

APPENDIX-B
FUNCTIONAL REQUIREMENTS

Functional Requirements

Fargo-Moorhead Regional ITS Architecture (Region)



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Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: ATAC data warehouse</i>	
<i>Entity: Archived Data Management Subsystem</i>	
<i>Functional Area: ITS Data Repository</i>	
Collect and maintain data and data catalogs from one or more data sources. May include quality checks, error notification, and archive coordination.	
<i>Requirement:</i>	Planned
1 The center shall collect data to be archived from one or more data sources.	
<i>Requirement:</i>	Planned
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).	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
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.	
<i>Functional Area: Traffic and Roadside Data Archival</i>	
Collects and archives traffic and environmental information directly from the roadside for use in off-line planning, research, and analysis.	
<i>Requirement:</i>	Planned
1 The center shall manage the collection of archive data directly from collection equipment located at the roadside.	
<i>Requirement:</i>	Planned
2 The center shall collect traffic sensor information from roadside devices.	
<i>Requirement:</i>	Planned
6 The center shall record the status about the imported traffic and roadside data.	
<i>Element: Fargo FD Vehicles</i>	
<i>Entity: Emergency Vehicle Subsystem</i>	
<i>Functional Area: On-board EV En Route Support</i>	
On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.	
<i>Requirement:</i>	Existing
5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	
<i>Element: Fargo PW Operations Center</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Functional Area: MCM Automated Treatment System Control</i>	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Fargo PW Operations Center	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Automated Treatment System Control	
Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.	
<i>Requirement:</i>	Planned
1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	
<i>Requirement:</i>	Planned
3 The center shall collect automated roadway treatment system and associated environmental sensor operational status.	
<i>Requirement:</i>	Planned
4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	
<i>Requirement:</i>	Planned
5 The center shall accept requests for automated roadway treatment system activation from center personnel.	
<i>Functional Area:</i> MCM Incident Management	
Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.	
<i>Requirement:</i>	Existing
4 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	
<i>Requirement:</i>	Existing
5 The center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers.	
<i>Requirement:</i>	Existing
6 The center shall exchange road network status assessment information with emergency management and traffic management centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	
<i>Requirement:</i>	Existing
7 The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.	
<i>Requirement:</i>	Existing
8 The center shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management.	
<i>Functional Area:</i> MCM Winter Maintenance Management	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Fargo PW Operations Center	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Winter Maintenance Management	
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.	
<i>Requirement:</i>	Existing
1 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	
<i>Requirement:</i>	Existing
6 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	
<i>Requirement:</i>	Existing
8 The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	
<i>Requirement:</i>	Existing
9 The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	
<i>Functional Area:</i> MCM Roadway Maintenance and Construction	
Overall management and support for routine maintenance on the roadway or right-of-way. Includes landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment.	
<i>Requirement:</i>	Existing
2 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	
<i>Requirement:</i>	Existing
4 The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	
<i>Requirement:</i>	Existing
10 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	
<i>Functional Area:</i> MCM Work Zone Management	
Remotely monitors and supports work zone activities, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity (e.g., traveler information systems, traffic management centers, other maintenance and construction centers).	
<i>Requirement:</i>	Existing
3 The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: Fargo PW Operations Center</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Element: Fargo PW Roadside Equipment</i>	
<i>Entity: Roadway Subsystem</i>	
<i>Functional Area: Roadway Equipment Coordination</i>	
Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
1 The field element shall include sensors (such as traffic, environmental, and work zone intrusion detection sensors) that provide data and status information to other field element devices (such as dynamic message signs, ramp meters, traffic signals, work zone intrusion alert systems), without center control.	
<i>Requirement:</i>	Planned
3 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that provide data and status information to other field element devices (such as dynamic message signs, traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
4 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that receive control information from other field element devices, without center control.	
<i>Functional Area: Roadway Automated Treatment</i>	
Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.	
<i>Requirement:</i>	Planned
1 The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	
<i>Requirement:</i>	Planned
4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	
<i>Element: Fargo TOC</i>	
<i>Entity: Traffic Management</i>	
<i>Functional Area: Collect Traffic Surveillance</i>	
Management of traffic sensors and surveillance (CCTV) equipment, and distribution of the collected information to other centers and operators.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Fargo TOC	
<i>Entity:</i> Traffic Management	
<i>Functional Area:</i> Collect Traffic Surveillance	
Management of traffic sensors and surveillance (CCTV) equipment, and distribution of the collected information to other centers and operators.	
<i>Requirement:</i>	Planned
1 The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	
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<i>Functional Area:</i> TMC Signal Control	
Remotely controls traffic signal controllers to implement traffic management strategies at major intersections and on main highways for urban areas, based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.	
<i>Requirement:</i>	Existing
1 The center shall remotely control traffic signal controllers.	
<i>Requirement:</i>	Existing
3 The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	
<i>Requirement:</i>	Existing
4 The center shall collect traffic signal controller fault data from the field.	
<i>Requirement:</i>	Planned
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.	
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<i>Functional Area:</i> 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.	
<i>Requirement:</i>	Planned
1 The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	
<i>Requirement:</i>	Planned
6 The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.	
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<i>Functional Area:</i> TMC Regional Traffic Control	
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.	
<i>Requirement:</i>	Planned
1 The center shall exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	
<i>Requirement:</i>	Planned
2 The center shall exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	
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<i>Functional Area:</i> TMC Incident Dispatch Coordination/Communication	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Fargo TOC	
<i>Entity:</i> Traffic Management	
<i>Functional Area:</i> TMC Incident Dispatch Coordination/Communication	
Center-based capability to formulate an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
2 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
5 The center shall respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.	
<i>Requirement:</i>	Planned
6 The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, and rail operations centers.	
<i>Requirement:</i>	Planned
7 The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.	
<i>Requirement:</i>	Planned
9 The center shall coordinate information and controls with other traffic management centers.	
<i>Functional Area:</i> TMC Traffic Network Performance Evaluation	
Systems to predict 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.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Fargo TOC	
<i>Entity:</i> Traffic Management	
<i>Functional Area:</i> TMC Traffic Network Performance Evaluation	
Systems to predict 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.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
3 The center shall collect and store plans from event promoters for major future events possibly impacting traffic to support overall network performance evaluations.	
<i>Requirement:</i>	Planned
5 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.	
<i>Functional Area:</i> Traffic Data Collection	
Collection and storage of traffic management data. For use by operations personnel or data archives in the region.	
<i>Requirement:</i>	Planned
1 The center shall collect traffic management data such as operational data, event logs, etc.	
<i>Requirement:</i>	Planned
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.	
<i>Element:</i> Fargo TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Signal Priority	
Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.	
<i>Requirement:</i>	Existing
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.	
<i>Requirement:</i>	Planned
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.	
<i>Functional Area:</i> Roadway Traffic Information Dissemination	
Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).	
<i>Requirement:</i>	Planned
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).	
<i>Requirement:</i>	Planned
4 The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	
<i>Functional Area:</i> Roadway Equipment Coordination	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Fargo TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Equipment Coordination	
Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
1 The field element shall include sensors (such as traffic, environmental, and work zone intrusion detection sensors) that provide data and status information to other field element devices (such as dynamic message signs, ramp meters, traffic signals, work zone intrusion alert systems), without center control.	
<i>Requirement:</i>	Planned
3 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that provide data and status information to other field element devices (such as dynamic message signs, traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
4 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that receive control information from other field element devices, without center control.	
<i>Functional Area:</i> Roadway Automated Treatment	
Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.	
<i>Requirement:</i>	Planned
1 The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	
<i>Requirement:</i>	Planned
4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	
<i>Functional Area:</i> 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.	
<i>Requirement:</i>	Existing
1 The field element shall collect traffic, road, and environmental conditions information.	
<i>Requirement:</i>	Planned
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.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Fargo TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> 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.	
<i>Requirement:</i>	Planned
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.	
<i>Element:</i> FM Ambulance Vehicles	
<i>Entity:</i> Emergency Vehicle Subsystem	
<i>Functional Area:</i> On-board EV En Route Support On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.	
<i>Requirement:</i>	Existing
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.	
<i>Requirement:</i>	Existing
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.	
<i>Requirement:</i>	Existing
3 The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	
<i>Requirement:</i>	Existing
4 The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	
<i>Requirement:</i>	Existing
5 The emergency vehicle shall send requests to traffic signal control equipment at the roadside to preempt the signal.	
<i>Element:</i> GTC	
<i>Entity:</i> Transit Management	
<i>Functional Area:</i> Transit Center Tracking and Dispatch Monitoring transit vehicle locations via interactions with on-board systems and determining vehicle schedule adherence. Furnish users with real-time transit related information and maintain interface with digital map providers.	
<i>Requirement:</i>	Planned
1 The center shall monitor the locations of all transit vehicles within its network.	
<i>Requirement:</i>	Planned
2 The center shall determine adherence of transit vehicles to their assigned schedule.	
<i>Requirement:</i>	Planned
3 The center shall collect trip monitoring data from on-board systems including transit vehicle mileage, fuel usage, passenger loading, availability, etc.	
<i>Requirement:</i>	Planned
4 The center shall provide transit operational data to traveler information service providers.	
<i>Functional Area:</i> Transit Center Fixed-Route Operations	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:GTC</i>	
<i>Entity:Transit Management</i>	
<i>Functional Area: Transit Center Fixed-Route Operations</i>	
Planning and scheduling associated with fixed and flexible route transit services, automatically updates customer service operator systems, and provides current vehicle schedule adherence and optimum scenarios for schedule adjustment.	
<i>Requirement:</i>	Planned
3 The center shall be able to generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.	
<i>Requirement:</i>	Planned
5 The center shall collect transit operational data for use in the generation of routes and schedules.	
<i>Functional Area: Transit Center Security</i>	
Monitor transit vehicle operator or traveler activated alarms; authenticate transit vehicle operators; remotely disable a transit vehicle; alert operators, travelers, and police to potential incidents identified by these security features.	
<i>Requirement:</i>	Planned
1 The center shall monitor transit vehicle operational data to determine if the transit vehicle is off-route and assess whether a security incident is occurring.	
<i>Requirement:</i>	Planned
2 The center shall receive reports of emergencies on-board transit vehicles entered directly by the transit vehicle operator or from a traveler through interfaces such as panic buttons or alarm switches.	
<i>Requirement:</i>	Planned
5 The center shall receive information pertaining to a wide-area alert such as weather alerts, disaster situations, or child abductions. This information may come from Emergency Management or from other Alerting and Advisory Systems.	
<i>Requirement:</i>	Planned
7 The center shall coordinate the response to security incidents involving transit with other agencies including Emergency Management, other transit agencies, media, traffic management, and traveler information service providers.	
<i>Functional Area: Transit Evacuation Support</i>	
Support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency. Coordinate regional evacuation plans and resources including transit and school bus fleets.	
<i>Requirement:</i>	Existing
1 The center shall manage the use of transit resources to support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency.	
<i>Functional Area: Transit Data Collection</i>	
Collection and storage of transit management data. For use by operations personnel or data archives in the region.	
<i>Requirement:</i>	Existing
1 The center shall collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.	

*Element:MAT Vehicles**Entity:Transit Vehicle Subsystem**Functional Area: On-board Transit Trip Monitoring*

Support fleet management with automatic vehicle location (AVL) and automated mileage and fuel reporting and auditing.

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: MAT Vehicles</i>	
<i>Entity: Transit Vehicle Subsystem</i>	
<i>Functional Area: On-board Transit Trip Monitoring</i> Support fleet management with automatic vehicle location (AVL) and automated mileage and fuel reporting and auditing.	
<i>Requirement:</i>	Planned
1 The transit vehicle shall compute the location of the transit vehicle based on inputs from a vehicle location determination function.	
<i>Functional Area: On-board Transit Fare and Load Management</i> On-board systems provide variable and flexible fare collection using a travelers fare medium (stored value cards or other payment instrument). Collect data required to determine accurate ridership levels and fare statistics.	
<i>Requirement:</i>	Existing
1 The transit vehicle shall detect embarking travelers on-board a transit vehicle and read data from the traveler card / payment instrument that they are carrying.	
<i>Requirement:</i>	Existing
10 The transit vehicle shall provide passenger loading and fare statistics data to the center.	
<i>Functional Area: On-board Transit Security</i> On-board video/audio surveillance systems, threat sensors, and object detection sensors to enhance security and safety on-board a transit vehicles. Also includes silent alarms activated by transit user or vehicle operator, operator authentication, and remote vehicle disabling.	
<i>Requirement:</i>	Existing
1 The transit vehicle shall perform video and audio surveillance inside of transit vehicles and output raw video or audio data for either local monitoring (for processing or direct output to the transit vehicle operator), remote monitoring or for local storage (e.g., in an event recorder).	
<i>Functional Area: On-board Transit Signal Priority</i> On-board systems to provides request signal priority through short range communication directly with traffic control equipment at the roadside (intersections, crossings, ramp meters, etc.).	
<i>Requirement:</i>	Planned
2 The transit vehicle shall send priority requests to traffic signal controllers at intersections, pedestrian crossings, and multimodal crossings on the roads (surface streets) and freeway (ramp controls) network that enable a transit vehicle schedule deviation to be corrected.	
<i>Functional Area: On-board Transit Information Services</i> On-board systems to furnish next-stop annunciation as well as interactive travel-related information, including routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, non-motorized transportation services, and special events.	
<i>Requirement:</i>	Planned
3 The transit vehicle shall broadcast advisories about the imminent arrival of the transit vehicle at the next stop via an on-board automated annunciation system.	
<i>Element: MnDOT D4 TOC</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Functional Area: MCM Automated Treatment System Control</i>	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: MnDOT D4 TOC</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Functional Area: MCM Automated Treatment System Control</i>	
Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.	
<i>Requirement:</i>	1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc. Planned
<i>Requirement:</i>	2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems. Planned
<i>Requirement:</i>	3 The center shall collect automated roadway treatment system and associated environmental sensor operational status. Planned
<i>Requirement:</i>	4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair. Planned
<i>Requirement:</i>	5 The center shall accept requests for automated roadway treatment system activation from center personnel. Planned
<i>Functional Area: MCM Incident Management</i>	
Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.	
<i>Requirement:</i>	4 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations. Existing
<i>Requirement:</i>	5 The center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers. Existing
<i>Requirement:</i>	6 The center shall exchange road network status assessment information with emergency management and traffic management centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery. Existing
<i>Requirement:</i>	7 The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts. Existing
<i>Requirement:</i>	8 The center shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management. Existing
<i>Functional Area: MCM Winter Maintenance Management</i>	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: MnDOT D4 TOC</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Functional Area: MCM Winter Maintenance Management</i>	
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.	
<i>Requirement:</i>	Existing
1 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	
<i>Requirement:</i>	Existing
6 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	
<i>Requirement:</i>	Existing
8 The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	
<i>Requirement:</i>	Existing
9 The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	
<i>Functional Area: MCM Roadway Maintenance and Construction</i>	
Overall management and support for routine maintenance on the roadway or right-of-way. Includes landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment.	
<i>Requirement:</i>	Existing
2 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	
<i>Requirement:</i>	Existing
4 The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	
<i>Requirement:</i>	Existing
10 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	
<i>Functional Area: MCM Work Zone Management</i>	
Remotely monitors and supports work zone activities, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity (e.g., traveler information systems, traffic management centers, other maintenance and construction centers).	
<i>Requirement:</i>	Existing
3 The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: MnDOT D4 TOC</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Entity: Traffic Management</i>	
<i>Functional Area: TMC Signal Control</i>	
Remotely controls traffic signal controllers to implement traffic management strategies at major intersections and on main highways for urban areas, based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.	
<i>Requirement:</i>	Existing
1 The center shall remotely control traffic signal controllers.	
<i>Requirement:</i>	Existing
3 The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	
<i>Requirement:</i>	Existing
4 The center shall collect traffic signal controller fault data from the field.	
<i>Requirement:</i>	Planned
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.	
<i>Functional Area: TMC Traffic Information Dissemination</i>	
Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.	
<i>Requirement:</i>	Existing
1 The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	
<i>Requirement:</i>	Existing
3 The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	
<i>Requirement:</i>	Existing
4 The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	
<i>Requirement:</i>	Planned
6 The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.	
<i>Functional Area: TMC Regional Traffic Control</i>	
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.	
<i>Requirement:</i>	Planned
1 The center shall exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	
<i>Requirement:</i>	Planned
2 The center shall exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	
<i>Functional Area: TMC Incident Dispatch Coordination/Communication</i>	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: MnDOT D4 TOC</i>	
<i>Entity: Traffic Management</i>	
<i>Functional Area: TMC Incident Dispatch Coordination/Communication</i>	
Center-based capability to formulate an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
9 The center shall coordinate information and controls with other traffic management centers.	
<i>Element: MnDOT D4 TOC Roadside Equipment</i>	
<i>Entity: Roadway Subsystem</i>	
<i>Functional Area: Roadway Signal Priority</i>	
Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.	
<i>Requirement:</i>	Existing
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.	
<i>Requirement:</i>	Planned
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.	
<i>Functional Area: Roadway Traffic Information Dissemination</i>	
Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).	
<i>Requirement:</i>	Planned
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).	
<i>Requirement:</i>	Planned
4 The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	
<i>Functional Area: Standard Rail Crossing</i>	
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.	
<i>Requirement:</i>	Planned
1 The field element shall collect and process, traffic sensor data in the vicinity of a highway-rail intersection (HRI).	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
6 The field element shall control the dynamic message signs (DMS) in the vicinity of a highway-rail intersection (HRI) to advise drivers, cyclists, and pedestrians of approaching trains.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> MnDOT D4 TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> 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.	
<i>Requirement:</i>	Existing
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.	
<i>Requirement:</i>	Existing
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.	
<i>Functional Area:</i> Roadway Equipment Coordination	
Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
1 The field element shall include sensors (such as traffic, environmental, and work zone intrusion detection sensors) that provide data and status information to other field element devices (such as dynamic message signs, ramp meters, traffic signals, work zone intrusion alert systems), without center control.	
<i>Requirement:</i>	Planned
3 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that provide data and status information to other field element devices (such as dynamic message signs, traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
4 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that receive control information from other field element devices, without center control.	
<i>Functional Area:</i> Roadway Automated Treatment	
Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.	
<i>Requirement:</i>	Planned
1 The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> MnDOT D4 TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Automated Treatment Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.	
<i>Requirement:</i>	Planned
4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	
<i>Element:</i> Moorhead FD Vehicles	
<i>Entity:</i> Emergency Vehicle Subsystem	
<i>Functional Area:</i> On-board EV En Route Support On-board systems for gathering of dispatch and routing information for emergency vehicle personnel, vehicle tracking, communications with care facilities, and signal preemption via short range communication directly with traffic control equipment at the roadside.	
<i>Requirement:</i>	[Not Defined]
<i>Element:</i> Moorhead PW Operations Center	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Automated Treatment System Control Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.	
<i>Requirement:</i>	Planned
1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	
<i>Requirement:</i>	Planned
3 The center shall collect automated roadway treatment system and associated environmental sensor operational status.	
<i>Requirement:</i>	Planned
4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	
<i>Requirement:</i>	Planned
5 The center shall accept requests for automated roadway treatment system activation from center personnel.	
<i>Functional Area:</i> MCM Incident Management Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.	
<i>Requirement:</i>	Existing
4 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	
<i>Requirement:</i>	Existing
5 The center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Moorhead PW Operations Center	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Incident Management Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.	
<i>Requirement:</i>	Existing
6 The center shall exchange road network status assessment information with emergency management and traffic management centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	
<i>Requirement:</i>	Existing
7 The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.	
<i>Requirement:</i>	Existing
8 The center shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management.	
<i>Functional Area:</i> MCM Winter Maintenance Management Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.	
<i>Requirement:</i>	Existing
1 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	
<i>Requirement:</i>	Existing
6 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	
<i>Requirement:</i>	Existing
8 The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	
<i>Requirement:</i>	Existing
9 The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.	
<i>Functional Area:</i> MCM Roadway Maintenance and Construction Overall management and support for routine maintenance on the roadway or right-of-way. Includes landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element: Moorhead PW Operations Center</i>	
<i>Entity: Maintenance and Construction Management</i>	
<i>Functional Area: MCM Roadway Maintenance and Construction</i>	
Overall management and support for routine maintenance on the roadway or right-of-way. Includes landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment.	
<i>Requirement:</i>	Existing
2 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.	
<i>Requirement:</i>	Existing
4 The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	
<i>Requirement:</i>	Existing
10 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	
<i>Functional Area: MCM Work Zone Management</i>	
Remotely monitors and supports work zone activities, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity (e.g., traveler information systems, traffic management centers, other maintenance and construction centers).	
<i>Requirement:</i>	Existing
3 The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.	
<i>Element: Moorhead PW Roadside Equipment</i>	
<i>Entity: Roadway Subsystem</i>	
<i>Functional Area: Roadway Equipment Coordination</i>	
Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
1 The field element shall include sensors (such as traffic, environmental, and work zone intrusion detection sensors) that provide data and status information to other field element devices (such as dynamic message signs, ramp meters, traffic signals, work zone intrusion alert systems), without center control.	
<i>Requirement:</i>	Planned
3 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that provide data and status information to other field element devices (such as dynamic message signs, traffic controllers on adjacent intersections), without center control.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> Moorhead PW Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Equipment Coordination	
Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
4 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that receive control information from other field element devices, without center control.	
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<i>Functional Area:</i> Roadway Automated Treatment	
Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.	
<i>Requirement:</i>	Planned
1 The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	
<i>Requirement:</i>	Planned
4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	
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<i>Element:</i> NDDOT TOC	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Automated Treatment System Control	
Remotely controls automated roadway treatment systems (to disperse anti-icing chemicals, etc.) directly, or via control of the environmental sensors that activate the treatment systems automatically in the field.	
<i>Requirement:</i>	Planned
1 The center shall remotely control automated roadway treatment systems. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The center shall remotely control the environmental sensors that upon detecting changes in environmental or atmospheric conditions, automatically activate roadway treatment systems.	
<i>Requirement:</i>	Planned
3 The center shall collect automated roadway treatment system and associated environmental sensor operational status.	
<i>Requirement:</i>	Planned
4 The center shall collect automated roadway treatment system and associated environmental sensor fault data and request repair.	
<i>Requirement:</i>	Planned
5 The center shall accept requests for automated roadway treatment system activation from center personnel.	
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<i>Functional Area:</i> MCM Incident Management	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> NDDOT TOC	
<i>Entity:</i> Maintenance and Construction Management	
<i>Functional Area:</i> MCM Incident Management	
Supports coordinated response to incidents - share incident notifications, manage incident response resources, and coordinate overall incident situation and response among allied response organizations.	
<i>Requirement:</i>	Existing
4 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	
<i>Requirement:</i>	Existing
5 The center shall respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers.	
<i>Requirement:</i>	Existing
6 The center shall exchange road network status assessment information with emergency management and traffic management centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	
<i>Requirement:</i>	Existing
7 The center shall provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.	
<i>Requirement:</i>	Existing
8 The center shall receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management.	
<i>Functional Area:</i> MCM Winter Maintenance Management	
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.	
<i>Requirement:</i>	Existing
1 The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.	
<i>Requirement:</i>	Existing
6 The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).	
<i>Requirement:</i>	Existing
8 The center shall determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:NDDOT TOC</i>	
<i>Entity:Maintenance and Construction Management</i>	
<i>Functional Area: MCM Winter Maintenance Management</i>	
Manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on weather information.	
<i>Requirement:</i>	Existing
9	The center shall provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.
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<i>Functional Area: MCM Roadway Maintenance and Construction</i>	
Overall management and support for routine maintenance on the roadway or right-of-way. Includes landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment.	
<i>Requirement:</i>	Existing
2	The center shall respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.
<i>Requirement:</i>	Existing
4	The center shall provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations.
<i>Requirement:</i>	Existing
10	The center shall collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).
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<i>Functional Area: MCM Work Zone Management</i>	
Remotely monitors and supports work zone activities, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity (e.g., traveler information systems, traffic management centers, other maintenance and construction centers).	
<i>Requirement:</i>	Existing
3	The center shall disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.
<i>Requirement:</i>	Existing
4	The center shall control traffic in work zones by providing remote control of dynamic message signs and highway advisory radio systems located in or near the work zone.
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<i>Entity:Traffic Management</i>	
<i>Functional Area: Collect Traffic Surveillance</i>	
Management of traffic sensors and surveillance (CCTV) equipment, and distribution of the collected information to other centers and operators.	
<i>Requirement:</i>	Existing
1	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.
<i>Requirement:</i>	Existing
2	The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> NDDOT TOC	
<i>Entity:</i> Traffic Management	
<i>Functional Area:</i> Collect Traffic Surveillance Management of traffic sensors and surveillance (CCTV) equipment, and distribution of the collected information to other centers and operators.	
<i>Requirement:</i>	Planned
8 The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	
<i>Functional Area:</i> TMC Signal Control Remotely controls traffic signal controllers to implement traffic management strategies at major intersections and on main highways for urban areas, based on traffic conditions, incidents, emergency vehicle preemptions, pedestrian crossings, etc.	
<i>Requirement:</i>	Existing
1 The center shall remotely control traffic signal controllers.	
<i>Requirement:</i>	Existing
3 The center shall collect traffic signal controller operational status and compare against the control information sent by the center.	
<i>Requirement:</i>	Existing
4 The center shall collect traffic signal controller fault data from the field.	
<i>Requirement:</i>	Planned
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.	
<i>Functional Area:</i> 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.	
<i>Requirement:</i>	Existing
1 The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	
<i>Requirement:</i>	Existing
2 The center shall remotely control driver information systems that communicate directly from a center to the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers.	
<i>Requirement:</i>	Existing
3 The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	
<i>Requirement:</i>	Existing
4 The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	
<i>Requirement:</i>	Planned
5 The center shall retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), etc.	
<i>Requirement:</i>	Planned
6 The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.	
<i>Functional Area:</i> TMC Regional Traffic Control	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> NDDOT TOC	
<i>Entity:</i> Traffic Management	
<i>Functional Area:</i> TMC Regional Traffic Control	
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.	
<i>Requirement:</i>	Planned
1 The center shall exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	
<i>Requirement:</i>	Planned
2 The center shall exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).	
<i>Functional Area:</i> TMC Incident Dispatch Coordination/Communication	
Center-based capability to formulate an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
2 The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
5 The center shall respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:NDDOT TOC</i>	
<i>Entity:Traffic Management</i>	
<i>Functional Area: TMC Incident Dispatch Coordination/Communication</i>	
Center-based capability to formulate an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.	
<i>Requirement:</i>	Planned
6 The center shall receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, and rail operations centers.	
<i>Requirement:</i>	Planned
7 The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.	
<i>Requirement:</i>	Planned
9 The center shall coordinate information and controls with other traffic management centers.	
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<i>Functional Area: TMC Traffic Network Performance Evaluation</i>	
Systems to predict 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.	
<i>Requirement:</i>	Planned
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.	
<i>Requirement:</i>	Planned
3 The center shall collect and store plans from event promoters for major future events possibly impacting traffic to support overall network performance evaluations.	
<i>Requirement:</i>	Planned
5 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.	
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<i>Functional Area: Traffic Data Collection</i>	
Collection and storage of traffic management data. For use by operations personnel or data archives in the region.	
<i>Requirement:</i>	Planned
1 The center shall collect traffic management data such as operational data, event logs, etc.	
<i>Requirement:</i>	Planned
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.	
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<i>Element:NDDOT TOC Roadside Equipment</i>	
<i>Entity:Roadway Subsystem</i>	
<i>Functional Area: Roadway Basic Surveillance</i>	
Field elements that monitor traffic conditions using loop detectors and CCTV cameras.	
<i>Requirement:</i>	Existing
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.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> NDDOT TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Basic Surveillance Field elements that monitor traffic conditions using loop detectors and CCTV cameras.	
<i>Requirement:</i>	Existing
2 The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	
<i>Requirement:</i>	Existing
6 The field element shall return sensor and CCTV system operational status to the controlling center.	
<i>Requirement:</i>	Existing
7 The field element shall return sensor and CCTV system fault data to the controlling center for repair.	
<i>Functional Area:</i> Roadway Signal Priority Field elements that provide the capability to receive vehicle signal priority requests and control traffic signals accordingly.	
<i>Requirement:</i>	Existing
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.	
<i>Requirement:</i>	Planned
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.	
<i>Functional Area:</i> Roadway Traffic Information Dissemination Driver information systems, such as dynamic message signs and Highway Advisory Radio (HAR).	
<i>Requirement:</i>	Planned
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).	
<i>Requirement:</i>	Planned
4 The field element shall provide operational status for the driver information systems equipment (DMS, HAR, etc.) to the center.	
<i>Functional Area:</i> Roadway Equipment Coordination Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
1 The field element shall include sensors (such as traffic, environmental, and work zone intrusion detection sensors) that provide data and status information to other field element devices (such as dynamic message signs, ramp meters, traffic signals, work zone intrusion alert systems), without center control.	
<i>Requirement:</i>	Planned
3 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that provide data and status information to other field element devices (such as dynamic message signs, traffic controllers on adjacent intersections), without center control.	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> NDDOT TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> Roadway Equipment Coordination	
Field elements that control and send data to other field elements (such as environmental sensors that send data to a DMS or coordination between traffic controllers on adjacent intersections), without center control.	
<i>Requirement:</i>	Planned
4 The field element shall include devices (such as arterial or freeway controllers, roadway automated treatment systems, barrier and safeguard systems, emissions or pollution systems, and work zone intrusion alert systems) that receive control information from other field element devices, without center control.	
<i>Functional Area:</i> Roadway Automated Treatment	
Field elements that activate automated roadway treatment systems (to disperse anti-icing chemicals, etc.) based on environmental or atmospheric conditions, or under center control.	
<i>Requirement:</i>	Planned
1 The field element shall activate automated roadway treatment systems based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
2 The field element shall activate automated roadway treatment systems under center control. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc.	
<i>Requirement:</i>	Planned
3 The field element shall return automated roadway treatment system and associated environmental sensor operational status to the maintenance center.	
<i>Requirement:</i>	Planned
4 The field element shall return automated roadway treatment system and associated environmental sensor fault data to the maintenance center for repair.	
<i>Functional Area:</i> Roadway Work Zone Traffic Control	
Field elements in a work zone that manage traffic conditions using CCTV cameras and driver information systems (such as DMS) to provide information directly to drivers affected by the work zone activity.	
<i>Requirement:</i>	Planned
1 The field element shall collect, process, and send work zone images to the center for further analysis and distribution, under center control.	
<i>Requirement:</i>	Planned
2 Under traffic and maintenance center control, the field element shall include driver information systems (such as dynamic messages signs and highway advisory radios) that advise drivers of activity around the work zone through which they are currently passing.	
<i>Requirement:</i>	Planned
4 The field element shall provide operational status for the surveillance (e.g. CCTV) and driver information systems in work zones to the maintenance center.	
<i>Requirement:</i>	Planned
5 The field element shall provide fault data for the surveillance (e.g. CCTV) and driver information systems in work zones to the maintenance center for repair.	
<i>Functional Area:</i> Roadway Data Collection	

Architecture	Status
Fargo-Moorhead Regional ITS Architecture (Region)	(Region)
<i>Element:</i> NDDOT TOC Roadside Equipment	
<i>Entity:</i> Roadway Subsystem	
<i>Functional Area:</i> 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.	
<i>Requirement:</i>	
1 The field element shall collect traffic, road, and environmental conditions information.	Existing
<i>Requirement:</i>	
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
<i>Requirement:</i>	
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
<i>Element:</i> RRRDC	
<i>Entity:</i> Emergency Management	
<i>Functional Area:</i> Emergency Call-Taking	
Provides interface to the emergency call-taking systems such as the Emergency Telecommunications System (e.g., 911) that correlate call information with emergencies reported by transit agencies, commercial vehicle operators, or other public safety agencies. Allows the operator to verify the incident and forward the information to the responding agencies.	
<i>Requirement:</i>	
1 The center shall support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.	Existing
<i>Requirement:</i>	
2 The center shall receive emergency call information from 911 services and present the possible incident information to the emergency system operator.	Existing
<i>Requirement:</i>	
3 The center shall receive emergency call information from motorist call-boxes and present the possible incident information to the emergency system operator.	Existing
<i>Requirement:</i>	
5 The center shall receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.	Existing
<i>Requirement:</i>	
6 The center shall receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.	Existing
<i>Requirement:</i>	
11 The center shall update the incident information log once the emergency system operator has verified the incident.	Existing
<i>Requirement:</i>	
12 The center shall provide the capability for digitized map data to act as the background to the emergency information presented to the emergency system operator.	Existing
<i>Requirement:</i>	
13 The center shall forward the verified emergency information to the responding agency based on the location and nature of the emergency.	Existing
<i>Functional Area:</i> Emergency Dispatch	

Architecture		Status
Fargo-Moorhead Regional ITS Architecture (Region)		(Region)
<i>Element:RRRDC</i>		
<i>Entity:Emergency Management</i>		
<i>Functional Area: Emergency Dispatch</i>		
Dispatch emergency vehicles to incidents, tracking their location and status. Pertinent incident information is gathered and relayed to the responding units; includes requests for signal preemption.		
<i>Requirement:</i>	1 The center shall dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.	Existing
<i>Requirement:</i>	2 The center shall store the current status of all emergency vehicles available for dispatch and those that have been dispatched.	Existing
<i>Requirement:</i>	3 The center shall relay location and incident details to the responding vehicles.	Existing
<i>Requirement:</i>	5 The center shall track the location and status of emergency vehicles responding to an emergency and update the incident status based on information from the emergency vehicle.	Planned
<i>Requirement:</i>	8 The center shall receive asset restriction information from maintenance centers to support the dispatching of appropriate emergency resources.	Existing
<i>Requirement:</i>	9 The center shall receive traffic information, including closures, traffic conditions, etc. from traffic management centers.	Planned
<i>Requirement:</i>	10 The center shall provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.	Existing
<i>Requirement:</i>	11 The center shall receive road network conditions and traffic images to support dispatch of emergency vehicles.	Planned
<i>Requirement:</i>	12 The center shall coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.	Existing