North Dakota
Department of Transportation

North Dakota Statewide ITS Plan II

Final Report

March 2016

Prepared for:
North Dakota Department of Transportation

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

NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

DISCLAIMER

NOTE: This manual provides a written account of how certain activities are performed and is designed to guide and assist staff in performing their functions. When appropriate, there may be deviations from these written procedures due to changes in personnel, policies, interpretation, law, experimentation with different systems, or simply evolution of the process itself. This manual may be changed at any time. Staff is encouraged to review this manual periodically and suggest changes in the manual to keep the manual current and to minimize differences between the manual and actual practices.

APPROVAL

This manual has been approved by:

Ronald J. Henke, P.E.
Deputy Director for Engineering

3/23/16
Date

North Dakota Statewide ITS Plan II

Final Report

March 2016

The information contained in this report was obtained through extensive input from various stakeholders in the state of North Dakota. This report builds upon the 2004 Statewide ITS Plan report and efforts performed hence in the development and update of the Statewide ITS Architecture. 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 Statewide ITS Plan.

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 – Fax 701-231-6265
www.ugpti.org - www.atacenter.org

TABLE OF CONTENTS

Executive Summary i

1. Introduction 1

2. North Dakota Planning Aspects 3

  2.1. Guiding Principles 3

  2.2. North Dakota Issues and Needs 4

    2.2.1. Stakeholders Input Mechanism 4

    2.2.2. Common Issues 5

  2.3. Contexts for ITS Deployment 6

    2.3.1. Area Type 6

    2.3.2. Customer Groups 9

3. ITS Primer 11

  3.1. ITS Defined 11

  3.2. National ITS Program 11

    3.2.1. Connected Vehicle Program Area 12

    3.2.2. Road Weather Management Program Area 13

    3.2.3. Applications for the Environment: Real-Time Information Synthesis (AERIS).... 13

    3.2.4. Commercial Vehicle Information Systems and Networks (CVISN) 13

    3.2.5. Rural and Statewide ITS Infrastructure 14

  3.3. ITS User Services 16

  3.4. ITS Resources 18

4. Goals and Objectives 19

  4.1. ITS Goals 19

    4.2.1. Sought Benefits 20

5. Existing conditions 22

  5.1. Travel and Traffic Management 22

    5.1.1. CCTV and other Surveillance Cameras 22

    5.1.2. Signal Operations 23

    5.1.3. Dynamic Message Signs (DMS) 23

    5.1.4. Traveler Information System 23

    5.1.5. Traffic Data Collection 24

    5.1.6. Warning and Advisory Systems 25

  5.2. Maintenance and Construction Management 25

5.2.1. Bridge Deck Anti-Icing Spray System 25
5.2.2. Roadway Weather Information Systems (RWIS) 25
5.2.3. Maintenance Decision Support System (MDSS) 25
5.2.4. Maintenance Vehicle Technologies 25
5.3. Regional and National ITS Efforts 26
6. Needs Assessment 27
6.1. Safety 27
6.2. Traffic Operations 29
6.3. Information for System Management 30
6.4. Customer Satisfaction 31
7. Priority ITS Services 32
7.1. North Dakota ITS User Services 32
8. ITS Project Deployment 35
8.1. Federal Requirements 35
8.2. ITS architecture and Systems Engineering Checklist 35
8.3. Deployment Plans 36
Appendix 1 – Stakeholder Survey 37
Appendix 2 – ITS and SE Checklist 53

EXECUTIVE SUMMARY

The Intelligent Transportation Systems (ITS) Plan is the product of a multi-year effort undertaken by the North Dakota Department of Transportation (NDDOT) to guide ITS deployment in North Dakota. The plan was developed through participation from various NDDOT divisions, districts, and other state stakeholders.

The main focus of the plan is on statewide projects in non-urban areas. The three metropolitan areas in the state have metropolitan ITS Plans and Regional ITS Architectures that guide ITS deployment in their locales. Therefore, the statewide ITS Plan does not duplicate those efforts.

Since completion of the first Statewide ITS Plan nearly a decade ago, the NDDOT has been deploying various ITS systems and technologies. The main focus of ITS deployment has been in the ITS service areas of Network Surveillance: where a network of cameras and Road Weather Information Systems (RWIS) cover the major highways in the state; Winter Maintenance: where a maintenance decision support system (MDSS) is utilized to determine the course of action for dealing with a weather event; and Information Dissemination: traveler information website for desktop and mobile devices and Dynamic Message Signs (DMS) at key locations that relay information about road conditions to travelers.

In the deployment of these systems, the NDDOT has started the shift from installing ITS devices in a sporadic matter as needs and opportunities arose, into more of an integrated system approach that takes into consideration technologies and functions. ITS projects in the past few years have taken advantage of the Statewide ITS Architecture and benefited from a Systems Engineering (SE) analysis, the NDDOT requiring a checklist to be completed for each ITS project ensures adherence to the architecture and that the necessary SE steps have been performed

For the future, the NDDOT is looking at opportunities for enhancing traveler information services to travelers by providing timely and accurate information to meet SAFETEA-LU Section 1201 Rule on a 24-hour basis through a variety of outlets. The NDDOT is also looking at enhancing their data collection and analysis efforts for the calculation of performance measures and tracking the system's level of service. Additionally the NDDOT is looking at advancing transit services in the state through the creation of regional transit centers that would coordinate operations and services; deploy technologies; and automate functions in each region. The NDDOT is also keeping abreast of ITS advances in the area of Connected Vehicles that has the potential to offer significant improvement in safety and information dissemination. The NDDOT will continue to work with the North Dakota Highway Patrol (NDHP) on deploying ITS technologies in the commercial vehicle operations (CVO) area. CVO ITS systems such as weigh-in-motion (WIM), electronic clearance, and roadside safety check can all improve CVO, especially with the increased truck traffic due to oil activity. The NDDOT is considering options for establishing a statewide transportation management center (TMC) that could serve as the focal point for ITS services and transportation operations in the state. The center could monitor the transportation network, dispatch maintenance resources, manage incidents, and provide traveler information in a coordinated matter from a centralized location. The TMC could help the

NDDOT explore Active Transportation and Demand Management (ATDM) systems such as variable speed limits, wind warning systems, and weather responsive signal control.

There, of course, remain some challenges and limitations. Perhaps the greatest challenge is to meet increasing ITS needs while maintaining funding for other programs, the current annual ITS budget is only sufficient for installing a handful of devices each year, especially those of larger systems such as DMS. Challenges related to infrastructure, the availability of communications and power, still exist although they have been largely alleviated thanks to advances in wireless networks and solar energy technologies. As the NDDOT deploys more systems and provides more ITS services both to system operators and travelers, there will be challenges for existing staff to handle the workload of operating and maintaining existing ITS.

Finally, under the current organizational structure, without the establishment of an ITS section within the NDDOT, ITS functions will remain distributed over several divisions and sections, this could result in missed opportunities for coordination and optimization, and would keep ITS from achieving a higher profile within the NDDOT.

1. INTRODUCTION

The purpose of this plan is to guide Intelligent Transportation Systems (ITS) deployment in North Dakota. In the last two decades, ITS technologies have been successfully deployed across the nation to facilitate traffic operations, reduce traffic delays, improve safety and enhance the ability of transportation agencies to manage their transportation systems. While the majority of ITS deployment has been somewhat limited to the largest metropolitan areas in the United States and other high traffic priority corridors, some rural states are deploying ITS technologies for their benefits in safety and efficiency.

ITS technologies refer to electronic sensing technologies that continuously monitor the system's operations, computer systems that process system performance data, electronic devices that can deliver critical information to travelers and communication networks that carry data flows between the field and processing centers. ITS, therefore, emphasizes system operations in an efficient and safe manner through integrated management of various components of the transportation system and its services.

Modern transportation systems are essential for growing national, regional, and local economies, and for providing access to employment, goods, and services to a diverse group of customers. The ability to manage and operate these complex systems efficiently and effectively to meet economic, social, and mobility needs depends on the strategic deployment of ITS applications.

One of the key elements of successful deployment of ITS technologies is effective planning. Both federal and state agencies have recognized the need for a planned and strategic approach to ITS deployment. This approach recognizes the state's unique characteristics and enables it to develop a plan that accomplishes the greatest benefit from targeted ITS technologies as well as be embraced by various stakeholders. Further, this approach establishes a direct link between ITS planning and other transportation and strategic planning efforts. Ideally, the outcomes of ITS planning are activities (projects) incorporated and programmed into statewide, regional, and metropolitan transportation plans.

The purpose of an ITS plan is to describe the strategic direction for the ITS planning process, highlight the priority areas to the state, identify relevant trends and discuss possible roles and responsibilities of various stakeholders. As the National ITS Architecture was becoming a mature product in the early 2000s, the Federal Highway Administration (FHWA) issued a conformity rule that required states and regions to develop their own ITS architectures by customizing the national ITS architecture to fit the states' and regions' needs. These ITS architectures became frameworks and roadmaps for ITS deployment in their respective regions.

North Dakota went through the process and developed ITS architecture in 2004-2005 to meet the federal rule. Four architectures were developed: a statewide architecture led by the NDDOT; and three regional architectures for Bismarck-Mandan, Grand Forks-East Grand Forks, and Fargo-Moorhead each led by each region's Metropolitan Planning Organization (MPO). The development of the first statewide ITS architecture benefited greatly from the statewide ITS plan. The plan development effort identified ITS stakeholders, performed inventory of existing systems, and identified ITS services applicable to North Dakota from the national ITS program which are all key ingredients of an ITS architecture. FHWA also required that ITS architectures be updated to reflect the most current ITS picture, North Dakota architectures have been update twice since they were completed in 2005. The most recent update to the statewide ITS architecture was completed in 2012-2013.

In these ITS architecture updates stakeholders were engaged to ensure the identified ITS services were still representative of the state's needs and adjustments were implemented as needed. Additionally, the inventory of existing systems was updated. With that, the ITS architecture as a living continuously updated document and building upon the foundation laid down in the initial statewide ITS plan, became the representative of the current ITS status in North Dakota and the roadmap for future ITS deployment in the state.

The next sections describe the effort performed in developing the original statewide ITS plan, along with the steps taken in the plan update. The development and update of North Dakota's ITS Plan recognizes the geographic and socio-economic characteristics of the state that impact North Dakota's transportation system and the deployment of ITS. It further recognizes emerging transportation and technology trends both nationally, regionally and in the state. The plan is developed through a coordinated effort that builds on input from internal NDDOT stakeholders, as well as other private and public stakeholders in the state. The NDDOT has a leadership role in ITS planning and deployment in the state and has the primary role for coordinating the plan with other activities as well as other partners.

2. NORTH DAKOTA PLANNING ASPECTS

In this chapter we address aspects that affect the outcome of the planning process both from a contextual perspective and from a North Dakota specific perspective.

2.1. Guiding Principles

The development of the North Dakota ITS Plan embraces a need-based approach rather than a technology-based approach. Often a problem with new technologies is that the technology is selected before a clear need is identified. Given the limited funding sources, especially for a rural state such as North Dakota, which has low population density, large expenditures on ITS technologies may not be possible. Instead, ITS technologies targeted for deployment are identified through analysis of needs and an examination of potential benefits. Technologies and systems which address most critical needs and yield the maximum benefits are targeted for deployment. Further, future implementation will follow a phased schedule that would take advantage of planned construction activities at various locations in the state.

Another consideration for planning ITS is to recognize the changing needs and transportation system characteristics in different areas of the state. The largest urban areas, such as Bismarck, Fargo and Grand Forks, continue to experience population and economic growth. These areas attract many rural residents for various economic, medical, social and cultural opportunities. They certainly experience a different set of transportation problems than in rural areas across the state. The increased oil activity over the last few years have also resulted in increased population and traffic in cities and counties within the Bakken oil formation, truck traffic in particular has seen rapid and large increases in that area of the state. While traffic congestion and customer service expectations in the areas experiencing growth is a priority, the main priorities for rural residents may include safety, traveler information, and access to transportation services.

While Fargo and Cass County continue to be the highest populated city and county in the state, cities and counties within the oil activity area in the Bakken have experienced the largest growth in population among North Dakota cities and counties between 2000 and 2012 (See Table 2.1) the city of Williston and Williams county were used as an example. The state's population grew by 9% over that time period and more people migrated from rural areas of the state to the urban centers. The number of vehicle-miles traveled (VMT) in North Dakota has typically increased by an average of 3.5% annually. However, between 2010 and 2011, overall VMT increased by more than 9%, the main reason for the large increase being oil activity traffic, indicative of such, the state saw an increase in truck traffic by over 26% in the same period.
Increases in VMT in areas outside of the Bakken are related to economic activity as well as the changing travel characteristics of the state residents as they travel longer distances to access socioeconomic opportunities. Therefore, the state's urban centers and high traffic areas will also have a major role in any statewide ITS deployment since they affect a large segment of travelers. These areas typically have a more suitable communications and information infrastructure which could support various ITS services and provide gateway services to statewide travelers.

Table 2.1 Population Trends for Selected North Dakota Cities and Counties (2000-2012)

Location	Population		Population Change	
	2000	2012	Change	Percent
Fargo	90,599	109,779	19,180	21%
Bismarck	55,532	64,751	9,219	17%
Grand Forks	49,321	53,456	4,135	8%
Minot	36,567	43,746	7,179	20%
Williston	12,550	18,532	5,982	48%
Burleigh County	69,416	85,774	16,358	24%
Cass County	123,138	156,157	33,019	27%
Grand Forks County	66,109	67,472	1,363	2%
Williams County	19,754	26,697	6,943	35%
North Dakota	642,200	699,628	57,428	9%

North Dakota's ITS Plan recognizes the differences discussed above by addressing ITS in several contexts. The purpose of organizing ITS needs and projects into distinct groups is to facilitate priority identification, ensure residents from various segments are served and take advantage of various funding programs and opportunities. These contexts are discussed in detail in later sections of this document.

2.2. North Dakota Issues and Needs

To start the process of identifying the state's ITS issues and needs a stakeholder group was convened with representatives from NDDOT divisions and districts, with the addition of other state agencies such as NDHP and the North Dakota Division of Emergency Services (DES), the state's three MPOs, and representatives from the ND FHWA division. The stakeholders were engaged for their input, this original group of stakeholders would serve a great purpose in developing the original statewide ITS plan, the original statewide ITS architecture and subsequent updates, and many members became part of NDDOT's ITS Steering Committee.

2.2.1. Stakeholders Input Mechanism

For the development of the original ITS plan, stakeholders were asked to react to a list of possible issues as they relate to their own agency/organization objectives and priorities. Further, breakout sessions of smaller groups focused on more specific ITS issues, such as information needs, urban needs, safety, etc. Follow up interviews were setup with key stakeholders to further develop an understanding of the functions and priorities of their agencies as well as possible involvement in ITS. A similar process was followed for the development and update of the ITS architecture which ensured that an up-to-date list of top issues and services for the state is identified.

At the start of the ITS plan update process, in addition to reconvening the ITS stakeholder group, an ITS stakeholder survey was sent to a wide group of recipients from NDDOT divisions and districts, MPOs, cities, and state agencies. The survey sought the participant's input on the following items:

- Their top issues and the ITS services necessary to mitigate these issues;
- Their goals and objectives as they relate to the state's transportation network;
- Their plans over the next 10 years for procuring systems and equipment related to ITS services;
- Their information exchange with other related agencies;
- And, their involvement with what is considered as the state's high priority services of Traveler Information, Roadway Operations, Incident and Emergency Management, and Commercial Vehicle Operations.

While the results from the survey varied based on the participant's area of specialty and locale, there was an overall agreement on the priority service areas. A summary of issues is provided in the following section, the full survey is included in Appendix 2.

2.2.2. Common Issues

Input from NDDOT's ITS steering committee, plan development stakeholder group, and interviews completed with NDDOT units and other stakeholders, along with results of the stakeholder survey suggest several issues could have an impact on ITS implementation. These issues were organized under main areas as follows:

1. Socio-economic/geographic
    a. Funding
    b. Oil activity traffic
    c. Weather
    d. Freight flows through state/across international border
    e. Service economy becoming more prominent
    f. Low population density and long distances between population centers (services)
    g. Population shift to cities and Bakken region
    h. Limited choice of transportation sources and modes
    i. Aging rural population
    j. Tourism points of interest

2. Institutional/organizational
    a. Leadership and a long range vision
    b. Coordinated information sharing among agencies
    c. Coordination among various stakeholders in the state
    d. Coordination with and among adjoining states and provinces
    e. Involvement of private sector in strategic planning
    f. Level of awareness of individual system capabilities (public and private)
    g. Performance measures – whose responsibility, how much, and how to measure?

3. Physical transportation infrastructure
    a. Aging infrastructure

   b. New infrastructure needs in the Bakken
   c. Infrastructure repair in the Bakken due to heavy truck traffic
   d. Rebuilding or repairing transportation infrastructure after natural disasters (e.g. flooding)
   e. Impacts of weather extremes on local, state, and Interstate system
   f. Damage to rural roads due to spring flooding

4. Information/data infrastructure
   a. Integration of existing data systems
   b. IT resources to support ITS
   c. Communication infrastructure
   d. Exchange of agency information across networks

5. Transportation system operations/services
   a. Winter operations
   b. Road closures due to weather or incidents
   c. Road/travel advisories and condition reports
   d. Urban traffic congestions (especially event traffic)
   e. Construction activities
   f. Load/weight restrictions
   g. Increase in commercial truck traffic, especially in the oil fields and at large agricultural processing plants

2.3. Contexts for ITS Deployment

The purpose of this section is to explore the possible contexts for ITS deployment. Although the statewide ITS Plan will focus on activities that have statewide significance, it is important to identify possible relationships (and interfaces) with regional and local ITS initiatives. Three general groups are used to classify ITS deployment: area type, customer group, and function. These groups are not meant to be exclusive, but rather to provide different frameworks for appreciating ITS planning.

2.3.1. Area Type

Relative to location or area type, ITS needs and potential projects may be segmented into three different area types. It should be noted that there will be interface points that would connect ITS elements among the various areas. Also, information will be shared across all area types for specific events when warranted. The responsibility of deploying and operating ITS services will depend on the area type, but will require close coordination among various public/private transportation, law enforcement, emergency and medical services and other entities. Further, the NDDOT initially has the leadership role in coordinating these activities and ensuring their consistency with the state’s strategic direction and priorities.

2.3.1.1. Statewide

This group includes issues, needs, and projects that have statewide significance. ITS deployment in this context serves a large segment of transportation system users including state residents as well as travelers from other states. A good way to illustrate this is to use traveler information as an example. Although traveler information systems have been deployed for cities, corridors, regions, and states, each application focuses on varying degrees of information details. For a statewide application, some of the potential information may include: weather (warnings for a large area and expected path), road conditions on major routes per segment, road work (location and activity) and major incidents (such as road closures due to incidents or weather).

For a rural state, statewide projects must recognize the sparse power and communication infrastructure in certain locales and the limited access points for various users and develop innovative ways to enhance resource utilization, especially through coordination and partnerships with relevant stakeholders.
Considerations for the availability of power include:

- Combining multiple devices at the same location when feasible. An example of this is co-locating a surveillance camera system with road weather information system (RWIS) or dynamic message sign (DMS).
- Use of solar energy when feasible. Advances in solar energy and battery technologies have allowed some ITS devices to be run without being connected to the power grid. The NDDOT currently uses camera systems, ATR, and over-height detection that are powered by solar energy.

Similarly, considerations for the availability of communications include:

- Combining multiple devices at the same location when feasible.
- Use of wireless communications when fiber optic connection is not available. NDDOT utilizes a range of wireless technologies including radio towers, repeaters, transmitters and receivers. Use of commercial cellular network wireless data networks. An advantage of the oil activity in the western part of the state is increased cell coverage in areas that in the past were considered too remote and sparsely populated to provide service at.

While these technologies increased the portion of the state's transportation network that can be covered with ITS services, some services still require devices that are hardline connected to power and/or communication such as fixed automated sprayer technology (FAST) systems.

2.3.1.2. Urban

ITS may be introduced in an urban context, focusing on urban transportation needs such as traffic congestion and personal mobility. In an urban setting, communication infrastructure is typically more available and can reach a large number of users without requiring significant additional investments. It is also important to recognize that users in an urban environment tend to have higher levels of service expectations. For instance, ITS may be required to provide more detailed information, updated more frequently, than in statewide rural applications. Urban issues emphasize short-term traffic operations such as traffic signal control, ramp metering, incident management, transit operations, and special events traffic.

2.3.1.3. Locations of special interest

This group includes points of interest (both activity and transportation infrastructure) that receive special attention in ITS deployment. Although some of these locations may be part of corridor or regional plans, it is important to identify their specific needs and possible interfaces with adjacent systems or the statewide system. Some examples of these locations include: oil fields, tourist attractions, high-priority security (e.g., military bases, key civil installations) and border crossings.

Examples of transportation infrastructure with additional points of interest include locations for increased automated traffic recorders (ATR) coverage for counting and classifying traffic, bridges that may be targeted for automated anti-icing systems, locations for high-speed warnings and locations of Weigh-in-Motion (WIM) equipment.

Figure 2.1 below shows a traveler information example for various area types and some of the differences anticipated in the required infrastructure as well as the range of services. Notice the different levels of required ITS infrastructure as well as the level of details required for the three sample applications.

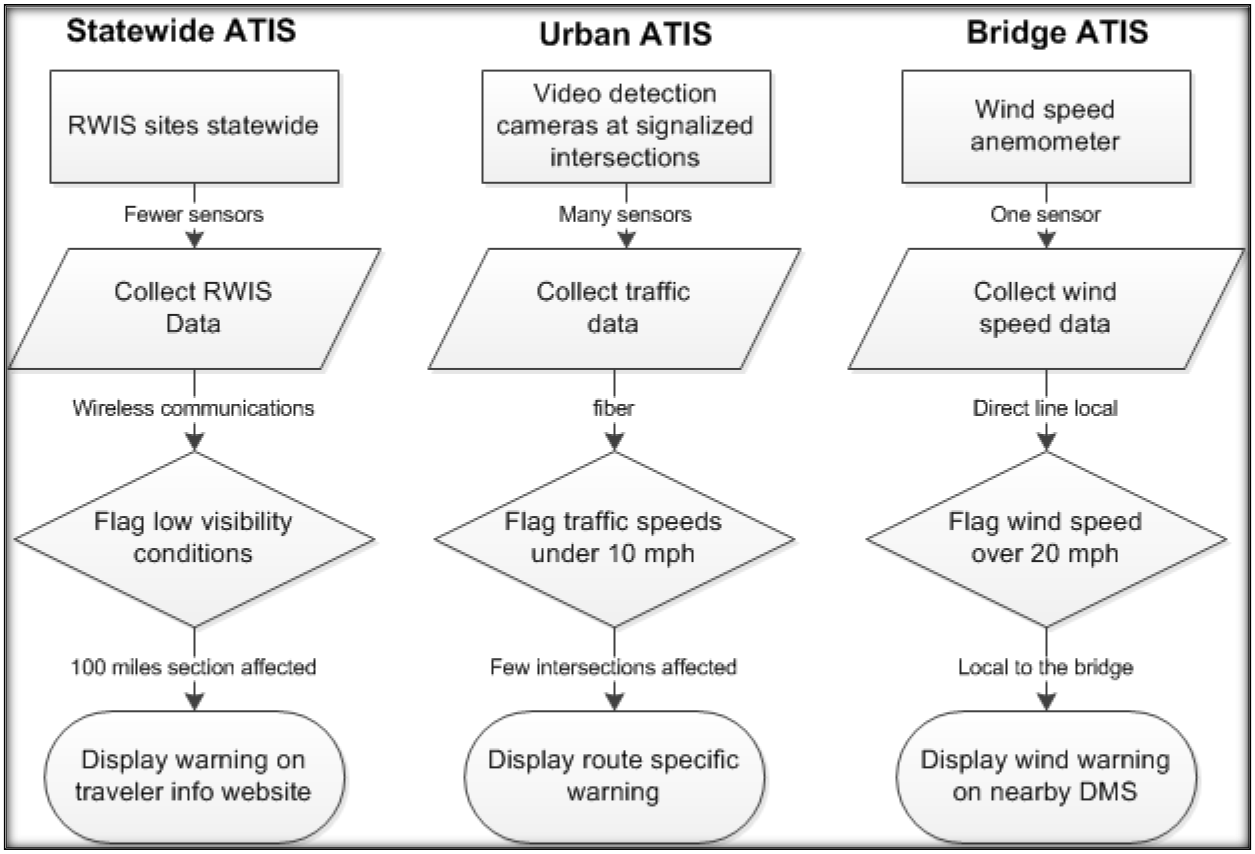
Statewide ATIS
RWIS sites statewide
Fewer sensors
Collect RWIS Data
Wireless communications
Flag low visibility conditions
100 miles section affected
Display warning on traveler info website
Urban ATIS
Video detection cameras at signalized intersections
Many sensors
Collect traffic data
fiber
Flag traffic speeds under 10 mph
Few intersections affected
Display route specific warning
Bridge ATIS
Wind speed anemometer
One sensor
Collect wind speed data
Direct line local
Flag wind speed over 20 mph
Local to the bridge
Display wind warning on nearby DMS

Figure 2.1. Example of different traveler information systems based on context of statewide, urban, and local.

2.3.2. Customer Groups

As mentioned earlier, the main focus of ITS is on improving the operations of existing transportation infrastructure through better information and coordination. As a result, ITS is often described using *user services* which correspond to functions that directly support a particular user group. Therefore, it is paramount that the ITS planning process understands and recognizes the distinct needs relevant to several customer groups. This delineation will also assist in identifying system design needs as well as interface requirements. Three main groups encompass potential users of ITS in North Dakota and include: NDDOT internal users, other public agencies and private users (motorists, firms or organizations). Below is a summary of individual users for each group.

1. NDDOT
    a) Management
        i. General Counsel
    b) Operations
        i. Maintenance
        ii. Construction Services
    c) Transportation Program Services
        i. Planning and Asset Management
        ii. Local Government
        iii. Programming
    d) Project Development
        i. Design
        ii. Environmental and Transportation Services
        iii. Bridge
        iv. Materials and Research
    e) Driver and Vehicle Services
        i. Drivers License
        ii. Motor Vehicle
        iii. Safety
    f) Business Support
        i. Information Technology
        ii. Legal
    g) NDDOT Districts
2. Other agencies
    a) ND Highway Patrol
        i. Motor Carrier
        ii. Safety and Education
        iii. NDHP Districts
    b) North Dakota Department of Emergency Services (DES)
        i. State Radio
    c) State Information Technology Department
    d) North Dakota GIS
    e) Tourism
    f) North Dakota cities and counties

3. Private
    a) Interstate motorists
    b) Local drivers (urban)
    c) Commercial vehicle drivers
    d) Farmers
    e) Transit operators
    f) School buses

3. ITS PRIMER

The purpose of this section is to provide a summary of ITS technologies and explain various classification schemes used in the national program. The section will also illustrate the relationships of various services and how they use the intelligent transportation infrastructure. Finally, the section provides links to some of the available resources of additional information about ITS that can be used to supplement information provided here.

3.1. ITS Defined

Intelligent Transportation Systems (ITS) in the most general terms are the integrated applications of advanced sensor, computer, electronics and communication technologies and management strategies to provide information to travelers and increase the safety and efficiency of the surface transportation system. It is often said that the “I” in ITS is for information. Another concept related to ITS is management strategies. These strategies directly influence operations of the transportation system and hence are more user-oriented than traditional infrastructure improvement strategies.

ITS is not only about new technology, but also how technologies are used to develop effective information that is integrated to enhance operations. Integration of ITS services with each other, as well as other systems, is key to seamless and effective operations. ITS expands the opportunity to coordinate and collaborate across systems, disciplines, and industries. ITS applies technologies developed by industry, university, government, and military researchers and inventors to maximize the transportation system’s safety and efficiency.

3.2. National ITS Program

The development of the national ITS program may be traced back to the early 1990s. Several national program plans have been developed, each typically valid for a five-year period, with the Year 2007 Program Plan being the most recent plan. Additionally, in December 2009, the USDOT’s ITS Joint Program Office released the Intelligent Transportation Systems (ITS) Strategic Research Plan, 2010-2014. This plan defines the strategic direction for the USDOT's ITS research program for a five year horizon and focused on the theme of “Transforming the Nation’s Transportation System through Connectivity.”

The national ITS program has shifted focus from the deployment of traditional ITS devices such as DMS and RWIS into researching and implementing advanced concepts mainly focused around the Connected Vehicle program area. While the congestion mitigation benefits of such advances might not be of importance in North Dakota’s rural setting, the safety aspect of these applications is relevant and applicable. In addition to providing background information on Connected Vehicles and other advanced areas, this section will include relevant rural ITS devices and technologies that can still be used to enhance the transportation network in North Dakota. The following is a description of national ITS programs main areas[1].

3.2.1. Connected Vehicle Program Area

The goal of the connected vehicle program is to equip all vehicle types (commercial, transit, fleet, and passenger) with technology and connectivity that would allow for the exchange of information among vehicles, and between vehicles and infrastructure. This would create an environment where vehicles monitor the conditions and traffic around them to warn drivers of adverse weather, traffic congestions, and potential hazards. This data can be used to reduce crashes by providing warning about the presence and speed of surrounding vehicles; can feed into advanced and active traffic management systems providing many more points of data than what is available through roadside devices; and can feed data into road-weather information systems to enhance forecasts and make better maintenance decisions.

The connected vehicle program aims to provide improvement in these three problem areas:

1. **Safety**
    - Problem: in 2011 traffic accidents accounted to 32,885 deaths; 5.8 million crashes; direct economic cost of $230.6 billion; and were the leading cause of death for ages 4-34.
    - Application: increase situational awareness and reduce or eliminate crashes through vehicle-to-vehicle and vehicle-to-infrastructure data transmission that supports driver advisories, driver warnings, and vehicle and/or infrastructure controls. With these applications, a connected transportation environment may potentially address up to 81% of crash scenarios with unimpaired drivers.

2. **Mobility**
    - Problem: the annual cost of traffic congestion is estimated at $100 billion drain on the U.S. economy; 4.8 billion lost hours; and 1.9 billion gallons of wasted fuel.
    - Application: create data-rich travel opportunities where the network captures real-time data from equipment located on board vehicles and within the infrastructure. The data are transmitted wirelessly and are used by system operators to manage the transportation system for optimum performance.

3. **Environment**
    - Problem: 1.9 billion gallons of fuel wasted each year; and vehicles account for 31% of carbon dioxide emissions in the U.S.
    - Application: generate and capture environmentally relevant real-time transportation data and use these data to create actionable information to support and facilitate "green" transportation choices. As an example, informed travelers may decide to avoid congested routes, take alternative routes, use public transportation, or reschedule their trip – which can result in a more fuel efficient and eco-friendly trip.

---

[1] ITS Strategic Research Plan, 2010 – 2014, Progress Update, U.S. DOT, October 2012

3.2.2. Road Weather Management Program Area

The road weather management program focuses on facilitating and improving the value of road weather information provided by both public and private sector weather communities to all transportation users and operators through robust data assimilation, quality checking, and effective dissemination. The program plans to achieve this objective by combining vehicle-based, road-weather and weather data to improve safety and mobility.

3.2.3. Applications for the Environment: Real-Time Information Synthesis (AERIS)

The AERIS program focuses on generating and acquiring environmentally-relevant real-time transportation data and using this data to create actionable information to support and facilitate "green" transportation choices, and assist system users and operators with "green" transportation alternatives or options. To achieve the program's objective, AERIS will build on Connected Vehicle investments and outcomes.

3.2.4. Commercial Vehicle Information Systems and Networks (CVISN)

The CVISN program represents a collection of information systems and communication networks that are owned and operated by government agencies, motor carries, and other stakeholders that support commercial vehicle operations (CVO).

The vision for this program is to implement Core CVISN and Expanded CVISN to improve the safety and productivity of motor carriers and their drivers while reducing regulatory and administrative costs for public and private sector stakeholders through improved data sharing, electronic credentialing, and targeted automated screenings and enforcement of high-risk carriers at the roadside.

Core CVISN capabilities are:

- **Safety Information Exchange**: requires providing carrier, vehicle, and driver safety information to roadside enforcement officers. This capability also includes reporting inspection outcomes to the national CV databases (e.g., ASPEN, SAFER (Safety and Fitness Electronic Records), etc.) and exchanging intrastate and interstate data through implementing CVIEW (Commercial Vehicle Information Exchange Window) or a similar system.
- **Credentials Administration**: requires automated electronic processing via a web-based solution that interfaces with the state and is accessible to carriers. The processing includes carrier application, credential issuance, and tax filing. Credentials include oversize/overweight and HAZMAT permitting.
- **Electronic Screening**: requires automated screening of vehicles that approach a roadside check station, determine whether further inspection or verification of credentials is required, and take appropriate action. For Core CVISN compliance electronic screening needs to be implemented at a minimum of one inspection site with the ability to replicate at other sites.

North Dakota has been working to achieve Core CVISN implementation for over a decade, some of the efforts towards that goal include: an ITS/CVO Business Plan was developed in 2001, agencies and personnel underwent CVISN training, a CVISN Deployment Plan was developed in

2009, and NDHP has launched an E-Permit system that supports automatic routing in 2013. The two main missing components for Core CVISN compliance are using CVIEW or equivalent system for information exchange; and implementing electronic screening.

Expanded CVISN capabilities include:

- **Virtual Weight Stations**: a roadside enforcement facility that does not require continuous staffing and is monitored from a remote location.
- **License Plate Readers**: license plate recognition (LPR) is an image processing technology used to identify vehicles through their license plates. Data from LPR can be used to augment electronic screening.
- **Oversize/Overweight Permitting**: deals with credentialing and routing of these special vehicles that takes into account mobility, infrastructure limitations (e.g. bridge clearance), safety, and security concerns.
- **One-Stop Shops and Electronic Portals**: requires the state to provide a web portal that gives a consistent look and feel across multiple applications for agency users, enforcement, and motor carriers.
- **Driver Information Sharing**: adds driver information and identification to the CVIEW system to check driver credentials for safety problems.

3.2.5. Rural and Statewide ITS Infrastructure

ITS deployment in rural areas has not progressed as quickly as in metropolitan areas. That is due largely to perceived lack of need for ITS in rural areas, limited availability of infrastructure, and lack of funding.

While the national ITS program has shifted focus from ITS infrastructure deployment, many rural areas still have gaps in the coverage of their network surveillance, road-weather sensors, and roadside traveler information systems. For this reason a listing of relevant technologies for North Dakota is still valid.

North Dakota has made important strides in expanding, enhancing, and modernizing their ITS infrastructure. The following is a listing of infrastructure components of interest:

1. Crash Prevention and Security
    a. Surveillance/monitoring
        i. Roadway conditions
        ii. Environmental
        iii. Rail intersections
        iv. Vehicle intrusion
    b. Information dissemination
    c. Collision avoidance systems

2. Emergency Services
    a. Detection
        i. Call taking and dispatch
            (1) 911

        ii. Surveillance
            (1) Loop detectors
            (2) Non-intrusive detectors (radar, infrared, machine vision, etc.)
            (3) Closed circuit television
    b. Mobilization & response
        i. Vehicle tracking via automated vehicle location (AVL) systems
        ii. Coordination
            (1) Interagency
    c. Information dissemination
        i. Traveler information website and mobile app
        ii. Notification to user's handheld devices
        iii. Dynamic Message Signs (DMS)
        iv. Highway Advisory Radio (HAR)

3. Travel and Tourism
    a. Traveler information
        i. Travel services
            (1) Hotels, restaurants
            (2) Tourist information
        ii. Route advisory
            (1) Pre-trip
            (2) En-route
        iii. Travel conditions
    b. Revenue collection
        i. Electronic payment

4. Traffic Management
    a. Surveillance
        i. Traffic conditions
        ii. Road conditions
        iii. Weather conditions
    b. Traffic control
        i. Lane control
            (1) Speed limits
            (2) Lane use
        ii. Work zone
        iii. Traffic signals
    c. Information dissemination

5. Transit Mobility
    a. Transit management
        i. Fixed-route and demand-response operations
        ii. Maintenance and fleet management
        iii. Route and service area planning
    b. Traveler information (e.g., bus arrival times)

    c. Electronic payment and fare cards
    d. Ride sharing and matching

6. Operations and Maintenance
    a. Fleet management
        i. Automated vehicle location (AVL)
        ii. Computer aided dispatch
    b. Infrastructure management
    c. Weather maintenance
    d. Work zone management
    e. Information dissemination

7. Road Weather Management
    a. Surveillance & monitoring
        i. Traffic conditions
        ii. Road surface conditions
        iii. Weather conditions
    b. Control
        i. Speed limit
        ii. Signals
        iii. Lane use
    c. Response & treatment
        i. Winter maintenance decision support
            (1) Mobile
            (2) Fixed
        ii. Automated Vehicle Location (AVL)
        iii. Interagency coordination
            iv. Information dissemination

3.3. ITS User Services

ITS user services are defined, not along lines of common technologies, but rather by how they meet the safety, mobility, comfort and other needs of transportation users and providers. User services document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators They represent essential, but not exclusive, ITS products and services. These services are often grouped into related functions called “bundles.” Below is a discussion of the major ITS user service bundles and the specific user services they cover, services relevant to ND are ***emphasized***:

1. **Travel and Traffic Management**
    1.1. Pre-trip Travel Information
    1.2. En-route Driver Information
    1.3. Route Guidance
    1.4. Ride Matching and Reservation

1.5. Traveler Services Information
1.6. Traffic Control
1.7. Incident Management
1.8. Travel Demand Management
1.9. Emissions Testing and Mitigation
1.10. Highway Rail Intersection

2. Public Transportation Management
2.1. Public Transportation Management
2.2. En-route Transit Information
2.3. Personalized Public Transit
2.4. Public Travel Security

3. Electronic Payment
3.1. Electronic Payment Services

4. **Commercial Vehicle Operations**
4.1. Commercial Vehicle Electronic Clearance
4.2. Automated Roadside Safety Inspection
4.3. On-board Safety and Security Monitoring
4.4. Commercial Vehicle Administrative Processes
4.5. Hazardous Material Security and Incident Response
4.6. Freight Mobility

5. Emergency Management
5.1. Emergency Notification and Personal Security
5.2. Emergency Vehicle Management

6. Advanced Vehicle Safety Systems
6.1. Longitudinal Collision Avoidance
6.2. Lateral Collision Avoidance
6.3. Intersection Collision Avoidance
6.4. Vision Enhancement for Crash Avoidance
6.5. Safety Readiness
6.6. Pre-Crash Restraint Deployment
6.7. Automated Vehicle Operation

7. Information Management
7.1. Archived Data

8. Maintenance and Construction Management
8.1. Maintenance and Construction Operations

3.4. ITS Resources

USDOT’s ITS e-primer: http://www.pcb.its.dot.gov/eprimer.aspx
ITS Strategic Research Plan, 2010 – 2014: http://www.its.dot.gov/strategic_plan2010_2014/
ITS information, cutting edge technologies and research, showcases of existing deployments all available on the ITS JPO website: http://www.its.dot.gov

4. GOALS AND OBJECTIVES

This section addresses the goals and objectives for ITS in North Dakota. The goals refer to ultimate outcomes that are coordinated with statewide goals of the transportation systems. The objectives represent specific deliverables from the ITS planning process.

4.1. ITS Goals

Setting goals for ITS follows the general areas outlined in transportation program goals in MAP-21 "Moving Ahead for Progress in the 21st Century". Those goal areas include:

1. Safety – To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
2. Infrastructure Condition – To maintain the highway infrastructure asset system in a state of good repair.
3. Congestion Reduction – To achieve a significant reduction in congestion on the National Highway System.
4. System Reliability – To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
5. Environmental Sustainability – To enhance the performance of the transportation system while protecting and enhancing the natural environment.

Although these goal areas would probably encompass many areas of interest for a state or region, they need to be refined to address specific needs. There may also be additional areas that are unique features of a state, region or project that would require special attention. Further, one of the keys to successful ITS planning and deployment is the integration of ITS into the transportation planning process. Therefore, ITS goals should be closely coordinated with transportation goals for the state as well.

Part of the NDDOT Statewide Transportation Plan, the following mission and vision were adopted[1]:

Mission:

> "*North Dakota will provide a safe, reliable, and sustainable transportation system.*"

Vision:

> *"North Dakota's multimodal transportation system is strategically developed and globally integrated"*

---

[1] TransAction III: North Dakota's Statewide Transportation Plan, North Dakota Department of Transportation, Bismarck, North Dakota 2012

Related to this mission and vision, the NDDOT identified five transportation goals:

1. Safe and secure transportation for residents, visitors and freight (ITS goal area 1 – safety)
2. Sustainable and reliable mobility (ITS goal areas 2, 4 – infrastructure and reliability)
3. Diversified and sufficient funding
4. Communication and cooperation
5. Strong economic growth with consideration of environmental, cultural, and social impacts (ITS goal area 4, 5 – reliability and sustainability)

4.2. North Dakota ITS Goals and Objectives

Goals:

- Deploy an electronic infrastructure that works in concert with the transportation physical infrastructure to maximize system efficiency, utility, and integration.
- Deploy a secure system that can both detect and respond to crises maximizing the system's reliability.
- Improve the transportation system's safety by minimizing the occurrence of incidents, traffic deaths, and lowering response times
- Disseminate information to system operators and travelers to help increase mobility and efficiency.
- Reduce energy consumption and negative environmental impact through technology, information exchange and operational practices towards sustainability.

Objectives:

- Coordinate the planning and deployment of ITS technologies among districts, divisions, and agencies to leverage funding and promote interoperability.
- Provide a working tool for improved planning, scheduling, and integration between state and other agencies.
- Improve the sharing and dissemination of information between state and other agencies.

4.2.1. Sought Benefits

4.2.1.1. **Capacity**: ITS serve as a method to increase the transportation system's capacity and throughput without adding physical infrastructure via improved management and increased efficiency. While capacity and congestions related issues remain a low priority area in North Dakota, many of the state urban centers deal with peak hour, special event, and incident related congestion. The congestion effects can be alleviated, and capacity increased through the use of actuated and coordinated traffic signal control systems. Integrated incident management strategies that coordinate the response of many responding jurisdictions and agencies can improve the incident clearance times. In the future, ramp metering strategies can be employed to manage demand on the state's freeways during congestions periods.

4.2.1.2. **Customer satisfaction**: Many of the ITS technologies in deployment interface directly with the system users i.e. travelers. In some ways, ITS represent the public face of the transportation agency and the accuracy, availability, accessibility, and timeliness of the information provided to the users will determine the users' level of satisfaction. The NDDOT has received positive user feedback for their 511 and traveler information systems (both web and mobile app, and DMS). However, improvements can be made in increasing the time coverage of the traveler information system (currently winter traveler information is updated from 5:00 AM to 10:00 PM daily including holidays, typically from November through mid-April). Another area of improvement is in providing more up-to-date information as in some occurrences outdated reports were kept on the system. All-day updates of the traveler information system can be achieved by partnering with agencies that already operate on a 24-hour basis such as the NDHP and State Radio. The issue with outdated reports can be alleviated with increasing the number of reports by creating a system that accepts road condition reports from travelers after they have gone through training on the reporting process.

4.2.1.3. **Productivity**: ITS applications in the areas of traveler information systems allow users to make informed decisions regarding trip departures and routes to avoid the loss of productivity from travel delays. Traveler information systems are increasingly becoming multi-modal in nature and North Dakota cities are beginning to provide transit traveler information that provide riders with real-time arrival and departure times hence increasing the systems productivity. Maintenance decision support systems (MDSS) increase the productivity of maintenance staff by targeting treatment at the optimal time.

4.2.1.4. **Energy and the Environment**: ITS applications contribute to the reduction of emissions through the efficient movement of traffic. Environmental benefits can also be achieved by the efficient use of roadway treatment materials based on MDSS recommendations. Renewable energy sources such as solar and wind, have become a more reliable power source for ITS devices when hardline power is not available.

4.3. ITS Plan Objectives

The main objectives of the plan include the following:

1. Develop an ITS vision and strategic direction for North Dakota
2. Develop a framework for coordinating ITS activities with the mission and strategic direction of the NDDOT, other relevant agencies, as well as among various stakeholders
3. Identify high priority ITS projects (technologies to be deployed, location of deployment and plan for deployment)
4. Identify the needed organizational changes and required resources for meeting the ITS Plan objectives in the state
5. Coordinate ITS activities at the state level with local and regional ITS initiatives
6. Coordinate ITS activities in North Dakota with neighboring states as well as the national ITS program, ITS Architecture, and ITS standards
7. Raise the awareness of ITS in the state, including internal NDDOT as well as other stakeholders
8. Develop a process to continually share information both internally within the NDDOT as well as with external stakeholders to keep the plan up to date (ITS Core Group)

5. EXISTING CONDITIONS

This section provides a detailed description of existing and currently planned ITS components throughout North Dakota. In addition to providing an inventory of existing components, this information will serve to reflect the most current picture of ITS deployment in the state while identifying candidate future deployments.

The NDDOT has been active in ITS since the mid-1990s, especially in the areas of winter maintenance and road weather travel information. North Dakota was among the first states to develop site-specific road and weather information to travelers while en route.

Weather naturally plays a major role in influencing the types of technologies that have been deployed in North Dakota. Examples of these technologies include: environmental sensing stations (ESS) for the road weather information system (RWIS), dynamic message signs (DMS), traveler information web page, and fixed automated spray technology (FAST).

As the state's metropolitan areas continue to grow, the need for urban ITS solutions has risen over the last decade. Urban oriented ITS deployments in North Dakota cities include: synchronized traffic signal corridors that are controlled by centralized software; video surveillance for traffic operations; ITS data collection; and transit ITS services to include fixed route and demand response operations, fare management, fleet management, and security. These types of services fall mostly outside of the scope of the statewide ITS plan, but integration opportunities should be considered at the state level as well.

When describing the existing inventory of ITS technologies, it is important to make the distinction between individual devices and an integrated ITS deployment that combines technologies, functions, operations, and their control systems. The NDDOT is moving away from device deployment and closer to system deployment though some challenges remain. Limited ITS funding often reduce deployments to when opportunities are present to combine ITS components with other projects.

The information in this section was compiled primarily from feedback obtained from various NDDOT sections. The information organization follows the national ITS program service bundles and is not intended to be an exhaustive list of all existing technologies and devices.

5.1. Travel and Traffic Management

5.1.1. CCTV and other Surveillance Cameras

Over the last decade the NDDOT has expanded their video surveillance network to cover the state highways near major cities and other points of interest. There are currently over 70 camera systems throughout the state. Images from these cameras are available to the public through the state's traveler information website.

The types of camera systems in operation include the following:

- Pan-tilt-zoom (PTZ) cameras: typically located at maintenance section boundaries at sites where power and communication are available. While video from these cameras is available at the control centers (i.e., district offices), only snapshot images are displayed on the traveler information website.
- Cameras combined with other ITS devices: co-located with ESS, ATR, and WIM sites, offer rotating snap shots of the roadway and surrounding area at fixed predetermined positions.
- Machine vision cameras: in addition to video surveillance, these systems can be used for collecting volume and speed data. These camera systems are typically used for traffic signal operations but they can also be used on freeways.
- Wireless streaming cameras: located in remote areas where power and communications infrastructure is not located. Utilize wireless data networks from cellphone service providers and can be powered using solar and wind energy. Full motion video from these cameras is made available on the traveler information website.

5.1.2. Signal Operations

The NDDOT owns and operates traffic signals on the ND state highway system, and on interstate ramp termini. The NDDOT has agreements in Grand Forks and Bismarck that allow the cities to operate and maintain NDDOT owned traffic signals. However, the NDDOT retains these functions in the Fargo district on the interstate system. The NDDOT works with the city of Fargo to develop coordinated traffic signal corridor plans to improve traffic operations, additionally, the city and state signal systems have been interconnected on most corridors. Most of the signals operate on preprogrammed coordination plans according to the time of day. Communications to the controllers consist of either a phone drop or fiber connections to the District office, allowing timing plans to be changed from either the District office or the Central Office in Bismarck.

5.1.3. Dynamic Message Signs (DMS)

Dynamic message signs play a major role in the state’s traveler information system and emergency alert system. Permanent DMS have been deployed around the state’s major cities along the interstates and state highways, and they are used to provide information about road and weather conditions, travel advisories, safety messages, and AMBER Alerts. DMS are also used in managing event traffic and providing border crossing information. There are currently 30 existing signs with 30 more planned for deployment.

In addition to permanent installations, the NDDOT owns portable systems that are used in emergency situations where a permanent sign is not available, they supplement that fixed DMS network in the winter months in addition to being used for construction and maintenance, detours, and road closures.

5.1.4. Traveler Information System

The NDDOT operates a statewide traveler information system that is updated from 5:00AM to 10:00PM daily including holidays from November to mid-April. The information provided via the system includes road weather information, incidents; work zones and construction related closures and detours; commercial vehicle load, width, and height restrictions; and emergency alert messages. The information is provided to travelers through three main channels described below.

5.1.4.1.Webpage

The NDDOT has operated a traveler information webpage for over a decade and has been updated over the years with the most recent major update being in 2011. The webpage includes an interactive GIS map that displays color coded highway sections based on roadway conditions, the map also displays camera images both still shots and video where available, and wind speeds as reported by National Weather Service stations. In addition to the map, the webpage provides the traveler information in text format and also an RSS feed.

5.1.4.2.Mobile Device Support

In addition to the desktop version of the webpage, the NDDOT makes available a snapshot of the map and text-based information to provide easy access to the information to travelers using mobile devices. Additionally, the NDDOT has developed a mobile application called ND Roads that allows the user to access more features such as travel information based on their GPS location, customized SMS alerts, route specific information, and a shortcut to call the 511 voice-based traveler information system. The mobile application is currently available to mobile devices utilizing the IOS and Android operating systems.

5.1.4.3. 511 Telephone System

"511" is a nationally designated number for traveler information on road and traffic conditions. North Dakota was a pioneer in using a telephone system to provide travelers with route-specific road and weather conditions. The national 511 system guidelines are largely based on North Dakota's #SAFE system that was developed in the late 1990s through partnership with the NDDOT, University of North Dakota and later Meridian Environmental Technologies Inc (now part of Iteris). The system has been updated over the years with additional features such as voice recognition and easier to navigate menus. Due to the prevalence of data equipped mobile devices, more travelers are accessing traveler information systems via the web. However, 511 calls still spike during storms and severe weather conditions showing the continued need for telephone-based information.

5.1.4.4. Roadside Devices

Roadside devices used for disseminating traveler information in North Dakota are primarily dynamic message signs (DMS). The NDDOT also has limited highway advisory radio (HAR) capabilities as well. In the future such devices will expand to include Connected Vehicle roadside devices that can disseminate traveler information through communicating directly with vehicles or onboard devices that vehicles are retrofitted with.

5.1.5. Traffic Data Collection

The NDDOT currently operates more than 50 Automated Traffic Recorders (ATR) across the state with over 60 that are planned for future deployment. The ATRs are used for traffic counts and classification. The NDDOT has been working on replacing and/or retrofitting the older ATR locations in the network and exploring nonintrusive data collection methods such as video, radar, and laser technologies to supplement the in-pavement inductive loop systems currently in use. The NDDOT has Weigh-in-motion (WIM) devices in 12 locations in the state that are used to collect commercial vehicle weight data and assist the NDHP in performing roadside screening and load enforcement. The WIM devices represent an important piece for the development of a statewide electronic clearance system for commercial vehicles.

5.1.6. Warning and Advisory Systems

The NDDOT operates systems that warn drivers based on the detection of certain conditions. Examples of such systems include: speed feedback signs which display the speed limit along with the speed the vehicle is traveling with a warning in the form of flashing when exceeding the speed limit; and over-height detection systems (OHDS) for bridges with low clearance where the system detects the vehicle's height and provide a warning before reaching the structure if the height exceeds the clearance, currently one OHDS is deployed on US85 at the Long X Bridge.

5.2. Maintenance and Construction Management

5.2.1. Bridge Deck Anti-Icing Spray System

NDDOT has installed two bridge deck fixed automated spray technology (FAST) systems, the first system is located on the Buxton Bridge along I-29 between Fargo and Grand Forks and the second on the Red River Bridge on I-94 between Fargo and Moorhead in a joint project with MnDOT. An evaluation of the systems conducted by ATAC has found that the systems are cost effective and especially efficient for dealing with frost conditions that often occur overnight and in early morning hours. The systems have known limitations in certain weather conditions; namely high wind and temperatures below a threshold that varies based on the anti-icing material used, the system is not activated due to the lack of effectiveness under these conditions.

5.2.2. Roadway Weather Information Systems (RWIS)

An effective road weather information system requires data to be collected from environmental sensing stations (ESS) that are deployed alongside roadways in a strategic matter. NDDOT currently has 26 active ESS with 33 planned for future deployment. These stations measure and report site-specific meteorological conditions including wind speed and direction, temperature, relative humidity, dew point temperature, precipitation and pavement temperature. These measurements are used by maintenance personnel to effectively manage road anti-icing and de-icing efforts. The sites also measure sub surface temperature data which are valuable for determining the proper time to implement weight restrictions.

5.2.3. Maintenance Decision Support System (MDSS)

The MDSS utilizes a private, site specific, weather forecast and takes input from ESS, field reports, maintenance vehicles onboard devices, and other sources to provide a recommended course of action for dealing with a forecasted weather condition. The recommendations of the system include resource allocation, treatment time, treatment type, and amount of material to use.

5.2.4. Maintenance Vehicle Technologies

An increasing number of vehicles in the NDDOT maintenance vehicle fleet, especially those used for winter maintenance are equipped with onboard systems that enhance the efficiency of responding to maintenance events. These systems include onboard environmental sensors that measure atmospheric and road surface temperatures to feed into the state's MDSS; automated vehicle location (AVL) systems that report the location of the maintenance vehicle and tracks the amount of materials used for treating the roadway surface and collect attributes of whether the plow blade was up or down for progress tracking; and records other operating parameters that can be used for automating the scheduling of vehicle maintenance.

5.3. Regional and National ITS Efforts

The NDDOT participates with neighboring states and provinces in efforts to improve travel in the region and enhance the services provided to travelers. One of these efforts is the North/West Passage Coalition which aims at streamlining ITS on I-94 and I-90 from Wisconsin to Washington, in addition to the two states that are the start and end point of the corridor, the coalition includes Minnesota, North and South Dakota, Montana, Idaho, and Wyoming. The eight states are members of a pooled fund study (PFS) for the corridor and have collaborated on over 40 projects since 2002. Within the North/West Passage framework, the NDDOT worked with MnDOT to develop a jointly deployed automated anti-icing system on I-94 across the Red River Bridge in Fargo/Moorhead. Recently MnDOT has installed a DMS along I-94 within NDDOT's right of way to provide traveler information to eastbound travelers.

The NDDOT participates in other coalitions and multistate efforts such as the Maintenance Decision Support System (MDSS) PFS that aimed to assess the needs; define the functional and user requirements; and build and evaluate an MDSS to improve the ability to forecast road conditions in response to changing weather and applied maintenance treatments. A national effort that the NDDOT participates in is the USDOT's research program titled Applications for the Environment: Real-Time Information Synthesis (AERIS). The objective of AERIS is to generate and acquire environmentally relevant real-time transportation data to be used for creating actionable information that support and facilitate environmentally friendly transportation choices by transportation system users and operators. The NDDOT also participates in an international partnership to perform road weather and winter maintenance related research through the Aurora Program. Aurora is a leader in road weather information systems (RWIS) research, development, and deployment.

The NDDOT is also involved with the neighboring province of Manitoba to improve border crossing operations and reduce congestion and wait time at the Pembina, ND and Emerson, MB crossing. The effort focuses on short-term improvement in addition to planning for anticipated demand through the year 2035.

6. NEEDS ASSESSMENT

The purpose of this section is to outline the general needs that will be addressed in the ITS planning process. These needs will guide the development of ITS strategies that will enhance safety, operational efficiency and effective management of the transportation system.

Transportation stakeholders around the state were engaged in a survey to identify ITS needs and priorities. The survey asked stakeholders to rank the top issues that affect their local transportation network and to identify the top ITS services for mitigating these issues. Additionally, the survey asked about planned projects; information sharing with other agencies; communication infrastructure; and data management. Summary results from the survey are provided in Figure 6.1., and a sample survey is provided in Appendix 2.

The NDDOT has also formed an ITS steering committee with members from NDDOT, FHWA ND Division, Department of Emergency Services (DES), and North Dakota Highway Patrol (NDHP) Motor Carrier Division. The steering committee's function is to provide direction for the North Dakota ITS program, assess needs and priorities, and review plans and decision documents. The steering committee was involved in the needs assessment portion of the ITS plan and its members will review the completed plan.

The following discussion addresses transportation service needs most relevant to ITS and classify them into four main categories: enhancing safety, enhancing operations, enhancing information for effective management and improving customer satisfaction.

6.1. Safety

Safety is a big focus for ITS applications in rural settings where there is less emphasis on congestion mitigation applications. North Dakota's traditional safety issues generally revolved around road conditions in adverse weather. With increased traffic due to oil activity especially in the western part of the state, vehicles miles traveled (VMT) has increased by roughly 32% since 2008 which marked the start of oil production. There has also been a rise in the fatalities rate. Historically, since the 1970s, North Dakota's motor vehicle fatality rate had been consistently lower than the national fatality rate. In recent year, the rate has crept beyond the national rate. [2]

Safety enhancements related to ITS applications in North Dakota have mainly resulted from effective traveler information that allows travelers to make informed decisions about their trips. Other candidate safety related ITS applications include:

Collision avoidance systems: 23% or 459 out of 2,012 severe crashes in North Dakota between 2007 and 2011 were intersection crashes. Collision avoidance systems utilize vehicle detection and warning/advisory roadside systems to warn drivers of potentially dangerous traffic conflicts at specific locations. These systems are typically deployed at high crash locations such as two-way stop high-speed and blind intersections.

---

[2] North Dakota Highway Safety Plan 2014.

	Frequency as top 3 priority	Score for survey #:																			
Issues		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Unfamiliar users	*3*	11	11	2	10	3	11	11	5	9	5	11	5	8	10	8	11	6	2		5
Road work zones	*9*	8	2	3	7	2	4	2	1	4	3	3	6	2	4	2	6	10	5		4
Emergency inter-division coordination	*4*	3	8	9	2	7	5	8	7	6	10	4	3	4	9	7	9	4	8		3
Transit facilities	*1*	4	9	5	5	10	12	10	11	10	8	8	11	11	11	11	10	9	9	1	8
Weather condition information	*7*	9	3	7	6	9	2	4	3	2	11	2	1	6	7	10	4	3	4		7
Transportation security	*2*	10	6	11	9	11	10	7	6	8	9	6	8	5	3	9	5	11	10	2	9
Commercial veicle operations	*4*	6	10	10	11	4	9	9	9	5	7	7	10	7	2	3	2	5	7		2
Special event traffic	*1*	2	4	4	4	5	7	4	10	11	4	10	9	9	5	6	8	12	11		11
Emergency response time	*7*	5	5	8	3	6	6	6	4	1	6	5	4	3	8	1	3	2	6		1
Road conditions info - traveler	*11*	7	7	6	8	8	1	1	2	3	2	1	2	1	1	4	1	7	3		6
Urban congestion/signal operations	*8*	1	1	1	1	1	8	5	8	7	1	9	7	10	6	5	7	8	1	3	10
Services		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
HAZMAT incident response	*4*	6	7	5	6	6	7	4		1	7	3	5	3	5	3	6	6	7		4
Emergency vehicle management	*7*	2	4	3	4	4	1	5		2	6	5	4	5	4	1	5	1	6		2
Highway-rail intersection	*4*	8	2	2	3	3	8	6		8	5	9	7	10	6	4	8	7	9		8
Traffic control enhancements	*8*	1	1	1	1	1	6	8		7	4	6	6	8	8	6	7	3	1	3	7
Public transportation operations	*2*	4	6	4	5	8	10	9		9	8	7	9	9	9	9	9	2	8	1	9
Incident management	*10*	5	3		2	6	5	3		4	3	4	3	2	3	2	3	5	5		3
Pre-trip traveler information	*10*	3	8	7	9	7	3	1		5	1	1	1	6	1	7	1	8	3	2	6
Commercial vehicle operations	*4*	7	5	6	8	2	9	7		3	9	8	8	7	7	5	2	4	4		1
en-route driver information	*7*	9	9	8	7	9	4	2		6	2	2	2	1	2	8	4	9	2		5

1 is highest priority
12 is lowest priority

Figure 6.1. Summary Results from ITS Needs and Issues Survey.

- Variable speed limit (VSL) systems: These systems change the speed limit based on roadway and traffic conditions. A typical VSL system is comprised of three main components: speed detection to determine current travel speed of vehicles; variable speed limit signs to display the changing speed limits; and an optional automated system that would devise a speed limit based on inputs of current speed, weather conditions, visibility range, etc. The safety benefits of such systems are achieved by reducing the variability of travel speed among vehicles in the same stretch of roadway in adverse conditions; this produces a harmonized speed that reduces interactions between slow and fast moving vehicles that usually results in collisions.
- Commercial vehicle electronic clearance and safety checks: The increased truck traffic with oil production activities has strained the NDHP resources. ITS services in the area of commercial vehicle operations (CVO) provide for automated clearance and safety monitoring and reporting at roadside check facilities. These systems free up valuable resources and simplify enforcement which typically results in decreased violations and improved safety.

The NDDOT's Driver's License and Traffic Safety Division has a well-developed process for highway safety performance measurement. The division produces an annual report on crash data as well as the North Dakota Highway Safety Plan which identifies planned, non-infrastructure safety activities and desired outcomes. It is also important to recognize the potential impact of Connected Vehicle technologies on safety improvements. Many automobile manufacturers already deploy safety systems such as adaptive cruise control, active brake assist, and lane departure warning. The function of these systems will be enhanced with Connected Vehicles where each safety system will have data coming from surrounding vehicles in addition to data from onboard devices; the additional data will enrich the safety systems and enhance their functionality. Lane departures accounted for 48% of severe crashes in North Dakota between 2007 and 2011.

6.2. Traffic Operations

North Dakota's transportation system provides adequate service to its users. Except for the busiest urban areas, traffic congestion is not an issue on North Dakota roads during normal conditions. However, the performance of the system can quickly change with changing weather conditions, especially during inclement winter weather. Accurate and timely information, as well as effective information access, are critical to improving winter operations and reducing potential safety risks to motorists. Another way to improve road operating conditions during inclement weather is by using automated systems for controlling ice in trouble spots (e.g., bridges known to have an ice problem). Use of such systems would reduce the staff resources required to implement ice control strategies at the sites and improve service to motorists because of significantly reduced response time.

System operations during natural disasters (e.g., flooding) is another area that could benefit from ITS. In recent years, North Dakota has experienced severe flooding problems during the spring in the eastern and central parts of the state, as well as longer lasting flooding in the Devils Lake area. These problems cause severe interruptions to the state's transportation system and require careful management. There is a need to provide accurate information about affected areas, alternative routes and other precautionary information depending on the event. This is especially important for commercial trucks as they could experience significant additional operating costs due to unexpected delays and detours.

There also has been an increase in traffic levels in urban areas which produces periods with high level of traffic congestion when combined with road work activities (i.e., Fargo, Bismarck, Grand Forks). Although this concerns local residents, it also impacts commuters who rely on these roadways for employment. In addition, visitors who seek these urban centers for various socioeconomic activities are also affected.

Finally, special user groups such as commercial trucking, fleet operators, and transit operators have distinct needs relating to targeted information and enhancement of the commercial vehicle administrative process. Transit operator informational needs should be addressed since the services they provide to rural residents could directly be impacted by operational problems and other restrictions.

6.3. Information for System Management

Effective system management is supported by accurate and timely information about the performance of its components, including the physical infrastructure (roads and bridges) and mobile assets (maintenance fleets, emergency response vehicles, and transit vehicles).

6.3.1 Infrastructure

This category of information includes infrastructure condition and any restrictions that may be placed on the system. Restrictions may include construction/maintenance work, environmental (weather) conditions, temporary incidents, and seasonal limitations (weight restriction). The information should also include the level of use of the system (i.e., traffic levels). This information is used in a variety of ways to help manage system operations, address problem areas, and aid in planning efforts.

It should be noted that data collection can be a resource-intensive activity and may often be cut when budgets are reduced. That is even more serious in a rural state where traffic densities may not always justify data collection devices that would support performance measurements of systems operations (i.e., system speeds for various segments). There is, however, great potential in improving this information through ITS technologies. Existing NDDOT ATR devices can be utilized for real-time collection of travel speeds for use by system operators, the speeds can also be displayed on the state’s traveler information map. The existing network of ATRs can be augmented by non-intrusive data collection technologies utilizing video machine vision, radar, infrared, and Bluetooth. The key is integration and coordination of various functions to yield the maximum benefit.

6.3.2 Mobile Assets (Fleets)

Another important area that benefits from better information is related to mobile assets (or fleets). State, county, and local transportation agencies operate several types of vehicles fleets for supporting road maintenance, snow removal, and ice control. Similarly, transit systems must manage their fleets in order to meet service demands. Emergency response agencies must also manage their vehicles to optimize incident response with limited resources. Therefore, accurate and timely information about vehicle location and status is key to supporting effective management. The system users also benefit from this information by having accurate information about the system performance which allows them to make informed decisions. The use of automated vehicle location (AVL) systems is becoming more prevalent in North Dakota agencies that operate a fleet of vehicles.

6.4. Customer Satisfaction

There are many factors that influence customer satisfaction, providing users with accurate and timely information is most critical. When motorists are presented with changes in driving conditions they are often more accepting of these changes if they are provided with information about them. The key is to develop information systems that provide adequate information and can be easily accessed by a wide segment of users. User information needs may be classified into two types:

1. Pre-trip information
    a. Road and weather conditions
    b. Warnings of adverse conditions
        i. Weather related closures or delays
        ii. Delays resulting from severe crashes
        iii. Delays at border crossings
    c. Advisories of possible adverse conditions
        i. Road work and maintenance activities
        ii. Traffic at special events that could affect normal operations

2. En-route information
    a. Information on changing road and weather conditions
    b. Information on incidents
    c. Information on traffic delays
    d. Information on alternative routes

7. PRIORITY ITS SERVICES

This section identifies high priority ITS services initially identified by working with stakeholders. The list on the following pages was developed using the National ITS Architecture format (user services and user service requirements). It also identifies applicable ITS Service Packages to support these user services. For more information please refer to the Statewide ITS Architecture. (http://www.atacenter.org/regional/northdakota)

7.1. North Dakota ITS User Services

1. **Travel and Traffic Management**
   1.1. **Pre-trip Travel Information:** Includes pre-trip travel information capability to assist travelers in making mode choices, travel time estimates and route decisions prior to trip departure.

      1.1.1. Provides the capability for users to access the current situation information on transportation systems.
      1.1.2. Provides the capability for user access.

   1.2. **En-route Driver Information:** Includes an en route driver information function. It provides vehicle drivers with information, while en route, which will allow alternative routes to be chosen for their destination.

      1.2.1. Should be implemented in a manner that is beneficial to the transportation system and the public.
      1.2.2. Includes a driver advisory function, which will be implemented in two phases first with short term capability and later with long term capability.

   1.3. **Traffic Control:** Includes a traffic control function that provides the capability to efficiently manage the movement of traffic on streets and highways.

      1.3.1. Includes a traffic surveillance function.
      1.3.2. Provides traffic control information to other elements of the ITS.

   1.4. **Incident Management:** Includes an incident management function that will identify incidents, formulate response actions and support initiation and ongoing coordination of those response actions.

      1.4.1. Provides an incident identification function to identify incidents.
      1.4.2. Provides a response formulation function to formulate appropriate response actions for each identified incident and revise those actions when necessary.
      1.4.3. Includes a response implementation function to provide services needed to implement a response coordinated with all appropriate agencies.

    - 1.4.4. Provides the capability to predict hazardous conditions, including the time and location of hazardous conditions that may cause an incident.

2. **Commercial Vehicle Operations**
    - 2.1. **Commercial Vehicle Electronic Clearance:** Provides commercial vehicle electronic clearance capability.
        - 2.1.1. Provides a fixed facility consisting of structures and equipment to include ports of entry, inspection stations, weigh stations and toll booths.
        - 2.1.2. Includes a vehicle system capability such as two-way communications with fixed facilities.
    - 2.2. **Commercial Vehicle Administrative Processes:** Includes a commercial vehicle administrative process function consisting of 3 sub-services to include electronic purchase of credentials, automated mileage and fuel reporting and auditing, and international border electronic clearance.
        - 2.2.1. Includes an electronic purchase of credentials function with capabilities that include electronic credentials, electronic permits and electronic payment.
        - 2.2.2. Includes an automated mileage and fuel reporting and auditing function that includes electronic vehicle log, tax reports etc.
        - 2.2.3. Includes an international border electronic clearance function.
    - 2.3. **Hazardous Material Security and Incident Response:** Includes a hazardous materials (HAZMAT) security and incident response service.
        - 2.3.1. Includes a HAZMAT incident notification function.
        - 2.3.2. Provides an operation focal point for initiating appropriate responses.
        - 2.3.3. Includes a communications function.
        - 2.3.4. Includes a HAZMAT security function.

3. **Emergency Management**
    - 3.1. **Emergency Notification and Personal Security:** Includes an emergency notification and personal security function that provides for faster notification when travelers are involved in an incident.
        - 3.1.1. Includes a remote security and emergency monitoring function to create an environment of safety in remote areas.

4. **Information Management**
    - 4.1. **Archived Data Function**: Provide an archived data function to control the archiving and distribution of ITS data. The archived data user service provides the historical data archive repositories and controls the archiving functionality for all ITS data. It collects data, analyzes historical performances, improves operation data integrity and provides

historical data to transportation communities, in turn assisting with planning, research and safety management activities.

  - 4.1.1. Provides a historical data archive system that collects ITS data from various field equipment and devices.
  - 4.1.2. Includes an operational data control function to ensure integrity of operational data as received from field equipment or data collection devices.
  - 4.1.3. Provides a data warehouse distribution function as the ITS data source to support the ITS community user functions.
  - 4.1.4. Provides ITS community interface to all ITS users for the specification and retrieval of data products. The interface may be an online (web-based) archive facilitating the community to analyze and download ITS data.

5. **Maintenance and Construction Management**
   5.1. **Maintenance and Construction Operations**: Provides maintenance and construction operations functions to support monitoring, operating, maintaining, improving and managing the physical condition of roadways, the associated infrastructure equipment and the required resources.

  - 5.1.1. Provides a maintenance vehicle fleet management function to schedule and dispatch, monitor and track location and monitor operational condition and maintenance requirements of public and contracted fleets of maintenance, construction and specialized service vehicles.
  - 5.1.2. Provides a roadway management function to monitor traffic, road surface and environmental conditions and forecast traffic and road surface conditions to support management of routine and hazardous road condition remediation and to communicate changes in conditions.
  - 5.1.3. Provides a work zone management and safety function, which provides support for the effectiveness, safety and efficiency of roadway operations during all work zone activities.
  - 5.1.4. Provides a roadway maintenance condition and work plan dissemination function to provide intra- and inter-agency coordination of work plans.

8. ITS PROJECT DEPLOYMENT

8.1. Federal Requirements

Rule 940: The Final Rule/Final Policy ensures that Intelligent Transportation Systems (ITS) projects carried out using funds from the Highway Trust Fund including the Mass Transit Account conform to the National ITS Architecture and applicable ITS standards. This will be accomplished through the development of regional ITS architectures and using a systems engineering process for ITS project development.

The regional ITS architecture shall include, at a minimum, the following:

1. A description of the region;
2. Identification of participating agencies and other stakeholders;
3. An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture;
4. Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture;
5. System functional requirements;
6. Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture);
7. Identification of ITS standards supporting regional and national interoperability; and
8. The sequence of projects required for implementation.

All ITS projects funded with highway trust funds shall be based on a systems engineering analysis. The analysis should be on a scale commensurate with the project scope. The systems engineering analysis shall include, at a minimum:

1. Identification of portions of the regional ITS architecture being implemented;
2. Identification of participating agencies roles and responsibilities;
3. Requirements definitions;
4. Analysis of alternative system configurations and technology options to meet requirements;
5. Procurement options;
6. Identification of applicable ITS standards and testing procedures; and
7. Procedures and resources necessary for operations and management of the system.

8.2. ITS architecture and Systems Engineering Checklist

In order to insure compliance with the federal rule for ITS projects and in order to incorporate systems engineering into the project development process, the NDDOT developed an ITS project checklist. The NDDOT has conducted several training sessions on the use of the ITS checklist, the current version (5.0) of the checklist is included in Appendix 2.

8.3. Deployment Plans

A summary of existing and planned deployment for cameras, DMS, and ESS devices in addition to maps containing existing and planned deployments are available in a separate document titles NDDOT ITS Plan – Deployment Plans.

APPENDIX 1 – STAKEHOLDER SURVEY

ITS Stakeholders Survey – Score Summary

		Score for survey #:																			
Issues	Frequency as top 3 priority	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***
Unfamiliar users	*3*	11	11	2	10	3	11	11	5	9	5	11	5	8	10	8	11	6	2		5
Road work zones	*9*	8	2	3	7	2	4	2	1	4	3	3	6	2	4	2	6	10	5		4
Emergency inter-division coordination	*4*	3	8	9	2	7	5	8	7	6	10	4	3	4	9	7	9	4	8		3
Transit facilities	*1*	4	9	5	5	10	12	10	11	10	8	8	11	11	11	11	10	9	9	1	8
Weather condition information	*7*	9	3	7	6	9	2	4	3	2	11	2	1	6	7	10	4	3	4		7
Transportation security	*2*	10	6	11	9	11	10	7	6	8	9	6	8	5	3	9	5	11	10	2	9
Commercial veicle operations	*4*	6	10	10	11	4	9	9	9	5	7	7	10	7	2	3	2	5	7		2
Special event traffic	*1*	2	4	4	4	5	7	4	10	11	4	10	9	9	5	6	8	12	11		11
Emergency response time	*7*	5	5	8	3	6	6	6	4	1	6	5	4	3	8	1	3	2	6		1
Road conditions info - traveler	*11*	7	7	6	8	8	1	1	2	3	2	1	2	1	1	4	1	7	3		6
Urban congestion/signal operations	*8*	1	1	1	1	1	8	5	8	7	1	9	7	10	6	5	7	8	1	3	10

Services		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***
HAZMAT incident response	*4*	6	7	5	6	6	7	4		1	7	3	5	3	5	3	6	6	7		4
Emergency vehicle management	*7*	2	4	3	4	4	1	5		2	6	5	4	5	4	1	5	1	6		2
Highway-rail intersection	*4*	8	2	2	3	3	8	6		8	5	9	7	10	6	4	8	7	9		8
Traffic control enhancements	*8*	1	1	1	1	1	6	8		7	4	6	6	8	8	6	7	3	1	3	7
Public transportation operations	*2*	4	6	4	5	8	10	9		9	8	7	9	9	9	9	9	2	8	1	9
Incident management	*10*	5	3		2	6	5	3		4	3	4	3	2	3	2	3	5	5		3
Pre-trip traveler information	*10*	3	8	7	9	7	3	1		5	1	1	1	6	1	7	1	8	3	2	6
Commercial vehicle operations	*4*	7	5	6	8	2	9	7		3	9	8	8	7	7	5	2	4	4		1
en-route driver information	*7*	9	9	8	7	9	4	2		6	2	2	2	1	2	8	4	9	2		5

1 is highest priority
12 is lowest priority

NORTH DAKOTA STATEWIDE ITS STRATEGIC PLAN

Stakeholder Survey

Intelligent Transportation Systems (ITS) are one of the tools that transportation agencies, organizations, and operators can use to improve the operations, management, and performance of the transportation network in North Dakota. As a key transportation stakeholder we are seeking to gather information from you concerning:

- the functions or activities that your division performs
- the systems that your division currently operates or plans to operate
- the information shared or exchanged between your division and other agencies

Please complete and return the attached survey to provide key information on transportation needs, issues, and services in your district or division, as well as your views on the current and anticipated use of transportation technologies to address these needs. Your answers to the survey questions should be based on your knowledge and experience to minimize the need for additional digging and research. The survey is designed to take 30 minutes or less to complete. Your input is critical to effectively guide and support the successful development and implementation of ITS initiatives in your region and throughout North Dakota.

This survey is organized into topical areas: Top Issues/Services, Your District/Division, Traveler Information, Roadway Operations, Transit Operations, Incident/Emergency Management, and Commercial Vehicle Operations. Please complete the sections that you feel apply to your district or division. The information you provide will help to develop a framework (blueprint) for organizing, planning, designing, deploying, and operating ITS projects, systems, strategies, and services. The framework will guide the future direction of integrated transportation systems. This survey will also help the North Dakota Department of Transportation (NDDOT) update earlier inventories of ITS facilities and provide critical data for the update of the Plan.

NDDOT has working with the Advanced Traffic Analysis Center at NDSU to update the Statewide ITS Strategic Plan and Architecture for North Dakota. If you have any questions, please feel free to contact either Ed Ryen, NDDOT ITS Engineer, at (701) 328-4274, or Mohammad Smadi, ATAC Project Manager, at (701) 231-8085. For more information, please refer to the NDDOT ITS website: www.dot.nd.gov/divisions/maintenance/its.htm .

Please email this completed questionnaire to Mohammad Smadi of ATAC at m.smadi@ndsu.edu no later than:

Please note that space has been provided at the end of the Your District/Division questions for you to provide additional information and/or comments.

Thank you in advance for your time and cooperation in this important initiative.

NORTH DAKOTA STATEWIDE ITS STRATEGIC PLAN

Before completing this survey, please provide the following information:

Name:

Title:

Organization:

Address:

Phone:

Fax:

E-mail:

Definitions

Traffic Incident/Emergency Management
A system that enables responders to quickly identify crashes/breakdowns and ensure division coordination so that the closest available and most appropriate emergency unit can be dispatched to minimize clean-up and medical response time.

Freeway Management
Freeway management systems provide information to motorists, detect problems for increased capacity and flow, and minimize congestion from crashes.

Arterial (Non-Freeway) Traffic Management
Systems that monitor traffic flow on arterial street and non-freeway rural roadway systems, provide information to the traveling public, and implement signal timing plans in order to optimize the progression of traffic, including railroad crossing coordination.

Public Transportation Management
Systems that allow new ways of electronic monitoring and management of transit fleets and parking facilities through advanced locating devices and public information systems, electronic fair management, and transit signal priority.

Commercial Vehicle Operations
Systems that support administrative functions for commercial vehicle operations, including credentialing, taxing, and enforcement of safety regulations, as well as oversize/overweight and HAZMAT permitting and detection.

Transportation Security
Systems that detect, respond to, and recover from threats against the surface transportation system and infrastructure.

Top Issues/Services

1. Please identify the top issues related to the local transportation network by ranking the items below from 1 to 12 with 1 being the most critical issue.

Unfamiliar Users

Road Work Zones

Emergency Inter-Division Coordination

Transit Facilities

Weather Condition Info

Transportation Security

Other

Commercial Vehicle Operations

Special Event Traffic Management, i.e. Tourism

Emergency Response Time

Road Condition Info – Traveler

Urban Congestion/Signal Operations

2. Please identify the top services for mitigating the most critical transportation issues identified above. Rank the items below from 1 to 10 with 1 being the most critical service.

HAZMAT Incident Response

Emergency Vehicle Management

Highway-Rail Intersection Enhancements

Traffic Control Enhancements (e.g., Communications, Pre-emption)

Public Transportation Operations

Other

Incident Management

Pre-trip Traveler Information

Commercial Vehicle Operations

En-Route Driver Information

NORTH DAKOTA STATEWIDE ITS STRATEGIC PLAN

Your Organization/Division

1. What are the primary goals and objectives of your district or division as it relates to the transportation network?

2. Is your district or division currently carrying out any major projects, including but not limited to operations center construction, highway improvements, vehicle procurement, communications infrastructure, monitoring (cameras), sensing equipment, etc.

☐ YES ☐ NO

If YES, please describe the project(s) and/or provide project name(s) and available documentation source(s).

3. Within the next ten years, is your district or division planning or has funding been programmed for any major projects, including but not limited to operations center construction, highway improvements, vehicle procurement, communications infrastructure, monitoring (cameras), sensing equipment, etc.

☐ YES ☐ NO

If YES, please describe the project(s) and/or provide project name(s) and available documentation source(s).

4. Does your district or division exchange voice or data information (such as by telephone, email, or fax) with any of the following types of organizations/agencies?

Please check all that apply and list the appropriate organizations/agencies by name.

☐ Incident/Emergency

☐ Freeway

☐ Public Transportation

☐ Arterial or Non-Freeway

☐ Commercial Vehicle

☐ Traveler Information

5. What specific types of information do you share with these organizations/agencies?

☐ Incident/Emergency

☐ Freeway

☐ Public Transportation

☐ Arterial or Non-Freeway

☐ Commercial Vehicle

☐ Traveler Information

6. Please list any current partnerships, agreements, or memoranda of understanding that your district or division has in place with any other organizations/agencies (e.g., maintenance of traffic signals, data sharing, media agreements).

7. Does your district or division have (or plan to have) a vehicle fleet?

☐ YES ☐ NO ☐ PLANNED

If NO, skip to question #11.

If YES:

How many vehicles?

What is the primary function?

Secondary function?

8. Does your district or division provide (or plan to provide) maintenance of the vehicles in your fleet?

☐ YES ☐ NO ☐ PLANNED

9. Does your district or division use (or plan to use) vehicle maintenance scheduling software to manage both routine and corrective maintenance activities on vehicles?

☐ YES ☐ NO ☐ PLANNED

10. Does your district or division use (or plan to use) an Automated Vehicle Location (AVL) system?

☐ YES ☐ NO ☐ PLANNED

11. Does your district or division operate or maintain (or plan to operate or maintain) a dispatch facility?

☐ YES ☐ NO

If NO, skip to question # 13.

If YES, what are the hours of operation?

If YES, how do your dispatchers communicate with the vehicle operators?

12. Does your district or division currently perform (or plan to perform) Computer Aided Dispatch (CAD) of your vehicles?

☐ YES ☐ NO ☐ PLANNED

13. Does your district or division use Geographic Information Systems (GIS)?

☐ YES ☐ NO

If YES, what types of information are GIS used for?

14. What type of radio communications system, if any, does your district or division currently operate?

15. Who in your district or division oversees your communications systems?

16. Based on your understanding of technology in transportation, what opportunities do you see for the application of ITS technologies in your area?

Traveler Information

1. Does your district or division receive (or plan to receive) information from the National Weather Service?

☐ YES ☐ NO ☐ PLANNED

2. Does your district or division receive (or plan to receive) surface transportation specific weather information from a private weather information service?

☐ YES ☐ NO ☐ PLANNED

3. Does your district or division use (or plan to use) any of the following real-time traffic data collection technologies?

☐ VEHICLE DETECTORS
☐ VIDEO DETECTION
☐ VEHICLE PROBE READERS
☐ SURVEILLANCE CAMERAS
☐ ROAD WEATHER INFORMATION SYSTEMS
☐ OVERHEIGHT VEHICLE DETECTION
☐ OTHER

4. Does your district or division process and store (or plan to process and store) collected traffic data for use in operations or for dissemination to the traveling public?

☐ YES ☐ NO ☐ PLANNED

5. Does your district or division disseminate (or plan to disseminate) traffic, transit, or weather condition information in any of the following ways?

☐ TV/RADIO DYNAMIC MESSAGE SIGNS
☐ INTERNET PAGERS or PDAs
☐ KIOSKS E-MAIL
☐ HIGHWAY ADVISORY RADIO ROUTE GUIDANCE
☐ 511 OR OTHER TELEPHONE PERSONALIZED TRAFFIC INFO
☐ OTHER

6. Do you feel that your district or division collects transportation information that could be included in a statewide traveler information outlet, like an Internet website or 511 Traveler Info?

☐ YES ☐ NO

If YES, please describe the information below.

Roadway Operations

1. Does your district or division use (or plan to use) environmental data or information to detect environmental hazards such as icy road conditions, high winds, or dense fog?

☐ YES ☐ NO ☐ PLANNED

If YES, at how many locations?

2. Does your district or division detect and verify (or plan to detect and verify) traffic incidents?

☐ YES ☐ NO ☐ PLANNED

3. Does your district or division control (or plan to control) any signalized intersections?

☐ YES ☐ NO ☐ PLANNED

If NO, skip to question # 5.

If YES, how many intersections?

If YES, do any of your signalized intersections have:

SIGNAL PRE-EMPTION CLOSED LOOP OPERATION

TRANSIT PRIORITY ADAPTIVE TRAFFIC CONTROL

WIRELESS COMMUNICATIONS OTHER

4. Does your district or division have (or plan to have) any signalized intersections that are interconnected with active railroad crossing devices?

☐ YES ☐ NO ☐ PLANNED

If YES, how many intersections?

5. Does your district or division monitor highway-rail intersections with any of the following technologies?

☐ VEHICLE DETECTORS

☐ VIDEO DETECTION

☐ TRAIN ARRIVAL PREDICTION

☐ ELECTRONIC TRAFFIC VIOLATOR DEVICES

☐ OTHER

6. Does your district or division operate (or plan to add) lane control devices (e.g., changeable overhead directional arrows) on the freeways?

☐ YES ☐ NO ☐ PLANNED

7. Does your district or division manage (or plan to manage) automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes?

☐ YES ☐ NO ☐ PLANNED

8. Does your district or division provide or support (or plan to provide or support) on-going operations and maintenance activities?

☐ YES ☐ NO ☐ PLANNED

9. Does your district or division perform (or plan to perform) winter maintenance activities?

☐ YES ☐ NO ☐ PLANNED

10. Does your district or division have (or plan to have) any roadway deicing systems?

☐ YES ☐ NO ☐ PLANNED

11. Does your district or division manage roadway work zone activities?

☐ YES ☐ NO

If YES, please identify below the devices or systems currently deployed or planned for work zone monitoring.

☐ DYNAMIC MESSAGE SIGNS
☐ VEHICLE SPEED MONITORING
☐ OTHER
☐ CLOSED CIRCUIT TELEVISION
☐ WORK ZONE INTRUSIONS

Incident/Emergency Management

1. Does your district or division use (or plan to use) mobile data terminals (MDT)?

☐ YES ☐ NO ☐ PLANNED

2. Does your district or division use (or plan to use) emergency vehicle preemption at any signalized intersections?

☐ YES ☐ NO ☐ PLANNED

3. Does your district or division participate (or plan to participate) in any kind of incident management program or coordination activities (such as major incident debriefing, tabletop exercises, etc.)?

☐ YES ☐ NO ☐ PLANNED

4. Does your district or division monitor (or plan to monitor) the transportation infrastructure (e.g., bridges, tunnels, and management centers) for potential threats using sensors and surveillance equipment?

☐ YES ☐ NO ☐ PLANNED

5. Does your district or division monitor (or plan to monitor) public travel related areas such as transit stations, transit stops, rest stops, and kiosk locations for potential threats using sensors and surveillance equipment?

☐ YES ☐ NO ☐ PLANNED

6. Does your district or division use (or plan to use) driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property?

☐ YES ☐ NO ☐ PLANNED

7. Does your district or division monitor (or plan to monitor) and detect potential, looming, and actual disasters including natural disasters and technological and man-made disasters (hazardous materials incidents, nuclear, chemical, biological, and radiological attacks) and notify all responding agencies of detected emergencies?

☐ YES ☐ NO ☐ PLANNED

8. Does your district or division support (or plan to support) disaster response and recovery, including coordination of emergency response plans and resources, damage assessment, service restoration, and transition back to normal operation?

☐ YES ☐ NO ☐ PLANNED

9. Does your district or division support (or plan to support) evacuation of the general public from a disaster area and manage subsequent reentry to the disaster area using transportation resources?

☐ YES ☐ NO ☐ PLANNED

10. Does your district or division provide (or plan to provide) disaster-related traveler information to the general public, regarding evacuation and reentry information and other information concerning the operation and availability of the transportation system during a disaster?

☐ YES ☐ NO ☐ PLANNED

Commercial Vehicle Operations

1. Does your district or division perform (or plan to perform) electronic credential administrative services for commercial vehicles?

☐ YES ☐ NO ☐ PLANNED

2. Does your district or division participate (or plan to participate) in roadside commercial vehicle inspection?

☐ YES ☐ NO ☐ PLANNED

If NO, no further responses are required in this section.

3. Does your district or division perform (or plan to perform) electronic screening?

☐ YES ☐ NO ☐ PLANNED

4. Does your district or division exchange (or plan to exchange) safety and/or security information?

☐ YES ☐ NO ☐ PLANNED

5. Does your district or division participate (or plan to participate) in high speed weigh-in-motion services?

☐ YES ☐ NO ☐ PLANNED

6. Does your district or division participate (or plan to participate) in HAZMAT detection?

☐ YES ☐ NO ☐ PLANNED

APPENDIX 2 – ITS AND SE CHECKLIST

NDDOT ITS PROJECT/ARCHITECTURE CHECKLIST
SYSTEMS ENGINEERING COMPLIANCE (Ver. 5.0)

North Dakota Department of Transportation, Maintenance Division
SFN60212 (Rev. 10-2012)

For All ITS Projects, a Systems Engineering Checklist must be submitted for review and approval **prior to approval of Federal funds (23 CFR 940.13)**. If the ITS portion of the project is **≥ $5M**, then FHWA must approve the Systems Engineering Checklist; allow an additional two weeks for FHWA approval. Attach or make available any documents referenced in this form when submitting.

Section 1 Project Information

Project Champion

Contact Address	City	State	ZIP Code
Contact Telephone Number	Contact Email Address		

Brief Description (Purpose of ITS project including list of ITS elements) ☐ See Attachment

New Project or Modification
☐ New Project ☐ Modification to existing project

Total Funds (ITS only)
☐ State $__________ ☐ Fed $__________ ☐ Other $__________

Project Number	PCN	Project Location

Nature of Work

☐ Scoping
☐ Planning
☐ Evaluations
☐ Design Software/Integration
☐ Maintenance (Equipment Replacement)
☐ Other - Specify ____________________
☐ Construction
☐ Operations

Relationship to Other ITS Projects and Phases ☐ See Attachment

Section 2 Needs Assessment (940 Requirement)

What is / are the current problem(s) with the current situation? ☐ See Attachment

What needs does this project address? ☐ See Attachment

How were these needs identified? (Must describe functional needs to meet portions of architecture identified in Section 3 on next page)**Reference any relevant documentation ☐ See Attachment

Section 3 Regional ITS Architecture (940 Requirement)

Portions of the Regional ITS Architecture being implemented

☐ Archived Data Management
☐ Traveler Information
☐ Commercial Vehicle Operations
☐ Traffic Management
☐ Public Transportation
☐ Emergency Management
☐ Maintenance and Construction Management

New ITS project or element described here:

Market Packages Attach all applicable market packages from Turbo or Regional Architecture; attach flow diagrams (940 Requirement)
NDDOT Market Packages Link

Market Package	Market Package Name	Flow Diagram Attached
		☐ No ☐ Yes
		☐ No ☐ Yes
		☐ No ☐ Yes
		☐ No ☐ Yes
		☐ No ☐ Yes

Inventory elements from the Architecture being implemented NDDOT Elements Link

Participating Agency Roles and Responsibilities (940 Requirement) Operational Concept Link

Regional Architectures impacted by the project

☐ ND Statewide	☐ Minnesota	☐ Bismarck/Mandan MPO	☐ Grand Forks/East Grand Forks MPO
☐ South Dakota	☐ Montana	☐ FM COG	☐ Other ______________

Changes recommended to NDDOT / Regional Architectures due to the project ☐ No ☐ Yes

If Yes Provide ND Statewide-ITS Architecture Change-Request (SFN60213) ☐ Attached ☐ To Be Completed

National ITS Standards Incorporated (940 Requirement)

☐ Yes (Standards Link)

☐ No (If No MUST Explain)

*Test procedures must be included (see below)

Project Matrix Documentation (Should be completed by someone familiar with the SE. Some projects have multiple ITS elements only some of which will have the required documentation, reference all that apply to the project.

NOTE: Items in **red** are **required**, while those marked with an * are needed based on project complexity and risk	**References:** Include full name of the document; date the document was prepared; and the heading or section number within the document where the information is provided. If not previously documented, this documentation **must** be included with **this** System Engineering Checklist.	**Date Verified**
Concept of Operations	☐ See Attachment	
Requirements	☐ See Attachment	
Alternatives Analysis	☐ See Attachment	
Test Plan	☐ See Attachment	
Detailed Design	☐ See Attachment	
Integration Plan*	☐ See Attachment	
System Acceptance Plan*	☐ See Attachment	

Section 4 Procurement (940 Requirement)

Procurement Methods (Should correspond with project complexity)

☐ **Low Bid with DOT Design** - typical for construction projects DOT design (low bid contractor)

☐ **Low Bid with Consultant Design**- typical for construction projects consultant design (low bid contractor)

☐ **System Manager -** manager responsible for delivering an operational system (quality based selection; RFP)

☐ **Commodity Supplier** - off-the-shelf ITS products (low bid selection of pre-qualified packages)

☐ **Consultant** - supplement in-house capabilities or consultant/manager selection (qualifications based; RFP)

☐ **Outsourcing** - for a capability of function rather than a specific system (best value or low bid; RFP)

☐ **Other**

Comments:

Spare Parts

Additional equipment (spare parts) requested? ☐ Yes ☐ No

If yes, please complete Attachment A: ☐ Attached ☐ To Be Completed

Section 5 Operations and Maintenance (940 Requirement)

Procedures and Resources Needed for Operation

Estimated Annual Operations Maintenance Costs

Stakeholder(s) responsible for maintenance and funding source

Section 6 Agreements

List any Agreements needed or utilized for this project

Section 7 Acceptance

Preliminary

Approved by NDDOT ITS Engineer

Date

FHWA Approval (ITS ≥ $5M)

FHWA Division Administrator

Date

FHWA Division ITS Engineer

☐ Not Approved:

Comments:

Attachment A - ITS Spare Parts Eligibility Assessment

For this project, which products are intended to be purchased beyond the quantities required for initial installation?

a.

b.

c.

Do you certify that the agency responsible for hardware maintenance on this facility has a system for inventory tracking of these products, which includes at least purchase dates, unique part identification, and quantity?

☐ Yes ☐ No

How, or by whom, may this inventory be located?

For the types of spare parts requested, what is the quantity of spare parts currently available by the agency responsible for maintenance?

a.	Newest part purchase date:
b.	Newest part purchase date:
c.	Newest part purchase date:

Do you certify that::

☐ Yes ☐ No The type(s) of spare parts requested are essential for the safe and successful operation of the system (system-critical)?

☐ Yes ☐ No The agency responsible for hardware maintenance on this facility has a system for inventory tracking of these products, which includes at least purchase dates, unique part identification, and quantity?

☐ Yes ☐ No Replacement of these parts is above and beyond what is expected of typical system "routine maintenance" (i.e., paint jobs, de-icing)?

☐ Yes ☐ No The order quantity of the spare parts is consistent with both the expected failure rate for those parts and the expected service life for the associated project function?

☐ Yes ☐ No The estimated purchase costs of the spare parts alone is less than 10% of the estimated total project cost?

☐ Yes ☐ No The time to purchase replacement equipment for these spare parts in the event of a failure would cause an unacceptable disruption to the safety or efficiency of the system?

If the answer to any of the above questions is "no," the purchase of these spare parts may still be eligible for Federal-aid reimbursement a public interest finding (PIF) approved by FHWA may serve in place of this checklist. Please coordinate with the NDDOT Maintenance Division ITS Engineer for submission of a PIF application in this regard.

☐ Yes ☐ No Is a PIF required for this purchase?

☐ Yes ☐ No If a PIF is required, has it been approved by FHWA?

For more information on Federal-aid eligibility of spare parts, please see the following Memoranda from FHWA:

"INFORMATION: Eligibility of Replacement Parts for Safety-related Hardware," March 18, 2008

"INFORMATION: Guidance on Federal-aid Eligibility of Operating Costs for Transportation Management Systems," January 03, 2000