



VISION ZERO
zero deaths • zero serious injuries

**MONTANA DEPARTMENT
OF TRANSPORTATION**

Montana Department of Transportation Statewide ITS Architecture

Update Report

May 2021

NDSU

UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

Montana Department of Transportation Statewide ITS Architecture

Update Report

May 2021

The information contained in this report was obtained through extensive input from various stakeholders in the state of Montana. 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 update of the Regional Architecture.

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

Dept. 2880 – PO Box 6050
NDSU – Fargo, ND 58108
Tel 701-231-8058
www.ugpti.org - www.atacenter.org

ACRONYMS

ARC-IT	The Architecture Reference for Cooperative and Intelligent Transportation
ATR	Automated Traffic Recorders
AVL	Automated Vehicle Location
CCTV	Closed Circuit Television
DES	Disaster and Emergency Services
DMS	Dynamic Message Sign
DOT	Department of Transportation
EAS	Emergency Alert System
FHWA	Federal Highway Administration
ITS	Intelligent Transportation Systems
MDT	Montana Department of Transportation
RA	Regional Architecture
RWIS	Road Weather Information System
TIC	Transportation Information Center
TMC	Traffic Management Center
VMS	Variable Message Sign
WIM	Weigh In Motion

Standards

ASTM	American Society for Testing and Materials
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
NTCIP	National Transportation Communications for ITS Protocol
SAE	Society of Automotive Engineers

Service Packages

CVO	Commercial Vehicle Operations
DM	Data Management
MC	Maintenance and Construction
PS	Public Safety
PT	Public Transportation
TI	Traveler Information
TM	Traffic Management
VS	Vehicle Safety
WX	Weather

TABLE OF CONTENTS

Executive Summary	i
1.0 Introduction	1
1.1 Report Organization.....	1
2.0 Architecture Scope	2
2.1 Geographical Boundaries.....	2
2.2 Scope of the Architecture.....	2
3.0 Stakeholders.....	3
4.0 System inventory	5
4.1 Montana Centers.....	5
4.1.1 Traffic Management Center	5
4.1.2 Emergency Management Center.....	7
4.1.3 Maintenance and Construction Management Center	7
4.1.4 Commercial Vehicle Administration Center	8
4.1.5 Transportation Information Center	8
4.1.6 Transit Management Center	9
4.2 Montana Field Devices	9
4.2.1 MDT Field Devices.....	9
4.2.2 Local Jurisdiction Devices	10
4.3 Montana Vehicles	10
4.4 Support.....	11
4.5 System Inventory.....	11
5.0 Service Packages.....	12
6.0 Operational Concept	15
7.0 Agreements	16
8.0 Functional requirements	17
9.0 ITS Standards.....	18
10.0 Planning Aspects.....	21
10.1 Planning and the Regional ITS Architecture.....	21
10.2 Regional ITS Architecture Maintenance.....	25

EXECUTIVE SUMMARY

The Montana Statewide Regional Intelligent Transportation Systems (ITS) Architecture was prepared under the leadership of the Montana Department of Transportation (MDT). This effort represents a significant update of the original architecture developed in 2005 by the Western Transportation Institute. The goal of the ITS architecture is to guide the implementation of ITS in the state and to coordinate funding, deployment, information sharing, and operations of ITS technologies. The main ITS goal areas for the state include enhanced traveler safety; coordinated maintenance and construction activities; effective traffic and transit management; coordinated incident management; enhanced commercial vehicle operations; and improved traveler information. A 15-year planning horizon was considered in the architecture development.

The update of the architecture 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 MDT for updating the architecture.

The architecture update process primarily followed the Federal Highway Administration (FHWA) guidelines. The process made use of completed planning efforts in the state including the original statewide architecture developed in 2005. This version of the architecture is based on the national Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT 9.0). ARC-IT combined services from the national ITS architecture and the connected vehicle reference implementation architecture, and reorganized the ITS service areas and service packages within them.

The architecture development was guided by various stakeholders who own and operate ITS in the state and included:

- MDT Management
- MDT Engineering
- MDT Maintenance
- MDT Motor Carrier Services
- MDT Rail Transit and Planning
- Montana Disaster and Emergency Services
- Montana Highway Patrol
- State DOT district engineering and maintenance staff
- Local jurisdictions including Metropolitan Planning Organizations, Cities, Counties, and Tribes.

The system inventory was updated to account for existing and planned ITS. The majority of these systems may be classified into the following service areas: traffic and travel management, maintenance and construction management, commercial vehicle operations, and transit management. The inventory identified systems and their functions by agency and jurisdiction.

ITS user services for the region were initially identified from previous ITS planning efforts as well as input from regional stakeholders. The National ITS Architecture was used to map these services and to develop service packages in support of these services.

A total of 52 Service Packages and service package instances were identified for the MDT statewide architecture comprising the agencies, devices, and information flows needed to achieve each ITS service. The service packages were also used to survey stakeholder roles and responsibilities for each system. System interconnections and relevant information flows were identified and customized for each service package. The selected service packages offer a breadth of scope that covers both statewide level services provided by MDT (e.g. traveler information), and local services provided by the state's many local jurisdictions (e.g. transit services).

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. Four potential agreements were identified for the Montana statewide architecture including traffic and regional signal control, weather forecasting, and National Park traveler information.

A regional ITS architecture is a planning tool that should interact with other state transportation plans, ideas can and should flow from and to the architecture and other planning efforts. To emphasize this connection, select service packages from the architecture were linked to specific goals and strategies from TranPlanMT; these service packages can help MDT in achieving its identified goals and strategies.

1.0 INTRODUCTION

This document summarizes the results of the update of the Montana Statewide Regional Intelligent Transportation Systems Architecture. Intelligent Transportation Systems (ITS) refer to integrated applications of sensing, communications, computer processing, and electronics to enhance the transportation system's safety and efficiency. The statewide architecture provides a roadmap to guide future ITS planning and deployment, define system requirements, coordinate agency roles and integrate functions across jurisdictional lines.

The Montana statewide ITS architecture was updated under the leadership of the Montana Department of Transportation (MDT). The main goal of the statewide architecture is to guide the implementation of ITS in Montana and coordinate funding, deployment, information sharing, and operations of ITS in the region. The main ITS focus areas for MDT include enhanced traveler safety; accurate and timely traveler information; coordinated incident management; effective maintenance of the roadway system; efficient commercial vehicle operations; and integrated data management. A 15-year planning horizon was considered in the RA development.

This update of the statewide ITS architecture was facilitated by the Advanced Traffic Analysis Center (ATAC) of the Upper Great Plains Transportation Institute at North Dakota State University. The original architecture was developed by the Western Transportation Institute of Montana State University in 2005.

1.1 Report Organization

The MDT statewide ITS architecture update report is organized into several main sections to facilitate the report use. In addition, an electronic database file has been prepared using the FHWA's regional architecture development for intelligent transportation (RAD-IT) software in order to improve access to the architecture and simplify making changes and future updates. The contents of the architecture database are available on a website for ease of use and enhanced access. A listing of the remaining sections of this report is as follows:

2 Scope	Identifies the geographical and architecture scope
3 Stakeholders	Agencies participating in the architecture
4 System Inventory	Existing and planned ITS
5 Service Packages	Existing and planned ITS services
6 Operational Concept	Roles and responsibilities of participating agencies
7 Potential Agreements	Regional agreements to facilitate integration
8 Functional Requirements	High-level descriptions of what the systems will do
9 ITS Standards	Brief discussion of applicable ITS standards
10 Planning Aspects	Relating planning goals to the ITS architecture

2.0 ARCHITECTURE SCOPE

This section describes the geographical boundaries and the scope of services of the statewide architecture.

2.1 Geographical Boundaries

The geographical area included in the MDT statewide architecture encompasses the entire state, with emphasis on systems of statewide significance such as Montana's three interstate freeways (Interstates 15, 90 and 94).

2.2 Scope of the Architecture

The scope of ITS services considered in the MDT statewide architecture focuses on state level services such as commercial vehicle operations, traveler information, and the statewide transportation management center (TMC). The architecture also covers urban services such as traffic signal control and transit management performed in the states three largest cities: Billings, Great Falls, and Missoula, and other local jurisdictions throughout the state including counties and tribes.

The service areas covered in the Montana statewide architecture are:

- Commercial Vehicle Operations
- Data Management
- Maintenance and Construction
- Public Safety
- Public Transportation
- Traffic Management
- Traveler Information
- Vehicle Safety
- Weather

3.0 STAKEHOLDERS

ITS stakeholders in Montana's statewide architecture include several MDT divisions and other transportation, public works, law enforcement, and emergency management partner agencies in the state.

Name	Description
Local Jurisdictions	Metropolitan planning organizations (MPOs), cities, counties, and tribes in Montana that perform roles in the ITS architecture. This includes traffic management, transit, emergency, and maintenance agencies.
MDT	Montana Department of Transportation
MDT Districts	The MDT District offices at Missoula, Butte, Great Falls, Glendive, and Billings.
MDT Engineering	MDT Engineering Division
MDT Information Services	MDT Information Services Division
MDT Maintenance	MDT Maintenance Division
MDT Motor Carrier Services	MDT Motor Carrier Services Division
MDT Rail Transit and Planning	MDT Rail, Transit and Planning Division. This division provides a broad range of multimodal planning, program, and data collection and analysis functions that support MDT's efforts to plan for and manage Montana's multimodal transportation system. The division includes the Policy, Program & Performance Analysis Bureau, Multimodal Planning Bureau, Data & Statistics Bureau, Project Analysis, Grants Bureau, and the Environmental Services Bureau.
MDT Traffic	MDT Traffic and Safety Bureau Responsible for providing management, design, and technical support for traffic and safety engineering functions. It is responsible for managing and coordinating the highway safety improvement and railroad crossing safety improvement programs. It develops and reviews plans and specifications for geometric features, signing, pavement marking, electrical, and highway safety improvement projects. It also performs traffic and safety engineering investigations.

Name	Description
Montana Disaster and Emergency Services	Montana DES operates the state's emergency operations center in response to large-scale emergencies and disasters. The DES coordinates emergency planning and response with various state agencies including MDT.
Montana Highway Patrol	The state's law enforcement agency with the mission of safeguarding the lives, property, and constitutional rights of people traveling the ways of Montana.
Montana Motor Carriers Association	A trade association dedicated to the furtherance of the trucking industry's goals and interests in Montana and the United States.
Montana Travelers	The public traveling on Montana's roadways via all modes.
National Park Service	The National Park Service is a stakeholder due to the unique traffic conditions and needs around the state's two national parks: Glacier and Yellowstone.
National Weather Service	The National Weather Service in Montana which in addition to regular duties, provides MDT with localized forecasts and weather information to assist in winter maintenance activities decision making and for providing location specific weather warnings.
Rail Agencies	Agencies that operate rail in the state with a focus on their role in maintaining wayside equipment at highway-rail intersections.

4.0 SYSTEM INVENTORY

This section summarizes the results of the system inventory process for the Montana statewide architecture. 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 Reference Architecture (ARC-IT). More emphasis was placed on the physical view of the 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, planned, or future. Both the planned and future designations referring to systems, components, or services which have been identified for upcoming deployment in the region; with ‘planned’ systems having a closer deployment horizon than ‘future’ systems.

Using the physical view of ARC-IT, four types of entities were identified for the Montana statewide architecture:

1. Centers
2. Field Devices
3. Vehicles
4. Support
5. Personal

These entities are explained in details in the following subsections. A representation of the Montana statewide Physical Architecture is shown in Figure 1.

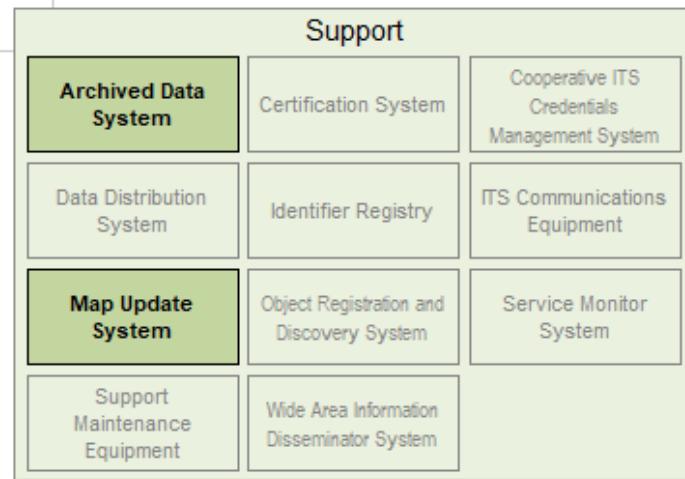
4.1 Montana Centers

These are the locations where functions are performed (i.e., process information, issue control commands, and produce output information). Various centers in ARC-IT 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.

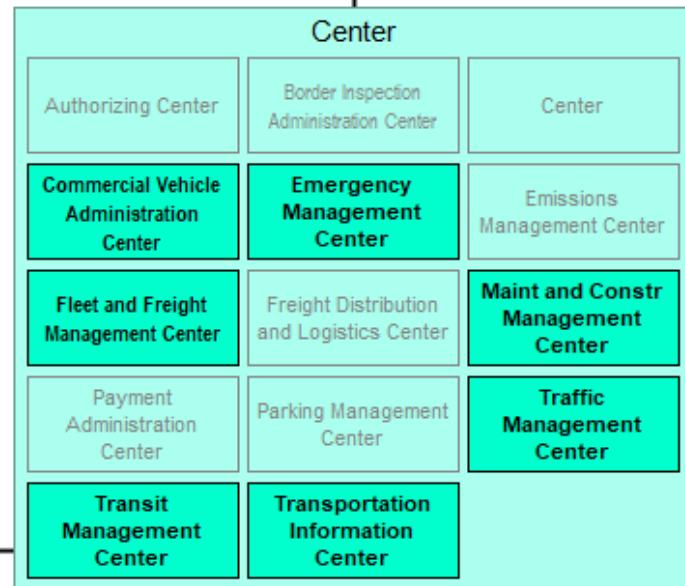
4.1.1 Traffic Management Center

The Traffic Management Center (TMC) monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including freeway systems, rural and suburban highway systems, and urban and suburban traffic control systems. It communicates with ITS Roadway Equipment and Connected Vehicle Roadside Equipment (RSE) to monitor and manage traffic flow and monitor the condition of the roadway, surrounding environmental conditions, and field equipment status. MDT established a statewide TMC in 2020 to create a dispatch center and centralize road reporting. The TMC controls dynamic message signs (DMS) and the states road weather information systems (RWIS) network.

Center to Center



Center to Center



Center to Center

Figure 1. Montana's Physical Architecture

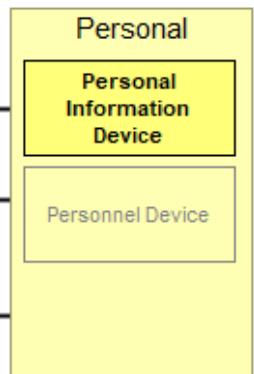
Center to Field



Field to Field

Wide Area Wireless

Short Range Wireless



Short Range Wireless



Short Range Wireless

4.1.2 Emergency Management Center

The Emergency Management Center represents systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications. It includes the functions associated with fixed and mobile public safety communications centers including public safety call taker and dispatch centers operated by police, fire, and emergency medical services. It includes the functions associated with Emergency Operations Centers that are activated at local, regional, state, and federal levels for emergencies and the portable and transportable systems that support Incident Command System operations at an incident.

The emergency management center function in Montana is performed by various agencies represented in the architecture including the Montana Disaster and Emergency Services (DES), Montana Highway Patrol (MHP), and Local Jurisdiction Emergency Centers. The DES activates a statewide emergency operations center when needed; MDT has representation at the center. MHP has a central dispatch facility at Fort Harrison in Helena that covers the entire state. Many of the state's local jurisdictions operate their own public safety answering point (PSAP) centers for receiving 911 calls and dispatching law enforcement, fire, and emergency medical services; calls requiring MHP response are forwarded from the local PSAP to central dispatch.

4.1.3 Maintenance and Construction Management Center

The Maintenance and Construction Management Center monitors and manages roadway infrastructure construction and maintenance activities. Representing both public agencies and private contractors that provide these functions, this physical object manages fleets of maintenance, construction, or special service vehicles (e.g., snow and ice control equipment). The physical object receives a wide range of status information from these vehicles and performs vehicle dispatch, routing, and resource management for the vehicle fleets and associated equipment. The physical object participates in incident response by deploying maintenance and construction resources to an incident scene, in coordination with other center physical objects. The physical object manages equipment at the roadside, including environmental sensors and automated systems that monitor and mitigate adverse road and surface weather conditions. It manages the repair and maintenance of both non-ITS and ITS equipment including the traffic controllers, detectors, dynamic message signs, signals, and other equipment associated with the roadway infrastructure. Weather information is collected and fused with other data sources and used to support maintenance decision making.

The physical object remotely monitors and manages ITS capabilities in work zones, gathering, storing, and disseminating work zone information to other systems. It manages traffic in the vicinity of the work zone and advises drivers of work zone status (either directly at the roadside or through an interface with the Transportation Information Center or Traffic Management Center physical objects.)

Construction and maintenance activities are tracked and coordinated with other systems, improving the quality and accuracy of information available regarding closures and other roadway construction and maintenance activities.

The statewide level of this function is performed by MDT Maintenance Division and the many district and area offices throughout the state. Maintenance activities at the local level are represented by the Local Jurisdiction Maintenance Centers architecture element.

4.1.4 Commercial Vehicle Administration Center

The Commercial Vehicle Administration Center performs administrative functions supporting credentials, tax, and safety regulations associated with commercial vehicles. It issues credentials, collects fees and taxes, and supports enforcement of credential requirements. It communicates with motor carriers to process credentials applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations. It also receives applications for, and issues special Oversize/Overweight and HAZMAT permits in coordination with cognizant authorities. It coordinates with other Commercial Vehicle Administration Centers (in other states/regions) to support nationwide access to credentials and safety information for administration and enforcement functions. It communicates with field equipment to enable credential checking and safety information collection at the roadside. It makes safety information available to qualified stakeholders to identify carriers and drivers that operate unsafely.

This element is represented by the MDT Commercial Vehicle Administration Center element in the Montana statewide architecture; activities are overseen and performed by MDT Motor Carrier Services division.

4.1.5 Transportation Information Center

The Transportation Information Center (TIC) collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The physical object can play several different roles in an integrated ITS. In one role, the TIC provides a data collection, fusing, and repackaging function, collecting information from transportation system operators and redistributing this information to other system operators in the region and other TICs. In this information redistribution role, the TIC provides a bridge between the various transportation systems that produce the information and the other TICs and their subscribers that use the information. The second role of a TIC is focused on delivery of traveler information to subscribers and the public at large. Information provided includes basic advisories, traffic and road conditions, and parking information. The TIC is commonly implemented as a website or a web-based application service, but it represents any traveler information

distribution service. The TIC function in Montana is coordinated through the statewide TMC and utilize the state's traveler information system for disseminating information.

4.1.6 Transit Management Center

The Transit Management Center manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning, and management functions for the transit property. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, and paratransit services. The physical object's interfaces support communication between transit departments and with other operating entities such as emergency response services and traffic management systems.

Transit services in Montana are performed at the local level by various transit providers throughout the state and are represented by the Local Jurisdiction Transit Providers element.

4.2 Montana Field Devices

This type of physical entity refers to infrastructure proximate to the transportation network, which performs surveillance (e.g. traffic detectors, cameras), traffic control (e.g. signal controllers), information provision (e.g. Dynamic Message Signs (DMS)), and local transaction (e.g., parking) functions. Typically governed by transportation management functions running in centers. Field also includes connected vehicle roadside equipment and other non-DSRC wireless communications infrastructure that provides communications between mobile elements and fixed infrastructure.

4.2.1 MDT Field Devices

1. Sensors
 - a. Weather
 - i. RWIS and surface sensors
 - ii. Vehicle mounted sensors
 - b. Traffic
 - i. ATR
 - ii. WIM
 - iii. Connected vehicle roadside equipment (CV RSE)

- c. Surveillance/monitoring
 - i. Standalone cameras for video surveillance
 - ii. Video cameras at RWIS sites
- 2. Commercial vehicle equipment
 - a. Electronic screening
 - b. Roadside safety check
- 3. Warning/advisory devices
 - a. Permanent DMS
 - b. Portable DMS
 - c. Highway Advisory Radio (HAR)
 - d. Spot weather warning signs

4.2.2 Local Jurisdiction Devices

- 1. Traffic signal sensing and control equipment
- 2. Highway-rail intersection control equipment

4.3 Montana Vehicles

This architecture element represents vehicles and driver information and safety systems. Vehicles with existing or planned ITS capabilities, i.e., vehicles with advanced communications, navigation and tracking, monitoring, and control systems are included.

- 1. Emergency Vehicle (MHP and Local Jurisdictions)
 - a. Fire (signal preemption, AVL)
 - b. Law enforcement (AVL)
 - c. Ambulance (signal preemption, AVL)
- 2. Transit Vehicle (Local Jurisdictions)

- a. Buses with electronic fare box, AVL capabilities, security equipment, and transit signal priority (TSP)
- 3. Maintenance Vehicle (MDT and Local Jurisdictions)
 - a. Snowplows equipped with AVL and atmospheric and operational sensors

4.4 Support

A center that provides a non-transportation specific service. Typically, these are enabling functions, such as communications facilitation, security, or management. In Montana, the support element is represented by the Archived Data System and Map Update System.

4.5 System Inventory

The Montana statewide ITS architecture inventory is available internally.

5.0 SERVICE PACKAGES

This section describes the ITS services selected in the Montana statewide architecture. These services were identified from previous ITS planning efforts and from stakeholders input throughout the architecture update process.

Service packages are slices of the architecture that address a specific service (e.g. traffic signal control); they are a collection of several different physical objects (systems and devices) along with the information flows needed to provide a desired service. When necessary, two service package instances were created: one to show the service from MDT's perspective, and the second to show the service from the perspective of local jurisdictions.

The table below lists Montana's service packages and their deployment status (existing, planned, or future). A complete description of the service packages along with customized information flows can be found on the statewide architecture website internally.

Service Package	Service Package Name	Status
CVO03	Electronic Clearance	Existing
CVO04	CV Administrative Processes	Existing
CVO05	Commercial Vehicle Parking	Planned
CVO07	Roadside CVO Safety	Existing
CVO08	Smart Roadside and Virtual WIM	Existing
CVO09	Freight-Specific Dynamic Travel Planning	Planned
DM01	ITS Data Warehouse	Planned
DM02	Performance Monitoring	Planned
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Existing
MC02	Maintenance and Construction Vehicle Maintenance	Existing
MC03	Roadway Automated Treatment	Existing
MC04	Winter Maintenance	Existing
	Winter Maintenance (Local Jurisdictions)	Existing
MC05	Roadway Maintenance and Construction	Existing

MC06	Work Zone Management	Existing
MC07	Work Zone Safety Monitoring	Existing
MC08	Maintenance and Construction Activity Coordination	Existing
MC09	Infrastructure Monitoring	Planned
PS01	Emergency Call-Taking and Dispatch	Existing
PS03	Emergency Vehicle Preemption	Existing
PS10	Wide-Area Alert	Existing
PS12	Disaster Response and Recovery	Existing
PS13	Evacuation and Reentry Management	Existing
PS14	Disaster Traveler Information	Existing
PT01	Transit Vehicle Tracking	Existing
PT02	Transit Fixed-Route Operations	Existing
PT03	Dynamic Transit Operations	Existing
PT04	Transit Fare Collection Management	Existing
PT05	Transit Security	Existing
PT08	Transit Traveler Information	Existing
PT09	Transit Signal Priority	Existing
SU04	Map Management	Planned
TI01	Broadcast Traveler Information	Existing
TI02	Personalized Traveler Information	Existing
TM01	Infrastructure-Based Traffic Surveillance	Existing
TM03	Traffic Signal Control	Existing
	Traffic Signal Control (Local Jurisdictions)	Existing
TM06	Traffic Information Dissemination	Existing

TM07	Regional Traffic Management	Planned
TM08	Traffic Incident Management System	Existing
TM12	Dynamic Roadway Warning	Existing
TM13	Standard Railroad Grade Crossing	Existing
	Standard Railroad Grade Crossing (Local Jurisdictions)	Existing
TM17	Speed Warning and Enforcement	Existing
TM19	Roadway Closure Management	Existing
TM20	Variable Speed Limits	Planned
TM25	Wrong Way Vehicle Detection and Warning	Future
VS05	Curve Speed Warning	Future
VS13	Intersection Safety Warning and Collision Avoidance	Future
WX01	Weather Data Collection	Existing
WX02	Weather Information Processing and Distribution	Existing
WX03	Spot Weather Impact Warning	Existing

6.0 OPERATIONAL CONCEPT

This section discusses the roles and responsibilities of stakeholders in the implementation and operation of the systems identified in the Montana statewide ITS architecture. The operational concept outlines these roles and responsibilities for specific scenarios, e.g., traffic incidents, major winter storms, floods, etc. In addition to providing a snapshot of how things are done for a certain scenario, the operational concept explores additional integration opportunities in the region with particular focus on stakeholder involvement.

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

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

The roles and responsibilities of stakeholders in the Montana statewide architecture are outlined here on the website available internally.

7.0 AGREEMENTS

This section briefly outlines potential agreements needed to support the Montana statewide architecture. The process of identifying needed agreements relied on the service packages to identify potential interagency exchanges. Anytime agencies shared operations of a system or shared formal access to system control and data, a potential agreement was flagged. Discussions with stakeholders helped to finalize the list of agreements, taking into consideration existing agreements with other agencies that they have in place as well as their own agency requirements.

Identified agreements are available internally.

8.0 FUNCTIONAL REQUIREMENTS

This section discusses detailed functional requirements for the user services and service packages identified for the Montana statewide architecture. The requirements were selected from the National ITS Architecture template based on desired functions for each system. RAD-IT software was used to build the functional requirements and produce a Functional Requirements Report.

The functional requirements are listed in the table below. The table contains the following columns with the headings described as follows:

1. Element Name: the element from the architecture inventory
2. Functional Object: element mapping to the national ITS architecture
3. Requirement number
4. Requirement
5. Status: Existing or planned.

The functional requirements table is available internally.

9.0 ITS STANDARDS

This section identifies applicable ITS Standards identified for the Montana statewide architecture. It should be noted that the development of ITS Standards is an ongoing process. Therefore, the set of applicable ITS standards should be updated as new standards are approved. The following table shows applicable standards for the Montana statewide architecture based on RAD-IT output. The information in the table is arranged in the following columns:

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

SDO	Standard Title	Document ID	Element
Advanced Traffic Controller Joint Committee	Advanced Transportation Controller	ITE ATC 5201	Local Jurisdiction Traffic Control Devices, MDT Field Devices, MDT Managed Traffic Control Devices
Advanced Traffic Controller Joint Committee	Application Programming Interface Standard for the Advanced Transportation Controller	ITE ATC 5401	Local Jurisdiction Traffic Control Devices, MDT Field Devices, MDT Managed Traffic Control Devices
Advanced Traffic Controller Joint Committee	Intelligent Transportation System Standard Specification for Roadside Cabinets	ITE ATC 5301	Local Jurisdiction Traffic Control Devices, MDT Field Devices, MDT Managed Traffic Control Devices
Advanced Traffic Controller Joint Committee	Model 2070 Controller Standard	ITE ATC 5202	Local Jurisdiction Traffic Control Devices, MDT Field Devices, MDT Managed Traffic Control Devices

SDO	Standard Title	Document ID	Element
International Organization for Standardization	Intelligent transport systems -- Communications access for land mobiles (CALM) -- Architecture	ISO 21217	Commercial Vehicle OBE, Fleet and Freight Management Center, Government Reporting Systems, Highway Patrol, Local Jurisdiction Emergency Centers, Local Jurisdiction Emergency Vehicles, Local Jurisdiction Maintenance Centers, Local Jurisdiction Maintenance Vehicles, Local Jurisdiction Traffic Centers, Local Jurisdiction Traffic Control Devices, Local Jurisdiction Transit Providers, Local Jurisdiction Transit Vehicle, MDT Commercial Vehicle Administration Center, MDT Commercial Vehicle Check Equipment, MDT CV Roadside Equipment, MDT Data Archival, MDT District and Area Offices, MDT Equipment Shops, MDT Field Devices, MDT Field Maintenance Equipment, MDT Maintenance Management, MDT Maintenance Vehicles, MDT Managed Traffic Control Devices, MDT Mapping Services, MDT MCS Enforcement, MDT TMC, MDT Traffic Signal Management, MDT Transportation Information, Media, Montana DES, National Parks, Personal Information Device, Truck Parking Area Equipment, Vehicle, Vehicle OBE, Wayside Equipment, Weather Service System
National Electrical Manufacturers Association	Cyber and Physical Security for Intelligent Transportation Systems	NEMA TS 8	Highway Patrol, Local Jurisdiction Emergency Centers, Local Jurisdiction Maintenance Centers, Local Jurisdiction Traffic Centers, Local Jurisdiction Traffic Control Devices, MDT Data Archival, MDT District and Area Offices, MDT Field Devices, MDT Maintenance Management, MDT Managed Traffic Control Devices, MDT TMC, MDT Traffic Signal Management, Montana DES
National Electrical Manufacturers Association	Hardware Standards for Dynamic Message Signs (DMS) With NTCIP Requirements	NEMA TS4	Local Jurisdiction Traffic Control Devices, MDT Field Devices, MDT Managed Traffic Control Devices
National Electrical Manufacturers Association	Portable Traffic Signal Systems (PTSS) Standard	NEMA TS 5	Local Jurisdiction Traffic Control Devices, MDT Field Devices, MDT Managed Traffic Control Devices

SDO	Standard Title	Document ID	Element
National Electrical Manufacturers Association	Traffic Controller Assemblies with NTCIP Requirements	NEMA TS2	Local Jurisdiction Traffic Control Devices, MDT Field Devices, MDT Managed Traffic Control Devices
National Institute for Standards and Technology	Security Requirements for Cryptographic Modules	NIST FIPS PUB 140-2	Commercial Vehicle OBE, Fleet and Freight Management Center, Government Reporting Systems, Highway Patrol, Local Jurisdiction Emergency Centers, Local Jurisdiction Emergency Vehicles, Local Jurisdiction Maintenance Centers, Local Jurisdiction Maintenance Vehicles, Local Jurisdiction Traffic Centers, Local Jurisdiction Traffic Control Devices, Local Jurisdiction Transit Providers, Local Jurisdiction Transit Vehicle, MDT Commercial Vehicle Administration Center, MDT Commercial Vehicle Check Equipment, MDT CV Roadside Equipment, MDT Data Archival, MDT District and Area Offices, MDT Equipment Shops, MDT Field Devices, MDT Field Maintenance Equipment, MDT Maintenance Management, MDT Maintenance Vehicles, MDT Managed Traffic Control Devices, MDT Mapping Services, MDT MCS Enforcement, MDT TMC, MDT Traffic Signal Management, MDT Transportation Information, Media, Montana DES, National Parks, Personal Information Device, Truck Parking Area Equipment, Vehicle, Vehicle OBE, Wayside Equipment, Weather Service System
Not Applicable	Dedicated Short-Range Communications Roadside Unit Specifications (FHWA-JPO-17-589)	USDOT RSU	MDT CV Roadside Equipment

10.0 PLANNING ASPECTS

10.1 Planning and the Regional ITS Architecture

This section ties service packages from the Montana statewide architecture to goals and objectives identified in TranPlanMT, which defines MDT's policy direction for operating, preserving, and improving Montana's transportation system over a 20-year period.

Goal 1: Safety

Goal statement: Improve safety for all transportation users to achieve Vision Zero: zero fatalities and zero serious injuries.

Strategies:

S1: Maintain infrastructure condition to provide safe conditions for the traveling public.

Associated Service Packages:

MC09: Infrastructure Monitoring

TM01: Infrastructure-Based Traffic Surveillance

WX01: Weather Data Collection

WX02: Weather Information Processing and Distribution

S3: Target safety improvement projects to address crash pattern locations.

Associated Service Packages:

MC03: Roadway Automated Treatment

TM12: Dynamic Roadway Warning

WX03: Spot Weather Impact Warning

S4: Incorporate technology advancements in project development to improve safety.

Associated Service Packages:

CVO07: Roadside CVO Safety

CVO08: Smart Roadside and Virtual WIM

MC03: Roadway Automated Treatment

MC07: Work Zone Safety Monitoring

TM08: Traffic Incident Management System

TM12: Dynamic Roadway Warning

TM13: Standard Railroad Grade Crossing

TM17: Speed Warning and Enforcement

TM20: Variable Speed Limits

WX03: Spot Weather Impact Warning

S6: Reduce unsafe driving behavior through targeted focus on transportation safety emphasis areas identified in Montana's Comprehensive Highway Safety Plan.

Associated Service Packages:

TM12: Dynamic Roadway Warning

TM17: Speed Warning and Enforcement

TM20: Variable Speed Limits

TM25: Wrong Way Vehicle Detection and Warning

S7: Enhance crash data integration and analysis to support decision-making and data-driven problem identification.

Associated Service Packages:

DM01: ITS Data Warehouse

DM02: Performance Monitoring

Performance Measures for Goal 1:

- Number of fatalities.
- Number of non-motorized fatalities and non-motorized serious injuries.
- Number of serious injuries.
- Rate of fatalities per 100 million VMT.
- Rate of serious injuries per 100 million VMT.

Goal 2. System Preservation and Maintenance

Goal statement: Preserve and maintain existing transportation infrastructure.

Strategies:

SPM1: Employ an asset management approach to monitor system performance and develop an optimal investment plan ensuring like conditions throughout state.

Associated Service Packages:

DM01: ITS Data Warehouse

DM02: Performance Monitoring

MC09: Infrastructure Monitoring

SPM5: Perform routine repairs and maintenance to provide consistent levels of service.

Associated Service Packages:

MC04: Winter Maintenance

MC05: Roadway Maintenance and Construction

MC08: Maintenance and Construction Activity Coordination

Goal 3. Mobility and Economic Vitality

Goal Statement: Facilitate the movement of people and goods recognizing the importance of economic vitality.

Strategies:

MEV02: Enhance the freight network with targeted improvements to freight corridors.

Associated Service Packages:

CVO03: Electronic Clearance

CVO04: CV Administrative Processes

CVO05: Commercial Vehicle Parking

MEV04: Promote efficient traffic management and operations by implementing practices that manage travel demand, reduce delay, and enhance mobility.

Associated Service Packages:

TM01: Infrastructure-Based Traffic Surveillance

TM03: Traffic Signal Control

TM06: Traffic Information Dissemination

TM07: Regional Traffic Management

TM08: Traffic Incident Management System

MEV10: Facilitate and coordinate access to recreational, historical, cultural, and scenic destinations for tourism purposes.

Associated Service Packages:

TI01: Broadcast Traveler Information

TI02: Personalized Traveler Information

MEV12: Perform winter maintenance activities to provide consistent levels of service and enable wintertime mobility.

Associated Service Packages:

MC04: Winter Maintenance

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

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

Associated Service Packages:

- PT01: Transit Vehicle Tracking
- PT02: Transit Fixed-Route Operations
- PT03: Dynamic Transit Operations
- PT08: Transit Traveler Information
- PT09: Transit Signal Priority

Goal 3 Performance Measures:

- Percent of person-miles traveled on the Interstate that are reliable.
- Percent of person-miles traveled on the NINHS that are reliable.

Goal 4. Accessibility and Connectivity

Goal statement: Preserve access to the transportation network and connectivity between modes.

AC1: Improve pedestrian, public transportation, and other MDT-owned facilities to ensure accessibility to individuals with disabilities.

Associated Service Packages:

- PT05: Transit Security
- TM03: Traffic Signal Control

AC5: Coordinate use of public transportation systems through integrated planning with providers.

Associated Service Packages:

- PT02: Transit Fixed-Route Operations
- PT03: Dynamic Transit Operations

AC6: Maximize efficiency of transportation options available to disadvantaged populations.

Associated Service Packages:

- PT03: Dynamic Transit Operations

Goal 5. Environmental Stewardship

Goal statement: Support MDT's transportation mission through regulatory compliance and responsible stewardship of the built and natural environment.

Associated Service Packages:

CVO03: Electronic Clearance

TM03: Traffic Signal Control

Goal 5 Performance Measures

- Total emissions reduction

Goal 6. Business Operations and Management

Goal statement: Provide efficient, cost-effective management and operation to accelerate transportation project delivery and ensure system reliability.

BOM1: Coordinate with state and federal agencies to support transportation security and enable appropriate response and recovery from emergency and disaster situations.

Associated Service Packages:

PS12: Disaster Response and Recovery

BOM2: Develop and implement a long-range multimodal transportation improvement program that addresses Montana's statewide transportation needs, is consistent with the statewide long-range transportation plan and management system output, and maximizes the use of federal funds through the Performance Programming Process (P3) to ensure a cost-effective, efficient, and safe transportation system

Associated Service Packages:

DM02: Performance Monitoring

10.2 Regional ITS Architecture Maintenance

The Montana Department of Transportation is responsible for maintaining and updating the Montana Statewide ITS Architecture. It is envisioned that the updates will be conducted as needed, upon the deployment of major ITS projects in the state. The updates will account for any changes to existing systems, as well as changes to regional needs and priorities, and changes in the National ITS Architecture.