Rural Technology Deployments

North Dakota State University

Total Project Cost: $12,200,000

ATCMTD Request: $6,100,000

Are matching funds restricted to a specific project component? No

State in which project is located: North Dakota

Is the project currently programmed in the: TRIP, STIP, MPO Long Range Transportation Plan, or State Long Range Transportation Plan – No

Technologies to be deployed

- Real-time traveler information systems: including **winter road conditions**, **work zone status**, and **traffic incidents**
- **Winter roadway management systems**, including fusions of environmental and pavement sensors and data generated from snow plows
- Real-time information systems **for emergency response dispatching and routing**
- **Truck platooning**
- **Dynamic routing** and real-time information systems for oilfield truckers

Contents

Project Description

Introduction

The North Dakota Department of Transportation (NDDOT), the North Dakota Department of Emergency Services (NDES), and the North Dakota State (Highway) Patrol (NDSP) are joining with the Upper Great Plains Transportation Institute (UGPTI) to form the Northern Plains Center for Advanced Transportation Technologies—referred to as Plains CATT, for short. The four state agencies will partner with the North Dakota Motor Carriers Association (NDMCA), General Electric Transportation, HERE, Pedigree Technologies, and Peloton to achieve the objectives of the planned deployment. The project is organized into four related components:

- Roadway Information Systems for Efficient and Safe Travel (RISEST)
- Advanced Technologies for Emergency Response Services (ATERS)
- Telematics and Information Systems for Oilfield Carriers (TISOC)
- Freight Platooning in Interstate and Rural Corridors (FPIRC)

Roadway Information Systems for Efficient and Safe Travel. Extreme weather conditions pose challenges for highway travelers and emergency responders in North Dakota. Blizzards, strong winds, and temperatures of minus 30-degrees Fahrenheit strand travelers in life-threatening situations and isolate communities from essential services. Floods and extended high-water levels block roads much of the year, creating lengthy detours for travelers and first responders. During construction season, work zones impede travelers on numerous routes. Changes in work zone boundaries and lane closures create uncertainties in route selection. Once implemented, RISEST will provide real-time and predictive information for travelers and emergency responders on a statewide basis, including: winter road conditions, road closures/blockages, warnings of high water and other events, traffic incidents that impede travel, work zone locations, and width, height, and load restrictions.

Advanced Technologies for Emergency Response Services. North Dakota's extreme weather and rural character pose challenges for emergency responders. In addition to closed and hazardous roads, blocked highway-rail grade crossings are impediments. North Dakota includes 5,550 public at-grade crossings. With high train volumes in many areas of the state, there is always a chance that a crossing may be blocked by a passing train when an emergency vehicle is trying to use the most direct route to get to the site of an accident or natural disaster. In some cases, trains may be switching in cities or on the peripheries of towns—in which case, a crossing may be blocked for an extensive period of time. During construction season, work zone changes affect travel times on specific routes. Once ATERS is fully implemented, real-time information from RISEST (along with blocked crossing information) will be fed to the emergency response center's computer-aided dispatching (CAD) algorithm, allowing dispatchers to select the optimal route based on real-time road status and condition information and expected travel speeds—saving minutes, property, and lives.

Telematics and Information Systems for Oilfield Carriers. North Dakota produces roughly 1 million barrels of oil per day. More than 90% of this production is concentrated in four counties. Trucks shuttle back and forth between wells and pipeline or rail transfer locations, creating some of the worst rural congestion in the nation. Once TISOC is fully implemented, real-time information on truck locations, travel speeds, and queues at access roads leading to terminals will be available to participating carriers and serve as an aid to traffic planning in energy-impacted areas.

Freight Platooning in Interstate and Rural Corridors. The ultimate goal of this component is to implement truck platooning in key corridors in North Dakota within the time frame of the project. Because of low population densities and low-to-moderate levels of rural highway congestion, North Dakota is an ideal site for the demonstration of long-distance truck platooning on rural interstate and principal arterial highways. A successful demonstration in North Dakota (with its harsh winter climate and varying road conditions) would be a milestone in nationwide deployment and offer the potential for future interstate operations under western states compacts. However, prior to the commencement of platooning operations, any necessary changes in policies or administrative procedures will be addressed and public support for platooning galvanized. A demonstration will be conducted in Year 2 on limited access highways. The most likely deployment corridor is I-94, which crosses the entire state and connects Chicago to Seattle. The project will facilitate widespread commercial deployment.

Safety Outcomes. The project will improve safety because of: (1) shorter and more reliable response times to emergencies, (2) statewide availability of real-time route status and condition information (including road surface conditions, weather, and work zones), (3) real-time information regarding train locations relative to grade crossings, and (4) safer motor carrier operations because of real-time oilfield traffic information and corridor freight platooning.

Efficiency Outcomes. The project will improve transportation efficiency because of: (1) fewer delays for travelers due to closed or slippery roads, work zones, and blocked grade crossings; (2) fewer delays and higher levels of service for oilfield carriers (as well as travelers in oilfield regions), and (3) lower trucking costs per ton-mile because of corridor freight platooning.

Broader Economic Benefits. The deployments will boost economic vitality in rural areas by reducing the cost per ton-mile of freight shipments and increasing the reliability and safety of trucking operations. These benefits (e.g., lower shipping costs per ton-mile, increased reliability of travel times and services, less cargo loss and damage, and potentially lower liability and insurance costs) will be felt throughout business supply chains—benefiting trucking companies, third-party logistics providers, distributors, and producers.

Partnership Arrangements and Program Management

Plains CATT includes agencies that collectively have statewide responsibilities for transportation services, safety, security, and emergency response. If this proposal is selected, the Upper Great Plains Transportation Institute will enter into an agreement with Federal Highway Administration on behalf of the coalition. NDSU-UGPTI will lead and manage the grant. The NDDOT, NDDES, and NDSP—which have statutory authority for the planning and delivery of services—will make decisions related to their missions. NDSU-UGPTI will provide research, technological knowledge, and administrative support to manage the center. In addition, NDSU will execute subcontract agreements with HERE, GE Transportation, Peloton, and Pedigree Technologies; and provide the necessary data protections and confidentiality assurances.

Primary Partners

The **Upper Great Plains Transportation Institute** is a state agency and department of North Dakota State University that offers a wide range of expertise and capabilities in highway planning, traffic analysis, intelligent transportation solutions, transportation technology, transportation safety, and security. UGPTI is the lead center of the **Mountain-Plains Consortium** (MPC), a U.S. DOT University Transportation Center. In the ATCMTD project, UGPTI will be responsible for budgeting, financial oversight, reporting, and the fulfillment of grant requirements. When desirable, UGPTI will draw from the broader resources of North Dakota State University.

As the lead transportation agency of the state, the **North Dakota Department of Transportation** is responsible for 8,518 miles of roadway and 4,858 bridges and all transportation planning functions in the state, including statewide and corridor freight planning. NDDOT has been a pioneer in the development of roadway weather management and traveler information systems. In addition to the state system, the NDDOT coordinates county road planning efforts and the development of multicounty transportation plans—particularly in oil-impacted counties. Moreover, NDDOT is responsible for identifying additional corridors for heavy double-trailer truck operations in the state and the overall planning of the state truck network.

The **North Dakota Department of Emergency Services** is comprised of the Division of Homeland Security and State Radio Communications. The Department maintains homeland security responsibilities and coordinates natural disaster preparedness, mitigation, response, and recovery activities. NDDES provides 24/7 emergency communications and resource coordination with more than 50 lead and support agencies, private enterprises, and voluntary organizations to assist local jurisdictions in disaster and emergency response activities.

The **North Dakota State Patrol** is responsible for traffic enforcement, crash investigation, and road condition reporting. The Motor Carrier Division of the NDSP is responsible for truck size, weight, and safety enforcement; the permitting and routing of oversize and overweight vehicles; and border inspections, The Motor Carrier Division has nine fixed weigh and inspection stations, 13 weigh-in-motion sites, and numerous turnout locations in the state that are used for inspections and weight enforcement. The Division's goals include: (1) reducing commercial vehicle crashes by conducting commercial vehicle inspections, safety audits, compliance reviews, and coordinating the permit system; and (2) protecting highway infrastructure through size and weight enforcement and the permitting of overweight/over-dimensional loads.

The North Dakota Motor Carriers Association is the leading education and advocacy organization for the transportation industry in North Dakota. Members of the Association range from owner operator/independent drivers to large multi-national carriers. NDMCA offers a wide range of programs, products, and services. The agency's mission is to promote highway safety, deliver services, and provide representation for its members.

General Electric Transportation combines decades of industrial leadership with cutting-edge data science and analytics to create an efficient and reliable digital-rail ecosystem: encompassing shippers, receivers, ports, intermodal terminals, yards, mainline locomotives, railcars, and operation centers. Table 1 summarizes four of the more than 15 digital products offered by GE Transportation.

HERE transforms information from devices, vehicles, infrastructure and other sources into real-time location services. For more than 30 years, HERE has supported government agencies, automotive companies, and enterprises with transportation technologies that focus on data and services. The digital three-dimensional maps developed by HERE are deployed in 4 out of 5 vehicles in North America and Europe. More than 30 government agencies now use traffic data from HERE for operations planning and other purposes. Some of HERE's capabilities (those that are most directly related to the proposal) are summarized in Table 2.

Table 1. General Electric Transportation (Selected) Products and Services	
Service	**Description/Use**
GoLINC™	A communication/application management platform for freight railroads. A mobile data center that provides onboard locomotive data processing, wireless communication, networking, video, and data storage capabilities; featuring onboard wireless capability for easy data transfer.
RailDOCS™	A cloud-based mobile software platform for configuration management, testing, inspecting, reporting and maintaining track, signal, bridge and communications equipment. RailDOCS tracks and manages signal, train crew and dispatcher time/availability.
Movement Planner	A sophisticated rail traffic control system/logistics planner that intelligently analyzes and optimizes traffic, allowing more locomotives to run on the same railroad at faster speeds, without laying new track.
Movement Planner Network Viewer	Uses real-time data to help dispatchers manage trains across the network—from identifying potential scheduling conflicts to increasing the fluidity of the entire network. Meet-pass decisions are quick and easy. Train conflicts are detected up to 24 hours in advance.

Table 2: HERE (Selected) Products and Services	
Service	**Description/Use**
Mapping & Location Data Analytics Platform	Cloud hosted enterprise data management built on HERE maps which integrate hundreds of location-related data sources including real-time data from vehicles, mobile devices, sensors, and transit. Data is packaged into APIs and SDKs to enable easy and open application development. Examples: directions (traffic enabled routing, truck specific routing, etc.), map rendering, search, and voice guidance. Scalable and interoperable with a common open specification and global coverage.
Probe-based Traffic Management and Performance Management	HERE collects and processes billions of probe points to generate a real-time view of traffic conditions on all roads for the U.S. (and in 58 countries). Incidents and road closures are collected and distributed for all major metros. Analytical traffic data is available for planning and performance management. Support metrics such as travel time reliability, congestion bottlenecks, and incidents are generated. Probe-based origin-destination information is available for travel modeling and analytics. Traffic signal data can be integrated with the system.
Connected and Automated Vehicle V2X	Digital Transportation Infrastructure (DTI) enables targeted safety messages to be sent to affected travelers. Moreover, messages connect vehicle and infrastructure for rapid V2X deployment leveraging existing cellular networks.

Pedigree Technologies' *OneView* platform is an integrated solution with fleet tracking, electronic logging devices, asset tracking, dispatching, tank monitoring, and many other capabilities. OneView captures data from workers, trucks, equipment, and other assets to gather valuable information—including location, run-time hours, machine health, work order details, etc. In data-driven dispatching, real-time changes are made to routes, stops are updated instantly, and changes are communicated safely with mobile workers. Through mobile tank monitoring, owners can remotely monitor crude oil, produced water, acid, and other liquid chemicals while in transit. OneView results in efficient (dynamic) dispatching, vehicle location and performance monitoring, reduced fuel consumption, operational cost savings, and improved safety.

Stonewater Control Systems (SCS) is an advanced technology company that focuses on (among other things) the development of advanced security solutions (which are developed in conjunction with Sandia National Laboratories) that include critical infrastructure such as airports and nuclear and logistics sites. In partnership with **Great Plains Growth Partners,** SCS brings more than 25 years of experience in transportation, supply-chain planning, commodity systems analysis, and business information/software support to the project.

One of the technology providers that has expressed potential interest in the corridor freight platooning component is **Peloton—**a connected and automated vehicle technology company (based in the Silicon Valley) dedicated to improving the safety and efficiency of the U.S. trucking industry. Peloton's flagship platooning system links the active safety systems of pairs of trucks, and connects them to a cloud-based Network Operations Center (NOC) that limits platooning to appropriate roads and conditions while providing safety-critical services to trucks and drivers, both in and out of platoons. Peloton's truck platooning system uses Vehicle-to-Vehicle (V2V) communication to connect the braking and acceleration between the two trucks. The V2V link allows the lead truck to control the acceleration and braking of both trucks virtually simultaneously, reacting faster than a human or even radar sensors could. Peloton's NOC provides eligibility for each platooning operation and continued monitoring that allows trucks to be paired on the fly or platoons to be dissolved in response to changing weather, traffic, truck, or other conditions. Potential service providers other than Peloton may be considered through an RFP process.

Essential Arrangements

Interoperability of Systems. All products and services provided by the private-sector partners in this project will allow for third-party interfaces and interoperability across systems. Each product will provide an application program interface (API) to integrate functionality with existing platforms. Software development kits (SDKs) will enable third-party developers to add value by building secure connections to other management systems.

Protection of Confidential and Proprietary Data. Although UGPTI is a separate state agency, it is administered by North Dakota State University, which has an established legal and administrative framework to guarantee the confidentiality and anonymity of data and protect proprietary information from FOI requests.

Research, Data Analytics, and Performance Measurement. Although the project is focused on technology deployments, performance measurement, research, and data mining capabilities are essential to sustain its success. As detailed in the proposal, all private-sector partners have data capture systems in place (or soon to be deployed) which will allow for the measurement of performance and the quantification of benefits. To some extent, all private-sector partners will be involved in data analytics during the demonstration. However, UGPTI will drive the overall performance measurement and combined data analytics process.

Information Security. For many reasons, the information systems developed and deployed in this effort must be secure. First responders and law enforcement personnel are potential targets of terrorists and hate groups. The hacking of information systems could result in false alarms and ruses that waste resources and prevent responders from focusing on the real disasters. In 2015, the first-ever state (cabinet level) Cybersecurity Task Force was established by the Governor of North Dakota to focus on the creation and securing of digital applications and information networks. The Cybersecurity Task Force will be of great benefit to this project, given that the security of private and sensitive data is central to the initiative. In addition, NDSU's newly established **Institute for Cybersecurity** will provide important expertise needed by Plains CATT. One of the Institute's areas of specialization is the security of communication and telematics systems for connected vehicles and platooning.

Federal Agency Collaboration

In this project, Plains CATT will invite the division or regional offices of the Federal Highway Administration, the Federal Railroad Administration, the Pipeline and Hazardous Materials Safety Administration, the Federal Motor Carrier Safety Administration, and the Department of Homeland Security to provide stakeholder participation and guidance. Although each agency has a unique role and issues in emergency response and safety, all agencies share a commitment to improve transportation safety and security in rural areas and to save lives through coordinated rapid responses to disasters. The intergovernmental and interagency collaboration will lead to a shared vision for deployment, and sustainment of the program.

Deployment Region

The full deployment area will encompass all of North Dakota (Figure 1), much of which is rural, including the Bakken oilfields. The heart of North Dakota's oil production region is delineated by the dashed lines shown in Figure 1. In the long-term view of many analysts, the Williston Basin has a great future, with massive oil and gas reserves. Advances in technology such as high-frack intensity systems, in combination with proven production methods of multilateral wells and batch drilling, have the potential to significantly lower the cost of production through "100-stage jobs with two- to three-mile laterals."[1] With the potential for emerging technologies to increase the ultimate recoveries in an oilfield by roughly 50%, many investors are forecasting "a sustained level of drilling in the Williston Basin that's less dependent on the oil price structure."[2] The deployment region for each component is referenced in Table 3.

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[1]Miller, Patrick C. *High-Frack Intensity, Multilateral Drilling Could Help Bakken*, the Bakken Magazine, May 18, 2016.
[2] Ibid.

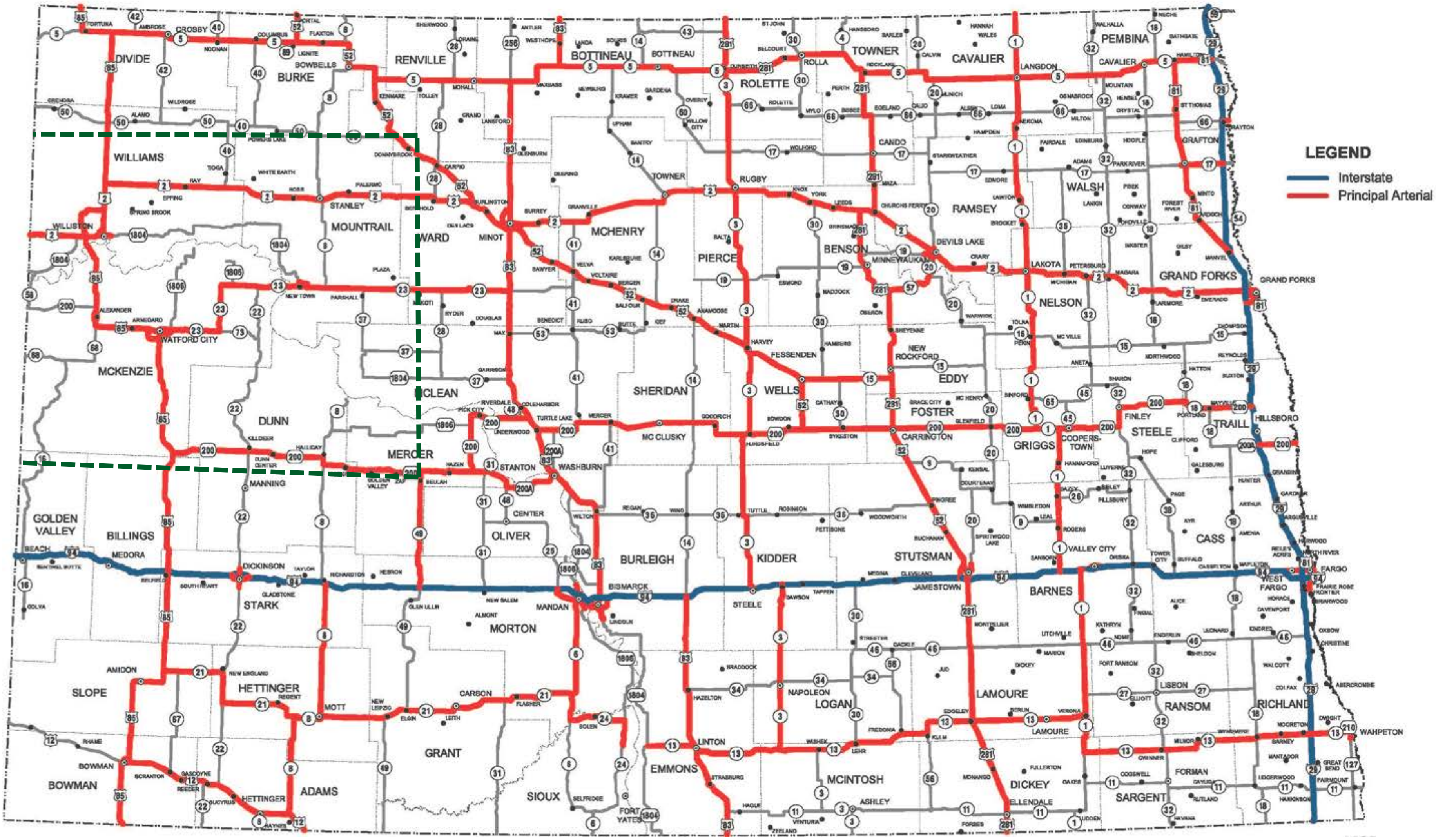

Figure 1 Scope of Deployment Area

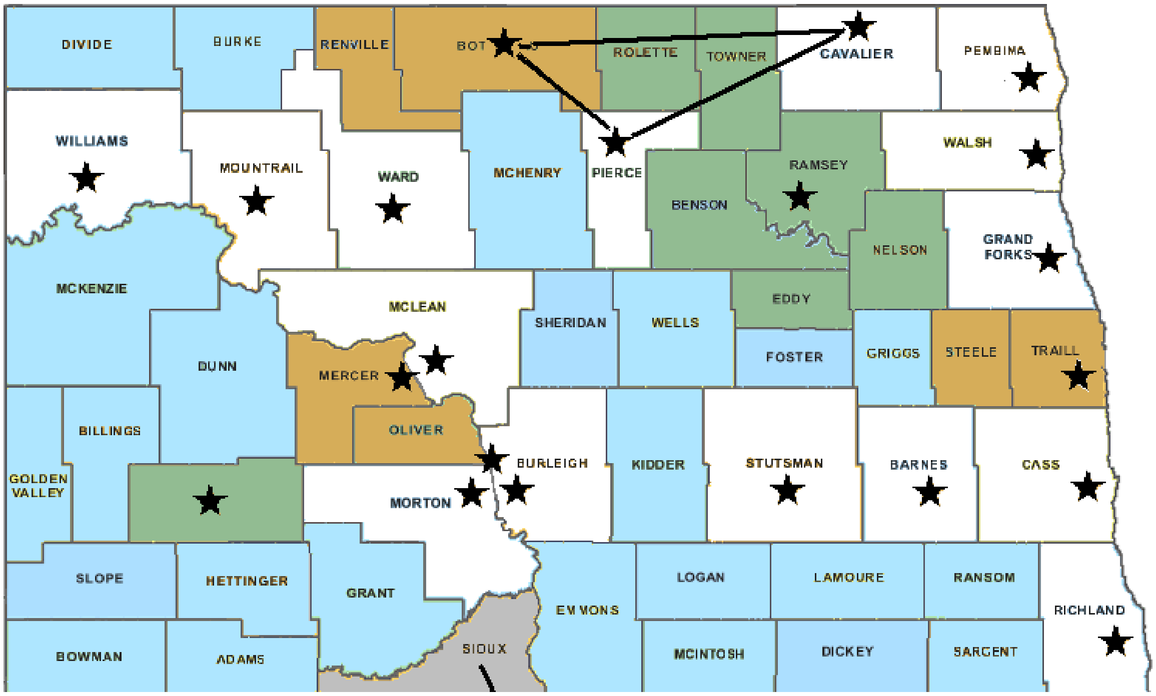

Figure 2 Public Safety Answering Point (PSAP) Sites for Emergency Response Dispatch

Table 3: Deployment Regions for ATCMTD Project Components	
Component	**Deployment Region**
RISEST	Statewide (Figure 1)
ATERS	Substate (Figure 2)
TISOC	Substate: Bakken Oilfields (Figure 1)
CFRP	Substate: Select highway corridors (Figure 1)

Challenges and Issues to be Addressed by the Proposed Deployments

Roadway Information Systems

Context. In winter, heavy and blowing snows, sizable drifts, dangerous wind chills, and slippery roads pose hazards for travelers. In these situations, advance travel information is essential. However, conditions may change rapidly, altering travel plans and stranding travelers in remote areas. Hence, real-time information distributed through multiple channels (including mobile devices) is indispensable. Pre-trip and real-time information are essential during construction season as well. Work zone arrangements may change several times during the course of a project. Although work zone activities and traffic details are updated regularly (from information provided by contractors), travelers want real-time notifications of changes while they are traveling. In addition to work zones, lengthy delays can occur at highway-railroad grade crossings.

State of the Art. The North Dakota Department of Transportation's Travel Advisory Map (which is accessible online) provides essential information for travelers and emergency responders, including: road closures/blockages, traffic incidents that impede travel, winter road conditions, warnings of high water and other events, work zone locations, and width, height, and load restrictions. The map synthesizes information from a variety of sources, including environmental sensor stations, construction plans, and work zone authorities. With a few exceptions, the map provides the most critical information needed by travelers and first responders. During winter, road status and condition information is updated periodically from 5 a.m. to 10 p.m. Travelers can access the information from the online map (useful primarily for pre-trip planning and route decisions), as well as via RSS feeds and the 511 traveler information system: both of which are accessible via mobile devices. The capability to integrate other data sources (such as crowd sourcing information) with input data streams and digitally and seamlessly transfer outputs to other platforms is feasible; however, it is currently practiced on a limited basis. Manual reentry of map data is required to incorporate road status and condition information in emergency response dispatching and operational systems.

Critical Needs. Given the technologies and systems in place, the primary needs addressed by the proposed deployments include:

1. The availability of real-time travel information that is digitally accessible to travelers and government agencies
2. The integration of roadway condition and status information with emergency response dispatching (and other essential) software systems to minimize the transcription and manual reentry of data
3. The provision of additional information regarding other types of road blockages (e.g., blocked highway-rail grade crossings)
4. The availability of information for major county roads, as well as for state highways.

Emergency Response

Context. The route that an emergency vehicle takes and the time needed to arrive at the scene of a highway crash, train derailment, or other disaster can make a critical difference in terms of lives and property saved. The optimization of vehicle, driver, and responder time is vitally important in rural emergency response, given the scarcity of personnel and assets and the vast territories that must be covered. Real-time communication between vehicles and dispatchers (and between vehicles) is essential for rapid and effective response. In addition to communicating with each other, the vehicle and dispatcher must have access to as much environmental and contextual information as possible, including highway and traffic conditions along the primary and alternate routes, road surface conditions, visibility, and impediments in the vehicle’s path (such as congestion, closed or blocked roads, and blocked highway-rail grade crossings).

State of the Art. North Dakota’s highway patrol vehicles are equipped with wireless communication capabilities and onboard computers and monitors that display the base digital map of the state and show the locations of other emergency vehicles and current emergencies/disasters. The computer aided dispatching (CAD) system selects the shortest route for an emergency responder to get to the scene of an emergency. However, dispatchers lack real-time information regarding closed or blocked roads and roadway weather information.

Critical Needs. Given the technologies and systems in place, the major needs addressed by the proposed deployments include:

1. Continuous access to comprehensive and current travel information
2. Predictive capabilities as to how conditions may change in the near future (e.g., the next 15 to 30 minutes)

3. Capabilities to adjust routes dynamically, even after vehicles have been dispatched

Oilfield Transportation

Context. With 50 rigs currently drilling in western North Dakota, more than 1,000 new wells are expected to be added each year. However, relatively modest increases in price could result in more drilling, as the costs of drilling, fracing, and production have dropped substantially during the last five years. Each well that is drilled results in 850 to 1,150 loaded truck trips, or as many as 2,300 loaded and empty trips (depending on rigs movements, pipeline access for fresh and produced water, and other factors). In the early days of a well, trucks shuttle back and forth between wells and rail and pipeline transfer locations, bringing inputs to drill and frac the well and hauling away prodigious volumes of crude oil and produced water. Shale oil production creates rather unique traffic patterns and poses congestion issues that are generally not seen in other rural areas. For example, some heavily impacted roads in the Bakken experience 3,500 to 5,000 large commercial trucks per day. Additional pipeline capacity has significantly reduced the delivered price of Bakken crude oil. However, trucking cost (and impedance to truck travel) are still important factors in the viability of shale oil production.

State of the Art. Dispatching, tank and load monitoring, and vehicle location and tracking information is available commercially and being used by oilfield carriers. The state of truck telematics is relatively advanced. However, the information is not available on a network basis. Therefore, information such as travel speeds and congested locations are not widely distributed within the region. Moreover, truck location and speed information are not integrated with the road network. Therefore, optimal routes that will provide the most benefits to all travelers cannot be determined, nor can highway planners provide the most helpful travel information to commercial motor carriers and motorists.

Critical Needs. Given the technologies and systems in place, the major needs addressed by the proposed deployments (in addition to the information provided by RISEST) include real-time information regarding:

1. Congestion and speeds on county, city, and local routes
2. Queues at intersections on access roads leading to terminals and transfer facilities
3. Queues within terminals

Corridor Freight Platooning

Context. North Dakota's economy is highly dependent on imports and exports and, thus, on efficient freight transportation. Most long-distance transportation occurs by railroad and pipeline. Because of limited competition in the hauling of goods, North Dakota shippers pay some of the highest freight rates per ton-mile in the nation. Shippers and industries are looking for ways to reduce shipment costs and increase reliability. In particular, they are focused on increased truck efficiency through the use of longer and heavier vehicles and the implementation of new technologies.

State of the Art. No autonomous or connected vehicle deployments are currently underway or planned. However, North Dakota is keenly interested in the deployment of automated vehicle technologies in the future. In the recently enacted HB 1202, the Legislature instructed the NDDOT to "study the use of vehicles equipped with automated driving systems on the highways in this state and the data or information stored or gathered by the use of those vehicles"—noting that the study must include "a review of current laws dealing with licensing, registration, insurance, data ownership and use, and inspection and how they should apply to vehicles equipped with automated driving systems." In HB 1255, the Legislature provided for the "creation of a large truck primary highway network and the permitting of increased vehicle weights," up to 129,000 pounds in certain corridors, under specific conditions. As a result of these legislative directives, the groundwork has been laid for efficient corridor freight transportation.

Critical Needs. Fully autonomous vehicles are likely to become operational in North Dakota in the future. However, many changes and milestones are necessary between now and then. In many respects, truck platooning is a low level automation solution that is feasible for demonstration within the time frame of the project. The critical needs include:

1. Pre-deployment planning that includes the identification of appropriate corridors
2. A demonstration that illustrates platoon operations, as well as safety and economic benefits
3. A public awareness campaign to notify the traveling public
4. The establishment of partnerships between technology providers and interested motor carriers
5. A phased deployment plan (which is described in this proposal)

Relationship of Proposed Deployments to ATCMTD Goals

ATCMTD Program Goals and Emphasis Areas Addressed by the Proposal

The proposed project addresses most of the goals listed in the Notice of Funding Opportunity (NOFO, p. 10). In particular, North Dakota's proposal identifies deployments and related activities that will make substantial progress toward the following goals:

- Collection, dissemination, and use of real time transportation related information to improve mobility, reduce congestion, and provide for more efficient and accessible transportation
- Reduced costs and improved return on investments, including through the enhanced use of existing transportation capacity
- Integration of advanced technologies into transportation system management and operations
- Demonstration, quantification, and evaluation of deployment impacts in improving safety, efficiency, and other goals
- Reproducibility of successful systems and services for technology and knowledge transfer to other locations

If selected, the activities and deployments described in this proposal will "improve safety, efficiency, system performance, and infrastructure return on investment" and facilitate "access to essential services" (NOFO, p. 6). Specifically, the proposal addresses the high-priority **Rural Technology Deployments** focus area—which is primarily concerned with the "deployment of advanced technologies to enhance safety, mobility, or economic vitality" (NOFO, p. 13). The proposal addresses "corridor freight platooning, mobile work zone alerts, improved roadway weather management, improved emergency response services and traffic incident management" (NOFO, p. 13). Moreover, the proposal addresses one of the primary goals of the Advanced Transportation and Congestion Management Technologies Deployment Initiative: the deployment of enhanced **Advanced Traveler Information Systems** that "provide real time, predicted, and individualized information about travel choices, based on data from sensors (traffic, weather), mobile sources (personal portable devices, connected vehicles), and other information systems … to allow travelers and shippers to make informed decisions regarding destinations, when to travel, routes, or modes" (NOFO, pp. 7-8).

Program Outcomes

Several overarching outcomes are mentioned in the NOFO, including: accessibility, economic vitality, efficiency, infrastructure return on investment (ROI), mobility, and safety. The proposed project addresses all of these high-level goals, at least to some extent.

Accessibility to personal and freight services is challenging in rural areas and has a major impact on income and quality of life. In particular, the connectivity and performance of the public road network influences accessibility. When RISEST is fully implemented, it will help residents identify the fastest and safest routes from farms and outlying villages to communities and service centers. Similarly, ATERS will reduce the response time for emergency services. Reducing travel and response time effectively increases the radii of service and response centers. In an analogous manner, faster and better routes make distant service centers more accessible to residents, providing them with additional options. Besides personal accessibility, RISEST offers potential benefits to motor carriers, allowing them to increase the frequency and volume of pickups and deliveries in remote areas.

Mobility. Network fluidity and the predictability of travel times are important indicators of personal and freight mobility. If this proposal is selected, RISEST will improve the reliability of predicted travel times for trucks and passenger vehicles, statewide. In a more specific manner, TISOC will streamline flows and increase trip-time reliability in the Bakken. Likewise, freight platooning will have a major impact on mobility in key corridors.

Safety. The project will improve traveler and trucking safety. In particular, it will reduce winter driving risks, increase the safety of long-distance trucking, and improve safety in the Bakken oilfields—where motor carrier safety has been a concern in the past. Real-time roadway and route information will enhance the safety of first responders and save lives and property.

Efficiency. TISOC will reduce trucking cost in the Bakken by reducing fuel consumption from idling and suboptimal speeds, while increasing labor and vehicle productivity—e.g., a given driver will be able to haul more loads in a shift and a tractor/trailer can accumulate more loaded miles. Similarly, freight platooning will reduce the cost of truck transportation in key corridors. Early tests have shown fuel savings of 4.5% for the lead unit and 15% for the trailing unit of a two-truck platoon.

Economic Vitality. The project will result in faster and more predictable travel speeds, greater accessibility, and lower freight transportation costs per ton-mile. More predictable truck travel speeds and lower line-haul costs will trigger supply-chain efficiencies and improve customer service. Greater accessibility will boost the economic vitality of rural regions and communities through increased retail and distributed manufacturing activities.

Infrastructure ROI. Optimized routings for trucks and passenger cars (that result from real-time information generated from the project) will result in better distributions of traffic among routes, faster speeds, and smoother traffic flows. As a result, highway levels of service can be improved (or maintained longer in the face of increasing traffic) without widening roads.

Transportation Systems and Services Offered

Several transportation management systems will be interfaced or integrated in RISEST. In an analogous manner, key transportation and emergency response systems will be interfaced/integrated in ATERS. The common information system will consist of distributed field sensors located in or near the roadway infrastructure that are fixed (for the most part), as well as mobile sensors roaming the infrastructure. Sensors aboard connected vehicles, trucks, and emergency management, and law enforcement vehicles will provide roaming sensor capabilities. In addition, field reports from snow plow operators and other personnel will provide near real-time information regarding route status and conditions.

Existing Systems

The project will build from existing platforms, so that new services and software systems can be integrated with existing ones. Previous efforts will not be duplicated. The effort will start with the North Dakota Department of Transportation's Travel Advisory Map (which is accessible online).

Roadway Weather Management. The North Dakota Department of Transportation utilizes its Road Weather Information System (RWIS) as a tool to obtain road weather information that is used to provide advance travel information and aid in decision making. The RWIS is a network of local "weather stations" (Figure 3) called environmental sensor stations (ESS). An ESS includes sensors that measure atmospheric and pavement conditions at specific locations. Each station provides atmospheric data including: air temperature, humidity, visibility distance, wind speed and direction, and precipitation type and rate. Roadway condition data are also available from many EES locations, including pavement temperature, pavement condition (e.g., wet, icy), and subsurface conditions (e.g., soil temperature). In addition, snow plow operators report the conditions of roads immediately after plowing.

Road conditions in the Travel Advisory Map are classified on a qualitative scale, ranging from "seasonal/good" to "no travel advised." Intermediate categories include: snow covered, scattered snow/drifts, ice/compacted snow, scattered ice, frost, scattered frost, wet/slush, and scattered wet/slush. The information is updated at least twice per day during winter (and more frequently when warranted). Updates and additional information are provided through Rich Site Summary (RSS) feeds (Table 4). In addition to road status, weather radar information can be displayed on the highway map. More than 50 weather cameras allow visible assessments of conditions during daylight hours on interstate and principal arterial highways.

Incidents and Work Zones. The travel advisory map alerts travelers to traffic incidents that affect travel conditions. Moreover, the map identifies work zones and provides the following information about each zone: the work zone limits (e.g., the route number, beginning mile point, and ending mile point); the affected segment (e.g., from Junction X to Y); the type of work (reconstruction, paving operations, shoulder work, bridge repair, etc.); lane reductions (e.g., reduced to one lane, no lane closures, etc.); configuration/traffic flow (e.g., shared use segment, one lane closed with flagger, etc.); expected travel speeds (e.g., 35-35 mph); expected delays (e.g., ≤ 15 min., > 15 min., etc.); width or height restrictions (e.g., width = 11 feet); and expected start and end dates. Work zone information is entered online in the Construction Automated Records System (CARS) and updated when it changes. In addition to work zones, the travel advisory map (and its GIS interface) provides information on high water, broken pavements, parades, and other planned events.

Table 4: RSS Feeds from NDDOT Travel Information System	
Information Category	**Feed Details**
Road status/ condition	Road conditions, road closures/incidents, any restrictions associated with road condition, travel speeds, precipitation, visibility
Road status, warnings, and events	Descriptions of the warning and/or event, road closures/incidents, any restrictions associated with warning/events, travel speeds
Work zones	Description of restrictions associated with work zone
Width/height	Description of width/height restrictions associated with work zones, incidents, warnings, and events

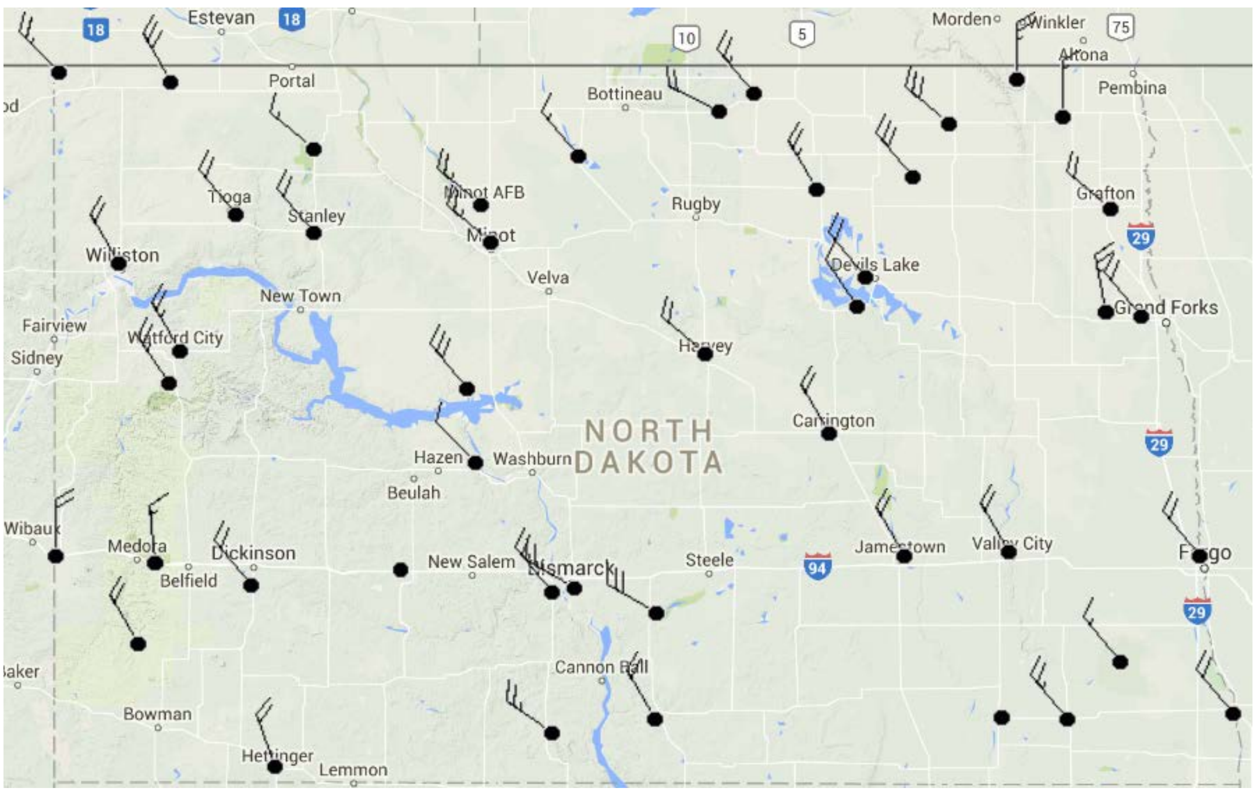

Figure 3. Existing Distribution of Environmental Sensor Stations in North Dakota

<u>State Travel Center</u>. Figure 4 shows the current flow of information (inputs) into the NDDOT travel center and the outputs: map and data files. In addition to roadway weather (ESS) and work zone data (CARS), data from snow plows (SP) and connected vehicles (CV) flow into the travel center. The latter comes from Google under a data sharing arrangement. While output data files are accessed by Google, information from the map is transcribed manually into the CAD at the Public Safety Answering Point (PSAP) sites for emergency response dispatch—signified by the dashed arrow.

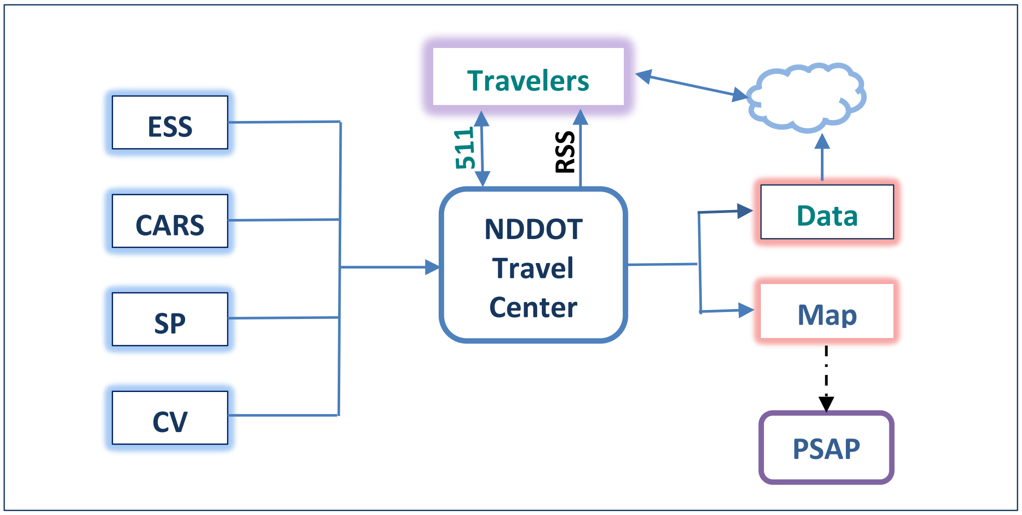

Figure 4 Current Information Flows in State Travel Advisory System

Travelers can access information in several ways other than going online to view the map. They can call 511, an automated voice messaging system; or, they can access RSS feeds with their mobile devices. Travelers can also access Google's in-vehicle route information, derived in part from information originally generated from environmental sensor stations, snow plows, and CARS. Although the information generated by the state travel advisory center is extremely valuable, the distribution is less than pervasive. Of equal importance is the limited intersystem connectivity that exists—e.g., the travel center is not digitally connected to emergency response dispatching. In addition, there are two other shortcomings: (1) the system covers state highways only, and (2) information on blocked highway-rail grade crossings is not currently available.

Some counties provide road condition information through a variety of sources. However, there is no analogy to the state travel map/data center. Information reporting is not consistent across counties and very limited in sparsely populated counties. Yet, most of the rural populace starts or ends their journeys on county or city roads. The state highway system in North Dakota comprises less than 20% of the total road mileage.

Enhanced Systems and Services

Providing comprehensive information for rural roads is a daunting task. However, several platforms exist that would allow this goal to be become a reality during the project. The Upper Great Plains Transportation Institute has developed and implemented a Geographic Roadway Inventory Tool that is currently available to all counties and major cities within the state of North Dakota. This tool allows each county and city to capture all planned and active construction activities. Thus, a construction activity GIS layer could be established for county roads that is similar to the NDDOT's system.

The base digital map of North Dakota (developed by the North Dakota Department of Emergency Services) provides a consistent and comprehensive map of all public roads. A road status and winter condition layer can be developed (as well as a work zone layer) for county and city roads and integrated with the base map. However, rural counties do not have the staff and in-house systems to easily compile and enter the road data. Therefore, the data collection process must be automated. In the technology deployment plan, a rugged onboard smart phone with the proper applications will track snow plow and sand truck routes. The information will be wirelessly transmitted to a data center and graphically displayed on the base map. The information primarily will be useful for pre-trip planning. However, CV technologies will complement this information and help provide updates.

Data Analytics

Predictive analyses and performance measures are essential to the proposal. Real-time information at the start of a trip is vital. Real-time updates during travel are just as important. However, it is not always possible to efficiently adjust routes during travel. Therefore, predictive capabilities are important. Blocked highway-rail grade crossings are an example. If a traveler or emergency responder knows that trains are in the vicinity, this information can be used to adjust the desirability of alternative routes. Even if a crossing is currently open, it may be blocked soon.

Predictive information is best used in combination with pattern (historic) information. If a scheduled train blocks a crossing for 10 minutes between 3 p.m. and 5 p.m. 70% of the time on Monday and Wednesday, this information may be of interest to travelers. However, few of them would take a longer optional route based solely on this information, because their probability of being at the crossing at the same time as the train is much less than 70%. But, what if the traveler knows the train is in the vicinity of the crossing? In this case, he or she may have actionable information. The knowledge would be even more valuable if the train is known to be approaching the crossing.

Data mining and statistical modeling can yield impedance probabilities for routes. Road traffic histories for specific times of the day, days of the week, and months of the year are valuable inputs. Expectations of congestion on certain routes could lead travelers to make decisions regarding preferred paths. Although the focus of this project is on real-time data, predictive capabilities are necessary in enhanced travel information systems to aid in route optimization. Such information could be especially useful in the Bakken, where recurring (but variable) congestion occurs. Because the oil industry is a 24/7 business, time of day and weekday traffic patterns are important. However, truck traffic fluctuates in relation to drilling and fracing schedules. Hence, congestion may move from road to road, as drilling activities shift from zone to zone. This is a much different pattern of congestion than is typically encountered in rural areas.

In TISOC, drilling and fracing plans will be used to forecast near-term congestion levels, in conjunction with current and historic traffic patterns. However, this will require adding specificity to UGPTI's current truck traffic forecasting model. The end result will be weekly or monthly forecasts of expected changes in congestion levels on primary oil-hauling routes due to changes in drilling, fracing, and terminal volumes. In all areas of the state, data analytics are essential to the crowd-sourcing congestion and travel information.

Cybersecurity

The products and services deployed during the project must be secure. All Plains CATT partners will collaborate in this effort. NDSU's Computer Science department will be offering a certificate in Cybersecurity (starting in 2018), which will create a pool of students to work as interns and provide support for researchers. The Institute for Cybersecurity will be conducting complementary studies of secure communication systems for automated and connected vehicles during the time frame of the project. Thus, a supplementary pool of experts will exist to draw from as needed. However, the private-sector partners (first and foremost) will be responsible for cybersecurity. All have impressive but discrete programs in place.

Deployment Plan

Table 5. Deployment Plan: Roadway Information Systems for Efficient and Safe Travel		
Year	**Objective**	
I	1.1	Fully articulate deployment schedules and relationships among work tasks (the results will include workflow arrangements, schedules, and critical path analyses)
	1.2	Conduct outreach to counties; develop preliminary road status reporting process to be implemented during winter of 2017 in select counties
	1.3	Develop smart phone app for county snow plow operators and other vehicles (such as sand trucks); conduct workshops regarding app and how it works
	1.4	Design county road work zone information program to compile data similar to that currently available for state highways
	1.5	Develop prototypes and detailed plans for integrating county winter road condition/work zone information with information gathered from drivers through HERE's CV platform
	1.6	Design data analytics plan, detailing all information needed for performance measurement and assessment; start collecting data from early deployments
	1.7	Report to the Interim Transportation Committee of the 65th North Dakota Legislative Assembly (if requested)
II	1.8	Deploy smart phone app for automated data collection/reporting from snow plows and other county vehicles in participating counties
	1.9	Fuse information gathered from drivers through HERE's CV platform with UGPTI's county winter road and work zone information
	1.10	Develop cybersecurity road map for deployments and action items needed in subsequent years
	1.11	Continue data collection efforts; conduct data mining and analysis as data becomes available
	1.12	Develop assessment report with feedback and recommended adjustments
	1.13	Report to the 66th North Dakota Legislative Assembly (if requested)
III	1.14	Implement automated data collection/reporting system for snow plows and other county vehicles statewide
	1.15	Fuse HERE's CV data with UGPTI's county winter road and work zone information to provide comprehensive travel information system
	1.16	Debut HERE's enhanced travel information system utilizing county plow/vehicle/work zone data
	1.17	Implement advanced data analytics systems, adding predictive capabilities
IV	1.18	Commercial distribution of statewide travel information system services (including state and county roads)

Table 6. Deployment Plan: Advanced Technologies for Emergency Response Services		
Year	**Objective**	
I	2.1	Fully articulate deployment schedules and relationships among work tasks
	2.2	M2M data transfer connecting state travel and lead emergency response dispatch center
	2.3	Grade crossing status capability interfaced with lead emergency response dispatch center
	2.4	Grade crossing status added to HERE's CV platform
	2.5	Data analytics and performance measurement system consist with RISEST
	2.6	Feedback from NDSP and NDES
	2.7	Report to the Interim Transportation Committee (if requested)
II	2.8	Cybersecurity road map consistent with RISEST (Obj. 1.8)
	2.9	Extension of 2.2, 2.3, and 2.4 to all other NDES DSAPs
	2.10	Debut of HERE's Emergency Response system for integrating state travel and emergency response systems (which will be transferable to other states)
	2.11	Advanced data analytics system
	2.12	Year-end performance/assessment report
	2.13	Report to the 66th Legislative Assembly (if requested)
III	2.14	Commercial marketing/distribution of ATERS system

Table 7. Deployment Plan: Telematics and Information Systems for Oilfield Carriers		
Year	**Objective**	
I	3.1	Fully articulate deployment schedules and relationships among work tasks
	3.2	Develop motor carrier real-time travel information system for Bakken oilfields
	3.3	Develop performance measurement system to measure efficiency gains
	3.4	Develop cooperative plan for information sharing with NDDOT and county highway governments
	3.5	Add electronic logging and driver safety support tools to existing telematics suite
	3.6	Develop comprehensive motor carrier activity based costing system for oilfield carriers
	3.7	Report to the Interim Transportation Committee (if requested)
II	3.8	Deploy systems developed in Year 1
	3.9	Use feedback to determine needed improvements
	3.10	Report to the 66th Assembly (if requested)
III	3.11	Deploy final commercial system that can be used by oilfield carriers in other shale oil producing regions

Table 8. Deployment Plan: Corridor Freight Platooning		
Year	**Objective**	
I	4.1	Establish technical and policy working groups to fully articulate corridor freight deployment schedules and relationships among work tasks
	4.2	Identify limited-access corridors for future deployment
	4.3	Identify any adjustments in policies and interagency working arrangements that may be needed (policy working group)
	4.4	Develop platooning demonstration plan and obtain agreements with carriers (technical working group)

Table 8. Deployment Plan: Corridor Freight Platooning		
Year	**Objective**	
	4.5	Develop and implement public awareness outreach effort
II	4.6	Conduct demonstration on limited access highway
	4.7	Report to the interim Transportation Legislative committee (if requested)
	4.8	Commence open road operations
	4.9	Develop and implement a system to collect data and measure efficiency benefits
III	4.10	Continue open road operations
	4.11	Report on results and potential efficiency gains
	4.12	Report to the 66th Legislative Assembly (if requested)
III	4.13	Continue deployment (adding carriers) to achieve corridor economies of scale
	4.14	Final report documenting safety, carrier efficiency, and supply chain benefits

Long-Term Operation and Maintenance Plan

The benefits (and services and products) generated from the project may continue after its 4-year life. Thus, on-going operation and maintenance costs may be incurred to sustain the deployments. The automated data collection system for county roads may need to be updated periodically—e.g., the app will be updated to take advantage of the increasing power of smart phones, tablets, and new operating systems. Similarly, changes in the CAD interface may be needed, as new versions of the CAD (or new CAD systems) are acquired by the Department of Emergency Services. These on-going costs will be borne by Plains CATT.

There are essentially three options for on-going funding for RESIST and ATERS. (1) The state agencies participating in the project will cover any on-going costs incurred after the 4-year life of the project. (2) Funding from the Department of Homeland Security will be requested through the annual grant application process. (3) The costs will be shared by UGPTI's

As the deployment plans indicate, the goal is for many of the enhanced products and services developed during the project to achieve full commercialization by project's end. In many instances, the on-going operational and maintenance costs will be paid by the end users of the services. The deployments will be permanent and independent of additional ATCMTD grant funding.

Challenges or Obstacles to Deployment

Corridor Freight Platooning. Driver training and acceptance issues may arise with platooning; however, participating freight carriers can work through these issues internally. Results from U.S. DOT studies indicate that driver training/acceptance will not be significantly different from other technologies recently introduced.[3] A driver credentialing process may be needed (although other

[3] FHWA-Funded Auburn University study: Heavy Truck Cooperative Adaptive Cruise Control: Evaluation, Testing, and Stakeholder Engagement for Near Term Deployment: Phase Two Final Report. Available at http://eng.auburn.edu/~dmbevly/FHWA_AU_TRUCK_EAR/

states have not elected to require credentialing specifically for platooning). Although additional highway capacity will not be required for platooning, an analysis of bridge effects may be warranted. However, state highway bridges were recently analyzed with respect to accommodating double-trailer 129,000-pound trucks. As a result, the bridges in potential platooning corridors have already been cleared by the Legislature for longer, heavier loads.

Data Sharing. The preservation of traveler privacy and the sharing of filtered data among public and private agencies will require explicit agreements and new working relationships. NDSU has proven practices in place for handling and protecting sensitive information. Moreover, the four state agencies work seamlessly together. However, new agreements will be needed between UGPTI and the private-sector partners. The letters of commitment shown in the appendix provide strong indications of mutual intents to collaborate and share data.

Intellectual Property can be a complicating issue that must be worked through for each innovation or resulting patent. However, it is simplified by the fact that: (1) this is largely a technology deployment rather than a research project (although the project clearly has research components), and (2) the four state agencies do not intend to develop commercial services. There will be no competition between public agencies and businesses. The intent is for the private-sector partners to offer enhanced and new commercial services as a result of this project.

Anticipated Improvements in Safety, Efficiency, and System Performance

RISEST. Fewer crashes are anticipated because of: (1) real-time knowledge of road and traffic conditions, and (2) fewer train/car conflicts. Faster overall traveler speeds are expected because of real-time information updates that allow travelers to adjust routes.

Emergency Response. The North Dakota Legislature mandates emergency response times in the state. The target values are 9 minutes in urban areas, 20 minutes in rural areas, and 30 minutes in frontier areas (North Dakota Legislature, 2010). Responding agencies must meet these targets on 90% or greater of the responses. While agencies generally meet these goals, there are outliers that take twice or more the allotted time. At the outset of this project, baseline measures will be analyzed without the anticipated solutions in place, so that benchmark performance indicators can be developed. Note that real-time information will aid in prevention, as well as in emergency response. With real-time information available for county and state highway routes, the likelihood of stranded travelers will be reduced.

Corridor Freight Platooning. Substantial fuel savings are envisioned: nearly 5% for the lead unit and 10% for the trailing unit.[4] Savings in labor and vehicle maintenance costs are also expected. Truck trip times will be reduced because of more efficient highway operations and increased driver productivity. Truck platooning costs with drivers is expected to be approximately 95% of traditional trucking costs. However, a three-truck platoon with one driver in the lead cab could reduce trucking costs by more than 25%.[5] The reliability of truck transportation may improve as a

[4] FHWA-Funded Auburn University study: Heavy Truck Cooperative Adaptive Cruise Control: Evaluation, Testing, and Stakeholder Engagement for Near Term Deployment: Phase Two Final Report. Available at http://eng.auburn.edu/~dmbevly/FHWA_AU_TRUCK_EAR/

[5] Ibid.

result of platooning, thereby reducing business inventory and other supply-chain costs. Driver fatigue will be reduced as drivers in trailing units rest part of the time. Better driving conditions will help driver recruitment and retention efforts, which have safety and efficiency connotations.

Oilfield Transportation. Fuel savings will result from less idling, acceleration, and deceleration. Traffic will flow smoother with real-time knowledge of incidents, road closures, and conditions. Labor and vehicle productivity will rise. All travelers will benefit from reduced congestion. Driver fatigue will be reduced and working conditions improved.

Quantifiable System Performance Improvements and Benefits

Emergency Response. Response time is a critical factor. One of the main objectives of ATERS is to help agencies reach higher levels of response performance—e.g., 95% or greater. If response times can be improved through the deployment of connected vehicle and transportation technologies, more responsive target values may be possible in the future. The overall satisfaction of first responders to the technology is an equally important indicator of success. UGPTI will survey responders and dispatchers periodically to ascertain and track changes in their satisfaction with the solutions. The surveys will provide answers to key questions, such as: (1) has the technology improved the overall efficiency and effectiveness of dispatching, (2) does the technology blend well with other communication systems and seem seamless to the responder, (3) does the technology improve the efficiency and effectiveness of specific human response tasks, (4) is the technology intimidating or does it raise new concerns, and (5) how can the technology can be improved to better serve responders and dispatchers?

Corridor Truck Efficiency. The combined effects of real-time travel information and corridor freight platooning will boost efficiency in key corridors. Ultimately, these gains will lead to improvements in fleet management and improved service to industries—which, in turn, will reduce total logistics costs and improve supply-chain reliability. To measure performance, baseline trucking costs will be estimated for traditional truck configurations using UGPTI's truck cost model. Trucking companies will be asked to verify the results. Participating carriers or platooning system developers will be asked to provide trip time and other data to allow a re-estimation of costs with corridor platooning. A survey of drivers will be used to gauge improvements in driver satisfaction with the new technology and identify additional training and support needs.

Oilfield Trucking Efficiency. In an analogous manner, UGPTI's truck cost model will be used (in conjunction with trip data generated from Pedigree Technologies telematics system for oilfield haulers) to establish baseline performance measures of: (1) trucking cost per ton-mile, (2) empty time ratio, (3) driver productivity (ton-miles per driver), and (4) vehicle productivity (ton-miles per vehicle). After TISOC is fully implemented, comparable performance measures will be estimated. The baseline and improved measures will be gauged in light of before and after traffic levels. A survey of companies and drivers will be used to assess satisfaction with the new technology.

Overall Traveler Satisfaction. This outcome is difficult to measure. Few travelers will respond to a broadly distributed survey, unless they are dissatisfied. Therefore, a traveler study/focus group will be established. Participants will be solicited through a variety of means. Non-monetary incentives may be offered. An information-generating survey instrument will be designed. Once established, the study group will provide feedback periodically during the project.

Agency Satisfaction. A survey of state troopers will provide insights to potential improvements and training/support needs. Specialists in the motor carrier division will be included.

Feedback/Continuous Improvement. During the project, UGPTI researchers will monitor efficiency and system performance measures to identify continuous improvements and quantify their benefits. The results will be distributed through reports and outreach events and validated through publications in peer-reviewed articles.

Vision, Goals, and Objectives

Emergency Response Vision: A region-wide information sharing and analytic system that utilizes data from emergency vehicles, other vehicles traveling the same roadways, and wayside and embedded infrastructure sensors (which monitor temperature, moisture, and other ambient conditions) to provide real time assessments of vehicle performance, localized environmental and contextual conditions, and conditions along the route the vehicle is taking. The fusion of all vehicle, roadway, and environmental data sources (including localized weather data) will provide emergency response dispatchers with a panoramic (virtual) view of the disaster site, routes leading to and from the site, the absolute and relative locations of vehicles en route to the site, the projected arrival times of vehicles on the scene, and impediments such as blocked roads or crossings that require rerouting of vehicles.

Highway Traveler Vision: A fully informed traveling public, connected through a variety of communication and technological systems: utilizing, but not dependent upon, smart phones. Travelers will have comprehensive pre-trip information for all state and county roads, as well as access to updates through a variety of means. The 511 voice phone network will be extended to major county routes.

Project Goals. By the end of project, Plains CATT will have achieved the following outcomes:

1. A management system and architecture for sharing real-time traffic, condition, incident, and work zone data among agencies, motor carriers, and the traveling public
2. Real-time travel information that is digitally accessible to travelers, motor carriers, and emergency responders; and which includes major county roads, in addition to state highways
3. An emergency response dispatch and routing algorithm based on real-time road status and condition information that:
    a. Includes information not currently available (e.g., blocked highway-rail grade crossings)
    b. Seamlessly communicates with other data systems to enable the electronic transfer of data to the CAD
    c. Optimizes the dispatching and routing of emergency vehicles in rural areas
4. A real-time truck routing and congestion management tool for the Bakken oilfields
5. Truck platoon operations in corridors within the state

Transferable Products. The following products will result from planned activities under the grant that can be transferred to other locations and settings, and/or offered by the private-sector partners participating in the project:

1. An improved commercially available real-time routing model (resulting from a collaborative effort of HERE and GE Transportation) that incorporates highway-rail grade crossing status information (i.e., blocked or open) and predictive capabilities
2. A seamless digital (machine-to-machine) transfer tool that connects state travel data systems and emergency response dispatch centers
3. A real-time motor carrier routing/optimization tool, that is integrated with a suite of truck telematics products (including electronic logging devices) that provide real-time information on vehicle location, speed, queue lengths, and driver status; and is specifically transferable to other oilfield operations

   A congestion management toolbox for county and local governments in shale oil producing regions that can be used for traffic planning and scenario analysis

Synergistic Coordination with Complementary Efforts. The following planned activities and trends will complement the goals of the project. (1) The NDDOT's study of autonomous vehicles (and subsequent report to the North Dakota Legislature) will spur advanced technology deployments in the state. Plains CATT will be in a leadership position; and, therefore, able to build legislative and public support for more extensive technology deployments. (2) Comfort with (and acceptance of) corridor freight platooning will lead to widespread adoption. Coordination with northern tier states through the Northwest Passage coalition will allow for platooning in a freight corridor extending from Minneapolis to Seattle. (3) A multicounty road planning process for the top four oil producing counties (developed in 2017) will continue, resulting in a model rural coordinated planning process. The multicounty energy-impact planning process will benefit TISOC, and vice versa. (4) Data generated from Plains CATT will be used to improve statewide and local transportation planning. The statewide transportation plan, the state freight plan, and multicounty energy road plans will benefit considerably. (5) The implementation of preclearance and wireless roadside inspection (WRI) will enhance motor carrier efficiency. The synthesis of preclearance, WRI, platooning, and real-time information systems will synergistically boost motor carrier productivity to new heights.

Stakeholders and Partnering Strategies

Although it will initially be dependent upon the ATCMTD grant, Plains CATT is intended to be an on-going entity that extends beyond the life of the project. Plains CATT will continuously communicate with other organizations with parallel and complementary missions. One such organization is the North Dakota Transportation Safety Advisory Group—which includes representatives from NDDOT, NDES, NDSP, and the North Dakota Public Service Commission; the division offices of FHWA, FRA, and FMCSA; and the regional PHMSA office. The ATCMTD project will be closely coordinated with NDDOT's on-going statewide transportation planning process, NDES's statewide plan for emergency services, and NDSP's safety and enforcement management plan. Plains CATT will be a catalyst for collaborative research efforts, in which NDSU and the private-sectors explore new opportunities for the deployment of emergent technologies and adjust/add elements to existing workforce development and educational programs. Graduates of the future must be fluent in technologies. Plains CATT offers a platform for faculty and students to interact with private-sector partners in shaping the transportation curriculum of tomorrow.

Leveraging and Optimizing Transportation Technology Investments

As a permanent consortium, Plains CATT will continue to leverage and optimize the investments made by U.S. DOT and the private-sector partners, creating benefits for years to come. As noted earlier, the North Dakota Legislature will be asked to provide supplemental funding for continued research and technology deployment in the future. As the timeline for autonomous vehicle deployment in North Dakota becomes clearer, Plains CATT will seek partnerships with original equipment manufacturers. Together with GE Transportation, HERE, and Pedigree Technologies, UGPTI will seek other sources of research funding—including funding from OEMs and foundations. The ATCMTD investment will fuel existing research interests within the Mountain-Plains Consortium, as several of NDSU's partners are engaged in research and development efforts with respect to automation of surface transportation systems. Moreover, several MPC partners (including UGPTI) are involved in research components of Denver, Colorado's Smart City initiative. In addition, UGPTI is partnering with the University of Modern Sciences in the United Arab Emirates on several related initiatives—one of which is the deployment of intelligent transportation solutions in Dubai.

If this proposal is selected, a knowledge exchange will be established that may potentially involve agencies such as the Roads and Transportation Authority of Dubai and private enterprises specializing in the automation of transportation systems. Dubai is on a fast track to automation and technology deployment, leading to the 2020 World Expo. The knowledge exchange between Plains CATT and the UAE could accelerate technology deployments in both countries.

Schedule

The project will be conducted over a four-year time frame. A kick-off meeting will be held with the U.S. DOT within 4 weeks of the award. The project schedule is detailed in the Deployment Plan, presented earlier. A more precise timeline of deployments within each year will be presented during the kickoff meeting. Monthly progress reports will be submitted to document the activities performed, anticipated activities, and any changes to the schedule. In addition, annual reports will be prepared and distributed.

Staffing Description

The Upper Great Plains Transportation Institute will lead Plains CATT, contract with Federal Highway Administration, and be responsible for grant fulfillment, compliance, and reporting. Denver Tolliver, the director of the Upper Great Plains Transportation Institute, will serve as the overall project manager and primary contact.

Key Staff Members

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