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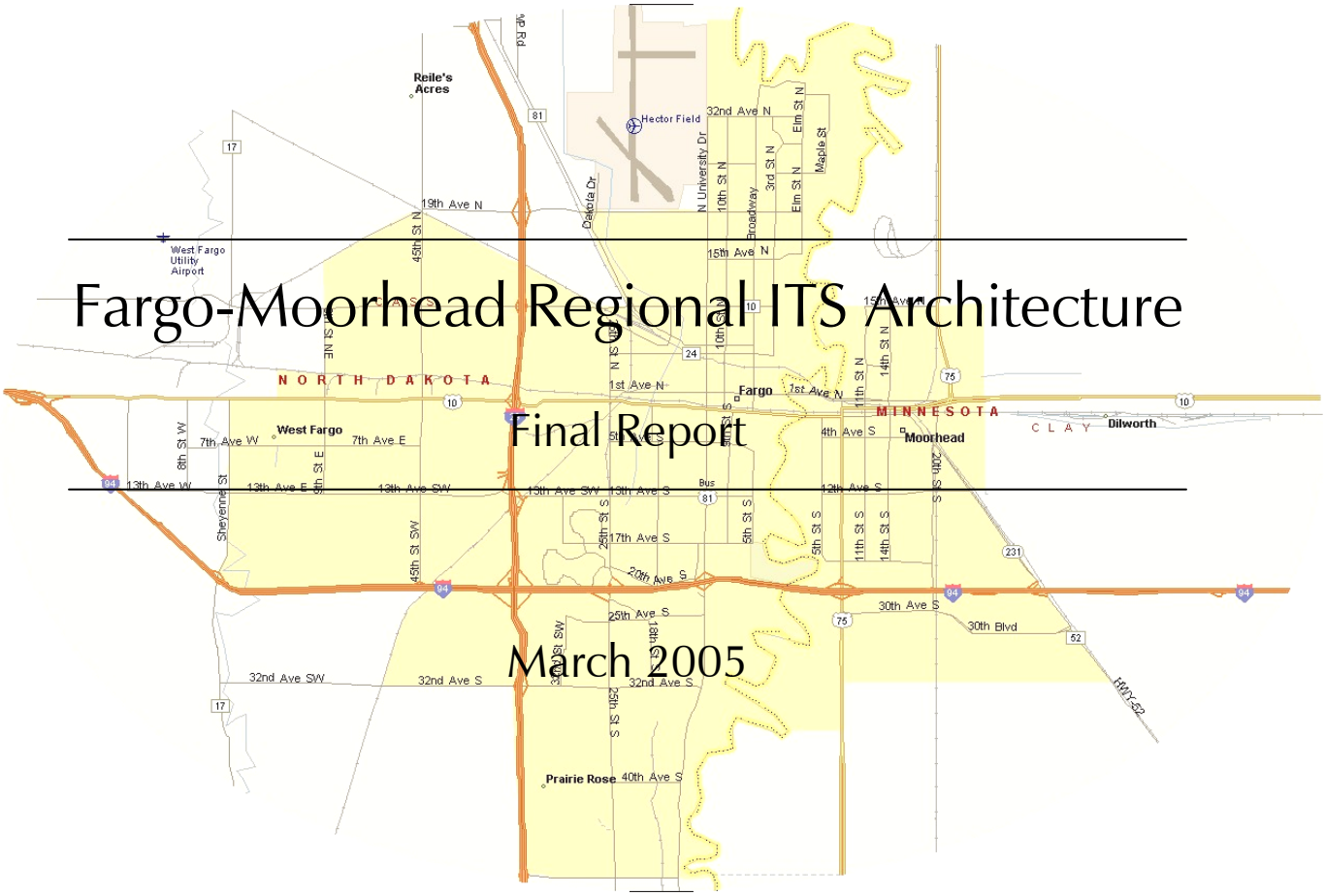

Fargo-Moorhead Regional ITS Architecture

Final Report

March 2005

Prepared for:
Fargo-Moorhead Council of Governments

Prepared by:
Advanced Traffic Analysis Center
Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

Fargo-Moorhead Regional ITS Architecture

Final Report

March 2005

The information contained in this report was obtained through extensive input from various stakeholders in the Fargo-Moorhead 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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EXECUTIVE SUMMARY

The Fargo-Moorhead Regional Intelligent Transportation Systems (ITS) Architecture was prepared under the leadership of the Fargo-Moorhead Council of Governments (F-M COG). The goal of the F-M regional architecture (RA) is to guide the implementation of ITS systems in the F-M region and coordinate funding, deployment, information sharing, and operations of ITS systems in the region. The main ITS goal areas for the F-M region include enhanced traveler safety; effective traffic and transit management; coordinated incidents 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 Bismarck-Mandan MPO, Fargo-Moorhead Council of Governments, and the Grand Forks-East Grand Forks MPO for supporting the RA development in each region.

The RA development process primarily followed the FHWA guidelines, with some modifications to reflect the unique characteristics of the region. The process made use of completed ITS planning efforts in the region and used the output of those efforts as a starting point for identifying regional needs and ITS services.

The F-M region is a rapidly growing area which continues to experience increased economic activity, serving as a business and cultural center for the vastly rural surrounding region. 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 F-M RA were primarily based on the F-M COG's metropolitan boundaries. Major jurisdictions include:

1. City of Fargo, North Dakota
2. City of Moorhead, Minnesota
3. City of West Fargo, North Dakota
4. City of Dilworth, Minnesota
5. Cass County, North Dakota
6. Clay County, Minnesota

In addition to these jurisdictions, the RA recognized interfaces with statewide architectures in North Dakota and Minnesota. Therefore, the North Dakota Department of Transportation (NDDOT), the Minnesota Department of Transportation (MnDOT), and the Federal Highway Administration (FHWA) were active participants in the RA development.

The RA development was guided by various regional stakeholders who were categorized into three groups:

1. Project Advisory Group: guide overall project in the three MPOs
    a. Two representative from each MPO
    b. FHWA Division Office, Bismarck, North Dakota
    c. NDDOT
2. Technical Steering Committee: provide technical information on existing and planned system and provide input on the architecture development
    a. City engineering and planning staff
    b. Transit staff
    c. MPO planning staff
    d. County engineering/planning staff
    e. Agency Information Technology technical staff
    f. State DOT district engineering staff
    g. FHWA representative
    h. Law enforcement (police and fire)
    i. Other agencies responsible for system operating/maintenance
3. Local Stakeholders: stakeholders not likely to own/operate ITS systems
    a. Elected official for supporting deployment and funding systems
    b. Event centers
    c. Colleges
    d. Airports
    e. Emergency Medical Services

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, transit 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 identified from previous ITS plans as well as input from regional stakeholders. The National ITS Architecture was used to map these services and to develop market packages in support of these services. ITS Market Packages were used extensively in the F-M RA development since they provided an easy to use tool for discussions with stakeholders. They also provided an effective entry point for Turbo Architecture. A total of 20 Market Packages were identified for the F-M area. The Market 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. Seven potential agreements were identified for the F-M region and they include regional traffic control, incident management, roadway closure, 911 coordination, emergency routing, work zone management, and traffic enforcement.

One of the greatest challenges to successful ITS deployment in the F-M area is funding for ITS infrastructure, especially communications. Therefore, coordination and integration of key system components were sited as critical factors for success. Given the number and diversity of agencies involved, it is important to capitalize on and expand existing partnerships to include new ITS systems. These partnerships would result in cost-effective strategies that meet the demands of each agency and the traveling public in the region.

It is expected that communication infrastructure on the main corridors within the F-M region will be completed within the next five years. Additional ITS hardware has been deployed in conjunction with major road construction projects in the area, including I-29 and Main Avenue in Fargo. The NDDOT and the MnDOT have also embarked on a partnership to improve traffic operations and reduce impacts of winter weather conditions on the Red River Bridge on I-94 between Fargo and Moorhead. ITS technologies in the areas of fleet management for transit, maintenance and construction, and emergency vehicles could be deployed within the next five years.

As part of the RA development, the F-M COG has been designated with the role of maintaining and updating the F-M Regional ITS Architecture as needed. The F-M COG will coordinate changes to the RA as more ITS projects have been planned or major changes to the transportation system have taken place.

1.0 INTRODUCTION

This document summarizes the results of the regional Intelligent Transportation architecture development for the Fargo-Moorhead Area. Intelligent Transportation Systems (ITS) refer to integrated applications of sensing, communications, computer processing, and electronics to enhance the transportation 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 Fargo-Moorhead Regional Intelligent Transportation Systems (ITS) Architecture was prepared under the leadership of the Fargo-Moorhead Council of Governments (F-M COG). The goal of the F-M regional architecture (RA) is to guide the implementation of ITS systems in the F-M region and coordinate funding, deployment, information sharing, and operations of ITS systems in the region. The main ITS goal areas for the F-M region include enhanced traveler safety; effective traffic and transit management; coordinated incident management; and enhanced traveler information. A 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 Bismarck-Mandan MPO, Fargo-Moorhead Council of Governments, and the Grand Forks-East Grand Forks MPO for supporting the RA development in each region.

1.1 Report Organization

The F-M RA Report is organized into several main sections to facilitate the report use. In addition, an electronic file has been prepared using Turbo Architecture 3.0 in order to access the architecture and make changes or future updates.

Below is a listing of the remaining sections of this report and a brief description of each section:

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 market 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	Interface Requirements	Shows systems interconnections and information flows
10	ITS Standards	Brief discussion of applicable ITS standards
11	Sequence of Projects	Time-frame for ITS projects
	Appendix A	Market Packages and Information Flows
	Appendix B	Functional Requirements

2.0 REGION AND SCOPE

This section describes the geographical characteristics of the F-M region. It also discusses the scope of the regional architecture (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 F-M RA primarily consisted of the F-M COG's metropolitan boundaries, which are also included in the F-M COG's transportation planning activities. Figure 1 shows a map of the region. Major jurisdictions within the region include:

1. City of Fargo, North Dakota
2. City of Moorhead, Minnesota
3. City of West Fargo, North Dakota
4. City of Dilworth, Minnesota
5. Cass County, North Dakota
6. Clay County, Minnesota

In addition, the North Dakota Department of Transportation (NDDOT) is responsible for operating and maintaining the state system within Fargo, including sections of two major Interstate highways (I-29 and I-94). The NDDOT also operates several traffic signals, primarily located at Interstate ramps. Similarly, the Minnesota Department of Transportation (MnDOT) is responsible for operating the state system on the Minnesota side as well as traffic signal operations in Moorhead and Dilworth.

2.2 Scope of the RA

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

1. Travel and Traffic Management
    a. Traffic control
    b. Traveler information
    c. Traffic surveillance
2. Public Transportation Management
    a. Fleet management (real-time information)
3. Incident Management
    a. Incident response coordination (integrated communications)
4. Information Management
    a. Data archival and analysis services
5. Maintenance and Construction Management
    a. Automated treatment (anti-icing systems)
    b. Winter maintenance
    c. Work zone and road closure management

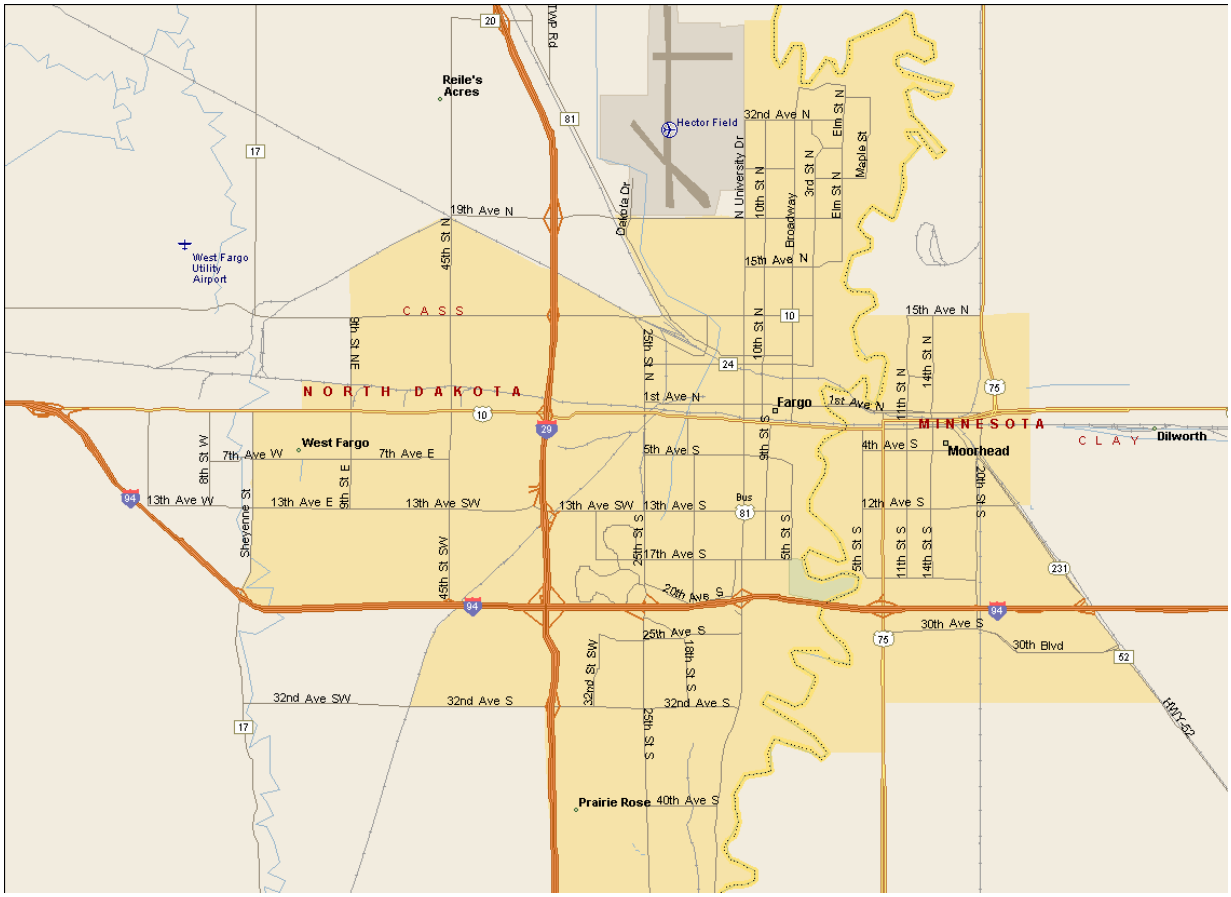

Figure 1 Map of the Fargo-Moorhead Region

3.0 STAKEHOLDERS

The development of the F-M RA was guided by several stakeholder groups. An ITS Architecture Core Group had the primarily role of supporting the RA development, providing needed data, and reviewing architecture relationships. This group mainly of representatives from agencies who currently (or will) own, operate, or maintain ITS in the F-M area. Other stakeholders in the region were involved in identifying regional needs, developing roles and responsibilities, and supporting the RA (Table 3.1). Table 3.2 lists stakeholders mapped to the F-M RA and identifies corresponding ITS elements.

Table 3.1 Fargo Moorhead Regional Stakeholders

Name		Organization	Telephone
Greg	Anderson	Moorhead Police Department	(701) 299-5117
Keven	Anderson	MnDOT District 4	(218) 847-1532
Bill	Bergquist	Clay County Sheriff	(218) 299-5151
Mark	Bittner	Fargo City Engineering	
Julie	Bommelman	Fargo Transit	(701) 241-8140
Robert	Bright	Metro COG	(701) 232-3242 ext 32
David	Bruckner	West Fargo Police Department	(701) 282-4154
Chris	Brungardt	West Fargo Public Works	(701) 282-2408
Steve	Busek	FHWA, ND Division	(701) 250-4343 Ex.112
Kathy	Colvin	RRRDC	(701) 451-7684
Jeremy	Gorden	Fargo Traffic Engineering	(701) 241-1529
Bruce	Hentges	MN State Patrol	(218) 847-1527
Chad	Martin	Moorhead Public Works	(218) 299-5421
David	Miller	Dilworth Police Department	(218) 287-2666
Dave	Rogness	Cass Co Emergency Management	(701) 239-6790
Don	Rudnick	Cass Co Sheriff's Department	(701) 241-5800
Al	Salvatore	NDHP	(701) 239-8960
Larry	Schuh	Fargo Fire Department	(701) 241-8129
Martin	Soeth	Moorhead Fire Department	(218) 299-5432
Tom	Swenson	MnDot-District 4	
Keith	Ternes	Fargo Police Department	(701) 241-1401
Stan	Thurlow	Dilworth Planning	(218) 287-2313
Lori	VanBeek	Moorhead Transit	(218) 299-5370
Dennis	Walaker	Fargo Public Works	(701) 241-1463
Bob	Walton	NDDOT-Fargo Division	(701) 239-8900
Bob	Zimmerman	Moorhead Public Works	(218) 299-5390
Georgia	Beaudry	Clay Co Rural Transit	(218) 299-7210
Paul	Benning	ND DOT Local Governments	(701) 328-2217
Keith	Berndt	Cass County Engineering	(701) 282-2047
John	Cousins	Clay County	(218) 299-5099
Mark	Johnson	FHWA, ND Division	(701) 250-4343 ext. 105
Tim	Magnusson	Clay County	(218) 299-5195
Brad	Monson	MnDOT-District 4	(218) 847-0418
Jeff	Schaumann	Moorhead	(218) 299-5374
Larry	Weil	West Fargo Planning	(701) 282-3837

Table 3.2 Fargo-Moorhead ITS Stakeholders		
Stakeholder	**Description**	**Associated ITS Elements**
ATAC	Advanced Traffic Analysis Center at North Dakota State University	ATAC data warehouse
County Sheriffs	Cass County and Clay County Sheriff Departments	County Sheriff Vehicles
Fargo Engineering	City of Fargo Engineering Department	Fargo TOC Fargo Engineers Fargo TOC Roadside Equipment
Fargo FD	Fargo Fire Department	Fargo FD Vehicles
Fargo PD	Fargo Police Department	Fargo PD Vehicles
Fargo PW	Fargo Public Works Department	Fargo PW Operations Center Fargo PW Personnel Fargo PW Roadside Equipment Fargo PW Vehicle
FM Ambulance	Ambulance service for the Fargo Moorhead area	FM Ambulance Vehicles
FM Event Venus	Fargodome Fargo Civic Center	Event Promoters
MAT	Fargo-Moorhead Metro Area Transit	MAT Bus Drivers GTC MAT Vehicles MAT Kiosks MAT Traveler Card MAT Operators
MnDOT D4	MnDOT District 4	MnDOT D4 TOC MnDOT D4 Personnel MnDOT D4 TOC Roadside Equipment MnDOT D4 Maintenance Vehicles
Moorhead FD	Moorhead Fire Department	Moorhead FD Vehicles
Moorhead PD	Moorhead Police Department	Moorhead PD Vehicles
Moorhead PW	Moorhead Public Works	Moorhead Public Works Operations Center Moorhead PW Vehicles Moorhead PW Roadside Equipment Moorhead PW Personnel
MSP DL	Minnesota State Patrol Detroit Lakes District	MSP DL Vehicles MSP DL District
ND Division of Emergency Management	North Dakota Division of Emergency Management	State Radio
NDDOT	NDDOT Fargo District	NDDOT TOC Roadside Equipment NDDOT TOC NDDOT TOC Personnel NDDOT TOC Maintenance Vehicles
NDHP	North Dakota Highway Patrol - Fargo	NDHP Vehicles

RRRDC Regional Partners Moorhead PD County Sheriffs Fargo PD Fargo FD FM Ambulance Moorhead FD	Red River Regional Dispatch Center	RRRDC Operators RRRDC

4.0 SYSTEM INVENTORY

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

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 F-M region:

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

These entities are explained in greater details in the following subsections. A summary of the F-M area ITS inventory as coded in the Turbo Architecture database is provided in section 4.5.

4.1 F-M Centers

These are the locations where functions are performed (i.e., process information, issue control commands, and produce output information). There are 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, six were found to apply to the F-M RA. A representation of the F-M area Physical Architecture is shown in Figure 2.

4.1.1 Traffic Management Center

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

Traffic management activities within the F-M area have increased over the last few years. However these activities are partial to the main corridors in the area. Below are specific traffic management systems within the F-M area classified by agency.

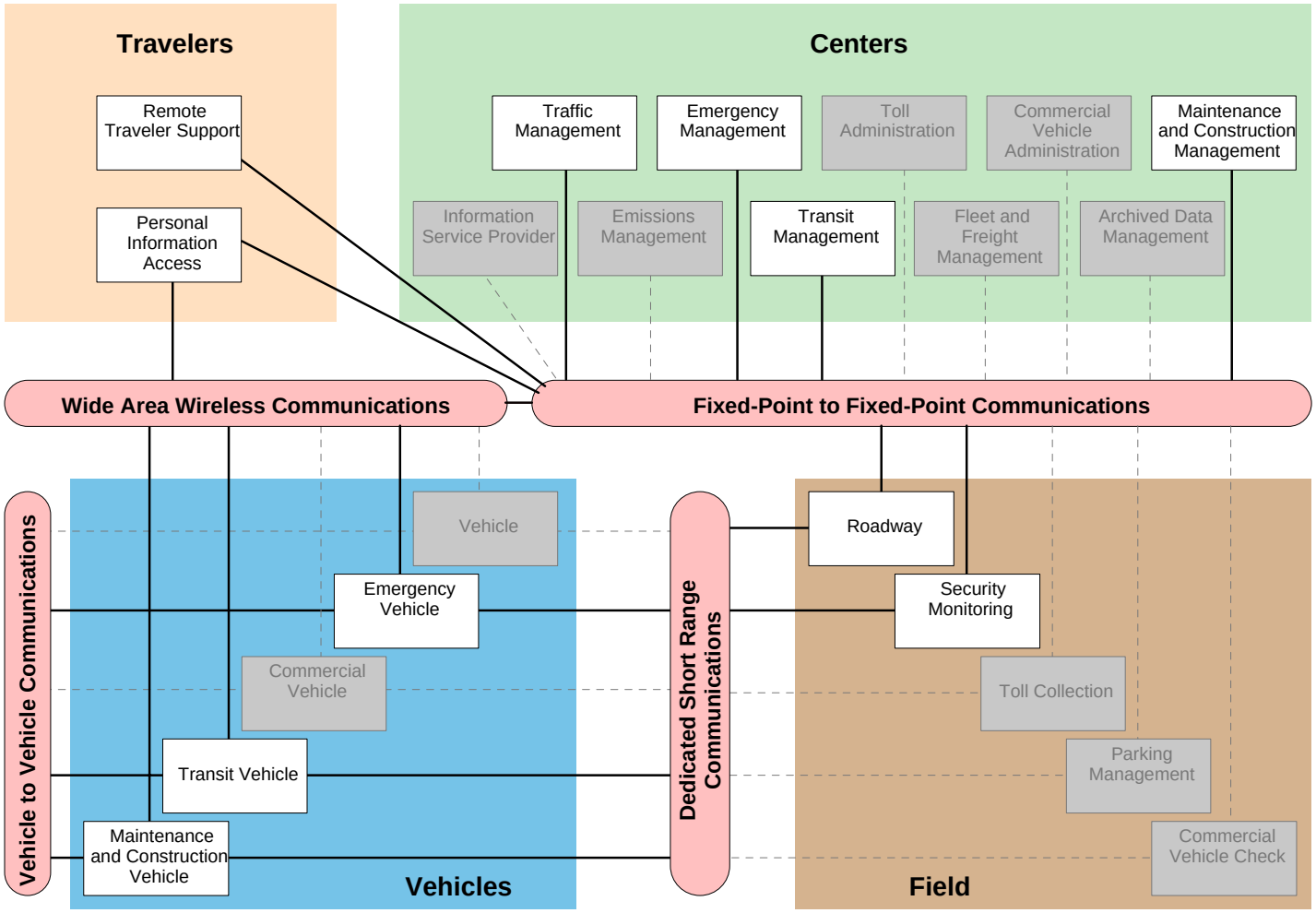

Figure 2 Fargo-Moorhead Physical Architecture

NDDOT Traffic Operations Center (TOC)

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

City of Fargo Traffic Signal System

The City of Fargo maintains a modern traffic signal control system which consists of approximately 162 signals. Most of these signals have communication capabilities using dial-up modems as well as fiber and twisted pair for closed-loop systems. The city is also planning to acquire software to facilitate effective traffic signal control management, facilitate traffic data collection, and support traffic flow analysis.

4.1.2 Emergency Management Center

The Red River Regional Dispatch Center (RRRDC) is among the few examples nationwide of coordinated dispatch centers. The RRRDC provides dispatch services to the cities of Fargo and Moorhead, as well as Cass and Clay Counties. It also coordinates emergency management with the North Dakota Highway Patrol (NDHP), the Minnesota State Patrol (MPS), and other local law enforcement. The RRRDC is located in a state-of-the-art facility which contains secure communications, computer-aided dispatch, and other support systems.

In addition to the RRRDC, each jurisdiction within the F-M area maintains an Emergency Operations Center (EOC). The EOC brings together law enforcement, fire, emergency management, and public works agencies to coordinate emergencies. These EOCs currently rely on traditional phone line communications for sharing information, i.e., they have little or no ITS.

4.1.3 Maintenance and Construction Management Center

Currently there are four entities which handle Maintenance and Construction Management (MCO) in the F-M area, including: Fargo Public Works, Moorhead Public Works, NDDOT, and MnDOT. The NDDOT will in the future coordinate its MCO activities through the TOC. It has the most significant equipment and systems in place to allow for MCO. Other agencies are considering adding fleet management capabilities, however, the timing of deploying these systems is highly tentative given funding uncertainties.

4.1.4 Information Service Provider

Functions associated with an Information Service Provider (ISP) are currently provided through multiple agencies in the F-M region. The NDDOT TOC is planned to coordinate traveler information dissemination especially for the freeway system.

This includes providing video snapshots at key locations and issuing road condition advisories for winter weather conditions.

4.1.5 Transit Management Center

The Metro Area Transit (MAT) provides public transportation services for the cities of Fargo and Moorhead. MAT operates 15 fixed routes in Fargo and 12 fixed routes in Moorhead. The Ground Transportation Center in Fargo provides the majority of support and management services, including a wireless system for downloading fare-box and bus data. MAT recently acquired an automated fare box system which provides enhanced management capabilities, including revenue analysis, ridership analysis, and in the future GPS bus location.

4.1.6 Archived Data Management Center

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

4.2 F-M Field Devices

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

4.2.1 NDDOT Field Devices

1. Sensors
    a. Weather
        i. RWIS and Surface sensors located on I-94
    b. Traffic
        i. Video traffic detectors
        ii. Loop detectors
    c. Surveillance/monitoring
        i. Video cameras on the I-29/I94 Interchange and the Main Avenue and I-29 Interchange.
2. Control devices
    a. Traffic signal controllers
3. Warning/advisory devices
    a. Two portable DMS
    b. Permanent DMS at Red River on I-94 (planned)

4.2.2 City of Fargo Field Devices

1. Sensors
    a. Traffic
        i. Video traffic detectors
        ii. Loop detectors

2. Control devices
    a. Traffic signal controllers

4.2.3 City of Moorhead/MnDOT Field Devices

1. Sensors
    a. Traffic
        i. Loop detectors
    b. Other
        i. Radar train detector for supporting Moorhead Area Train Detection and Traffic Control System
2. Control devices
    a. Traffic signal controllers
3. Warning/advisory devices
    a. Permanent DMS on I-94 and Hwy 336

4.3 F-M Vehicles

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

1. Emergency Vehicle for Fargo, Moorhead, Cass County, and Clay County
    a. Fire (planned)
    b. Law enforcement (existing plus planned)
    c. Ambulance (planned)
2. Transit Vehicle
    a. MAT buses with electronic fare box (existing)
3. MCO vehicles for NDDOT and Fargo
    a. Snowplows equipped with AVL (planned)

4.4 F-M Communication Infrastructure

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

1. Fiber
    a. I-29 and I-94 (NDDOT)
    b. Arterial network (Fargo)
2. Phone drops (dial-up)
    a. Fargo traffic signals
    b. Moorhead traffic signals
3. Wireless/cellular
    a. Moorhead train detection system
    b. NDDOT DMS
    c. Red River Bridge anti-icing system (planned)

4.5 Summary of F-M ITS Inventory

Entity	Element Name	Status	Element Description	Stakeholder Name
Alerting and Advisory Systems	State Radio	Existing	ND State Radio	ND Division of Emergency Management
Archived Data Management	ATAC data warehouse	Planned	Advanced Traffic Analysis Center	ATAC
Basic Vehicle	Basic Vehicle	Existing	Terminator	
Driver	Driver	Existing	Terminator	
Emergency Management	RRRDC	Existing	Red River Regional Dispatch Center	RRRDC Regional Partners
	State Radio	Existing	ND State Radio	ND Division of Emergency Management
	MSP DL District	Existing	Minnesota State Patrol Detroit Lakes district	MSP DL
Emergency System Operator	RRRDC Operators	Existing	RRRDC Operators	RRRDC Regional Partners
Emergency Vehicle Subsystem	FM Ambulance Vehicles	Existing	FM Ambulance vehicles	FM Ambulance
	Fargo PD Vehicles	Existing	Fargo Police Department Vehicles	Fargo PD
	Moorhead PD Vehicles	Existing	Moorhead Police Department Vehicles	Moorhead PD
	County Sheriff Vehicles	Existing	Cass and Clay county sheriff vehicles	County Sheriffs
	NDHP Vehicles	Existing	NDHP vehicles	NDHP
	MSP DL Vehicles	Existing	Minnesota State Patrol Detroit Lakes district vehicles	MSP DL
	Fargo FD Vehicles	Existing	Fargo Fire Department vehicles	Fargo FD
	Moorhead FD Vehicles	Existing	Moorhead Fire Department vehicles	Moorhead FD
Event Promoters	Event Promoters	Existing	Fargo Dome, Civic Center, other venues	FM Event Venus
Maintenance and Construction Center Personnel	NDDOT TOC Personnel	Existing	NDDOT traffic/maintenance and construction engineers	NDDOT
	MnDOT D4 Personnel	Existing	MnDOT traffic/maintenance and construction engineers	MnDOT D4
	Fargo PW Personnel	Existing	Fargo Public Works operations personnel	Fargo PW
	Moorhead PW Personnel	Existing	Moorhead Public Works operations personnel	Moorhead PW

Maintenance and Construction Management	Fargo PW Operations Center	Existing	Fargo Public Works	Fargo PW
	NDDOT TOC	Existing	NDDOT Traffic Operations Center. Handles freeway management and maintenance and construction functions	NDDOT
	MnDOT D4 TOC	Existing	MnDOT District 4 Traffic Operations Center	MnDOT D4
	Moorhead PW Operations Center	Existing	Moorhead Public Works	Moorhead PW
Maintenance and Construction Vehicle	Fargo PW Vehicle	Existing	Fargo Public Works vehicles, snow plows, and other maintenance vehicles	Fargo PW
	Moorhead PW Vehicles	Existing	Moorhead Public Works vehicles, snow plows, and other maintenance vehicles	Moorhead PW
	MnDOT D4 Maintenance Vehicles	Existing	MnDOT D4 snow plows and other maintenance vehicles	MnDOT D4
	NDDOT TOC Maintenance Vehicles	Existing	NDDOT snow plows and other maintenance vehicles	NDDOT
Media	Media	Existing	Terminator	
Other Roadway	Other Roadway	Existing	Terminator	
Pedestrians	Pedestrians	Existing	Terminator	
Personal Information Access	User Personal Computing Devices	Planned	User Personal Computing Devices	
Remote Traveler Support	MAT Kiosks	Planned	MAT Kiosks	MAT
Roadway Subsystem	NDDOT TOC Roadside Equipment	Existing	NDDOT roadside monitoring and control equipment	NDDOT
	Fargo TOC Roadside Equipment	Existing	Fargo roadside monitoring and control equipment	Fargo Engineering
	MnDOT D4 TOC Roadside Equipment	Existing	MnDOT D4 traffic sensors and control devices	MnDOT D4
	Fargo PW Roadside Equipment	Planned	Fargo Public Works roadside equipment	Fargo PW
	Moorhead PW Roadside Equipment	Planned	Moorhead Public Works roadside equipment	Moorhead PW
Traffic	Traffic	Existing	Terminator	

Traffic Management	Fargo TOC	Existing	Fargo Surface Street Traffic Management Center	Fargo Engineering
	NDDOT TOC	Existing	NDDOT Traffic Operations Center. Handles freeway management and maintenance and construction functions	NDDOT
	MnDOT D4 TOC	Existing	MnDOT District 4 Traffic Operations Center	MnDOT D4
Traffic Operations Personnel	Fargo Engineers	Existing	Fargo TOC Engineers	Fargo Engineering
	NDDOT TOC Personnel	Existing	NDDOT traffic/maintenance and construction engineers	NDDOT
	MnDOT D4 Personnel	Existing	MnDOT traffic/maintenance and construction engineers	MnDOT D4
Transit Management	GTC	Existing	Fargo-Moorhead Metropolitan Area Transit's Ground Transportation Center	MAT
Transit System Operators	MAT Operators	Existing	MAT Personnel	MAT
	MAT Bus Drivers	Existing		MAT
Transit Vehicle Subsystem	MAT Vehicles	Existing	MAT buses	MAT
Traveler	Traveler	Existing	MAT users	
Traveler Card	MAT Traveler Card	Existing	MAT fare cards	MAT

5.0 NEEDS AND SERVICES

This section describes the ITS user services selected for the F-M area. These services were identified from previous ITS planning efforts and from stakeholders input throughout the RA development. To facilitate the discussions with the stakeholders, the results from the inventory were used to identify corresponding ITS user services from the National Architecture. Additional ITS user services were added to address current and future regional needs and priorities.

5.1 Needs

The process of identifying the F-M regional needs consisted of 1) using output from the Fargo-Moorhead Metropolitan ITS Plan, 2) updating ITS project deployment since the plan was developed in 1998, and 3) seeking input from stakeholders on additional needs or issues. Stakeholders were extensively involved in updating the status of ITS projects identified in the ITS plan as well as identify new projects and applications given their experience over the past five years since the plan was developed.

Generally, the F-M area enjoys a well-developed transportation system which supports the mobility needs of individuals and businesses in the area. Several major transportation projects which greatly expanded the system's capacity have either been completed over the last few years or are currently underway. These projects came in response to the significant growth in the area and local agencies' plan to respond to future demands.

F-M regional transportation needs 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. Incident traffic management
    c. Special events traffic management
    d. Work-zone and road construction management
    e. Winter weather impact management
2. Enhance tools for system monitoring and management
    a. Better system performance data
3. Enhance traveler information and customer service
4. Enhance transit operations to improve service and increase transit use
5. Coordinate emergency and security management

5.2 Services

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

5.2.1 F-M 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. Pre-trip information can be provided via web, information hot lines (511), etc.

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

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

1.7. Incident Management: Identify incidents, such as flooded underpasses, icy bridges, special events (4th of July) etc., 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 HRIs

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 and high-occupancy vehicle 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 F-M Market Packages

The following Market Packages were identified for the F-M region 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 F-M area 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 in the F-M area but additional portions are planned for deployment. Customized F-M Market Packages and associated Information Flows are shown in more detail in Appendix A.

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.

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.

Freeway Control (Existing *)

This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways. This package is consistent with typical urban traffic freeway control systems. It incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option. This market package also includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a traffic management center; however, developments might allow for point detection with roadway equipment. Additionally, this market package allows general advisory and traffic control information to be provided to the driver while en route.

Traffic Information Dissemination (Existing *)

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.

Regional Traffic Control (Planned)

This market package provides for the sharing of traffic information and control among traffic management centers to support a regional traffic control strategy. 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 control. Several levels of coordination are supported from sharing of information to sharing of control between traffic management centers.

Traffic Incident Management System (Planned)

This market package manages both unexpected incidents and planned events so that 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 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. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds.

Standard Railroad Grade Crossing (Existing *)

This market 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 on 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.

Speed Monitoring (Existing *)

This market package monitors the speeds of vehicles traveling through a roadway system. If the speed is determine to be excessive, roadside equipment can suggest a safe driving speed. Environmental conditions may be monitored and factored into the safe speed advisories that are provided to the motorist. This service can also support notifications to an enforcement agency to enforce the speed limit on a roadway system.

Roadway Automated Treatment (Planned)

This market package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The market 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.

Winter Maintenance (Existing)

This market 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.

Work Zone Management (Planned)

This market package directs activity in work zones, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity (e.g., traffic management centers) for better coordination management. Work zone speeds and delays are provided to the motorist prior to the work zones.

Transit Vehicle Tracking (Planned)

This market 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.

Transit Fixed-Route Operations (Existing *)

This market 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. Static and real time transit data is exchanged with Information Service Providers where it is integrated with data from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

Transit Passenger and Fare Management (Existing)

This market package manages passenger loading and fare payments onboard transit vehicles using electronic means. It allows transit users to use a traveler card or other electronic payment device. Sensors mounted on the vehicle permit the operator and central operations to determine vehicle loads, and readers located onboard 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.

Transit Security (Existing *)

This market 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.

Multi-modal Coordination (Planned)

This market package establishes two way communications between multiple transit and traffic agencies to improve service coordination. 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 the overall performance of the traffic network. Local coordination between the transit vehicle and the intersection for signal priority is also supported by this package.

Emergency Call-Taking and Dispatch (Existing)

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

Emergency Routing (Existing *)

This market 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.

Wide-Area Alert (Existing *)

This market 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 Internet sites.

ITS 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..

6.0 OPERATIONAL CONCEPT

This section discusses the roles and responsibilities of stakeholders in the implementation and operation of the regional systems identified in the F-M RA. The operational concept outlines these roles and responsibilities for specific scenarios, e.g., traffic incidents, major winter storm, 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 Market Packages for the F-M area was the vehicle used for facilitating the operational concept development. Using Market 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 Market Package. Once the small group discussions were completed, the results (i.e., customized Market Packages) were presented to all the stakeholders participating in the RA development.

After the Market Packages were approved by the stakeholders, relevant changes were entered into Turbo Architecture. Turbo was used to generate the operational concept for each Market 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 F-M area. Subsection 6.1 shows implementation roles and responsibilities, arranged by Market Package. Subsection 6.2 summarizes operational roles and responsibilities, organized by stakeholders.

6.1 Implementation Roles

Market Packages	Stakeholders with Implementation Roles
Network Surveillance	NDDOT, Fargo, Moorhead
Surface Street Control	Fargo Engineering, Moorhead Engineering, MnDOT, NDDOT
Freeway Control	NDDOT
Traffic Information Dissemination	NDDOT
Regional Traffic Control	Fargo Engineering, Moorhead Engineering, MnDOT, NDDOT
Traffic Incident Management System	NDDOT, MnDOT
Standard Railroad Grade Crossing	Fargo Engineering, Moorhead Engineering, MnDOT
Speed Monitoring	NDDOT
Roadway Automated Treatment	Fargo PW, Moorhead PW, MnDOT, NDDOT
Winter Maintenance	Fargo PW, Moorhead PW, MnDOT, NDDOT
Work Zone Management	Fargo PW, NDDOT
Transit Vehicle Tracking	MAT
Transit Fixed-Route Operations	MAT
Transit Passenger and Fare Management	MAT
Transit Security	MAT
Multi-modal Coordination	Fargo Engineering, MAT, Moorhead Engineering
Emergency Call-Taking and Dispatch	RRRDC
Emergency Routing	Fargo Engineering, Moorhead Engineering, MnDOT, NDDOT
Wide-Area Alert	Fargo PD, Moorhead PD, NDHP, MSP, RRRDC
ITS Data Warehouse	ATAC, Fargo Engineering, NDDOT

6.2 Operational Roles and Responsibilities

Responsibility Area	Stakeholder	Roles
Archived Data Systems	ATAC	1. Perform studies 2. Provide access to data 3. Store data
	Fargo Engineering	Collect and provide data to ATAC for archival
	NDDOT	Collect and provide data for archiving
Emergency Management	County Sheriffs	1. Coordinate with other law enforcement agencies 2. Respond to events in county jurisdictions
	Fargo PD	1. Coordinate with other law enforcement agencies 2. Respond to emergencies
	Moorhead PD	1. Coordinate with other law enforcement agencies 2. Respond to emergencies
	ND Division of Emergency Management	Issue Amber Alerts
	NDHP	Coordinate Amber Alert efforts
	RRRDC Regional Partners	1. Coordinate with NDHP, West Fargo PD, and other agencies 2. Provide 9-1-1 services for the Fargo-Moorhead area 3. Provide dispatch for Fargo, Moorhead, Cass and Clay counties
Freeway Management	MnDOT D4	Manage traffic operations on Minnesota's state system
	NDDOT	Manage traffic operations on North Dakota's state system
Incident Management	County Sheriffs	Respond to incidents on county road system
	Fargo Engineering	Develop, maintain, and apply incident signal plans
	Fargo PD	1. Direct traffic on city streets 2. Respond to incidents 3. Send information out to media
	Fargo PW	Provide resources
	FM Event Venus	Provide event plans
	MnDOT D4	1. Provide resources 2. Provide surveillance images to MSP
	Moorhead PD	1. Direct traffic on city streets 2. Respond to incidents 3. Send information out to media
	Moorhead PW	Provide resources
	MSP DL	1. Coordinate with other law enforcement and emergency management agencies 2. Respond to incidents on MN state system

	NDDOT	1. Broadcast traveler information 2. Provide resources 3. Provide surveillance images to NDHP
	NDHP	1. Coordinate with other law enforcement and emergency management agencies 2. Respond to incidents on ND state system
	RRRDC Regional Partners	1. Coordinate response 2. Provide dispatch and communications
Maintenance and Construction	Fargo PW	1. City system road maintenance
		2. Provide maintenance information
		3. Winter maintenance (snow plow operations, sanding, anti icing) on Fargo city system
	MnDOT D4	1. Provide maintenance information 2. Roadway maintenance on MN state system 3. Winter maintenance (snow plow operations, sanding, anti-icing) on MN state system
	Moorhead PW	1. Moorhead city system road maintenance 2. Provide maintenance information 3. Winter maintenance (snow plow operations, sanding, anti icing) on Moorhead city system
	NDDOT	1. Provide maintenance information 2. Roadway maintenance on ND state system 3. Winter maintenance (snow plow operations, sanding, anti-icing) on ND state system
Surface Street Management	Fargo Engineering	1. Design, operate, and maintain signal control in Fargo city system 2. Coordinate with NDDOT and Moorhead
	MnDOT D4	Design, operate, and maintain signal control in Moorhead
	Moorhead Engineering	Coordinate activities with MnDOT
	NDDOT	Signal control at freeway exit ramps
Transit Services	MAT	Operate transit fixed route in Fargo, Moorhead, and West Fargo
Traveler Information	NDDOT	Provide Interstate road conditions

7.0 AGREEMENTS

This section briefly outlines potential agreements needed to support the F-M RA. 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. Discussions with stakeholders helped in finalizing the list of agreements taking into consideration existing agreements with other agencies that they have in place as well as their own agency requirements.

The table on the following page shows a summary of potential agreements in the F-M region. 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

(This space was intentionally left blank)

Market Packages	Purpose	Stakeholders	Issues
AD2-ITS Data Warehouse	Data use/storage	ATAC, NDDOT, Fargo	Security, resource sharing
ATMS01-Network Surveillance	Share data	Fargo Engineering Moorhead Public Works West Fargo Public Works NDDOT-Fargo District MnDOT-District 4	Access to sensors Access to databases Access to networks/servers
ATMS04-Freeway Control	I-94 traffic operations	NDDOT-Fargo District MnDOT-District 4	Shared use of devices Access to data Communications links
ATMS06-Traffic Information Dissemination	Coordinate traveler information	Fargo Engineering Fargo Public Works NDDOT-Fargo District MnDOT-District 4	Communications links Notification protocols
ATMS07-Regional Traffic Control	Sharing data (flow, video) Corridor operations	Fargo Engineering Moorhead Public Works West Fargo Public Works Dilworth NDDOT-Fargo District MnDOT-District 4	Communications links Hardware compatibility Operating standards

ATMS08-Traffic Incident Management	Incident traffic response Sharing data (flow, video)	Fargo Police Dept Moorhead Police Dept West Fargo Police Dept Dilworth Police Dept ND Highway Patrol MN State Patrol Cass Co. Sheriff Clay Co. Sheriff Joint Dispatch West Fargo Dispatch	Communications links Response protocols
EM01-Emergency Call-Taking and Dispatch	Coordinating 911 and dispatch	RRRDC participants	Joint facility/resources (existing)
EM02-Emergency Routing	Signal pre-emption	Fargo Engineering MnDOT-District 4 Joint Dispatch West Fargo Dispatch	Equipment compatibility (existing)

8.0 FUNCTIONAL REQUIREMENTS

This section discusses detailed functional requirements for the user services and market packages identified for the F-M 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

Fargo-Moorhead Regional ITS Architecture (Region)
Element: **Fargo Fire Department Vehicles**
Entity: **Emergency Vehicle Subsystem**
Functional Area: **On-board EV En Route Support**
On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, and signal preemption via short range communication directly with traffic control equipment at the roadside.

Requirement:	1	The emergency vehicle, including roadway service patrols, shall compute the location of the emergency vehicle based on inputs from a vehicle location determination function.	Planned
Requirement:	2	The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Planned
Requirement:	3	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Planned
Requirement:	4	The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Planned
Requirement:	5	The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	Existing
Requirement:	6	The emergency vehicle shall provide the personnel onboard with dispatch information, including incident type and location, and forward an acknowledgment from personnel to the center that the vehicle is on its way to the incident scene.	Planned

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9.0 INTERFACE REQUIREMENTS

This section outlines the possible interconnects in the F-M RA. Interconnects simply imply which entities in the architecture are linked. However, the detailed information flows carried over these interconnects are shown in more detail in Appendix A.

Network Surveillance		
Fargo Engineers	Fargo TOC	Existing
Fargo TOC	Fargo TOC Roadside Equipment	Existing
Fargo TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
Fargo TOC Roadside Equipment	Other Roadway	Planned
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	Other Roadway	Planned
NDDOT TOC	NDDOT TOC Personnel	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC Roadside Equipment	Other Roadway	Planned
Surface Street		
Driver	Fargo TOC Roadside Equipment	Planned
Driver	MnDOT D4 TOC Roadside Equipment	Planned
Driver	NDDOT TOC Roadside Equipment	Planned
Fargo Engineers	Fargo TOC	Existing
Fargo TOC	Fargo TOC Roadside Equipment	Existing
Fargo TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
Fargo TOC Roadside Equipment	Other Roadway	Planned
Fargo TOC Roadside Equipment	Pedestrians	Existing
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	Other Roadway	Planned

MnDOT D4 TOC Roadside Equipment	Pedestrians	Existing
NDDOT TOC	NDDOT TOC Personnel	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC Roadside Equipment	Other Roadway	Planned
NDDOT TOC Roadside Equipment	Pedestrians	Existing
Freeway		
Driver	MnDOT D4 TOC Roadside Equipment	Planned
Driver	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	Other Roadway	Planned
NDDOT TOC	NDDOT TOC Personnel	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC Roadside Equipment	Other Roadway	Planned
Traffic Information Dissemination		
Basic Vehicle	Fargo TOC Roadside Equipment	Planned
Basic Vehicle	NDDOT TOC Roadside Equipment	Planned
Driver	Fargo TOC Roadside Equipment	Planned
Driver	MnDOT D4 TOC Roadside Equipment	Planned
Driver	NDDOT TOC Roadside Equipment	Planned
Fargo Engineers	Fargo TOC	Existing
Fargo PW Operations Center	Fargo TOC	Existing
Fargo PW Operations Center	NDDOT TOC	Planned
Fargo TOC	Fargo TOC Roadside Equipment	Existing
Fargo TOC	GTC	Planned
Fargo TOC	Media	Planned
Fargo TOC	MnDOT D4 TOC	Planned
Fargo TOC	NDDOT TOC	Planned
Fargo TOC	RRRDC	Existing
Fargo TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
Fargo TOC Roadside Equipment	Other Roadway	Planned
GTC	NDDOT TOC	Existing
Media	MnDOT D4 TOC	Existing
Media	NDDOT TOC	Existing

MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	MSP DL District	Planned
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC	RRRDC	Existing
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	Other Roadway	Planned
NDDOT TOC	NDDOT TOC Personnel	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC	RRRDC	Existing
NDDOT TOC Roadside Equipment	Other Roadway	Planned
Regional Traffic		
Fargo Engineers	Fargo TOC	Existing
Fargo TOC	Fargo TOC Roadside Equipment	Existing
Fargo TOC	MnDOT D4 TOC	Planned
Fargo TOC	NDDOT TOC	Planned
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
NDDOT TOC	NDDOT TOC Personnel	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
Traffic Incident Management		
County Sheriff Vehicles	RRRDC	Existing
Event Promoters	Fargo TOC	Planned
Event Promoters	NDDOT TOC	Planned
Fargo FD Vehicles	RRRDC	Existing
Fargo PD Vehicles	RRRDC	Existing
Fargo PW Operations Center	Fargo TOC	Existing
Fargo PW Operations Center	NDDOT TOC	Planned
Fargo PW Operations Center	RRRDC	Existing
Fargo TOC	Fargo TOC Roadside Equipment	Existing
Fargo TOC	Media	Planned
Fargo TOC	MnDOT D4 TOC	Planned
Fargo TOC	NDDOT TOC	Planned
Fargo TOC	RRRDC	Existing
Fargo TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
Fargo TOC Roadside Equipment	Other Roadway	Planned

FM Ambulance Vehicles	RRRDC	Existing
GTC	RRRDC	Existing
Media	MnDOT D4 TOC	Existing
Media	NDDOT TOC	Existing
Media	RRRDC	Existing
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC	RRRDC	Existing
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	Other Roadway	Planned
Moorhead FD Vehicles	RRRDC	Existing
Moorhead PD Vehicles	RRRDC	Existing
Moorhead PW Operations Center	RRRDC	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC	RRRDC	Existing
NDDOT TOC Roadside Equipment	Other Roadway	Planned
RRRDC	RRRDC Operators	Existing
Speed Monitoring		
Driver	NDDOT TOC Roadside Equipment	Planned
Highway Rail Intersection		
Driver	MnDOT D4 TOC Roadside Equipment	Planned
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC Roadside Equipment	Pedestrians	Existing
Automated Treatment		
Driver	Fargo PW Roadside Equipment	Planned
Driver	Fargo TOC Roadside Equipment	Planned
Driver	MnDOT D4 TOC Roadside Equipment	Planned
Driver	Moorhead PW Roadside Equipment	Planned
Driver	NDDOT TOC Roadside Equipment	Planned
Fargo PW Operations Center	Fargo PW Roadside Equipment	Planned
Fargo PW Operations Center	Fargo TOC Roadside Equipment	Existing
Fargo PW Operations Center	NDDOT TOC Roadside Equipment	Existing
Fargo PW Roadside Equipment	Other Roadway	Planned
Fargo TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned

Fargo TOC Roadside Equipment	Other Roadway	Planned
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
MnDOT D4 TOC Roadside Equipment	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC Roadside Equipment	Other Roadway	Planned
Moorhead PW Operations Center	Moorhead PW Roadside Equipment	Planned
Moorhead PW Roadside Equipment	Other Roadway	Planned
NDDOT TOC	NDDOT TOC Personnel	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC Roadside Equipment	Other Roadway	Planned
Winter Maintenance		
Fargo PW Operations Center	Fargo PW Vehicle	Existing
Fargo PW Operations Center	GTC	Existing
Fargo PW Operations Center	NDDOT TOC	Planned
Fargo PW Operations Center	RRRDC	Existing
GTC	Moorhead PW Operations Center	Existing
GTC	NDDOT TOC	Existing
MnDOT D4 Maint Vehicles	MnDOT D4 TOC	Existing
MnDOT D4 TOC	RRRDC	Existing
Moorhead PW Operations Center	Moorhead PW Vehicles	Existing
Moorhead PW Operations Center	RRRDC	Existing
NDDOT TOC	NDDOT TOC Maint Vehicles	Existing
NDDOT TOC	RRRDC	Existing
MCO Management		
Maintenance and Construction Vehicle	Public Works	Planned
Work Zone Management		
Fargo PW Operations Center	Fargo PW Vehicle	Existing
Fargo PW Operations Center	Fargo TOC	Existing
Fargo PW Operations Center	Fargo TOC Roadside Equipment	Existing
Fargo PW Operations Center	GTC	Existing
Fargo PW Operations Center	Media	Existing
Fargo PW Operations Center	NDDOT TOC	Planned
Fargo PW Operations Center	NDDOT TOC Roadside Equipment	Existing
Fargo PW Operations Center	RRRDC	Existing
Fargo PW Vehicle	Fargo TOC Roadside Equipment	Planned
Fargo PW Vehicle	NDDOT TOC Roadside Equipment	Planned
Fargo TOC	Fargo TOC Roadside Equipment	Existing

Fargo TOC	MnDOT D4 TOC	Planned
Fargo TOC	NDDOT TOC	Planned
GTC	Moorhead PW Operations Center	Existing
GTC	NDDOT TOC	Existing
Media	MnDOT D4 TOC	Existing
Media	Moorhead PW Operations Center	Existing
Media	NDDOT TOC	Existing
MnDOT D4 Maint Vehicles	MnDOT D4 TOC	Existing
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	MSP DL District	Planned
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC	RRRDC	Existing
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
Moorhead PW Operations Center	Moorhead PW Vehicles	Existing
Moorhead PW Operations Center	RRRDC	Existing
NDDOT TOC	NDDOT TOC Maint Vehicles	Existing
NDDOT TOC	NDDOT TOC Personnel	Existing
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC	RRRDC	Existing
Transit Vehicle Tracking		
MAT Vehicles	Existing	MAT Vehicles
Transit Fixed Route		
Fargo PW Operations Center	GTC	Existing
Fargo TOC	GTC	Planned
GTC	MAT Operators	Existing
GTC	MAT Vehicles	Existing
GTC	Moorhead PW Operations Center	Existing
GTC	NDDOT TOC	Existing
MAT Bus Drivers	MAT Vehicles	Existing
Transit Fare Management		
GTC	MAT Kiosks	Planned
GTC	MAT Vehicles	Existing
MAT Kiosks	MAT Traveler Card	Planned
MAT Kiosks	Traveler	Planned
MAT Traveler Card	MAT Vehicles	Existing
MAT Vehicles	Traveler	Existing
Transit Security Management		
GTC	MAT Operators	Existing
GTC	MAT Vehicles	Existing
GTC	RRRDC	Existing

MAT Bus Drivers	MAT Vehicles	Existing
MAT Kiosks	Traveler	Planned
MAT Vehicles	Traveler	Existing
Transit Management		
Transit Management	Transit Vehicles	Existing
Multimodal Coordination		
Fargo TOC Roadside Equipment	MAT Vehicles	Planned
MAT Vehicles	MnDOT D4 TOC Roadside Equipment	Planned
MAT Vehicles	NDDOT TOC Roadside Equipment	Planned
Emergency Call Taking		
County Sheriff Vehicles	RRRDC	Existing
Fargo FD Vehicles	RRRDC	Existing
Fargo PD Vehicles	RRRDC	Existing
Fargo TOC	RRRDC	Existing
FM Ambulance Vehicles	RRRDC	Existing
GTC	RRRDC	Existing
MnDOT D4 TOC	MSP DL District	Planned
MnDOT D4 TOC	RRRDC	Existing
Moorhead FD Vehicles	RRRDC	Existing
Moorhead PD Vehicles	RRRDC	Existing
MSP DL District	MSP DL Vehicles	Existing
MSP DL District	RRRDC	Planned
MSP DL District	State Radio	Planned
NDDOT TOC	RRRDC	Existing
NDHP Vehicles	State Radio	Existing
Emergency Routing		
Fargo FD Vehicles	Fargo TOC Roadside Equipment	Existing
Fargo FD Vehicles	MnDOT D4 TOC Roadside Equipment	Existing
Fargo FD Vehicles	NDDOT TOC Roadside Equipment	Existing
Fargo TOC Roadside Equipment	FM Ambulance Vehicles	Existing
Fargo TOC Roadside Equipment	Moorhead FD Vehicles	Existing
FM Ambulance Vehicles	MnDOT D4 TOC Roadside Equipment	Planned
FM Ambulance Vehicles	NDDOT TOC Roadside Equipment	Existing
MnDOT D4 TOC Roadside Equipment	Moorhead FD Vehicles	Existing
Moorhead FD Vehicles	NDDOT TOC Roadside Equipment	Existing

Wide Area Alert		
Driver	Fargo TOC Roadside Equipment	Planned
Driver	MnDOT D4 TOC Roadside Equipment	Planned
Driver	NDDOT TOC Roadside Equipment	Planned
Fargo PW Operations Center	RRRDC	Existing
Fargo TOC	Fargo TOC Roadside Equipment	Existing
Fargo TOC	RRRDC	Existing
GTC	MAT Kiosks	Planned
GTC	MAT Vehicles	Existing
GTC	RRRDC	Existing
MAT Kiosks	Traveler	Planned
MnDOT D4 TOC	MnDOT D4 TOC Roadside Equipment	Existing
MnDOT D4 TOC	MSP DL District	Planned
MnDOT D4 TOC	NDDOT TOC Roadside Equipment	Planned
MnDOT D4 TOC	RRRDC	Existing
MnDOT D4 TOC Roadside Equipment	NDDOT TOC	Planned
MSP DL District	RRRDC	Planned
MSP DL District	State Radio	Planned
NDDOT TOC	NDDOT TOC Roadside Equipment	Existing
NDDOT TOC	RRRDC	Existing
RRRDC	State Radio	Existing
Traveler	User Personal Computing Devices	Planned

10.0 ITS STANDARDS

This section identifies applicable ITS Standards identified for the F-M RA. It should be noted that the development of ITS Standards is an ongoing process. Therefore, the set of applicable ITS standards should be updated as new standards are approved. The table below shows applicable standards for the F-M RA based on Turbo Architecture output.

Standard Name	Document ID
NTCIP Center-to-Center Standards Group	NTCIP 1102 NTCIP 1104 NTCIP 1105 NTCIP 1106 NTCIP 2104 NTCIP 2202 NTCIP 2303 NTCIP 2304 NTCIP 2305 NTCIP 2501 NTCIP 2502
NTCIP Center-to-Field Standards Group	NTCIP 1101 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 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 for Signal Control Priority	NTCIP 1211
TCIP - Common Public Transportation (CPT) Business Area Standard	NTCIP 1401
TCIP - Incident Management (IM) Business Area Standard	NTCIP 1402

TCIP - Passenger Information (PI) Business Area Standard	NTCIP 1403
TCIP - Scheduling/Run-cutting (SCH) Business Area Standard	NTCIP 1404
TCIP – Spatial Representation (SP) Business Area Standard	NTCIP 1405
TCIP - Onboard (OB) Business Area Standard	NTCIP 1406
TCIP - Control Center (CC) Business Area Standard	NTCIP 1407
TCIP - Fare Collection (FC) Business Area Standard	NTCIP 1408
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 E2259-xx
Incident Management Standards Group	IEEE 1512.1-2003 IEEE 1512.3-2002 IEEE 1512-2000 IEEE P1512.2
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
Advanced Traveler Information Systems (ATIS) General Use Standards Group	SAE J2266 SAE J2354 SAE J2529 SAE J2540 SAE J2540-1 SAE J2540-2 SAE J2540-3 SAE J2630
Dedicated Short Range Communication at 5.9 GHz Standards Group	IEEE 1609.1 IEEE 1609.2 IEEE 1609.3 IEEE 1609.4 IEEE 802.11 IEEE 802.2 ISO 21210

11.0 PROJECTS SEQUENCE

This section briefly outlines possible time frame for deployment for selected ITS projects in the F-M area. Market Packages are arranged into short, medium, and long-term deployment categories. It should be noted that not all of the planned services for the F-M area have been fully developed into ITS projects yet.

Market Packages	Time Frame
Network Surveillance	Short
Surface Street Control	Short
Freeway Control	Long
Traffic Information Dissemination	Medium
Regional Traffic Control	Short-Medium
Traffic Incident Management System	Medium-Long
Standard Railroad Grade Crossing	Medium-Long
Speed Monitoring	Short-Medium
Roadway Automated Treatment	Short
Winter Maintenance	Short
Work Zone Management	Medium-Long
Transit Vehicle Tracking	Medium
Transit Fixed-Route Operations	Short-Medium
Transit Passenger and Fare Management	Short
Transit Security	Short
Multi-modal Coordination	Medium-Long
Emergency Call-Taking and Dispatch	Short-Medium
Emergency Routing	Short-Medium
Wide-Area Alert	Short
ITS Data Warehouse	Medium

11.1 Architecture Maintenance

As more ITS projects are deployed or the regional needs/services change in the Fargo-Moorhead area, the regional architecture must be updated to account for these changes. The Fargo-Moorhead Council of Governments has been designated with the role of maintaining the F-M regional ITS architecture. The FM-COG will accomplish this role through a partnership with the Advanced Traffic Analysis Center. It is envisioned that updates will be conducted every two years or upon the deployment of a major ITS project in the area.