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Fargo-Moorhead Traffic Operations Center

Project ITS Architecture: Hybrid TOC

Version 1.1

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Prepared for:
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1. INTRODUCTION

This document summarizes the results of developing a project architecture (PA) for the Fargo-Moorhead Traffic Operations Center (F-M TOC). The architecture was developed as an expanded subset from the Fargo-Moorhead regional architecture (RA). This PA will serve as a tool to guide future ITS planning in the areas of traffic management and supports the development of a regional hybrid TOC to integrate functions across jurisdictional lines. The PA assists in the Systems Engineering (SE) process by establishing roles and responsibilities of participating agencies and defining the systems requirements.

2. SCOPE

The geographical area covered in this architecture includes the cities of Fargo, ND; Moorhead, MN; and West Fargo, ND. The ITS services covered under the TOC project include the following:

1. Travel and Traffic Management
    a. Traffic control
    b. Traveler information
    c. Traffic surveillance
2. Public Transportation Management
    a. Transit signal priority
3. Emergency Management
    a. Incident management
4. Information Management
    a. Data archival and analysis services

3. STAKEHOLDERS

The development of the F-M TOC PA was guided by the F-M Metropolitan Traffic Operations Working Group and other stakeholders were contacted individually on an as-needed basis. The list of stakeholders includes the following:

1. City of Fargo
2. City of Moorhead
3. NDDOT Fargo District
4. Mn/DOT District 4
5. City of West Fargo
6. NDDOT Central Office
7. Metro Area Transit (MAT)
8. Red River Regional Dispatch Center (RRRDC) and the following partners:
    a. Fargo Police
    b. Fargo Fire
    c. Moorhead Police
    d. Moorhead Fire
    e. FM Ambulance
9. North Dakota Highway Patrol Fargo District
10. Minnesota State Patrol Detroit Lakes District
11. Upper Great Plains Transportation Institute (UGPTI) – NDSU
12. Metro COG
13. Federal Highway Administration (FHWA)

4. INVENTORY

This section summarizes the ITS inventory for the TOC project. Inventory elements from the regional architecture were used as a starting point and changes were made to reflect the TOC needs, which are provided by the stakeholders. Inventory elements are differentiated into four different types: centers, field devices, vehicles, and communications.

4.1 Centers

Centers are the locations where functions are performed (i.e., process information, issue control commands, and produce output information). The following four centers have been identified for the F-M TOC:

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. In this PA these functions will be performed at the City of Fargo traffic center and NDDOT Fargo District.
2. Transit Management Center: The Metro Area Transit (MAT) provides public transportation services for the cities of Fargo and Moorhead. MAT operates several fixed routes in Fargo and Moorhead in addition to paratransit services. MAT
3. Emergency Management Center: The Red River Regional Dispatch Center (RRRDC) provides dispatch services to the cities of Fargo, Moorhead, and West Fargo, as well as Cass and Clay Counties. It also coordinates emergency management with the North Dakota Highway Patrol (NDHP), the Minnesota State Patrol (MSP), and other local law enforcement and emergency response agencies.
4. Archived Data Management: Several agencies currently collect data from ITS sensors. However, there currently is no single center for archiving or processing these data. The Advanced Traffic Analysis Center (ATAC) at North Dakota State University (NDSU)has been designated as the future Data Warehouse entity for the F-M area.

4.2 Field Devices

These physical entities refer to field devices used to support ITS systems. The majority of field devices in the F-M area may be classified under the Roadway Subsystem and they include the following:

1. Sensors
    a. Video traffic detectors
    b. Loop detectors
    c. Wireless sensors
2. Control devices
    a. Traffic signal controllers
3. Surveillance/monitoring
    a. Pan-tilt-zoom (PTZ) closed circuit television (CCTV) cameras
4. Warning/advisory devices
    a. Permanent Dynamic Message Signs (DMS)
    b. Portable DMS where needed

4.3 Vehicles

The vehicles subsystem refers to vehicles with ITS capabilities including advanced communications, navigation, monitoring, and control system. For the TOC PA these vehicles include:

1. Emergency vehicle signal preemption
    a. Fire
    b. Law enforcement
    c. Ambulance
2. Transit vehicle
    a. MAT buses with electronic fare box and automated vehicle location (AVL) capabilities

4.4 Communication Infrastructure

Communications among centers and between centers and field devices is required in order to perform ITS functions. To perform the desired TOC functions, more communication infrastructure will need to be installed, especially on the Minnesota side, and links between different jurisdictions communication need to be established. The following are the main types of communication in the F-M area:

1. Fiber
    a. I-29 and I-94
    b. Arterial network (Fargo)
2. Phone drops and twisted pair
    a. Mostly in Moorhead traffic signals
3. Wireless/cellular
    a. Moorhead train detection system
    b. NDDOT portable DMS

5. SERVICES/MARKET PACKAGES

The following Market Packages were identified for the TOC project in order to support ITS needs and services. The descriptions are based on information from the National ITS Architecture. The status of each Market Package in the project is also indicated (i.e., existing or planned. Market Packages with an Existing followed by the * indicates there are portions of the Market Package already deployed but additional portions are planned for deployment). Customized F-M Market Packages and associated Information Flows are shown in more detail in **Appendix A**.

5.1 ATMS01: Network Surveillance (Existing)

This market 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 market 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.

5.2 ATMS03: Surface Street Control (Existing)

This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. Traffic signal control systems represented by this market package range from fixed-schedule control systems to fully traffic-responsive. Additionally, 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 market package is consistent with typical urban traffic signal control systems.

5.3 ATMS06: Traffic Information Dissemination (Planned)

This market 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.

5.4 ATMS07: Regional Traffic Management (Planned)

This market package provides for the sharing of traffic information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include coordinated signal control in a metropolitan area and coordination between freeway operations and arterial signal control within a corridor. This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated inter-jurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and fixed-point to fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.

5.5 ATMS08: Traffic Incident Management (Planned)

This market package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The market package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this market package to detect and verify incidents and implement an appropriate response. This market package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between center subsystems. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination market package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information market packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency

field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

5.6 AD2: Archived Data Warehouse (Planned)

This market package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this market package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

6. OPERATIONAL CONCEPT

This section discusses the roles and responsibilities of stakeholders in the implementation and operation of the F-M TOC. The operational concept outlines these roles and responsibilities for specific scenarios, e.g., traffic signal operation and maintenance, identifying and responding to traffic incidents, 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 can be found in **Appendix B**.

7. AGREEMENTS

This section briefly outlines potential agreements needed to support the F-M TOC. The process of identifying needed agreement relied on the Market 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. Some established agencies such as RRRDC and MAT have existing agreements in place.

Table 7.1 provides a summary of potential agreements for the F-M TOC project. The table provides the following information for each agreement:

1. Market Package
    a. The Market Package where the agreement is needed
2. Purpose
    a. Brief statement on what the agreement addresses
3. Stakeholders
    a. List the stakeholders (agencies) which would be included in the agreement
4. Issues
    a. List specific issues to be included in the agreement

7.1 Potential Agreements for Hybrid F-M TOC

Market Packages	Purpose	Stakeholders	Issues
AD2-ITS Data Warehouse	Data use/storage	Fargo NDDOT-Fargo District MnDOT-District 4 NDSU West Fargo RRRDC Regional Partners	Security Communications Resource sharing
ATMS01-Network Surveillance	Share data	Fargo NDDOT-Fargo District MnDOT-District 4 RRRDC Regional Partners	Access to sensors Access to databases Access to networks/servers
ATMS03-Surface Street Control	Traffic operations	Fargo Moorhead NDDOT-Fargo District MnDOT-District 4	Access to devices
ATMS06-Traffic Information Dissemination	Coordinate traveler information	Fargo NDDOT-Fargo District MnDOT-District 4 RRRDC Regional Partners MAT	Communications links Notification protocols
ATMS07-Regional Traffic Control	Sharing data (flow, video) Corridor operations	Fargo West Fargo NDDOT-Fargo District	Communications links Hardware compatibility Operating standards
ATMS08-Traffic Incident Management	Incident traffic response Sharing data (flow, video)	Fargo NDDOT-Fargo District RRRDC Regional Partners ND Highway Patrol MN State Patrol	Communications links Response protocols

8. ITS STANDARDS

This section identifies applicable ITS Standards identified for the TOC Projects. It should be noted that ITS standards presented here may represent a superset of options, and in some cases, provide redundant capabilities. In addition, these ITS standards are at different maturity levels. Care should be taken to select the standards that best meet the needs of the project.

8.1 ITS Standards for Hybrid F-M TOC

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
Data Dictionary for Closed Circuit Television (CCTV)	NTCIP 1205
Data Collection and Monitoring Devices	NTCIP 1206
Ramp Meter Controller Objects	NTCIP 1207
Object Definitions for Video Switches	NTCIP 1208
Transportation System Sensor Objects	NTCIP 1209
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
Standard Specification for Archiving ITS Generated Traffic Monitoring Data	ASTM WK7604
Incident Management Standards Group	IEEE 1512 -2006 IEEE 1512.1-2006 IEEE 1512.2-2004 IEEE 1512.3-2006 IEEE P1512.4
Standard for Functional Level Traffic Management Data Dictionary (TMDD)	ITE TM 1.03
Message Sets for External TMC Communication (MS/ETMCC)	ITE TM 2.01

9. FUNCTIONAL REQUIREMENTS

This section provides the detailed functional requirements for the user services and market packages identified for the hybrid F-M TOC. 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:

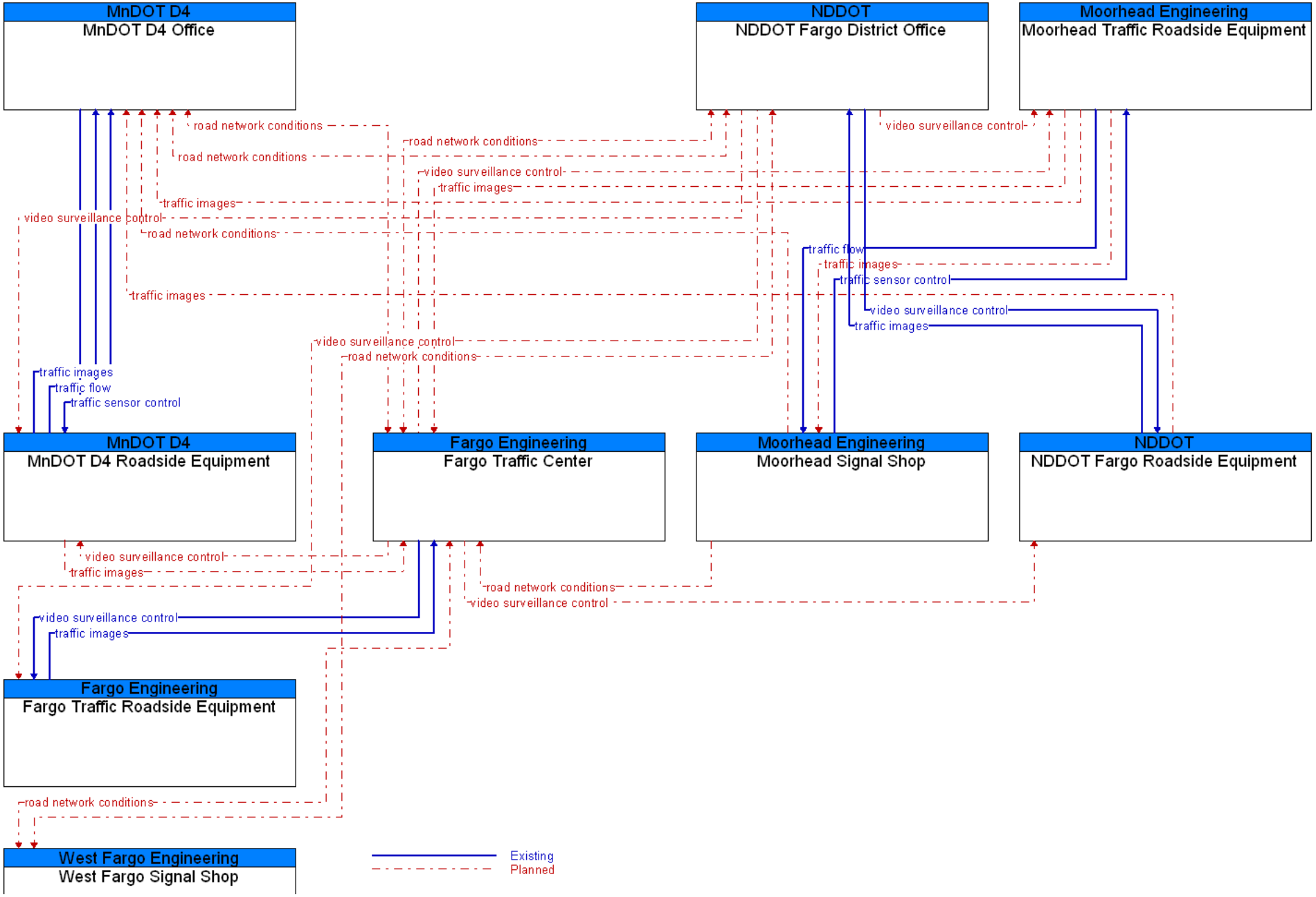
1. Element: Subsystems or Centers in the regional architecture
2. Entity: stakeholders in the statewide architecture
3. Functional Area: ITS Market Package service area
4. Requirements: specific functions to be carried out by the system
5. Status: existing or planned

Appendix C.

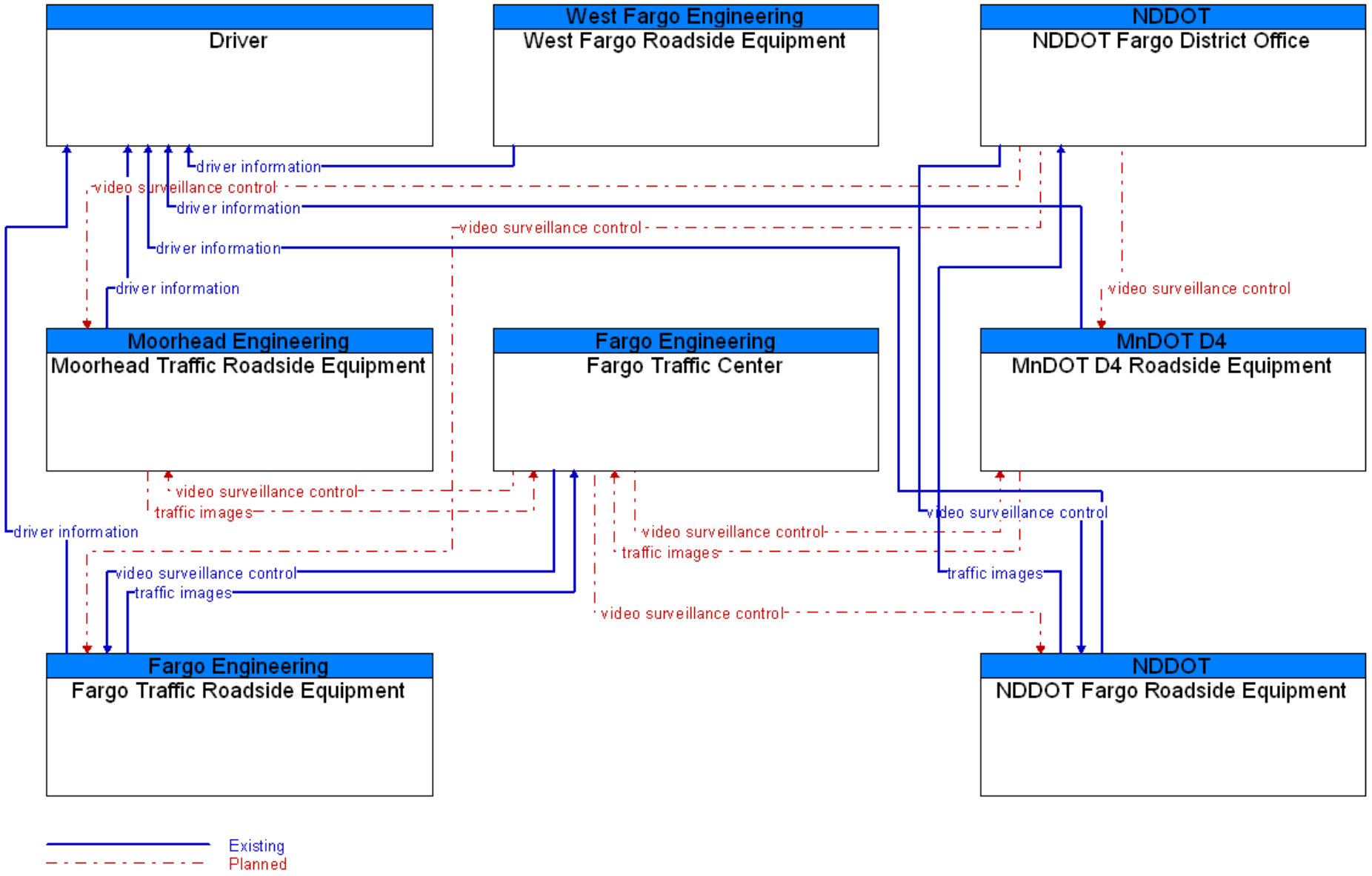
APPENDIX A: MARKET PACKAGE FLOW DIAGRAMS

AD2 – ITS Data Warehouse (Hybrid)

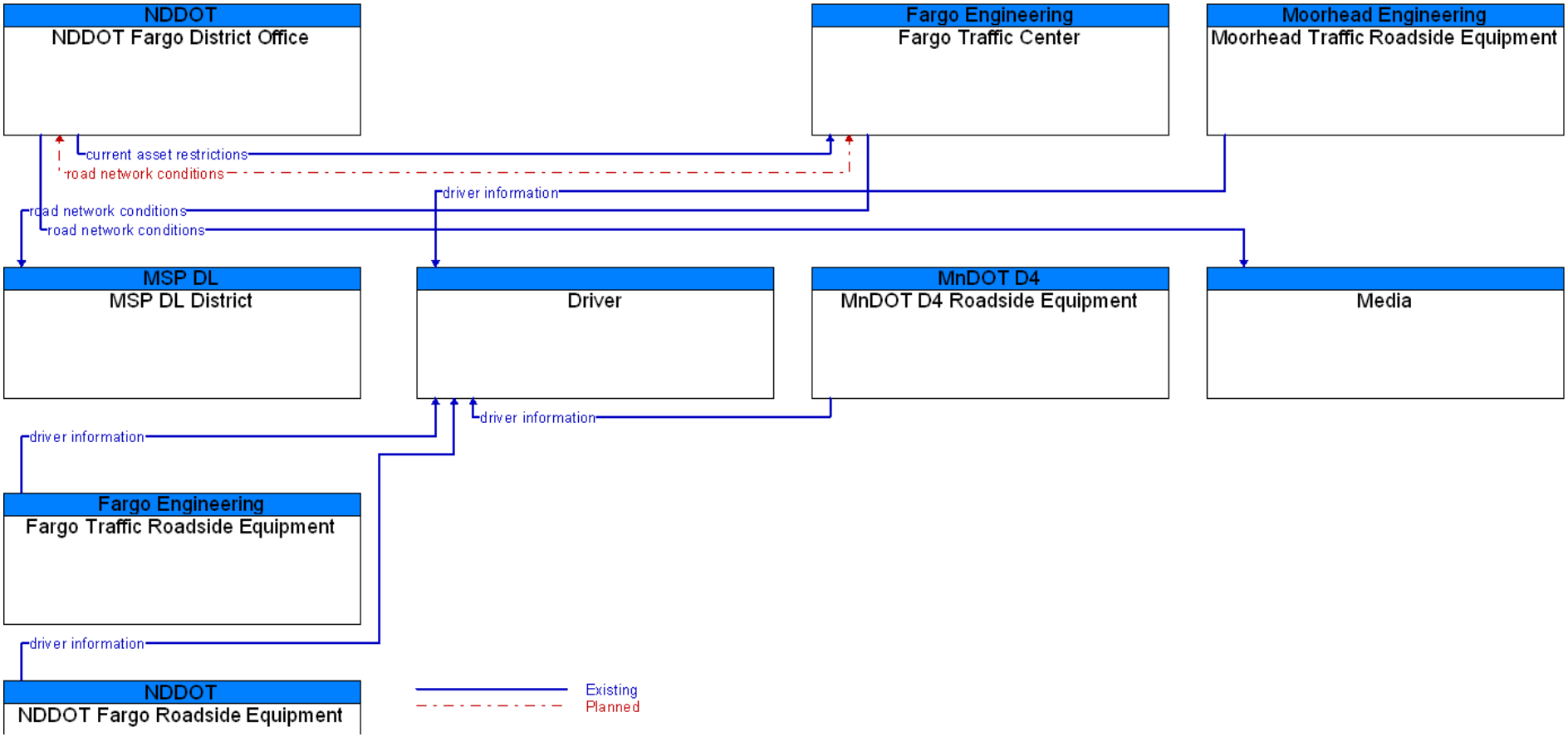
ATMS01 – Network Surveillance (Hybrid)



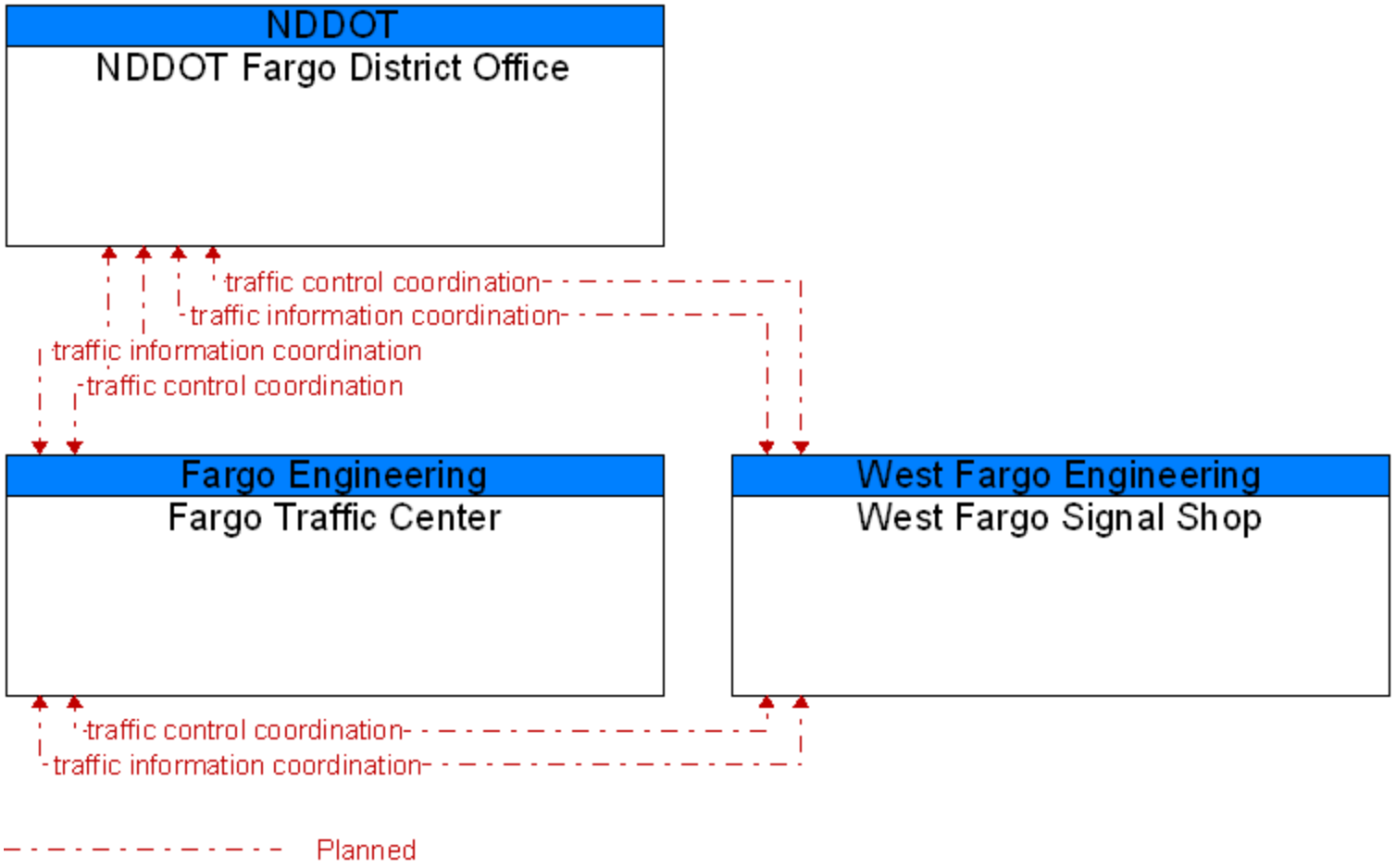
ATMS03 – Surface Street Control (Hybrid)



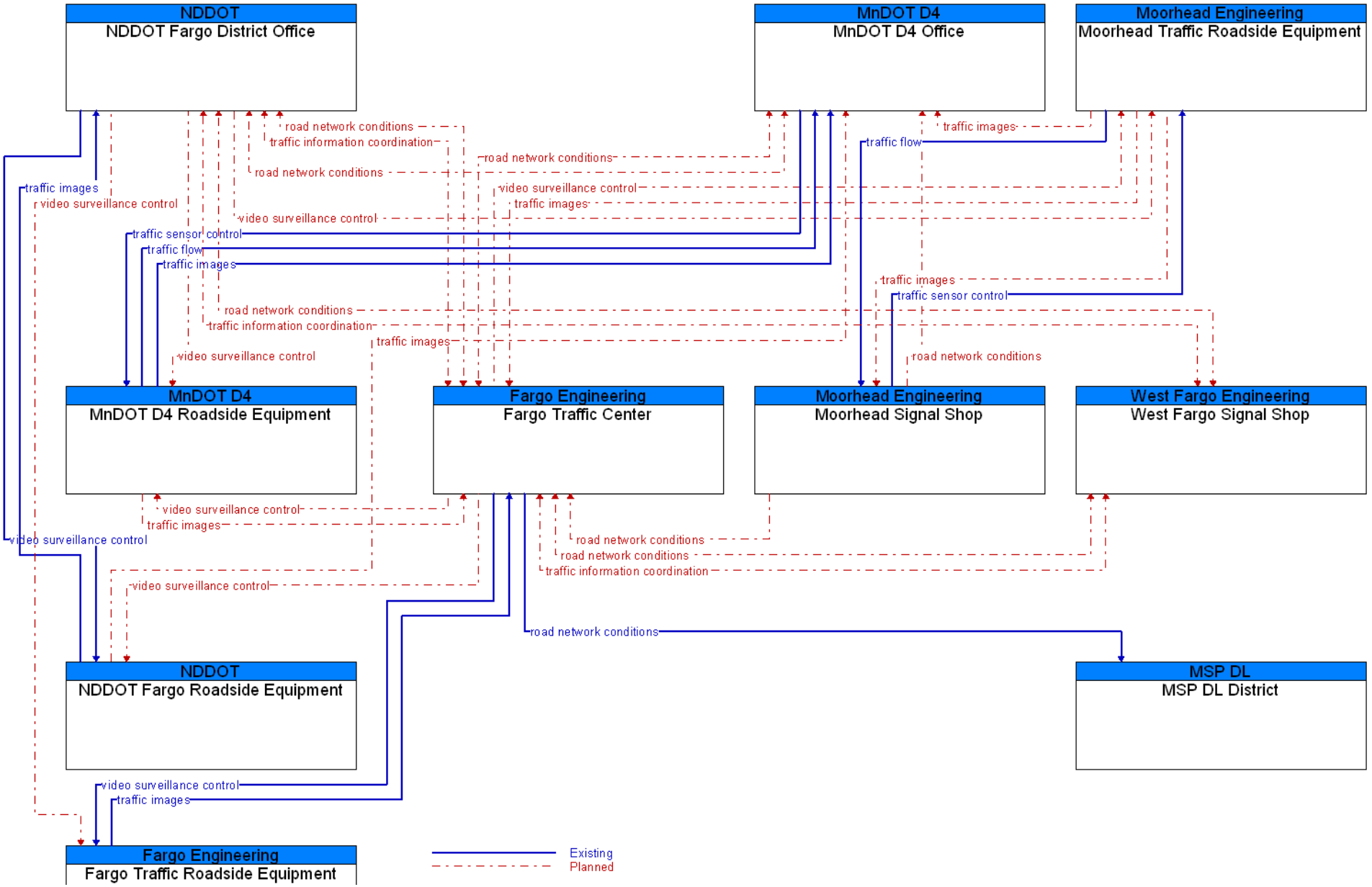
ATMS06 – Traffic Information Dissemination (Hybrid)



ATMS07 – Regional Traffic Management (Hybrid)



ATMS08 – Traffic Incident Management (Hybrid)



APPENDIX B: OPERATIONAL CONCEPT (ROLES AND RESPONSIBILITIES)

Operational Concept (Roles & Responsibilities)
FM TOC (Hybrid)

RR Area: **Archived Data Systems for FM TOC (Hybrid)**

Stakeholder
Fargo Engineering

Roles and Responsibilities	*Status*
Collect and provide data for archival	Planned

Stakeholder
MAT

Roles and Responsibilities	*Status*
Collect and provide data for archival	Planned

Stakeholder
MnDOT D4

Roles and Responsibilities	*Status*
Collect and provide data for archival	Planned

Stakeholder
MSP DL

Roles and Responsibilities	*Status*
Collect and provide data for archival	Planned

Stakeholder
NDDOT Fargo

Roles and Responsibilities	*Status*
Collect and provide data for archival	Planned

Stakeholder
NDHP Fargo

Roles and Responsibilities	*Status*
Collect and provide data for archival	Planned

Stakeholder
NDSU - UGPTI

Roles and Responsibilities	*Status*
Format and provide data to requesters	Existing
Perform analysis	Planned
Store data	Planned

Stakeholder
RRRDC Regional Partners

Roles and Responsibilities	*Status*

*RR Area:***Archived Data Systems for FM TOC (Hybrid)**

Collect and provide data for archival	Planned

Stakeholder

West Fargo Engineering

Roles and Responsibilities	*Status*
Collect and provide data for archival	Planned

MarketPackage

AD2: ITS Data Warehouse (Hybrid)

*RR Area:***Incident Management for Fargo-Moorhead Regional ITS Architecture (Hybrid)**

Stakeholder

Fargo Engineering

Roles and Responsibilities	*Status*
Implement special events timing plans and control strategies	Planned
Provide incident information to regional partners	Planned

Stakeholder

MnDOT D4

Roles and Responsibilities	*Status*
Provide resources	Existing
Provide incident information to regional partners	Planned
Provide surveillance images to MSP	Planned

Stakeholder

MSP DL

Roles and Responsibilities	*Status*
Coordinate with other law enforcement and emergency management agencies	Existing
Respond to incidents on MN state system	Existing
Provide incident information to regional partners	Planned

Stakeholder

NDDOT Fargo

Roles and Responsibilities	*Status*
Implement special events timing plans and control strategies	Planned
Provide incident information to regional partenrs	Planned

Stakeholder

NDHP Fargo

Roles and Responsibilities	*Status*
Coordinate with other law enforcement and emergency management agencies	Existing
Respond to incidents on ND state system	Existing
Provide incident information to regional partners	Planned

RR Area: **Incident Management for Fargo-Moorhead Regional ITS Architecture (Hybrid)**

Stakeholder

RRRDC Regional Partners

Roles and Responsibilities	*Status*
Coordinate response	Existing
Provide dispatch and comms	Existing
Provide incident information to regional partners	Planned

MarketPackage

ATMS08: Traffic Incident Management System (Hybrid)

RR Area: **Surface Street Management for Fargo-Moorhead Regional ITS Architecture (Hybrid)**

Stakeholder

Fargo Engineering

Roles and Responsibilities	*Status*
Design, operate, and maintain signal control system in Fargo and Moorhead	Existing
Coordinate with NDDOT and West Fargo to perform active traffic system management	Planned

Stakeholder

NDDOT Fargo

Roles and Responsibilities	*Status*
Design, operate, and maintain signal control system on ND state system	Existing
Coordinate with Fargo and West Fargo to perform active traffic system management	Planned

Stakeholder

West Fargo Engineering

Roles and Responsibilities	*Status*
Design, operate, and maintain signal control system in West Fargo	Existing
Coordinate with Fargo and NDDOT to perform active traffic system management	Planned

MarketPackage

ATMS01: Network Surveillance (Hybrid)
ATMS03: Surface Street Control (Hybrid)
ATMS06: Traffic Information Dissemination (Hybrid)
ATMS07: Regional Traffic Management (Hybrid)

APPENDIX C: FUNCTIONAL REQUIREMENTS

Functional Requirements
FM TOC (Hybrid)

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **Fargo Traffic Center**			
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
Requirement:	6	The center shall disseminate weather information to travelers.	Planned
Requirement:	7	The center shall disseminate event information to travelers.	Planned
Requirement:	9	The center shall provide the capability to support requests from the media for traffic and incident data.	Planned
Requirement:	10	The center shall provide the capability for a system operator to control the type and update frequency of broadcast traveler information.	Planned
Functional Area: **ISP Emergency Traveler Information** Distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.			
Requirement:	1	The center shall disseminate emergency evacuation information to the traveler interface systems, including evacuation zones, shelter information, available transportation modes, road closures and detours, changes to transit services, and traffic and road conditions at the origin, destination, and along the evacuation routes.	Existing
Requirement:	3	The center shall disseminate wide-area alert information to the traveler interface systems, including major emergencies such as a natural or man-made disaster, civil emergency, child abductions, severe weather watches and warnings, military activities, and law enforcement warnings.	Existing
Requirement:	4	The center shall provide the capability for a system operator to control the type and update frequency of emergency and wide-area alert information distributed to travelers.	Planned
Functional Area: **ISP Data Collection** Collection and storage of information supporting the operations of traveler information service providers. For use by operations personnel or data archives in the region.			
Requirement:	1	The center shall collect traveler information data, such as parking lot data, rideshare data, road network use data, vehicle probe data, and other data from traveler information system operations.	Planned
Requirement:	4	The center shall receive and respond to requests from ITS Archives for either a catalog of the traveler information data or for the data itself.	Planned

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **Fargo Traffic Center**		
Entity: **Information Service Provider**		
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.	Existing
Requirement:	4 The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	Planned
Requirement:	5 The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Planned
Requirement:	7 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.	Planned
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 implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.	Existing
Functional Area: **TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.		
Requirement:	1 The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Existing

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **Fargo Traffic Center**		
Entity: **Traffic Management**		
Functional Area: **TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.		
Requirement:	2 The center shall exchange traffic control information with other traffic management centers to support remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	Existing
Functional Area: **TMC Incident Dispatch Coordination/Communication** Formulates an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management. Facilitates the dispatch of emergency response and service vehicles and coordinates the response with cooperating agencies.		
Requirement:	1 The center shall exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.	Planned
Requirement:	2 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Planned
Requirement:	3 The center shall support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.	Planned
Requirement:	4 The center shall exchange incident information with emergency management centers, maintenance and construction centers, transit centers, information service providers, and the media including description, location, traffic impact, status, expected duration, and response information.	Planned
Requirement:	5 The center shall share resources with allied agency centers to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.	Planned
Requirement:	6 The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, border crossings, and rail operations centers.	Planned
Requirement:	7 The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.	Planned

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **Fargo Traffic Center**		
Entity: **Traffic Management**		
Functional Area: **TMC Incident Dispatch Coordination/Communication** Formulates an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management. Facilitates the dispatch of emergency response and service vehicles and coordinates the response with cooperating agencies.		
Requirement:	9 The center shall exchange road network status assessment information with emergency management and maintenance centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	Planned
Requirement:	10 The center shall coordinate information and controls with other traffic management centers.	Planned
Functional Area: **TMC Evacuation Support** Development, coordination, and execution of special traffic management strategies during evacuation and subsequent reentry of a population in the vicinity of a disaster or major emergency. Interfaces with emergency management and other traffic management centers.		
Requirement:	1 The center shall coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc.	Planned
Requirement:	2 The center shall support requests from emergency management centers to preempt the current traffic control strategy, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems to support evacuation traffic control plans.	Planned
Requirement:	4 The center shall coordinate execution of evacuation strategies with emergency management centers - including activities such as setting closures and detours, establishing routes, updating areas to be evacuated, timing the process, etc.	Planned
Functional Area: **TMC Traffic Network Performance Evaluation** Measures performance and predicts travel demand patterns to support traffic flow optimization, demand management, and incident management. Collects data from surveillance equipment as well as input from other management centers including emissions, event promoters, and other TMCs.		
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 to support overall network performance evaluations.	Planned
Requirement:	3 The center shall collect and store plans from event promoters for major future events possibly impacting traffic to support overall network performance evaluations.	Planned
Requirement:	6 The center shall exchange traffic information with other traffic management centers, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.	Planned

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **Fargo Traffic Center**		
Entity: **Traffic Management**		
Functional Area: **Traffic Maintenance** Monitoring and remote diagnostics of field equipment - detect failures, issue problem reports, and track the repair or replacement of the failed equipment.		
Requirement:	1 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.	Existing
Requirement:	2 The center shall collect and store CCTV surveillance system (traffic, pedestrian) operational status.	Planned
Requirement:	3 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.	Existing
Requirement:	4 The center shall collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.	Planned
Requirement:	8 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic maintenance data.	Planned
Functional Area: **Traffic Data Collection** Collection and storage of traffic management data. For use by operations personnel or data archives in the region.		
Requirement:	1 The center shall collect traffic management data such as operational data, event logs, etc.	Existing
Requirement:	3 The center shall receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.	Planned
Functional Area: **TMC Transportation Operations Data Collection** Collects real-time information on the state of the regional transportation system for operational use by the center. It establishes communications with a regional repository, requests or subscribes to information relevant to the center, and distributes the received information for use.		
Requirement:	1 The center shall collect real-time information on the state of the regional transportation system including current traffic and road conditions, weather conditions, special event and incident information.	Planned
Requirement:	2 The center shall support the capability for the system operator to monitor and control the information collection service.	Planned
Element: **Fargo Traffic Roadside Equipment**		
Entity: **Roadway Subsystem**		
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

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **Fargo Traffic Roadside Equipment**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Basic Surveillance** Field elements that monitor traffic conditions using loop detectors and CCTV cameras.		
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
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 at intersections and on main highways for urban and rural areas, under center control.	Existing
Requirement:	2 The field element shall collect pedestrian images and pedestrian sensor data, and respond to pedestrian crossing requests via display, audio signal, or other manner.	Existing
Requirement:	4 The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from the indicator control information.	Existing
Requirement:	5 The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from known indicator preemptions.	Existing
Requirement:	6 The field element shall return traffic signal controller operational status to the controlling center.	Existing
Requirement:	7 The field element shall return traffic signal controller fault data to the maintenance center for repair.	Existing
Functional Area: **Roadway Signal Priority** Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.		
Requirement:	1 The field element shall respond to requests for indicator (e.g., signal) preemption requests from emergency vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Requirement:	2 The field element shall respond to requests for indicator (e.g., signal) priority requests from transit vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Functional Area: **Standard Rail Crossing** Field elements at highway-rail intersections (HRIs) where operational requirements do not dictate advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Includes traditional HRI warning systems augmented with other standard traffic management devices.		
Requirement:	1 The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	Existing
Requirement:	2 The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the traffic management center.	Existing

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **Fargo Traffic Roadside Equipment**			
Entity: **Roadway Subsystem**			
Functional Area: **Standard Rail Crossing** Field elements at highway-rail intersections (HRIs) where operational requirements do not dictate advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Includes traditional HRI warning systems augmented with other standard traffic management devices.			
Requirement:	7	The field element shall close the highway-rail intersection (HRI) when a train is approaching using gates, lights/signs, barriers, and traffic control signals.	Existing
Requirement:	8	The field element shall support the integrated control of adjacent traffic signals to clear an area in advance of an approaching train and to manage traffic around the intersection.	Existing
Functional Area: **Roadway Data Collection** Field elements to collect traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications. Includes the sensors, supporting roadside infrastructure, and communications equipment.			
Requirement:	1	The field element shall collect traffic, road, and environmental conditions information.	Existing
Requirement:	2	The field element shall include the sensors and supporting roadside devices that sense, collect, and send traffic, road, and environmental conditions information to a center for archival.	Existing
Requirement:	3	The field element shall collect sensor status and sensor faults from roadside equipment and send it along with the recorded data to a center for archival.	Existing
Element: **MnDOT D4 Office**			
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
Requirement:	6	The center shall disseminate weather information to travelers.	Existing
Requirement:	10	The center shall provide the capability for a system operator to control the type and update frequency of broadcast traveler information.	Planned
Functional Area: **ISP Data Collection** Collection and storage of information supporting the operations of traveler information service providers. For use by operations personnel or data archives in the region.			
Requirement:	1	The center shall collect traveler information data, such as parking lot data, rideshare data, road network use data, vehicle probe data, and other data from traveler information system operations.	Planned

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **MnDOT D4 Office**		
Entity: **Information Service Provider**		
Functional Area: **ISP Data Collection** Collection and storage of information supporting the operations of traveler information service providers. For use by operations personnel or data archives in the region.		
Requirement:	4 The center shall receive and respond to requests from ITS Archives for either a catalog of the traveler information data or for the data itself.	Planned
Element: **MnDOT D4 Roadside Equipment**		
Entity: **Roadway Subsystem**		
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.	Planned
Requirement:	2 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Planned
Requirement:	4 The field element shall return sensor and CCTV system operational status to the controlling center.	Planned
Requirement:	5 The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Planned
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 at intersections and on main highways for urban and rural areas, under center control.	Existing
Requirement:	2 The field element shall collect pedestrian images and pedestrian sensor data, and respond to pedestrian crossing requests via display, audio signal, or other manner.	Existing
Requirement:	4 The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from the indicator control information.	Existing
Requirement:	5 The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from known indicator preemptions.	Existing
Requirement:	6 The field element shall return traffic signal controller operational status to the controlling center.	Planned
Requirement:	7 The field element shall return traffic signal controller fault data to the maintenance center for repair.	Planned

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **MnDOT D4 Roadside Equipment**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Signal Priority** Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.		
Requirement:	1 The field element shall respond to requests for indicator (e.g., signal) preemption requests from emergency vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Requirement:	2 The field element shall respond to requests for indicator (e.g., signal) priority requests from transit vehicles at intersections, pedestrian crossings, and multimodal crossings.	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
Functional Area: **Standard Rail Crossing** Field elements at highway-rail intersections (HRIs) where operational requirements do not dictate advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Includes traditional HRI warning systems augmented with other standard traffic management devices.		
Requirement:	1 The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	Existing
Requirement:	2 The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the traffic management center.	Existing
Requirement:	7 The field element shall close the highway-rail intersection (HRI) when a train is approaching using gates, lights/signs, barriers, and traffic control signals.	Existing
Requirement:	8 The field element shall support the integrated control of adjacent traffic signals to clear an area in advance of an approaching train and to manage traffic around the intersection.	Existing
Functional Area: **Roadway Data Collection** Field elements to collect traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications. Includes the sensors, supporting roadside infrastructure, and communications equipment.		
Requirement:	1 The field element shall collect traffic, road, and environmental conditions information.	Planned

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **MnDOT D4 Roadside Equipment**			
Entity: **Roadway Subsystem**			
Functional Area: **Roadway Data Collection** Field elements to collect traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications. Includes the sensors, supporting roadside infrastructure, and communications equipment.			
Requirement:	2	The field element shall include the sensors and supporting roadside devices that sense, collect, and send traffic, road, and environmental conditions information to a center for archival.	Planned
Requirement:	3	The field element shall collect sensor status and sensor faults from roadside equipment and send it along with the recorded data to a center for archival.	Planned
Element: **Moorhead Traffic Roadside Equipment**			
Entity: **Roadway Subsystem**			
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.	Planned
Requirement:	2	The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	Planned
Requirement:	4	The field element shall return sensor and CCTV system operational status to the controlling center.	Planned
Requirement:	5	The field element shall return sensor and CCTV system fault data to the controlling center for repair.	Planned
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 at intersections and on main highways for urban and rural areas, under center control.	Planned
Requirement:	2	The field element shall collect pedestrian images and pedestrian sensor data, and respond to pedestrian crossing requests via display, audio signal, or other manner.	Existing
Requirement:	4	The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from the indicator control information.	Planned
Requirement:	5	The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from known indicator preemptions.	Planned
Requirement:	6	The field element shall return traffic signal controller operational status to the controlling center.	Planned
Requirement:	7	The field element shall return traffic signal controller fault data to the maintenance center for repair.	Planned

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **Moorhead Traffic Roadside Equipment**		
Entity: **Roadway Subsystem**		
Functional Area: **Roadway Signal Priority** Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.		
Requirement:	1 The field element shall respond to requests for indicator (e.g., signal) preemption requests from emergency vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Requirement:	2 The field element shall respond to requests for indicator (e.g., signal) priority requests from transit vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Functional Area: **Standard Rail Crossing** Field elements at highway-rail intersections (HRIs) where operational requirements do not dictate advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Includes traditional HRI warning systems augmented with other standard traffic management devices.		
Requirement:	1 The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	Existing
Requirement:	2 The field element shall monitor the status of the highway-rail intersection (HRI) equipment, including both the current state and mode of operation and the current equipment condition, to be forwarded on to the traffic management center.	Existing
Requirement:	7 The field element shall close the highway-rail intersection (HRI) when a train is approaching using gates, lights/signs, barriers, and traffic control signals.	Existing
Requirement:	8 The field element shall support the integrated control of adjacent traffic signals to clear an area in advance of an approaching train and to manage traffic around the intersection.	Existing
Functional Area: **Roadway Data Collection** Field elements to collect traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications. Includes the sensors, supporting roadside infrastructure, and communications equipment.		
Requirement:	1 The field element shall collect traffic, road, and environmental conditions information.	Existing
Requirement:	2 The field element shall include the sensors and supporting roadside devices that sense, collect, and send traffic, road, and environmental conditions information to a center for archival.	Planned
Requirement:	3 The field element shall collect sensor status and sensor faults from roadside equipment and send it along with the recorded data to a center for archival.	Planned
Element: **NDDOT Fargo District Office**		
Entity: **Information Service Provider**		
Functional Area: **ISP Traveler Data Collection** Collects traveler information from other centers, consolidates and refines the collected data, and makes this data available to traveler information applications.		

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **NDDOT Fargo District Office**			
Entity: **Information Service Provider**			
Functional Area: **ISP Traveler Data Collection** Collects traveler information from other centers, consolidates and refines the collected data, and makes this data available to traveler information applications.			
Requirement:	1	The center shall collect, process, and store traffic and highway condition information, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.	Existing
Requirement:	2	The center shall collect, process, and store maintenance and construction information, including scheduled maintenance and construction work activities and work zone activities.	Existing
Requirement:	7	The center shall collect, process, and store event information.	Existing
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
Requirement:	6	The center shall disseminate weather information to travelers.	Existing
Requirement:	7	The center shall disseminate event information to travelers.	Existing
Requirement:	9	The center shall provide the capability to support requests from the media for traffic and incident data.	Existing
Requirement:	10	The center shall provide the capability for a system operator to control the type and update frequency of broadcast traveler information.	Existing
Functional Area: **ISP Emergency Traveler Information** Distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.			
Requirement:	1	The center shall disseminate emergency evacuation information to the traveler interface systems, including evacuation zones, shelter information, available transportation modes, road closures and detours, changes to transit services, and traffic and road conditions at the origin, destination, and along the evacuation routes.	Existing
Requirement:	3	The center shall disseminate wide-area alert information to the traveler interface systems, including major emergencies such as a natural or man-made disaster, civil emergency, child abductions, severe weather watches and warnings, military activities, and law enforcement warnings.	Existing
Requirement:	4	The center shall provide the capability for a system operator to control the type and update frequency of emergency and wide-area alert information distributed to travelers.	Existing

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **NDDOT Fargo District Office**			
Entity: **Information Service Provider**			
Functional Area: **ISP Data Collection** Collection and storage of information supporting the operations of traveler information service providers. For use by operations personnel or data archives in the region.			
Requirement:	1	The center shall collect traveler information data, such as parking lot data, rideshare data, road network use data, vehicle probe data, and other data from traveler information system operations.	Existing
Requirement:	4	The center shall receive and respond to requests from ITS Archives for either a catalog of the traveler information data or for the data itself.	Existing
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.	Existing
Requirement:	4	The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	Planned
Requirement:	5	The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing
Requirement:	7	The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.	Planned
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 implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.	Existing

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **NDDOT Fargo District Office**		
Entity: **Traffic Management**		
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.	Existing
Requirement:	3 The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Existing
Requirement:	4 The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Existing
Requirement:	6 The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.	Planned
Requirement:	7 The center shall distribute traffic data to the media; the capability to provide the information in both data stream and graphical display shall be supported.	Planned
Requirement:	8 The center shall provide the capability for center personnel to control the nature of the data that is available to non-traffic operations centers and the media.	Existing
Functional Area: **TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.		
Requirement:	1 The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Existing
Requirement:	2 The center shall exchange traffic control information with other traffic management centers to support remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	Existing
Functional Area: **TMC Incident Detection** Remotely monitors traffic sensor and surveillance systems to detect and verify incidents. Also monitors external advisory and incident reporting systems, intermodal freight depots, and border crossings for additional incident information. Identified incidents are reported to operations personnel and other centers.		
Requirement:	1 The center shall receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System.	Planned
Requirement:	2 The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.	Planned
Requirement:	3 The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, border crossings, and intermodal freight depots.	Existing

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **NDDOT Fargo District Office**			
Entity: **Traffic Management**			
Functional Area: **TMC Incident Detection** Remotely monitors traffic sensor and surveillance systems to detect and verify incidents. Also monitors external advisory and incident reporting systems, intermodal freight depots, and border crossings for additional incident information. Identified incidents are reported to operations personnel and other centers.			
Requirement:	4	The center shall exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.	Planned
Requirement:	6	The center shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.	Planned
Requirement:	7	The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.	Existing
Functional Area: **TMC Incident Dispatch Coordination/Communication** Formulates an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management. Facilitates the dispatch of emergency response and service vehicles and coordinates the response with cooperating agencies.			
Requirement:	1	The center shall exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.	Existing
Requirement:	2	The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing
Requirement:	3	The center shall support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.	Planned
Requirement:	4	The center shall exchange incident information with emergency management centers, maintenance and construction centers, transit centers, information service providers, and the media including description, location, traffic impact, status, expected duration, and response information.	Planned
Requirement:	5	The center shall share resources with allied agency centers to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.	Existing

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **NDDOT Fargo District Office**			
Entity: **Traffic Management**			
Functional Area: **TMC Incident Dispatch Coordination/Communication** Formulates an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management. Facilitates the dispatch of emergency response and service vehicles and coordinates the response with cooperating agencies.			
Requirement:	6	The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, border crossings, and rail operations centers.	Existing
Requirement:	7	The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.	Planned
Requirement:	9	The center shall exchange road network status assessment information with emergency management and maintenance centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	Planned
Requirement:	10	The center shall coordinate information and controls with other traffic management centers.	Planned
Functional Area: **TMC Evacuation Support** Development, coordination, and execution of special traffic management strategies during evacuation and subsequent reentry of a population in the vicinity of a disaster or major emergency. Interfaces with emergency management and other traffic management centers.			
Requirement:	1	The center shall coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc.	Existing
Requirement:	2	The center shall support requests from emergency management centers to preempt the current traffic control strategy, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems to support evacuation traffic control plans.	Existing
Requirement:	4	The center shall coordinate execution of evacuation strategies with emergency management centers - including activities such as setting closures and detours, establishing routes, updating areas to be evacuated, timing the process, etc.	Existing
Functional Area: **TMC Traffic Network Performance Evaluation** Measures performance and predicts travel demand patterns to support traffic flow optimization, demand management, and incident management. Collects data from surveillance equipment as well as input from other management centers including emissions, event promoters, and other TMCs.			
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 to support overall network performance evaluations.	Planned
Requirement:	3	The center shall collect and store plans from event promoters for major future events possibly impacting traffic to support overall network performance evaluations.	Planned

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **NDDOT Fargo District Office**		
Entity: **Traffic Management**		
Functional Area: **TMC Traffic Network Performance Evaluation** Measures performance and predicts travel demand patterns to support traffic flow optimization, demand management, and incident management. Collects data from surveillance equipment as well as input from other management centers including emissions, event promoters, and other TMCs.		
Requirement:	6 The center shall exchange traffic information with other traffic management centers, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.	Planned
Functional Area: **Traffic Maintenance** Monitoring and remote diagnostics of field equipment - detect failures, issue problem reports, and track the repair or replacement of the failed equipment.		
Requirement:	1 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.	Existing
Requirement:	2 The center shall collect and store CCTV surveillance system (traffic, pedestrian) operational status.	Existing
Requirement:	3 The center shall collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.	Existing
Requirement:	4 The center shall collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.	Existing
Requirement:	8 The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic maintenance data.	Planned
Functional Area: **Traffic Data Collection** Collection and storage of traffic management data. For use by operations personnel or data archives in the region.		
Requirement:	1 The center shall collect traffic management data such as operational data, event logs, etc.	Existing
Requirement:	3 The center shall receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.	Existing
Functional Area: **TMC Transportation Operations Data Collection** Collects real-time information on the state of the regional transportation system for operational use by the center. It establishes communications with a regional repository, requests or subscribes to information relevant to the center, and distributes the received information for use.		
Requirement:	1 The center shall collect real-time information on the state of the regional transportation system including current traffic and road conditions, weather conditions, special event and incident information.	Planned
Requirement:	2 The center shall support the capability for the system operator to monitor and control the information collection service.	Existing

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **NDDOT Fargo Roadside Equipment**			
Entity: **Roadway Subsystem**			
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
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 at intersections and on main highways for urban and rural areas, under center control.	Existing
Requirement:	2	The field element shall collect pedestrian images and pedestrian sensor data, and respond to pedestrian crossing requests via display, audio signal, or other manner.	Existing
Requirement:	4	The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from the indicator control information.	Existing
Requirement:	5	The field element shall monitor operation of traffic signal controllers and report to the center any instances in which the indicator response does not match that expected from known indicator preemptions.	Existing
Requirement:	6	The field element shall return traffic signal controller operational status to the controlling center.	Existing
Requirement:	7	The field element shall return traffic signal controller fault data to the maintenance center for repair.	Existing
Functional Area: **Roadway Signal Priority** Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.			
Requirement:	1	The field element shall respond to requests for indicator (e.g., signal) preemption requests from emergency vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing
Requirement:	2	The field element shall respond to requests for indicator (e.g., signal) priority requests from transit vehicles at intersections, pedestrian crossings, and multimodal crossings.	Existing

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **NDDOT Fargo Roadside Equipment**		
Entity: **Roadway Subsystem**		
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
Functional Area: **Roadway Data Collection** Field elements to collect traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications. Includes the sensors, supporting roadside infrastructure, and communications equipment.		
Requirement:	1 The field element shall collect traffic, road, and environmental conditions information.	Existing
Requirement:	2 The field element shall include the sensors and supporting roadside devices that sense, collect, and send traffic, road, and environmental conditions information to a center for archival.	Existing
Requirement:	3 The field element shall collect sensor status and sensor faults from roadside equipment and send it along with the recorded data to a center for archival.	Existing
Element: **NDSU Data Warehouse**		
Entity: **Archived Data Management Subsystem**		
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.	Existing
Requirement:	2 The center shall collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data; e.g., time range of entries, number of entries; or a sample of the data (e. g. a thumbnail).	Existing
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
Requirement:	4 The center shall include capabilities for performing quality checks on the incoming archived data.	Planned
Requirement:	5 The center shall include capabilities for error notification on the incoming archived data.	Planned

Architecture			Status
FM TOC (Hybrid)			Planned
Element: **NDSU Data Warehouse**			
Entity: **Archived Data Management Subsystem**			
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:	7	The center shall support a broad range of archived data management implementations, ranging from simple data marts that collect a focused set of data and serve a particular user community to large-scale data warehouses that collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a region.	Planned
Requirement:	8	The center shall perform quality checks on received data.	Planned
Requirement:	9	The center shall provide the capability to execute methods on the incoming data such as cleansing, summarizations, aggregations, or transformations applied to the data before it is stored in the archive.	Planned
Requirement:	11	When data or a catalog of data is received from the archive, the center shall generate the requested data product for the users systems.	Planned
Element: **RRRDC**			
Entity: **Emergency Management**			
Functional Area: **Incident Command** Tactical decision support, resource coordination, and communications integration among emergency management agencies for Incident Commands that are established by first responders to support local management of an incident.			
Requirement:	1	The center shall provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.	Existing
Requirement:	2	The center shall provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.	Existing
Requirement:	3	The center shall track and maintain resource information and action plans pertaining to the incident command.	Existing
Requirement:	4	The center shall share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.	Existing
Requirement:	5	The center shall assess the status of responding emergency vehicles as part of an incident command.	Existing

Architecture		Status
FM TOC (Hybrid)		Planned
Element: **West Fargo Signal Shop**		
Entity: **Traffic Management**		
Functional Area: **TMC Regional Traffic Management** Coordination between traffic management centers in order to share traffic information between centers as well as control of traffic management field equipment. This may be used during incidents and special events and during day-to-day operations.		
Requirement:	1 The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	Planned
Requirement:	2 The center shall exchange traffic control information with other traffic management centers to support remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	Planned