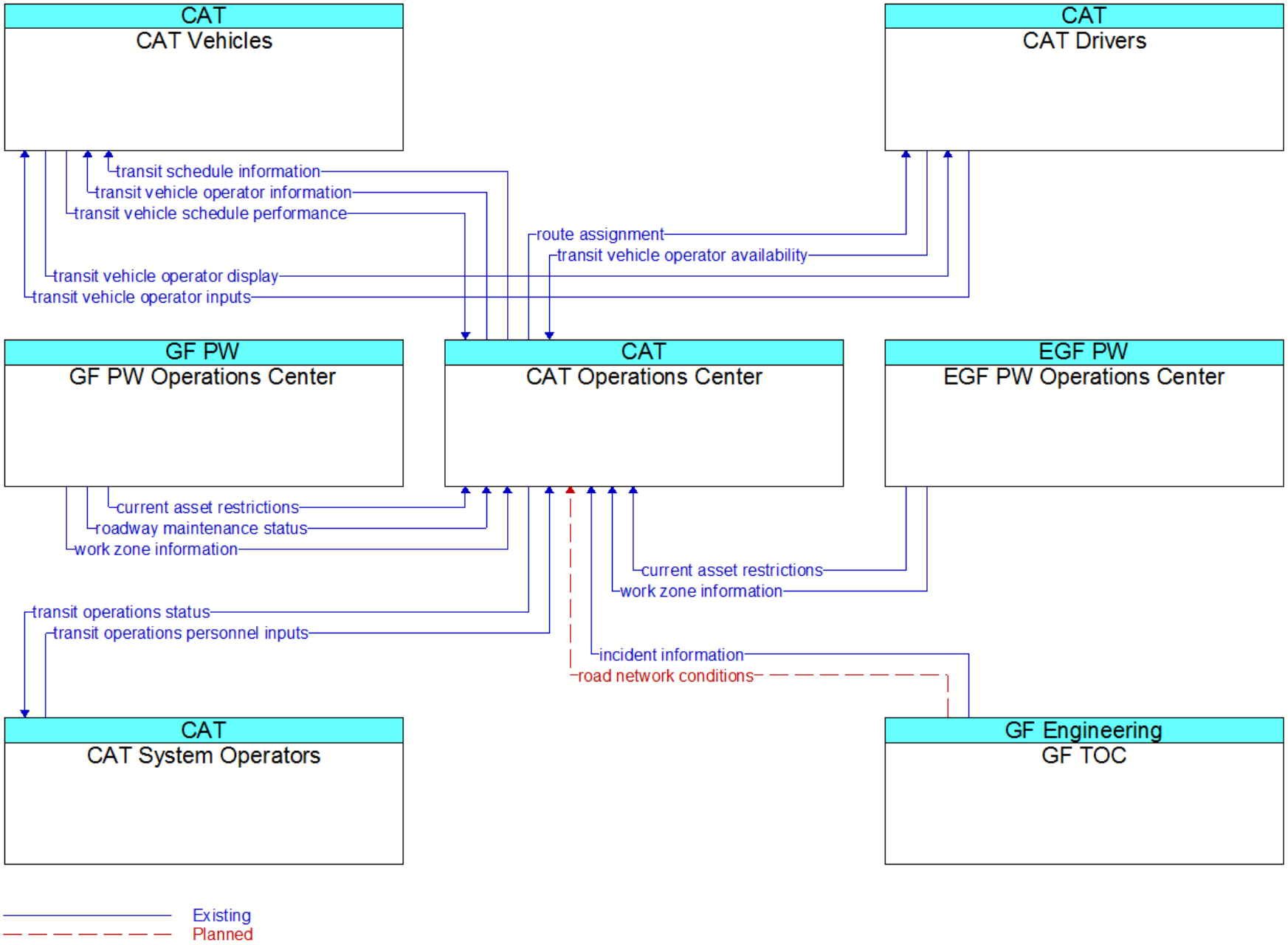
MC06 Winter Maintenance



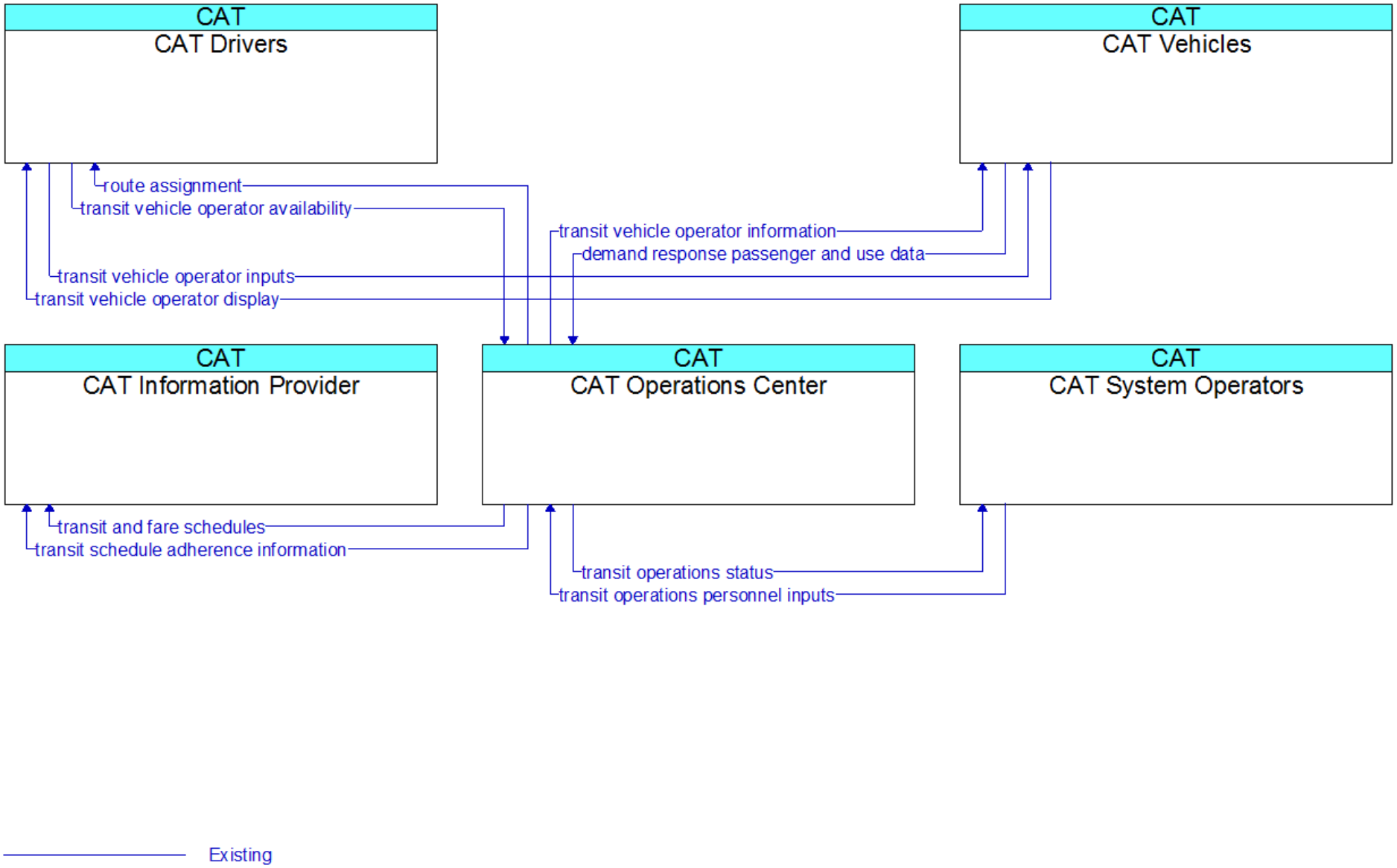
APTS01 Transit Vehicle Tracking



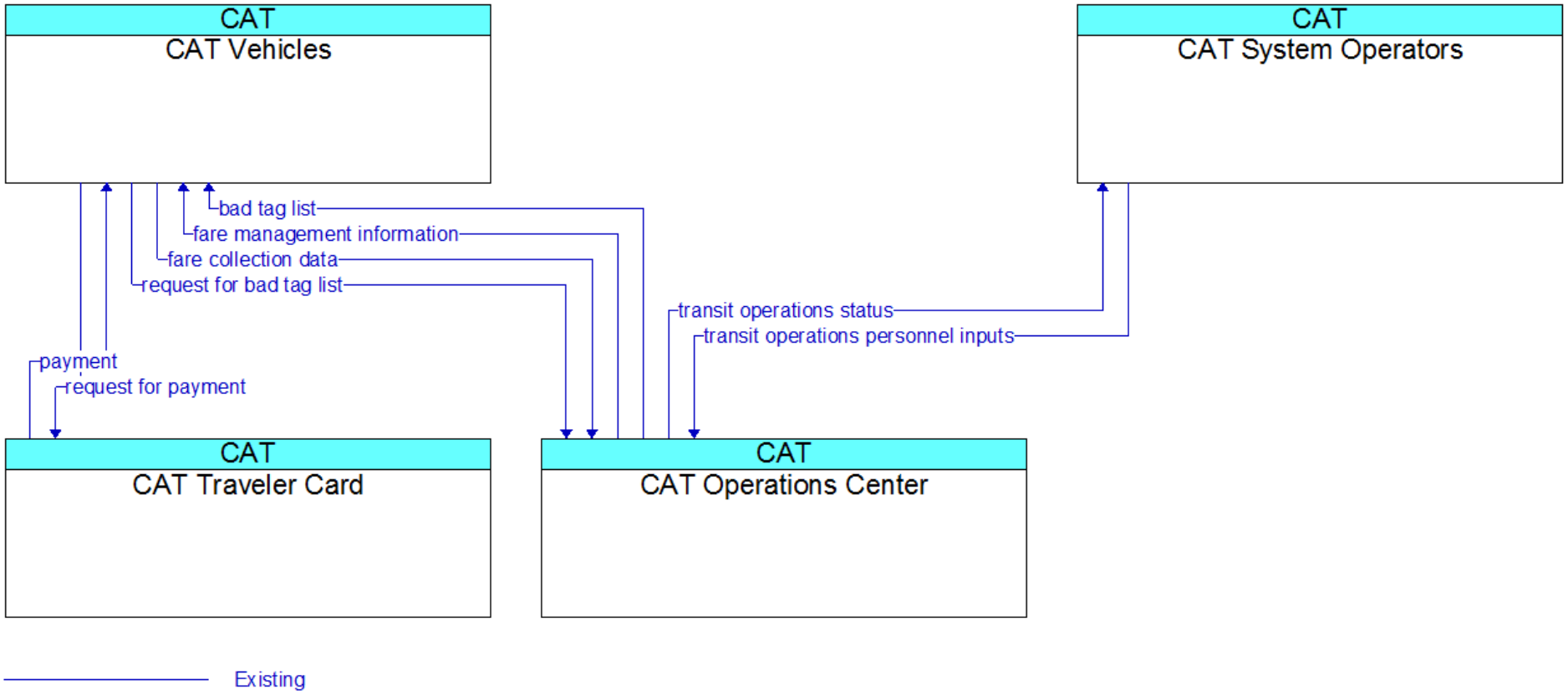
APTS02 Transit Fixed Route Operations



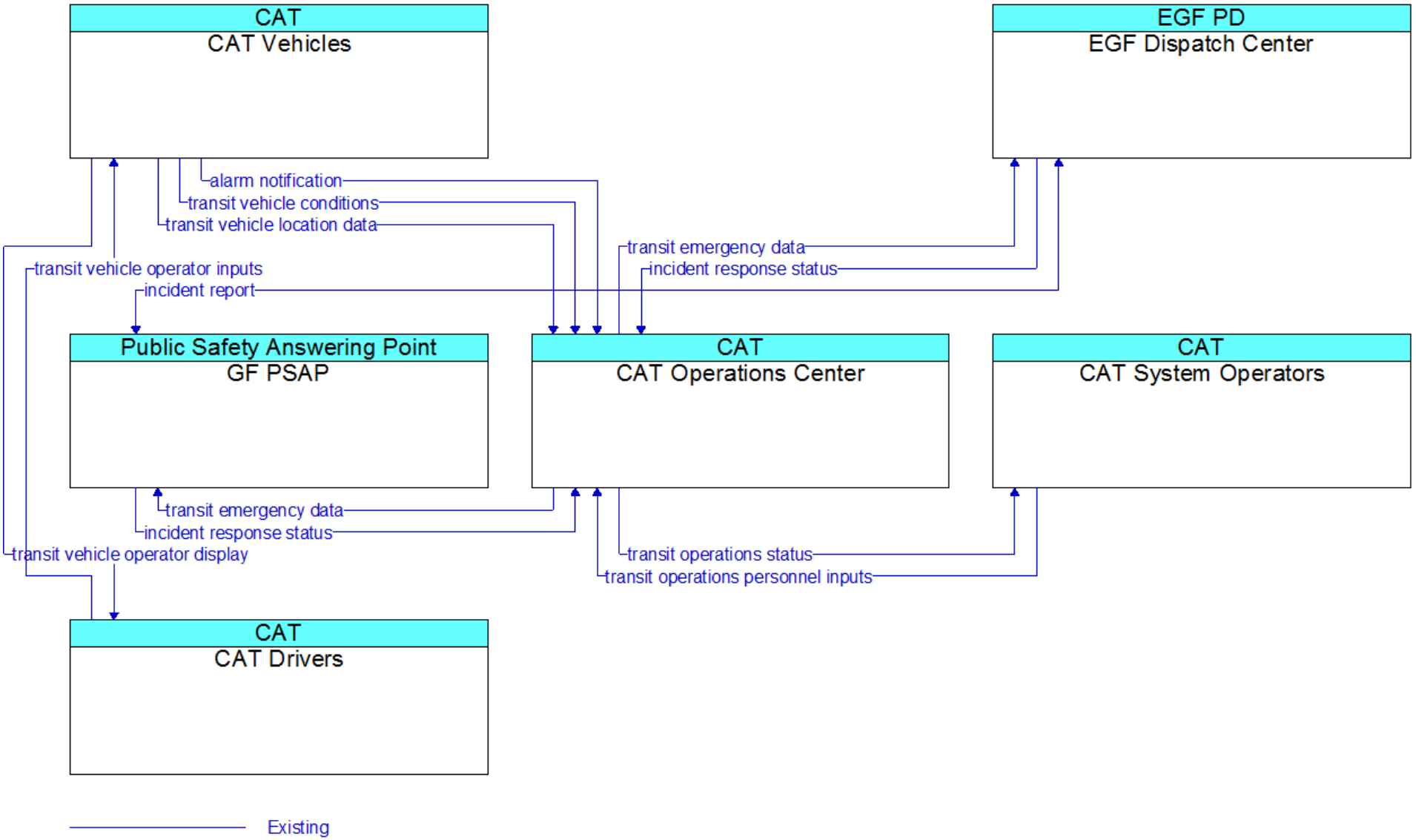
APTS03 Demand Response Transit Operations



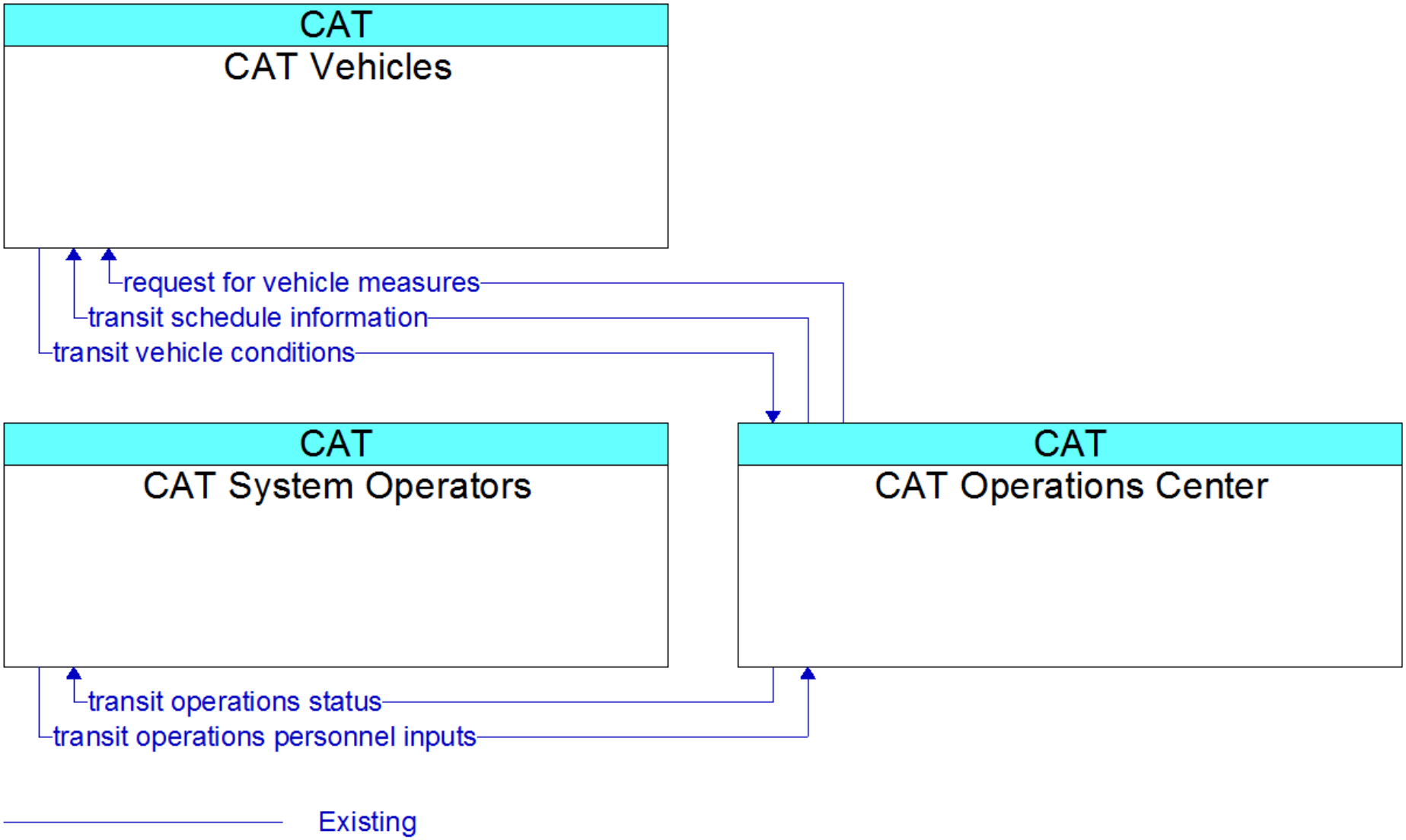
APTS04 Transit Fare Collection Management



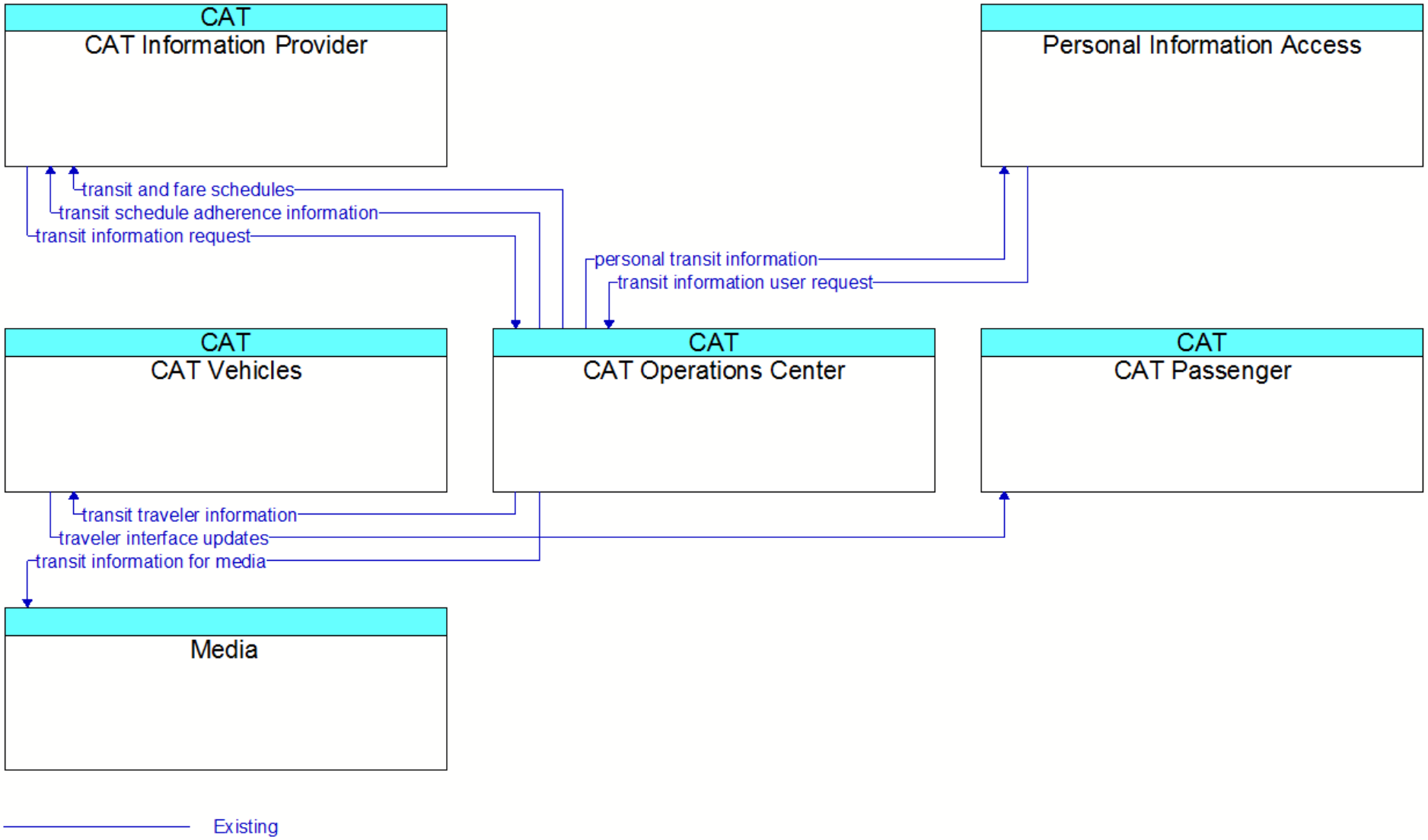
APTS05 Transit Security



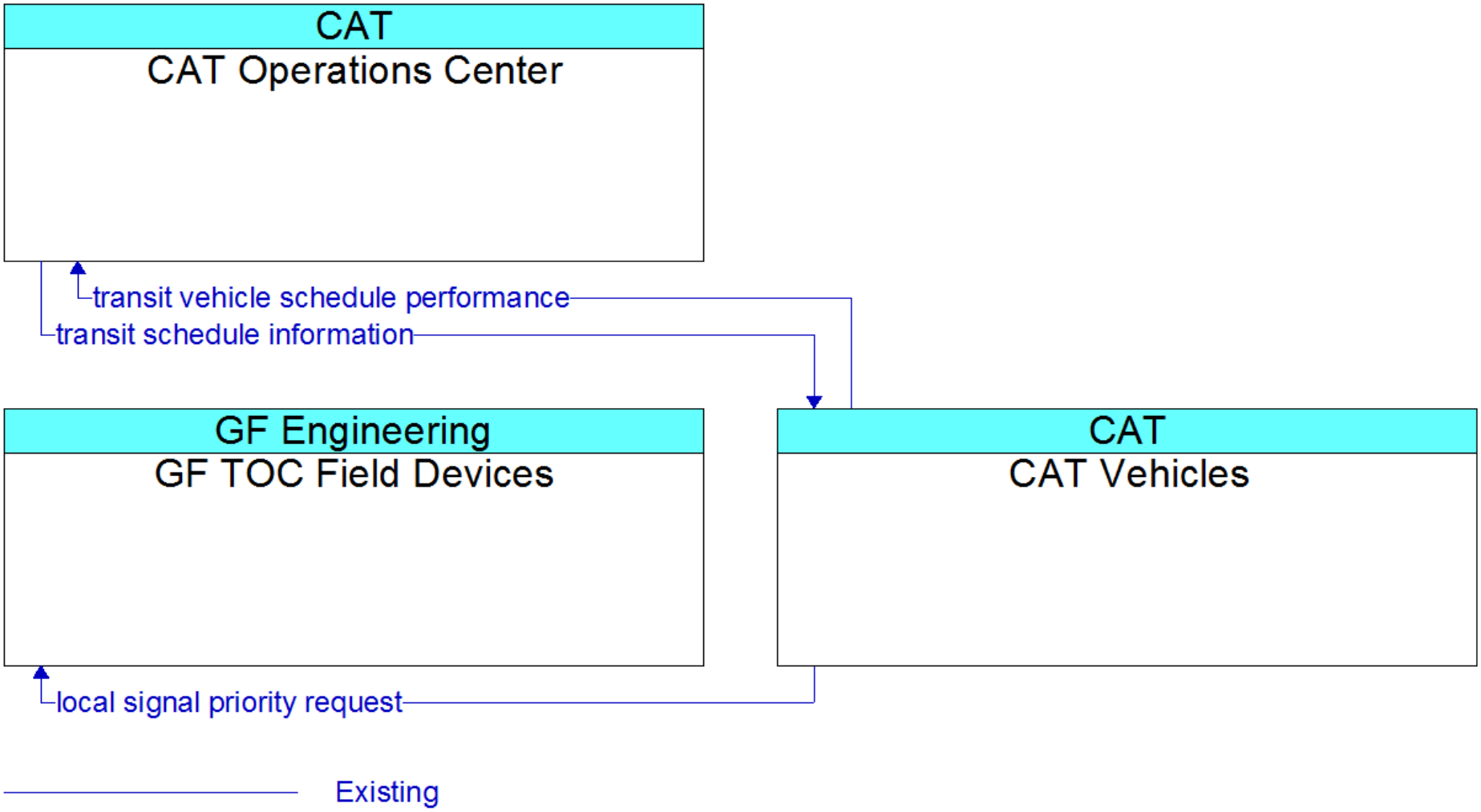
APTS06 Transit Fleet Management



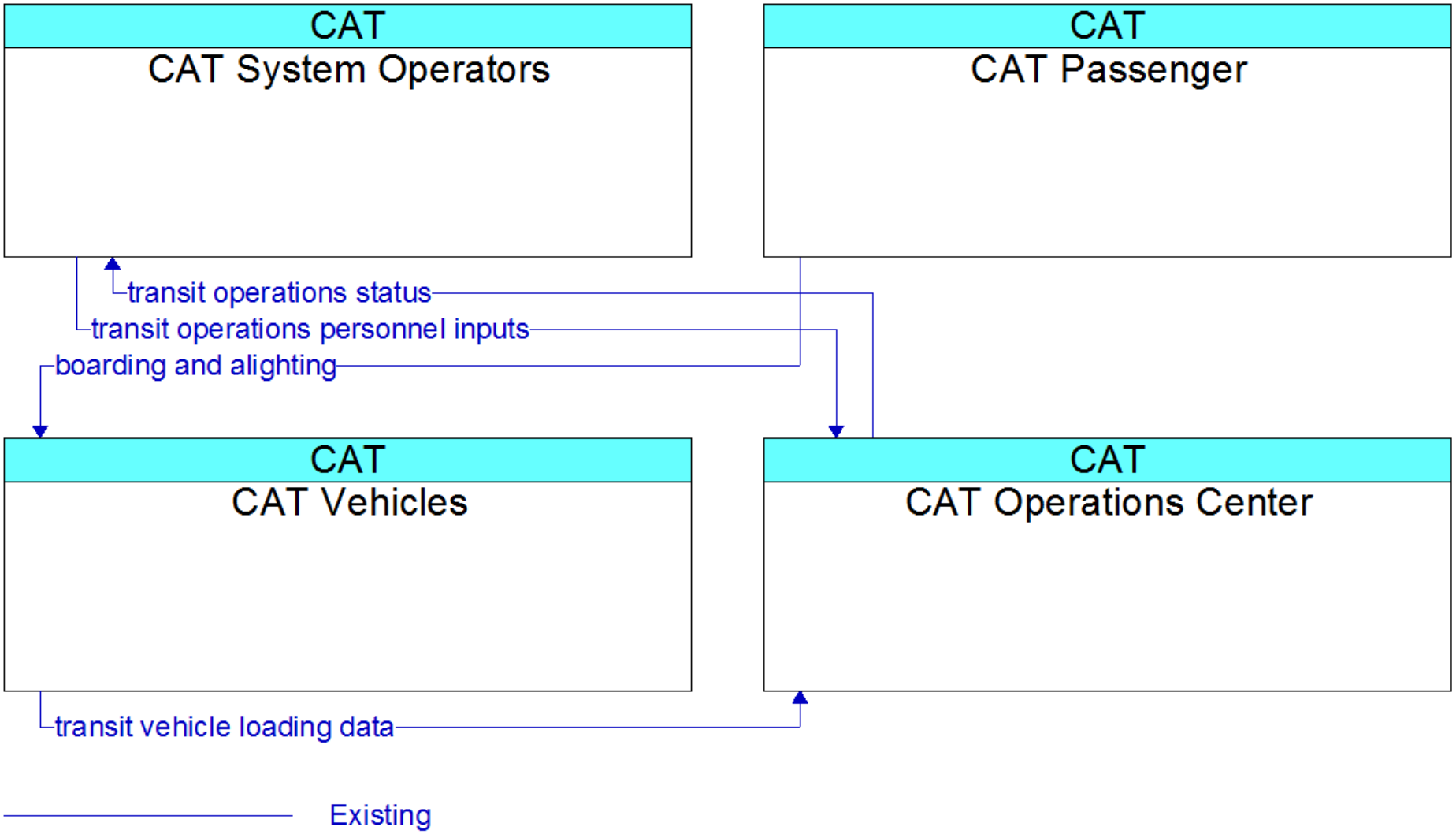
APTS08 Transit Traveler Information



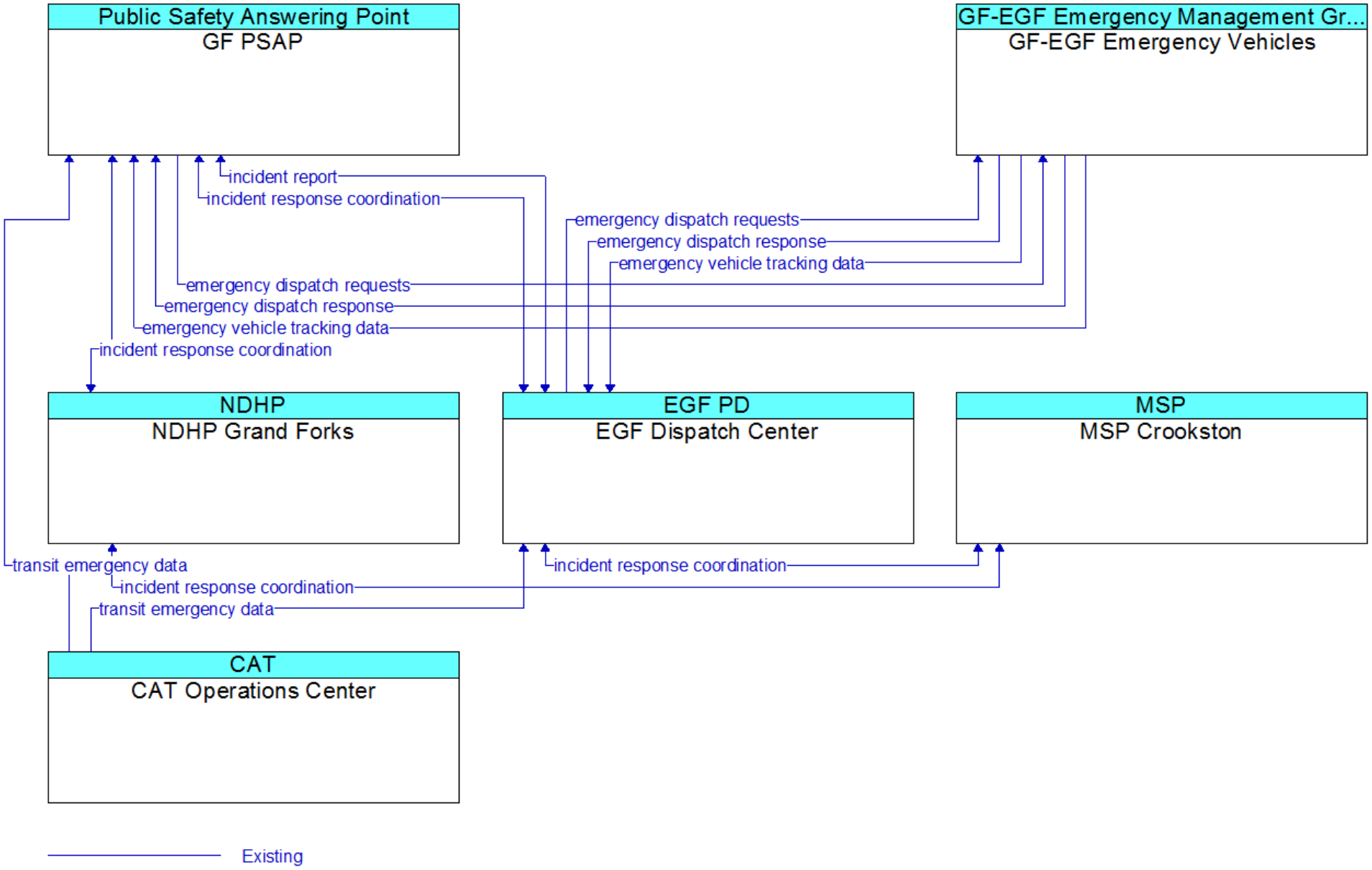
APTS09 Transit Signal Priority



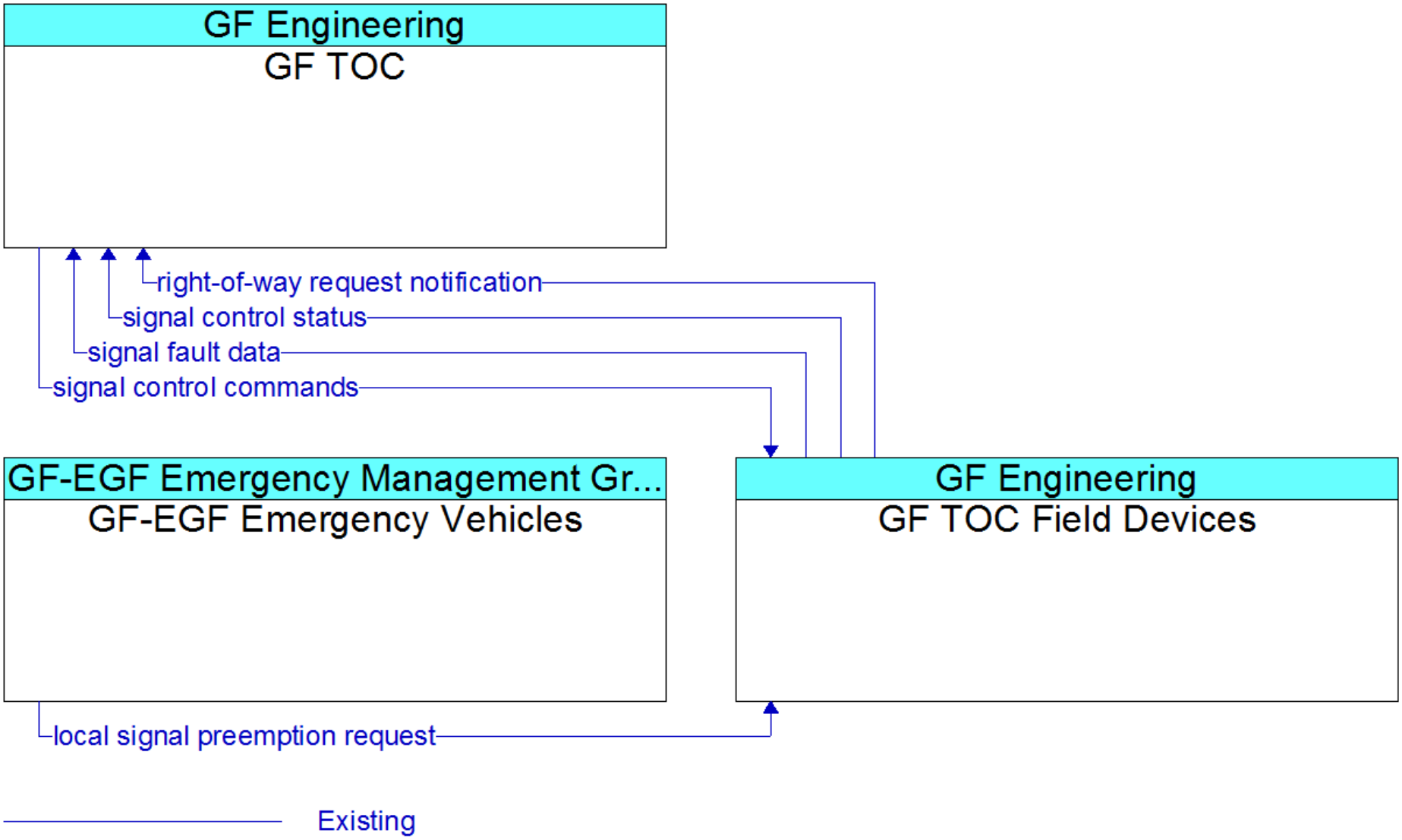
APTS10 Transit Passenger Counting



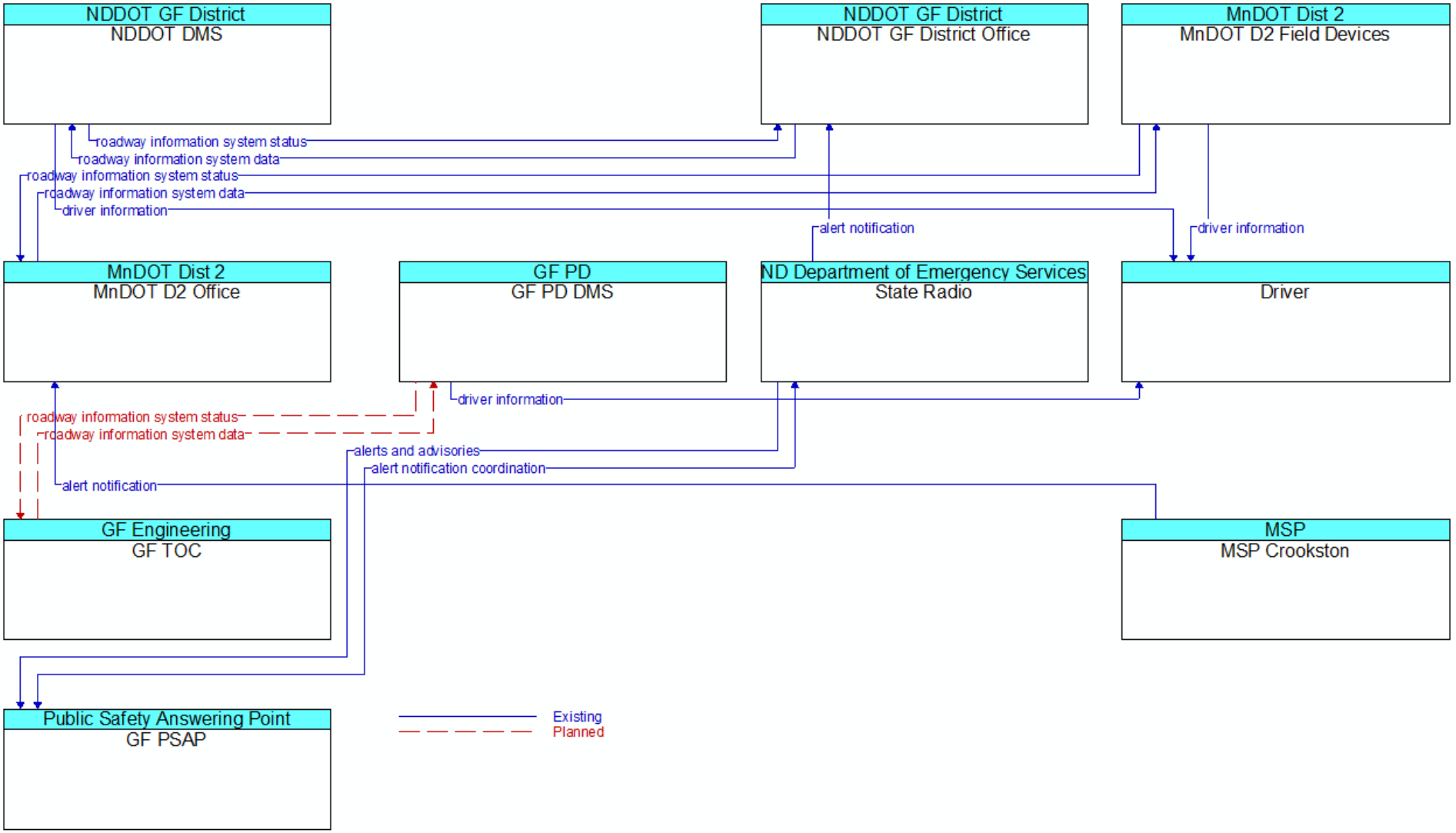
EM01 Emergency Call Taking and Dispatch



EM02 Emergency Routing



EM06 Wide Area Alert



APPENDIX-B

FUNCTIONAL REQUIREMENTS

Architecture		Status
GF-EGF Regional Architecture RA (Region)		(Region)
Element: **Altru Ambulances**		
Entity: **Emergency Vehicle**		
Functional Area: **On-board EV En Route Support** On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.		
Requirement:	5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing
Element: **CAT Operations Center**		
Entity: **Transit Management**		
Functional Area: **Transit Center Vehicle Tracking** Monitoring transit vehicle locations via interactions with on-board systems. Furnish users with real-time transit schedule information and maintain interface with digital map providers.		
Requirement:	1 The center shall monitor the locations of all transit vehicles within its network.	Existing
Requirement:	2 The center shall determine adherence of transit vehicles to their assigned schedule.	Existing
Functional Area: **Transit Center Fixed-Route Operations** Management of fixed route transit operations. Planning, scheduling, and dispatch associated with fixed and flexible route transit services. Updates customer service operator systems, and provides current vehicle schedule adherence and optimum scenarios for schedule adjustment.		
Requirement:	3 The center shall be able to generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	Existing
Requirement:	4 The center shall dispatch fixed route or flexible route transit vehicles	Existing
Requirement:	5 The center shall collect transit operational data for use in the generation of routes and schedules.	Existing
Requirement:	6 The center shall provide instructions or corrective actions to the transit vehicle operators based upon operational needs.	Existing
Requirement:	7 The center shall manage large deviations of individual transit vehicles, deviations in rural areas, and deviations of large numbers of vehicles.	Existing
Requirement:	9 The center shall exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.	Planned
Requirement:	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
Functional Area: **Transit Center Fare Management** Management of fare collection at the center - includes setting and distributing fare information, central processing of fares for transit as well as other ITS services, links to financial institutions and enforcement agencies.		

Element: **CAT Operations Center**

Entity: **Transit Management**

Functional Area: **Transit Center Fare Management**
Management of fare collection at the center - includes setting and distributing fare information, central processing of fares for transit as well as other ITS services, links to financial institutions and enforcement agencies.

Requirement:	4	The center shall support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.	Existing
Requirement:	6	The center shall process requests for transit fares to be paid in advance.	Existing
Requirement:	9	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

Functional Area: **Transit Data Collection**
Collection and storage of transit management data. For use by operations personnel or data archives in the region.

Requirement:	1	The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	Existing
Requirement:	3	The center shall receive and respond to requests from ITS Archives for either a catalog of the transit data or for the data itself.	Planned
Requirement:	4	The center shall be able to produce sample products of the data available.	Existing

Element: **CAT Vehicles**

Entity: **Transit Vehicle**

Functional Area: **On-board Transit Trip Monitoring**
Support fleet management with automatic vehicle location (AVL) and automated mileage and fuel reporting and auditing.

Requirement:	1	The transit vehicle shall track the current location of the transit vehicle.	Existing
Requirement:	3	The transit vehicle shall record transit trip monitoring data including vehicle mileage and fuel usage.	Existing
Requirement:	4	The transit vehicle shall record transit trip monitoring data including operational status information such as doors open/closed, running times, etc.	Existing
Requirement:	5	The transit vehicle shall send the transit vehicle trip monitoring data to center-based trip monitoring functions.	Existing

Functional Area: **On-board Transit Fare Management**
On-board systems provide fare collection using a travelers non-monetary fare medium. Collected fare data are made available to the center.

Requirement:	1	The transit vehicle shall read data from the traveler card / payment instrument presented by boarding passengers.	Existing
Requirement:	8	The transit vehicle shall support an emergency fare structure overriding all other fares that can be activated during disasters, states of emergency or evacuations.	Existing
Requirement:	10	The transit vehicle shall provide fare statistics data to the center.	Existing

Element: **CAT Vehicles**

Entity: **Transit Vehicle**

Functional Area: **On-board Transit Security**
On-board video/audio surveillance systems, threat sensors, and object detection sensors to enhance security and safety on-board a transit vehicles. Also includes silent alarms activated by transit user or vehicle operator, operator authentication, and remote vehicle disabling.

Requirement:	1	The transit vehicle shall perform video and audio surveillance inside of transit vehicles and output raw video or audio data for either local monitoring (for processing or direct output to the transit vehicle operator), remote monitoring or for local storage (e.g., in an event recorder).	Existing

Functional Area: **On-board Transit Signal Priority**
On-board systems request signal priority through short range communication directly with traffic control equipment at the roadside (intersections, ramps, interchanges, etc.).

Requirement:	2	The transit vehicle shall send priority requests to traffic signal controllers at intersections, pedestrian crossings, and multimodal crossings on the roads (surface streets) and freeway (ramp controls) network that enable a transit vehicle schedule deviation to be corrected.	Existing
Requirement:	4	The transit vehicle shall prevent a priority request from being sent when the transit vehicle cannot use the priority (e.g., when the transit vehicle makes a passenger stop on the approach to an intersection).	Existing

Element: **EGF Dispatch Center**

Entity: **Emergency Management**

Functional Area: **Emergency Call-Taking**
Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.

Requirement:	1	The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
Requirement:	2	The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
Requirement:	5	The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing
Requirement:	6	The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
Requirement:	9	The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
Requirement:	10	The center shall update the incident information log once the emergency system operator has verified the incident.	Existing

Element: **EGF Dispatch Center**

Entity: **Emergency Management**

Functional Area: **Emergency Call-Taking**
Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.

Requirement:	11	The center shall provide the capability for digitized map data to act as the background to the emergency information presented to the emergency system operator.	Existing

Functional Area: **Emergency Dispatch**
Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.

Requirement:	1	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3	The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	6	The center shall provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.	Existing
Requirement:	9	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing

Functional Area: **Emergency Routing**
Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.

Requirement:	1	The center shall collect current traffic and road condition information for emergency vehicle route calculation.	Existing
Requirement:	4	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing

Element: **EGF FD Vehicles**

Entity: **Emergency Vehicle**

Functional Area: **On-board EV En Route Support**
On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.

Requirement:	5	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing

Element: **EGF PW Operations Center**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Automated Treatment System Control**

Element: **EGF PW Operations Center**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Automated Treatment System Control**
Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.

Requirement:	1	The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2	The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Planned
Requirement:	3	The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Planned
Requirement:	4	The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Planned
Requirement:	5	The center shall accept requests for automated roadway treatment system activation from center personnel.	Planned

Functional Area: **MCM Winter Maintenance Management**
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.

Requirement:	1	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	Existing
Requirement:	6	The center shall collect real-time information on the state of the regional transportation system from other centers including current traffic and road conditions, weather conditions, special event and incident information and use the collected information to support winter maintenance operations.	Existing
Requirement:	7	The center shall dispatch and route winter maintenance vehicle drivers and support them with route- specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
Requirement:	8	The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
Requirement:	9	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing

Element: **GF FD Vehicles**

Entity: **Emergency Vehicle**

Functional Area: **On-board EV En Route Support**

Element: **GF FD Vehicles**

Entity: **Emergency Vehicle**

Functional Area: **On-board EV En Route Support**
On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.

Requirement:	5	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing

Element: **GF PSAP**

Entity: **Emergency Management**

Functional Area: **Emergency Call-Taking**
Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.

Requirement:	1	The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
Requirement:	2	The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
Requirement:	5	The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing
Requirement:	6	The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
Requirement:	9	The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
Requirement:	10	The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
Requirement:	11	The center shall provide the capability for digitized map data to act as the background to the emergency information presented to the emergency system operator.	Existing

Functional Area: **Emergency Dispatch**
Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.

Requirement:	1	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3	The center shall relay location and incident details to the responding vehicles.	Existing

Element: **GF PSAP**

Entity: **Emergency Management**

Functional Area: **Emergency Dispatch**
Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.

Requirement:	6	The center shall provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.	Existing
Requirement:	9	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing

Functional Area: **Emergency Routing**
Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.

Requirement:	1	The center shall collect current traffic and road condition information for emergency vehicle route calculation.	Existing
Requirement:	4	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing

Element: **GF PW Operations Center**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Automated Treatment System Control**
Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.

Requirement:	1	The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2	The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Planned
Requirement:	3	The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Planned
Requirement:	4	The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Planned
Requirement:	5	The center shall accept requests for automated roadway treatment system activation from center personnel.	Planned

Functional Area: **MCM Winter Maintenance Management**
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.

Requirement:	1	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	Existing

Element: **GF PW Operations Center**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Winter Maintenance Management**
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.

Requirement:	6	The center shall collect real-time information on the state of the regional transportation system from other centers including current traffic and road conditions, weather conditions, special event and incident information and use the collected information to support winter maintenance operations.	Existing
Requirement:	7	The center shall dispatch and route winter maintenance vehicle drivers and support them with route- specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
Requirement:	8	The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
Requirement:	9	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing

Element: **GF PW Vehicles**

Entity: **Maintenance and Construction Vehicle**

Functional Area: **MCV Vehicle Location Tracking**
On-board systems to track vehicle location and reports the position and timestamp information to the dispatch center.

Requirement:	1	The maintenance and construction vehicle shall track its current location.	Existing
Requirement:	2	The maintenance and construction vehicle shall send the time stamped vehicle location to the controlling center.	Existing

Element: **GF TOC**

Entity: **Traffic Management**

Functional Area: **Collect Traffic Surveillance**
Management of traffic sensors and surveillance (CCTV) equipment, collection of current traffic conditions, and distribution of the collected information to other centers and operators.

Requirement:	1	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing
Requirement:	2	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Planned
Requirement:	5	The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing

*Element:***GF TOC**

*Entity:***Traffic Management**

Functional Area: **Collect Traffic Surveillance**
Management of traffic sensors and surveillance (CCTV) equipment, collection of current traffic conditions, and distribution of the collected information to other centers and operators.

Requirement:	6	The center shall maintain a database of surveillance equipment and sensors and associated data (including the roadway on which they are located, the type of data collected, and the ownership of each)	Existing

Functional Area: **TMC Signal Control**
Remotely controls traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.

Requirement:	1	The center shall remotely control traffic signal controllers.	Existing
Requirement:	3	The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	Existing
Requirement:	4	The center shall collect traffic signal controller fault data from the field.	Existing
Requirement:	5	The center shall manage (define, store and modify) control plans to coordinate signalized intersections, to be engaged at the direction of center personnel or according to a daily schedule.	Existing
Requirement:	6	The center shall implement control plans to coordinate signalized intersections based on data from sensors.	Existing
Requirement:	7	The center shall manage boundaries of the control sections used within the signal system.	Existing
Requirement:	8	The center shall maintain traffic signal coordination including synchronizing clocks throughout the system.	Existing

Functional Area: **TMC Traffic Information Dissemination**
Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.

Requirement:	1	The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	Planned

*Element:***GF TOC Field Devices**

*Entity:***Roadway**

Functional Area: **Roadway Basic Surveillance**
Field elements that monitor traffic conditions using loop detectors and CCTV cameras.

Requirement:	1	The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.	Existing
Requirement:	2	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
Requirement:	4	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing
Requirement:	5	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing

Element: **GF TOC Field Devices**

Entity: **Roadway**

Functional Area: **Roadway Signal Controls**
Field elements including traffic signal controllers for use at signalized intersections; also supports pedestrian crossings.

Requirement:	1	The field element shall control traffic signals under center control.	Existing
Requirement:	6	The field element shall return traffic signal controller operational status to the center.	Existing
Requirement:	7	The field element shall return traffic signal controller fault data to the center.	Existing

Functional Area: **Roadway Signal Priority**
Field elements that provide the capability to receive transit vehicle signal priority requests and control traffic signals accordingly.

Requirement:	1	The field element shall respond to signal priority requests from transit vehicles.	Existing

Functional Area: **Roadway Signal Preemption**
Field elements that receive signal preemption requests from approaching emergency vehicles and overrides the current operation of the traffic signals

Requirement:	1	The field element shall respond to signal preemption requests from emergency vehicles.	Existing

Element: **GF Transportation Data Archival**

Entity: **Archived Data Management**

Functional Area: **ITS Data Repository**
Collect and maintain data and data catalogs from one or more data sources. May include quality checks, error notification, and archive coordination.

Requirement:	1	The center shall collect data to be archived from one or more data sources.	Planned
Requirement:	3	The center shall store the archived data in a focused repository that is suited to a particular set of ITS data users.	Planned

Element: **GF-EGF Automated Treatment**

Entity: **Roadway**

Functional Area: **Roadway Automated Treatment**
Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.

Requirement:	1	The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2	The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	3	The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	Planned

Element: **GF-EGF Automated Treatment**

Entity: **Roadway**

Functional Area: **Roadway Automated Treatment**
Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.

Requirement:	4	The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	Planned

Element: **MnDOT D2 Field Devices**

Entity: **Roadway**

Functional Area: **Roadway Signal Preemption**
Field elements that receive signal preemption requests from approaching emergency vehicles and overrides the current operation of the traffic signals

Requirement:	1	The field element shall respond to signal preemption requests from emergency vehicles.	Existing

Functional Area: **Roadway Traffic Information Dissemination**
Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).

Requirement:	1	The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
Requirement:	4	The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing
Requirement:	5	The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Existing

Element: **MnDOT D2 Office**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Automated Treatment System Control**
Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.

Requirement:	1	The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2	The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Planned
Requirement:	3	The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Planned
Requirement:	4	The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Planned
Requirement:	5	The center shall accept requests for automated roadway treatment system activation from center personnel.	Planned

Functional Area: **MCM Winter Maintenance Management**

Element: **MnDOT D2 Office**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Winter Maintenance Management**
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.

Requirement:	1	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	Existing
Requirement:	6	The center shall collect real-time information on the state of the regional transportation system from other centers including current traffic and road conditions, weather conditions, special event and incident information and use the collected information to support winter maintenance operations.	Existing
Requirement:	7	The center shall dispatch and route winter maintenance vehicle drivers and support them with route- specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing
Requirement:	8	The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
Requirement:	9	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing

Entity: **Traffic Management**

Functional Area: **TMC Signal Control**
Remotely controls traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.

Requirement:	1	The center shall remotely control traffic signal controllers.	Existing
Requirement:	4	The center shall collect traffic signal controller fault data from the field.	Existing
Requirement:	5	The center shall manage (define, store and modify) control plans to coordinate signalized intersections, to be engaged at the direction of center personnel or according to a daily schedule.	Existing

Element: **MSP Crookston**

Entity: **Emergency Management**

Functional Area: **Emergency Dispatch**
Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.

Requirement:	1	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing
Requirement:	2	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3	The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	9	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing

Functional Area: **Emergency Routing**
Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.

Requirement:	4	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing

Element: **NDDOT Cameras**

Entity: **Roadway**

Functional Area: **Roadway Basic Surveillance**
Field elements that monitor traffic conditions using loop detectors and CCTV cameras.

Requirement:	2	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Existing
Requirement:	4	The field element shall return sensor and CCTV system operational status to the controlling center.	Existing
Requirement:	5	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Existing

Element: **NDDOT DMS**

Entity: **Roadway**

Functional Area: **Roadway Traffic Information Dissemination**
Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).

Requirement:	1	The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	Existing
Requirement:	4	The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	Existing
Requirement:	5	The field element shall provide fault data for the driver information systems equipment (DMS, HAR, etc.) to the center for repair.	Existing

Element: **NDDOT GF District Office**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Automated Treatment System Control**
Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.

Requirement:	1	The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	Planned
Requirement:	2	The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	Planned
Requirement:	3	The center shall collect automated roadway treatment system and associated environmental sensor operational status.	Planned
Requirement:	4	The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	Planned
Requirement:	5	The center shall accept requests for automated roadway treatment system activation from center personnel.	Planned

Functional Area: **MCM Winter Maintenance Management**
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.

Requirement:	1	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	Existing
Requirement:	6	The center shall collect real-time information on the state of the regional transportation system from other centers including current traffic and road conditions, weather conditions, special event and incident information and use the collected information to support winter maintenance operations.	Existing
Requirement:	7	The center shall dispatch and route winter maintenance vehicle drivers and support them with route- specific environmental, incident, advisory, threat, alert, and traffic congestion information.	Existing

Element: **NDDOT GF District Office**

Entity: **Maintenance and Construction Management**

Functional Area: **MCM Winter Maintenance Management**
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.

Requirement:	8	The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	Existing
Requirement:	9	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	Existing

Element: **Personal Information Access**

Entity: **Personal Information Access**

Functional Area: **Personal Basic Information Reception**
Personal traveler interface that provides formatted traffic advisories, transit, event, and other traveler information, as well as broadcast alerts. Devices include personal computers and personal portable devices such as PDAs and pagers.

Requirement:	1	The personal traveler interface shall receive traffic information from a center and present it to the traveler.	Existing
Requirement:	2	The personal traveler interface shall receive transit information from a center and present it to the traveler.	Existing

Element: **PIC**

Entity: **Information Service Provider**

Functional Area: **Basic Information Broadcast**
Broadcast dissemination of traffic, transit, maintenance and construction, event, and weather information to traveler interface systems and vehicles.

Requirement:	1	The center shall disseminate traffic and highway condition information to travelers, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.	Existing
Requirement:	2	The center shall disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.	Existing

Element: **State Radio**

Entity: **Emergency Management**

Functional Area: **Emergency Dispatch**
Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.

Requirement:	1	The center shall dispatch emergency vehicles to respond to verified emergencies under center personnel control.	Existing

Element: **State Radio**

Entity: **Emergency Management**

Functional Area: **Emergency Dispatch**
Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units.

Requirement:	2	The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
Requirement:	3	The center shall relay location and incident details to the responding vehicles.	Existing
Requirement:	9	The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing

Functional Area: **Emergency Routing**
Routing of emergency vehicles to facilitate the quickest/safest arrival. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by Traffic Management on request.

Requirement:	4	The center shall receive asset restriction information to support the dispatching of appropriate emergency resources.	Existing

APPENDIX-C

PUBLIC INPUT AND STAKEHOLDER ENGAGEMENT

The GF-EGF Regional ITS Architecture Update project relied on stakeholder participation. The following engagement activities took place.

Project Kickoff Meeting

The project kickoff meeting was held on May 14, 2014. The MPO sent an email invitation was sent to the complete stakeholder group as shown in the table below. The meeting was held in conjunction with the MPO's TAC[1], attendees included: Les Noehre, Dale Bergman, Jane Williams, Earl Haugen, Stephanie Erickson.
A presentation was provided that covered the purpose of updating the architecture and steps involved in the process. (See Presentation 1: Kick Off at the end of this appendix)

Small Group Meetings

The purpose of these meetings was to engage stakeholders from each GF-EGF ITS service area individually. On June 30, 2014 separate meetings were held with stakeholders from each of the major service areas:

- Traffic: Les Noehre, Jane Williams, Earl Haugen;
- Transit: Dale Bergman;
- Maintenance: Les Noehre, Jason Strodahl, Darren Laesch;
- Follow up phone conversations with Becky Ault from the Emergency group and Darren Laesch from MnDOT.

A memo was provided to each group participants to facilitate the discussions at the meetings. (See Small Group Memos at the end of this appendix)

Project Update Meeting

On September 10, 2014 a progress report was presented at the September TAC meeting[1]. (see Presentation 2: Progress Update at the end of this appendix)

ITS Inventory Update Report

On September 16, 2014 the updated ITS inventory was emailed to the stakeholders for their review. (See ITS Inventory Update at the end of this appendix)

Project Wrap-up

December 10, 2014. A presentation was provided to the stakeholder committee and TAC meeting[1] along with the draft final report. (See Presentation 3: Project Wrap-up).

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[*]TAC meetings records and list of attendees are available on the MPO website at: http://www.theforksmpo.org/

List of Grand Forks-East Grand Forks Stakeholders by ITS Service Area

Last Name	First Name	Organization	ITS Service Area
Aubol	Mark	GF Public Works - Streets	Maintenance
Bergman	Dale	Cities Area Transit	Public Transportation
Kouba	Teri	GF-EGF MPO	MPO
Campbell	Jim	Grand Forks Co. Em Mgt	Emergency
Plummer	Eric	UND Police Dept	Emergency
Bergstrom	John	GF Public Info Center	Information Provider
Laesch	Darren	MnDOT District 2	Maintenance/Transit
Hickman	Stephanie	FHWA - ND Division	FHWA
Larson	Gary	EGF Fire Dept	Emergency
Haugen	Earl	GF-EGF MPO	MPO
Pirkl	Bill	MnDOT District 2	Traffic
Hedlund	Mike	EGF Police Dept/EGF Dispatch	Emergency
McNamee	Kitt	City of Grand Forks	Information Provider
Hanson	Mike	MN State Patrol	Emergency
Ault	Becky	PSAP	Emergency
Noehre	Les	NDDOT - Grand Forks	Maintenance/Traffic
O'Neill	Peter	GF Fire Dept	Emergency
West	Nick	Grand Forks County	Maintenance/Traffic
Orluck	Gary	ND Highway Patrol	Emergency
Johnson	Michael	NDDOT-Local Government	NDDOT-Local Government
Sanders	Richard	Polk County	Maintenance/Traffic
Kirby	Michael	GF Police Dept	Emergency
Stordahl	Jason	EGF Public Works	Maintenance
Erdman	Barb	Polk Co. Em Mgt	Emergency
Riesenberg	Kris	FHWA-MN Div	FHWA
Boppre	Greg	City of East Grand Forks	Traffic
Williams	Jane	City of Grand Forks	Traffic

Presentation 1: Kick Off

Grand Forks-East Grand Forks Regional ITS Architecture Update

Kickoff Meeting
May 14, 2014

Mohammad Smadi
Advanced Traffic Analysis Center

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

Outline

- ITS Architecture Background
- GF-EGF Regional Architecture
- Architecture Update
- Next Steps

Intelligent Transportation Systems (ITS)

Intelligent Transportation Systems (ITS) apply a variety of technologies to monitor, evaluate, and manage transportation systems to enhance their efficiency and safety.

ITS Architecture

- Framework (roadmap) for guiding ITS deployment
- Defines
  - Functions that must be performed (user services)
  - Physical entities where these functions reside (subsystems)
  - Interfaces between subsystems (information flows)
  - Communications requirements for interfaces
  - Stakeholder roles

ITS RA Federal Conformity Rule

- ITS projects shall conform to the National ITS Architecture and standards
  - Requires:
    - Use of the National ITS Architecture to develop a regional ITS architecture (RA)
    - All subsequent ITS projects must comply with the RA
  - Applies to:
    - ITS projects funded by the Highway Trust Fund

Architecture Requirements

- Scope: describe the region, agencies and stakeholders
- Operational concept (roles and responsibilities)
- Agreements required for performing services
- System functional requirements
- Interface requirements and information exchanges
- ITS standards supporting interoperability
- The sequence of projects required for implementation

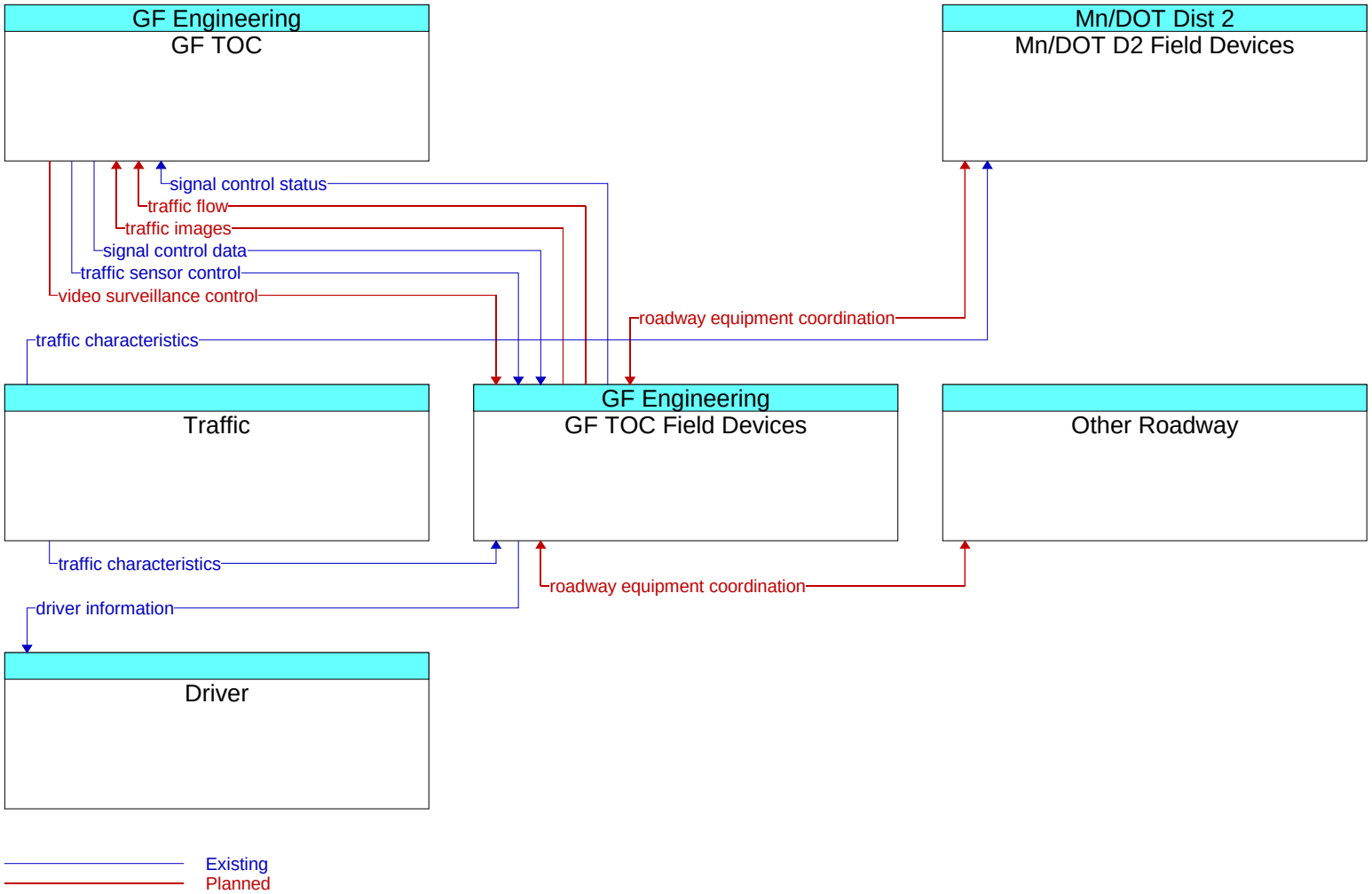
GF-EGF RA Overview

- Completed March 2005
- Updated December 2008
- 5 User Service Areas
- 19 Service Packages
  - 15 existing
  - 4 planned
- On the web:
  - http://regional.atacenter.org/grandforks/

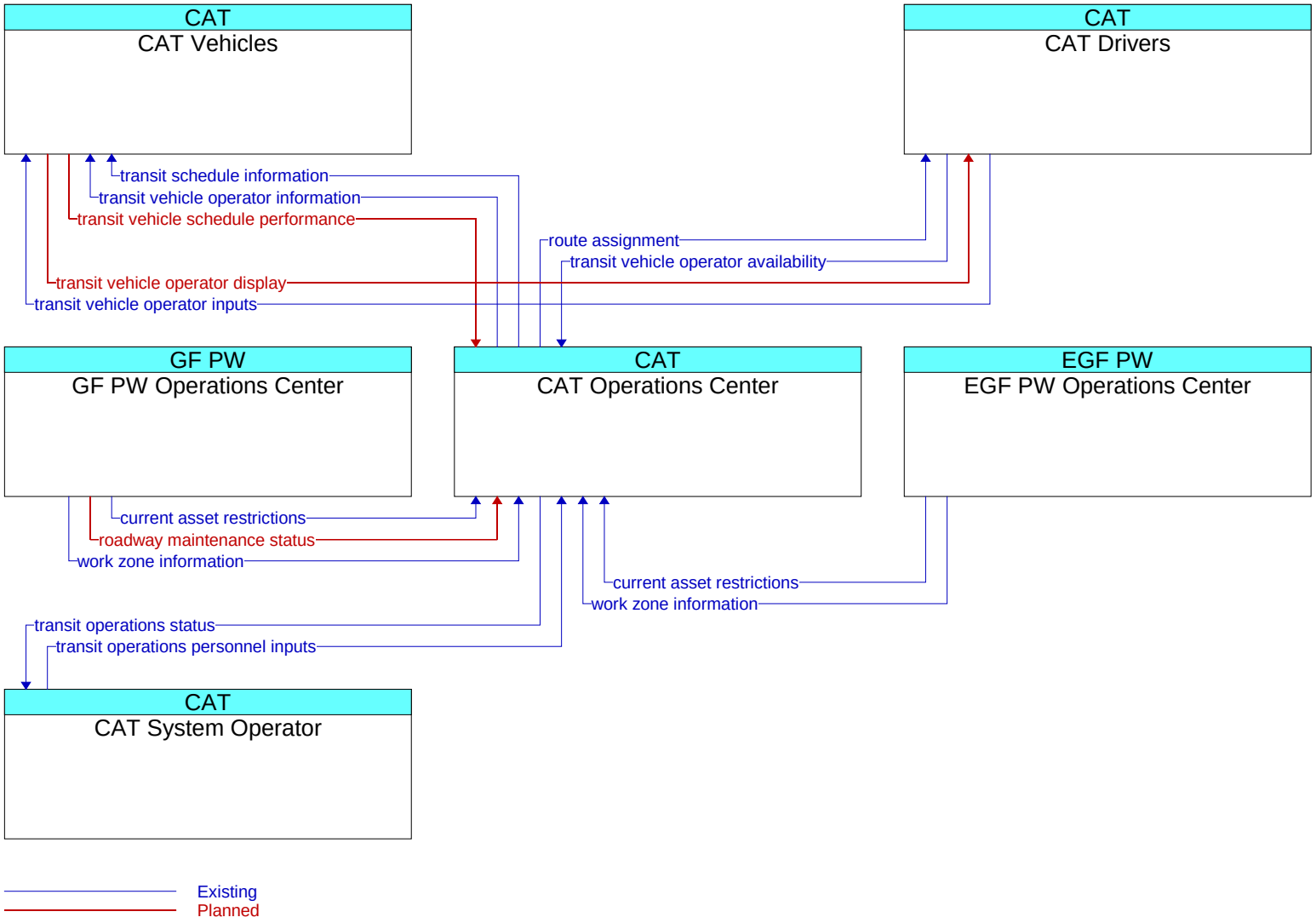
ITS User Service Areas

- Functions: what the system will do from the user's perspective
- GF-EGF User Services
  - Travel and Traffic Management
  - Public Transportation Management
  - Emergency Management
  - Information Management
  - Maintenance and Construction Management

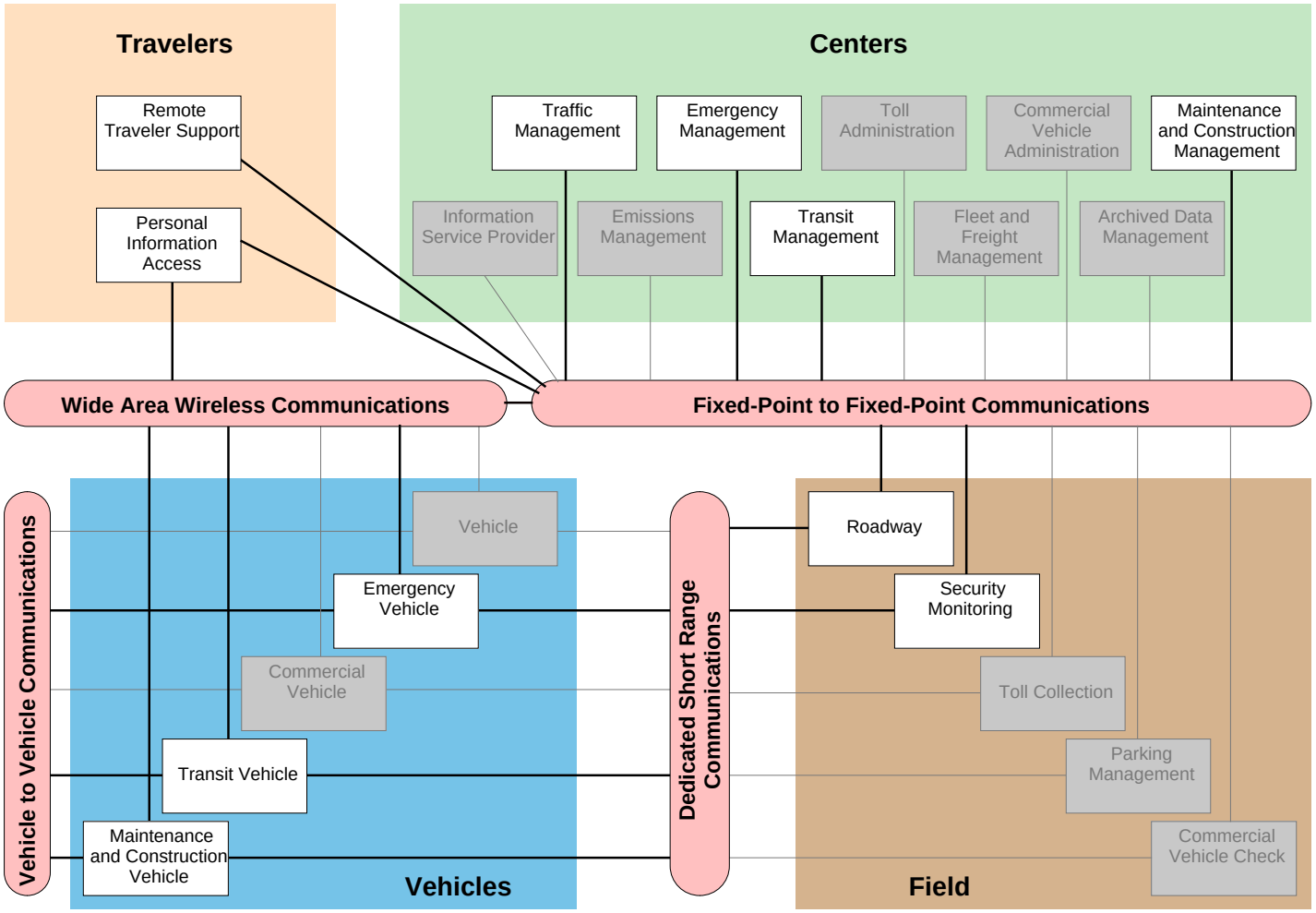
Example SP: Signal Control



Example SP: Transit Fixed Route



GF-EGF RA Overview



GF-EGF Centers

- Traffic Management Center
- Emergency Management Center
- Maintenance and Construction Management Center
- Information Service Provider
- Transit Management Center

GF-EGF Vehicles

- Vehicles with ITS capabilities
  - Emergency vehicles (AVL, Connectivity)
  - Transit vehicles (AVL, Electronic fair boxes, ridership data collection, security cameras)
  - MCM vehicles (AVL, sensing, material use monitoring)

RA Update

- As ITS projects are implemented the RA needs to be maintained
- The updates need to:
  - Reflect new ITS priorities and strategies
  - Account for expansion in ITS scope
  - Allow for the evolution and incorporation of new ideas

RA Update

- Why maintain*?*
  - Reasons relating to events in the region:
    - Changes in regional needs
    - New stakeholders
    - Changes in scope of services considered
    - Changes in the National ITS Architecture
  - Relating to project definition:
    - Project definition and implementation
    - Project addition/deletion
    - Project priority/timing
  - Changes in the National Architecture
    - Version 7.0

RA Update

- What will be updated?
  - Stakeholders
  - Operational concept
  - ITS elements
  - Agreements
  - Interface between elements
  - Functional requirements
  - ITS standards
  - Project sequencing

RA Update Tasks

- Data collection
  - Small group or agency meetings (May-June)
- Identify RA changes and update inventory (June-July)
- Review and update needs and requirements (August)
- Implement updates (September-October)
  - Update Turbo database
  - Create architecture website
  - Update report
- Review, finalize, and ratify (November)

Next Steps

- Data collection
  - Contact agencies to identify changes
  - Collect relevant data/information
  - Summarize changes
  - Provide to stakeholders for review

Small Group Meeting Memos

Grand Forks-East Grand Forks Regional ITS Architecture Update

Traffic Management

ITS Architecture Background

The Grand Forks-East Grand Forks MPO is working with NDSU's Advanced Traffic Analysis Center (ATAC) to update the GF-EGF regional intelligent transportation systems (ITS) architecture.

The ITS architecture serves as a framework and a roadmap that guides the deployment of computing, electronics, communications technologies, and management strategies that improve the safety, efficiency, and mobility of the surface transportation system in the region.

An up-to-date architecture is a requirement for receiving federal funding for ITS projects. The original GF-EGF architecture was developed in 2005 and updated in 2008.

To be valid, an ITS architecture must define the following:

- Stakeholders: owners and operators of ITS in the state;
- Operational concept: the roles and responsibilities of stakeholders;
- ITS elements: an inventory of subsystems such as centers, vehicles, and field devices and communication links owned and operated by the stakeholders;
- Interfaces between elements: the information flows needed to perform an ITS function;
- Functional requirements: specification of the functionality of the system;
- ITS standards: standardized channels of communication to allow interoperability;
- Agreements: whenever needed to address inter-jurisdictional issues;
- Project sequencing: defines the priority and deployment horizon for projects.

Why Maintain?

The architecture needs to reflect the region's current and future status of ITS deployment. To achieve this goal, the RA needs to be maintained periodically to address changes in regional needs, the addition of new stakeholders, and changes in the scope of services considered as needs and new technologies evolve.

The architecture update will specifically address projects identified in previous versions of the architecture and update their status from "planned" to "existing" as appropriate. Projects can also be added or removed, and their deployment horizon adjusted based on evolving conditions, regional priorities, and funding opportunities.

Traffic Management ITS Services

The architecture covers ITS services under many different areas and uses the concept of a service package (SP) to detail a specific service in a simplified and concise manner. A SP combines the subsystems, equipment, and information flows required to provide the desired service. The following SPs were identified under the traffic management area:

- **Network Surveillance**: deals with gathering network conditions data from detectors and/or video surveillance.
- **Traffic Signal Control**: this service package is consistent with typical traffic signal control systems. Inter-jurisdictional coordination?

- **Freeway Management**: deals with monitoring area freeways and coming up with management strategies based on conditions on the road.
- **Traffic Information Dissemination**: deals with sharing information with other agencies and travelers.
- **Traffic Incident Management**: deals with clearing traffic resulting from incidents or planned events in the most efficient and timely matter.
- **Speed Warning**: deals with using roadside devices to encourage adherence to posted speed limits.
- **Emergency Routing**: deals with providing signal preemption for emergency vehicles at signalized intersections.

Traffic Management Questions

As part of the RA maintenance we will visit with stakeholders to reassess their needs and capture updates within their service area. Specifically for the traffic management area, input and information is requested on the following topics:

- Update on the central signal software use and operations;
- Any planned installation of new signals and other traffic control and traveler information devices;
- Update from the NDDOT on Pembina border crossing operations;
- Information on expansion of the communication network and interconnecting more devices;
- Information on any plans for using adaptive signal control and other sophisticated control strategies.

Grand Forks-East Grand Forks Regional ITS Architecture Update

Transit Management

ITS Architecture Background

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Transit Management ITS Services

The architecture covers ITS services under many different areas and uses the concept of a service package (SP) to detail a specific service in a simplified and concise manner. A SP combines the subsystems, equipment, and information flows required to provide the desired service. The following SPs were identified under the transit management area:

- **Transit Vehicle Tracking**: deals with monitoring the current location of the transit vehicle using Automated Vehicle Location Systems (AVL). The location data can be used to determine schedule adherence and for ride dispatch in demand response operations.

- **Demand Response Transit Operations**: deals with dispatch and system monitoring for demand responsive transit. This service assists with scheduling and operator assignment, and monitors fleet status while supporting resource allocation to service incoming requests.
- **Transit Fare Collection Management**: manages fare collection on-board transit vehicles via electronic means. Allows riders to use electronic payment devices (e.g. e-Card). Fare data is processed and stored on-board the vehicle and later transferred to the transit management center.
- **Transit Security** : deals with physical security for riders and drivers. On-board surveillance equipment is deployed including video and event recorder systems (e.g. G-force hard braking). Data is transferred to the transit management center and can be analyzed for performance or in case of an incident.
- **Transit Fleet Management**: supports automatic maintenance scheduling and monitoring. On-board condition sensors monitor vehicle status and the data is used for scheduling preventative and corrective maintenance. The service can also support day to day management of the transit fleet, including assignment of specific vehicles to routes and services.
- **Transit Passenger Counting**: deals with counting the number of riders entering and exiting the transit vehicle. The data collected is transferred to the transit management center to be used to calculate ridership figures and measuring passenger load information.

Transit Management Questions

As part of the RA maintenance we will visit with stakeholders to reassess their needs and capture updates within their service area. Specifically for the transit management area, input and information is requested on the following topics:

- Automated vehicle location (AVL): information is requested on the current AVL system used on transit vehicles and if bus location information is being shared with the public;
- Vehicle maintenance and fleet operations: information is requested on automated scheduling of maintenance and fleet management;
- Data capabilities in vehicles: information is requested on the availability of a data connection in emergency vehicles and available bandwidth;
- Dispatch systems: information is requested on the use of computer aided dispatch (CAD) in transit operations;
- Information on the planned acquisition and deployment of transit vehicles and related technologies, devices, and software.

Grand Forks-East Grand Forks Regional ITS Architecture Update

Maintenance and Construction Management

ITS Architecture Background

The Grand Forks-East Grand Forks MPO is working with NDSU's Advanced Traffic Analysis Center (ATAC) to update the GF-EGF regional intelligent transportation systems (ITS) architecture.

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To be valid, an ITS architecture must define the following:

- Stakeholders: owners and operators of ITS in the state;
- Operational concept: the roles and responsibilities of stakeholders;
- ITS elements: an inventory of subsystems such as centers, vehicles, and field devices and communication links owned and operated by the stakeholders;
- Interfaces between elements: the information flows needed to perform an ITS function;
- Functional requirements: specification of the functionality of the system;
- ITS standards: standardized channels of communication to allow interoperability;
- Agreements: whenever needed to address inter-jurisdictional issues;
- Project sequencing: defines the priority and deployment horizon for projects.

Why Maintain?

The architecture needs to reflect the region's current and future status of ITS deployment. To achieve this goal, the RA needs to be maintained periodically to address changes in regional needs, the addition of new stakeholders, and changes in the scope of services considered as needs and new technologies evolve.

The architecture update will specifically address projects identified in previous versions of the architecture and update their status from "planned" to "existing" as appropriate. Projects can also be added or removed, and their deployment horizon adjusted based on evolving conditions, regional priorities, and funding opportunities.

Maintenance and Construction Management ITS Services

The architecture covers ITS services under many different areas and uses the concept of a service package (SP) to detail a specific service in a simplified and concise manner. A SP combines the subsystems, equipment, and information flows required to provide the desired service. The following SPs were identified under the maintenance and construction management area:

- **Maintenance and Construction Vehicle Tracking**: deals with using AVL technology on maintenance vehicles to track their location to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

- **Maintenance and Construction Vehicle Maintenance**: 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 maintenance.
- **Roadway Automated Treatment**: deals with automatic anti-icing systems on bridges based on environmental and atmospheric conditions.
- **Winter Maintenance**: deals with 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.
- **Network surveillance**: deals with the use of cameras and other sensors for determining roadway conditions and making maintenance decisions.
- **Work Zone Management**: deals with using ITS technologies to control traffic in roadways where maintenance, construction, and utility work is underway.

Maintenance and Construction Management Questions

As part of the RA maintenance we will visit with stakeholders to reassess their needs and capture updates within their service area. Specifically for the maintenance and construction (MCM) area, input and information is requested on the following topics:

- Automated vehicle location (AVL): information is requested on the use of AVL on maintenance vehicles (e.g. snow plows) how is it utilized, and if there has been any issues with the system;
- Vehicle onboard sensors: information is requested on the use of sensors and equipment on snow plow vehicles that measure atmospheric and road surface conditions, and provide operations information about the amount of anti-icing material used, and the status of the plow blade (i.e., up or down).
- Computer aided dispatch (CAD): information is requested about the current dispatch system in use;
- Information on the planned acquisition and deployment of related technologies and devices.

Grand Forks-East Grand Forks Regional ITS Architecture Update

Emergency Management

ITS Architecture Background

The Grand Forks-East Grand Forks MPO is working with NDSU's Advanced Traffic Analysis Center (ATAC) to update the GF-EGF regional intelligent transportation systems (ITS) architecture.

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- Functional requirements: specification of the functionality of the system;
- ITS standards: standardized channels of communication to allow interoperability;
- Agreements: whenever needed to address inter-jurisdictional issues;
- Project sequencing: defines the priority and deployment horizon for projects.

Why Maintain?

The architecture needs to reflect the region's current and future status of ITS deployment. To achieve this goal, the RA needs to be maintained periodically to address changes in regional needs, the addition of new stakeholders, and changes in the scope of services considered as needs and new technologies evolve.

The architecture update will specifically address projects identified in previous versions of the architecture and update their status from "planned" to "existing" as appropriate. Projects can also be added or removed, and their deployment horizon adjusted based on evolving conditions, regional priorities, and funding opportunities.

Emergency Management ITS Services

The architecture covers ITS services under many different areas and uses the concept of a service package (SP) to detail a specific service in a simplified and concise manner. A SP combines the subsystems, equipment, and information flows required to provide the desired service. The following SPs were identified under the emergency management area:

- **Traffic Incident Management**: deals with both planned events and traffic accidents and coordinates the response between traffic management, emergency management (law enforcement, fire, and EMS) and maintenance and construction management agencies in the region.

- **Emergency Call-Taking and Dispatch**: deals with 911 and dispatching of LE, Fire, and EMS personnel
- **Emergency Routing**: deals with providing signal preemption for emergency vehicles at signalized intersections.
- **Wide Area Alert** : deals with mass alerts that are issued to the public using existing ITS infrastructure such as dynamic message signs (DMS) and the 511 traveler information systems (e.g. Amber Alert.)
- **Disaster Response and Recovery**: deals with enhancing the ability of the surface transportation system to respond and recover from disasters including floods and major winter storms. It supports the coordination of emergency response plans and identifies key points of integration between the transportation system and public safety. This SP builds on the Traffic Incident Management SP while addressing additional complexities and coordination requirements associated with responding to large scale incidents and natural disasters.
- **Evacuation and Reentry Management**: deals with evacuating the general public from a disaster area and managing the subsequent reentry to the area. This SP supports coordination of evacuation plans among federal, state, and local transportation, emergency, and law enforcement agencies. Strategies considered include lane reversal, highway shoulder usage, special signal control strategies to expedite the evacuation and reentry process.

Emergency Management Questions

As part of the RA maintenance we will visit with stakeholders to reassess their needs and capture updates within their service area. Specifically for the emergency management (EM) area, input and information is requested on the following topics:

- Automated vehicle location (AVL): information is requested on the use of AVL on emergency vehicles, how is it utilized, and if there has been any issues with the system;
- Computer aided dispatch (CAD): information is requested about the current CAD system in use and it's capabilities;
- Data capabilities in vehicles: information is requested on the availability of a data connection in emergency vehicles and available bandwidth;
- Incident management strategies (for both traffic accidents and planned events): review of current procedures and practices to identify how response can be enhanced by use of ITS technologies and coordination with traffic management agencies;
- Information on the planned acquisition and deployment of related technologies and devices (e.g. emergency traffic control and traveler information systems);
- Signal preemption: satisfaction with the existing system and any plans for upgrades.

Presentation 2: Progress Update

Grand Forks-East Grand Forks Regional ITS Architecture Update

Regional ITS Architecture – Project Update
September 10, 2014

Mohammad Smadi
Advanced Traffic Analysis Center

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

ITS Defined

Intelligent Transportation Systems (ITS) apply a variety of technologies to monitor, evaluate, and manage transportation systems to enhance their efficiency and safety.

ITS Architecture

- Framework (roadmap) for guiding ITS deployment
- A tool to visualize an agreed-upon ITS vision for the region that all stakeholders can work toward
- Bridge the gap between transportation strategic planning and the ITS projects needed to achieve it
- Defines
  - Functions that must be performed Physical entities where these functions reside
  - Interfaces between subsystems
  - Communications requirements for interfaces
  - Stakeholder roles

GF-EGF ITS User Service Areas

- Travel and Traffic Management (ATMS)
- Public Transportation Management (APTS)
- Emergency Management (EM)
- Information Management (AD)
- Maintenance and Construction Management (MCM)

RA Update

- As ITS projects are implemented the RA needs to be maintained
- The updates need to:
  - Reflect new ITS priorities and strategies
  - Account for expansion in ITS scope
  - Allow for the evolution and incorporation of new ideas

Regional Update Highlights

- Traffic signal central control software – Centracs (ATMS)
- Traffic signal detector data collection (AD)
- Transit management software – RouteMatch (APTS)
  - AVL/tracking
  - Transit traveler information
- Transit signal priority and emergency signal preemption (ATMS/APTS/EM)
- ND emergency dispatch assessment project (EM)
- Snow plows with AVL/other sensors (MCM)
- DMS installation (ATMS)

Project Progress

- Data collection
  - Small group or agency meetings (May-June) ✓
- Identify RA changes and update inventory (June-July) ✓
- Review and update needs and requirements (August) ✓

- Implement updates (September-October)
  - Update Turbo database (~50%)
  - Create architecture website
  - Update report
- Review, finalize, and ratify (November)

ITS Inventory Update

Inventory Report

9/16/2014 2:06:17PM

Stakeholder Inventory for Region GF-EGF Regional Architecture RA

Element: Driver *Status:* Existing
Description:
Mapped to Entity: Driver

Element: EGF PW Vehicles *Status:* Existing
Description: East Grand Forks public works vehicles
Mapped to Entity: Maintenance and Construction Vehicle

Element: Media *Status:* Existing
Description:
Mapped to Entity: Media

Element: Other Roadway *Status:* Planned
Description: DMS and other devices operating in conjuntion of sensors and systems (i.e., anti-icing system)
Mapped to Entity: Other Roadway

Element: Traffic *Status:* Existing
Description:
Mapped to Entity: Traffic

Altru Ambulance

Element: Altru Ambulances *Status:* Existing
Description: Altru ambulance vehicles
Mapped to Entity: Emergency Vehicle

CAT

Element: CAT Drivers *Status:* Existing
Description: CAT bus drivers
Mapped to Entity: Transit Vehicle Operator

Element: CAT Operations Center *Status:* Existing
Description: Cities Area Transit dispatch center
Mapped to Entity: Transit Management

Element: CAT Passenger *Status:* Existing
Description: Passengers using the CAT system
Mapped to Entity: Traveler

Element: CAT System Operator *Status:* Existing
Description: CAT dispatch and operations personnel
Mapped to Entity: Transit Operations Personnel

Element: CAT Traveler Card *Status:* Existing
Description: 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.
Mapped to Entity: Traveler Card

Element: CAT Vehicles *Status:* Existing

Element: CAT Vehicles *Status:* Existing
Description: 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.
Mapped to Entity: Transit Vehicle

EGF FD

Element: EGF FD Vehicles *Status:* Existing
Description: East Grand Forks Fire Department Vehicles
Mapped to Entity: Emergency Vehicle

Element: GF FD Vehicles *Status:* Existing
Description: Grand Forks Fire Department Vehicles
Mapped to Entity: Emergency Vehicle

EGF PD

Element: EGF Dispatch Center *Status:* Existing
Description: East Grand Forks and Polk County dispatch
Mapped to Entity: Emergency Management

Element: EGF PD Vehicles *Status:* Existing
Description: East Grand Forks Police Department Vehicles
Mapped to Entity: Emergency Vehicle

EGF PW

Element: EGF PW Field Devices *Status:* Planned
Description: East Grand Forks public works devices
Mapped to Entity: Roadway

Element: EGF PW Operations Center *Status:* Existing
Description: East Grand Forks public works operations center
Mapped to Entity: Maintenance and Construction Management

GF Engineering

Element: GF Rail Detection and Information System *Status:* Planned
Description: A system that would detect/monitor rail activity at specific roadway-rail intersections and provide information to travelers so they can take alternate routes.
Mapped to Entity: Roadway

Element: GF TOC *Status:* Existing
Description: Grand Forks Traffic Operations Center
Mapped to Entity: Traffic Management

Element: GF TOC Field Devices *Status:* Existing
Description: Grand Forks area traffic sensors and control devices
Mapped to Entity: Roadway

Element: GF Transportation Data Archival *Status:* Planned
Description: Archival center for transportation data, initially this wil house traffic counts but other data could be warehoused there including transit data, incident data, etc.
Mapped to Entity: Archived Data Management

GF Event Venus

Element: Event Promoters *Status:* Existing
Description: Alerus Center, Ralph Engelstad Arena, other venues

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Description: Alerus Center, Ralph Engelstad Arena, other venues
Mapped to Entity: Event Promoters

GF PD

Element: GF PD DMS *Status:* Existing
Description: Grand Forks Police Department portable Dynamic Message Signs
Mapped to Entity: Roadway

Element: GF PD Vehicles *Status:* Existing
Description: Grand Forks Police Department Vehicles
Mapped to Entity: Emergency Vehicle

GF PW

Element: GF PW Field Devices *Status:* Planned
Description: Grand Forks public works devices
Mapped to Entity: Roadway

Element: GF PW Operations Center *Status:* Existing
Description: Grand Forks public works operations center
Mapped to Entity: Maintenance and Construction Management

Element: GF PW Vehicles *Status:* Existing
Description: Grand Forks public works vehicles
Mapped to Entity: Maintenance and Construction Vehicle

Grand Forks

Element: PIC *Status:* Existing
Description: Public Information Center
Mapped to Entity: Information Service Provider

Element: PSAP *Status:* Existing
Description: Grand Forks County Public Safety Answering Point
Mapped to Entity: Emergency Management

MnDOT Dist 2

Element: MnDOT D2 Field Devices *Status:* Existing
Description: Mn/DOT District 2 sensors and control devices
Mapped to Entity: Roadway

Element: MnDOT D2 Office *Status:* Existing
Description: Mn/DOT District 2 Traffic Operations Center
Mapped to Entity: Maintenance and Construction Management
Mapped to Entity: Traffic Management

Element: MnDOT D2 Vehicles *Status:* Existing
Description: MnDOT District 2 maintenance and construction vehicles
Mapped to Entity: Maintenance and Construction Vehicle

MSP

Element: MSP Crookston *Status:* Existing
Description: Minnesota State Patrol Crookston District
Mapped to Entity: Emergency Management

Element: MSP Vehicles *Status:* Existing

Element: MSP Vehicles *Status:* Existing
Description: Minnesota State Patrol vehicles
Mapped to Entity: Emergency Vehicle

ND Department of Emergency Services

Element: State Radio *Status:* Existing
Description: ND State Radio
Mapped to Entity: Alerting and Advisory Systems
Mapped to Entity: Emergency Management

NDDOT GF District

Element: NDDOT Cameras *Status:* Existing
Description: NDDOT surveillance cameras
Mapped to Entity: Roadway

Element: NDDOT District Office *Status:* Existing
Description: NDDOT District maintenance and construction
Mapped to Entity: Maintenance and Construction Management

Element: NDDOT District Vehicles *Status:* Existing
Description: NDDDOT maintenance and construction vehicles
Mapped to Entity: Maintenance and Construction Vehicle

Element: NDDOT DMS *Status:* Existing
Description: NDDOT dynamic message signs
Mapped to Entity: Roadway

NDHP

Element: NDHP Vehicles *Status:* Existing
Description: NDHP vehicles
Mapped to Entity: Emergency Vehicle

Presentation 3: Project Wrap-up

Grand Forks-East Grand Forks Regional ITS Architecture Update

Project Wrap-up
December 10, 2014

Mohammad Smadi
Advanced Traffic Analysis Center

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

M.P.O. M.P.O. M.P.O. Grand Forks - East Grand Forks Metropolitan Planning Organization

ITS Defined

Intelligent Transportation Systems (ITS) apply a computing and communications technologies to monitor, evaluate, and manage transportation systems to enhance their efficiency and safety.

ITS Architecture

- Framework (roadmap) for guiding ITS deployment
- A tool to visualize an agreed-upon ITS vision for the region that all stakeholders can work towards
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Regional Update Highlights

- Traffic signal central control software – Centracs (ATMS)
- Traffic signal detector data collection (AD)
- Transit management software – RouteMatch (APTS)
  - AVL/tracking
  - Transit traveler information
- Automated transit signal priority and emergency signal preemption in Grand Forks (ATMS/APTS/EM)
- Snow plows with AVL/other sensors (MCM)
- DMS installation (ATMS)

Tasks Completed

- The following items were updated based on changes in the region and changes in the National ITS Architecture 7.0
  - ITS services and their status
  - Information flows
  - System inventory
  - Functional requirements
- Linked architecture services to LRTP goals

Project Deliverables

- Updated ITS architecture report
- Updated Turbo Architecture database
- Web access to the information in the architecture

- The deliverables will be available at http://regional.atacenter.org/grandforks/