
Towards the Establishment of a Centre of Expertise
and Testbed in Rural and Low-Density Intelligent
Transportation Applications at the University of
New Brunswick



Final Report

Prepared for:

Transport Canada
Intelligent Transportation Systems
Transportation Technology & Innovation

(Official TC publication number is pending)

Trevor R. Hanson, MScE, P.Eng
Eric Hildebrand, PhD, P.Eng



University of New Brunswick
Transportation Group

April 2009

Executive Summary

In September 2008, the University of New Brunswick Transportation Group was contracted by Transport Canada to conduct a study into Intelligent Transportation Systems (ITS) and rural and low-density applications. The purpose of the project was to conduct intelligence gathering and requirements development for the establishment of a Centre of Expertise in Rural ITS and a Cooperative Vehicle Infrastructure System (CVIS) enabled test-bed for rural and low-density transportation safety applications at the University of New Brunswick.

Based on site visits of Alaskan and Finnish rural ITS experience, combined with stakeholder surveys and other discussions, a dedicated applied research effort in rural ITS focused on wireless technologies and CVIS is needed. The Canadian Centre for Rural ITS (CCRITS) is proposed to be an independent, but UNB-affiliated, organization that would meet this need through a Centre of Expertise and test-bed. Once established, this effort is expected to have broad-based local, national and international interest and support from government, private sector, and academic stakeholders. There are significant opportunities for national and international collaborations and partnerships, as well as developing capacity building and highly qualified personnel. In addition, small and mid-sized municipalities present opportunities for collaboration and stand to significantly benefit from an applied research program that includes them.

Specific areas for potential proof-of-concept, pre-deployment, operational evaluations, and pilot projects include (in order of level of interest by survey respondents).

1. Upcoming real time highway conditions (weather/traffic)
2. Highway speed limits that change based on weather condition or traffic congestion
3. Presence of animals on the road
4. Bridge capacity warnings/no through trucking warning
5. In-vehicle warning of a train approaching a crossing (rural area)
6. Alternate route information for when a train is blocking a crossing
7. Parking facilities and number of available spaces in an urban area

A proposed framework for applied Rural ITS research has been developed based on the stakeholder surveys and other intelligence gathering and is “shovel ready”. This framework is based on a holistic approach to rural transportation issues, including addressing four themes: safety, security, efficiency and environmental mitigation. The next step involves obtaining sufficient funding to move this forward, estimated at \$500,000 per year.

Table of Contents

Executive Summary	i
1.0 Introduction.....	1
1.1 Definitions.....	2
1.2 Historical context	3
1.3 Recent research activities by UNB	3
1.4 The need for a rural transportation focus	3
1.4.1 Practical challenges.....	4
1.4.2 Institutional challenges	4
1.4.3 Technical challenges	4
1.5 Current applied research gaps and opportunities	4
1.5.1 Views on VII from the 2008 National Rural ITS Conference	5
2.0 ITS lessons from Alaska	7
2.1 Challenges facing rural and remote deployments	7
2.2 Maximizing efficient use of infrastructure	8
3.0 ITS lessons from Finland	10
3.1 Finnish Road Administration initiatives	10
3.2 Profile of Destia Road Management.....	11
3.3 VTT Technical Research Centre of Finland initiatives	12
3.3.1 VTT research into rural rail systems.....	13
3.4 Research at the Helsinki University of Technology	15
4.0 Stakeholder survey	16
4.1 Summary results.....	16
4.2 Research directions with broad-based stakeholder interest	17
4.2.1 Real-time weather and traveller information	17
4.2.2 Intelligent variable speed limits	17
4.2.3 Detection of animal road obstructions	18
4.3 Research directions with more selective stakeholder interest.....	18
4.3.1 Bridge capacity warnings/no through trucking warning.....	18
4.3.2 In-vehicle warning of a train approaching a rural crossing	18
4.3.2.1 Opportunities for testing and research	19
4.4 Specialized research directions for commercialization.....	20
4.5 Caveats.....	20
4.6 Requirements for enabling technologies.....	20
5.0 Framework for a Centre of Expertise.....	22
5.1 Vision.....	22
5.2 Mission.....	22
5.3 Action areas	22
5.4 Concept of Operations – Proposed	23
The most recent Rural ITS Research agreement has produced some recommendations for best practices for the development of new Rural ITS Research, which are reflected in the proposed concept of operations.	23
5.5 Administrative best practices.....	23
5.5.1 In-kind contributions.....	23
5.5.2 Financial submission packages	24

5.5.3	Project administration	24
5.6	Deliverables	24
5.7	Estimated costs.....	24
5.8	Summary of potential research partners	25
6.0	Conclusions and recommendations.....	26
7.0	Next steps	26
8.0	Selected photos	27
9.0	Appendices.....	33
9.1	Catalogue of subject matter experts.....	33
9.2	Profile of VTT and European ITS, V2V, V2I initiatives.....	34
9.3	Survey results by organizational type	36
9.3.1	Results from municipalities in NB.....	38
9.3.2	Results from universities.....	40
9.3.3	Results from vehicle user group	41
9.3.4	Results from private sector respondent.....	41
9.4	Views on VII (IntelliDrive)/CVIS	42
9.4.1	Rural rail grade crossings.....	42
10.0	References.....	45

1.0 Introduction

In September 2008, the University of New Brunswick Transportation Group was contracted by Transport Canada to conduct a study into Intelligent Transportation Systems (ITS) and rural and low-density applications. The purpose of the project was to conduct intelligence gathering and requirements development for the establishment of a Centre of Expertise in Rural ITS and a Cooperative Vehicle Infrastructure System (CVIS) enabled test-bed for rural and low-density transportation safety applications at the University of New Brunswick. Currently, no such Centre of Expertise or rural test-bed exists in Canada.

This research project had two goals:

- 1 Developing a Framework for the Establishment of a Centre of Expertise in Rural ITS Applications at UNB.
- 2 Requirements Development for a CVIS enabled test-bed for rural and low-density transportation safety applications at the University of New Brunswick.

Satisfying these goals required undertaking several activities:

- Site visit of Power and Communications Requirements in Extreme Rural Settings
- Site Visit to Rural and Low-Density Rail Grade Crossing Testbed for Requirements Development and Exploration of Possible International Research Collaboration;
- Intelligence Gathering of High-Level Functional Testbed Requirements from Key Stakeholders from the Rail Transportation Safety Domain.
- Distribution and processes of stakeholder surveys

The intelligence gathering included:

- Attending the National Rural ITS Conference in Anchorage, Alaska
 - Included tours of the Whittier road/rail tunnel and the Turnagain Arm Road Weather Information System (RWIS) station
 - Discussions with many ITS stakeholders
 - Attending ENTERPRISE pooled research fund meeting
 - Attending and participating in the rural Vehicle Infrastructure Integration (VII) conference session
 - A self-guided tour of transportation technology installations on the Glenn Highway and Parks Highway in Alaska
- Visiting transportation installations in Helsinki, Finland
 - Tour of the Finnra Traffic Management Centre
 - Meeting with ITS researchers from VTT Technical Research Centre of Finland
 - Discussions with Helsinki University of Technology Department of Civil Engineering

- Tour of Destia Road Management
- A self-guided tour of transportation technology installations in Helsinki
- Preparation, distribution and analysis of stakeholder surveys
 - Distributed directly to stakeholders
 - Distributed via industry associations including ITS Canada and ITS America

1.1 Definitions

Due to the highly specialized nature of the transportation technologies and programs, three key terms require definition:

Rural ITS

Rural ITS can be characterized by all of the technologies that make a transportation system more intelligent, though the bulk of deployments appear to focus on wayside infrastructure either supporting a centralized decision-making complex (e.g. Traffic management centres, Weigh-in-motion) or relaying information to drivers (e.g. variable message signs).

VII – Vehicle-Infrastructure Integration (now IntelliDrive)

VII is a U.S. developed program that “combines leading edge technologies—advanced wireless communications, on-board computer processing, advanced vehicle-sensors, GPS navigation, smart infrastructure, and others—to provide the capability for vehicles to identify threats and hazards on the roadway and communicate this information over wireless networks to give drivers alerts and warnings” (IntelliDrive, 2009)¹. Since early 2009, VII has been rebranded as “IntelliDrive”. Though the name has changed, VII is still used in this report to ensure consistency with previous research efforts in this field.

VII (IntelliDrive) makes the vehicle central to the data sharing process, either as a platform for relaying information, or to supply direct real-time information to drivers. The concepts that make up VII are found in the ITS Architectures of both Canada and the United States², though VII does have its own architecture. The defining feature of VII is its reliance on licensed 5.9 Ghz Dedicated Short-Range Communications (DSRC) for relaying information. It would be enabled by roadside wireless “hotspots” permitting vehicular and backhaul communications¹.

CVIS - Cooperative Vehicle-Infrastructure Systems

Cooperative Vehicle-Infrastructure Systems (CVIS) is an emerging field of ITS that uses wireless communications to connect, in real-time, vehicles to vehicles, vehicles to infrastructure and vehicles to personal devices. CVIS focuses on systems and applications that support active and passive safety, mobility, e-commerce and info-tainment. VII (IntelliDrive) refers to the program, CVIS refers to the approach to enable the program.

¹ <http://www.intelldriveusa.org/overview/>

² <http://www.iteris.com/itsarch/html/entity/paents.htm>

1.2 Historical context

In 2004, Transport Canada and the New Brunswick Department of Transportation signed an agreement for up to \$1 million in shared funding for research into rural Intelligent Transportation Systems. This established a National Rural ITS Research Program at the University of New Brunswick, with the Transportation Group as the primary research partner. The Research Program was funded on a project-by-project basis, with five projects included with the original signing of the agreement in 2004. By 2008 the five projects grew to ten projects and the \$1 million funding had been totally committed. The project agreement expired in 2008. With ten projects successfully completed, a new agreement and approach is needed to ensure long-term successful innovation and applied research partnerships.

The recent Rural ITS Research Program had been an excellent first step, demonstrating the strength of the professional networks, academic research, and research potential of those involved with it. Given the expiration of the federal/provincial funding agreement in 2008, efforts have been underway to take this program to the next level to take advantage of the existing relationships, knowledge and spirit of innovation. Achieving success in this field requires renewed commitments to enhance program scope and funding resulting in a strong applied research and development initiative.

1.3 Recent research activities by UNB

Research completed in April 2008 by the University of New Brunswick Transportation Group (UNBTG) for Transport Canada consisted of a feasibility study of using Vehicle Infrastructure Cooperation (VIC is now referred to as CVIS) to enhance safety at rural and low-density passive rail grade crossings, including the development of a test-bed. Since The UNBTG report concluded that further background work and intelligence gathering should be considered to successfully lay the groundwork for a new research initiative in this domain. Literature and background research identified the United States (U.S.) and Finland as being leaders in rural ITS and in rural grade crossing technology. The report recommended developing a better understanding of current state of the art developments in Finland and the U.S. and to develop national and international research networks. The 2008 National Rural ITS Conference was identified as an excellent opportunity to speak with peers regarding the challenges and opportunities for deployment of this technology on the rural network.

The report also recommended exploring the broader vision of using wireless technologies to enhance the safety and efficiency of rural surface transportation (such as rural highways and corridors). The report concluded that a *Centre of Expertise in Rural [CVIS]* should be explored in further research efforts.

1.4 The need for a rural transportation focus

While some applied rural ITS research has been undertaken by organizations such as the National Research Council (NRC) Centre for Surface Transportation Technology³, Transport Canada's Transportation Technology and Innovation Directorate

³ http://www.nrc-cnrc.gc.ca/doingbusiness/tech_cstt_e.html

(Transportation Development Centre and ITS policy branch), and the University of Toronto's ITS Testbed⁴ it has been on a project-by-project basis and not in the context of a larger applied research application for rural and low-density areas.

Rural and low-density transportation needs are different from urban areas: Higher highway operating speeds; mix of commercial, recreational and automobile traffic; long distances between centres; localized or limited congestion, variable weather conditions and topography; presence of animals are all circumstances faced by rural transportation users. These circumstances reflect the practical, institutional and technical challenges faced by jurisdictions that are looking to address these issues in their rural and low-density areas.

1.4.1 Practical challenges

Practical challenges for rural areas relate to the timely collection, organization, dissemination, and interpretation of relevant data. A robust data supply chain is required to ensure that end users will have the proper information on which to base their travel decisions. The same is true for VII (IntelliDrive), which relies on the same criteria for information relayed by other vehicles or wayside infrastructure.

1.4.2 Institutional challenges

Institutional challenges relate to perceived lack of uptake of ITS by rural and low-density jurisdictions. The institutional barriers may be due to a lack of perceived need or lack of available staffing to focus on ITS. It has been suggested that the lack of small and mid-sized municipalities as members in ITS Canada is not due to lack of interest in technology, but reflective of the lack of resources at this level to participate in ITS deployments that are unproven in the local and small municipal contextⁱⁱ.

1.4.3 Technical challenges

Technical challenges for rural areas relate to the deployment of transportation technology in low-density settings where power supply and communications may be limited. Wayside installations may require an exclusive power supply and a remote location may be subject to infrequent maintenance inspections. Rural installations may also be subject to vandalism. Vehicle-based initiatives, such as VII (IntelliDrive) are being developed where the vehicle itself is a mobile data platform that can communicate with other vehicles (Vehicle to Vehicle or V2V), with wayside infrastructure (Vehicle to Infrastructure or V2I), or a combination of the two and with platforms such as mobile communication devices (Open network)ⁱⁱⁱ. Another challenge is that direct communication V2V may not be reliable in areas of low vehicle volume since vehicle headways may be too large to be within communication range.

1.5 Perspectives on addressing applied research gaps

The recent research program with the University of New Brunswick, the New Brunswick Department of Transportation, and Transport Canada represented the first investment exclusively for rural ITS research in Canada. In addition, discussions with stakeholders

⁴ <http://www.civil.engineering.utoronto.ca/infoabout/research/transport/subpages/ITS.htm>

suggest that there is a national and international research gap in vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communication applications for rural and low-density transportation applications. This provides additional impetus for the case to formalize and organize rural ITS research efforts into a long-term approach to address rural and low-density transportation safety, security, efficiency and environmental mitigation. Organizing these efforts will also allow for researchers to contribute to rural ITS transportation policy, of which very little exists in Canada. This can be a virtual centre of expertise, open to researchers and public and private sector partners from Canada and internationally.

1.5.1 Views on VII from the 2008 National Rural ITS Conference

The National Rural ITS Conference is an annual event that brings together public agencies, technology vendors, consultants and academics from the U.S. (and Canada) to discuss the latest trends in rural ITS. The National Rural ITS conference in Anchorage, AK in September 2008 held a special session that focused on VII (IntelliDrive) and VII in the rural context.

Discussion centred on the requirement for every vehicle to be instrumented so that the VII system can meet its potential. Universal instrumentation is appearing to be less and less likely to be realized. There are both practical and institutional challenges to VII deployment (beyond demonstration projects), though speakers such as Ralph Robinson (formerly of Ford and now of UMTRI) suggested that technology is not the limitation for VII, rather institutional issues were at play. He suggested that VII for mobility needs to be separated from VII for safety deployments. Vehicle-to-Vehicle communications will remain the domain of the car companies, while Vehicle-to-Infrastructure presents promising research opportunities. He also suggested that VII mobility applications tied to DSRC will be slow and costly to implement.

Scott Belcher, CEO of ITS America, also concurred that the challenges of VII are not a technology issue and contended that there is a lack of leadership in the United States surrounding VII that is hampering progress on this file. He stated that there is too much focus on DSRC and there needs to be a new focus on safety, but there is no business model and no money. He also spoke of three VII-related test-beds operating in the U.S: Michigan (Federal), California (State), and New York City (ITS America).

Clint Gregory spoke to the Trans-Sierra Rural VII Corridor test-bed on State Route 88 in California. Nic Ward from the Western Transportation Institute argued that there needs to more focus on the users of the technology, rather than just the technology itself, including causal factors for accidents and whether VII can actually help. Deployment of VII in rural areas will be a slow process as data show rural residents tend to keep their vehicles longer, which increases the length of time for fleet penetration. In addition, by the time the vehicle fleet has completely turned over, advances in technology may have made the original concept obsolete. Based on the discussions at this conference, the concept of VII in the U.S. appears to face an uncertain future, especially in the context of the exhaustion of the Highway Trust Fund and the looming U.S. budget crisis. Some

have even suggested that the program will be scaled back considerably following the VII demonstration project at the ITS World Congress.

Conversely, there appear to be opportunities for further research into low-cost and after-market solutions, as well as Vehicle-to-Infrastructure (or vice-versa) communication for the purposes of enhancing safety. There appears to be some support within the VII community for a rural-based test-bed since such a test-bed appears to be lacking. There was no open discussion amongst participants regarding train-to-vehicle communications, though private discussion with one researcher suggested that a train-to-vehicle grade crossing warning system would make a good PhD research area.

A test-bed focused on aftermarket solutions would be consistent with the direction that appears to be under discussion in the U.S. Paul Brubaker, Administrator of the USDOT Research and Innovative Technology Administration (RITA), in speaking with ITS International magazine (Jan/Feb 2008) highlighted one current challenge that presents an opportunity for future research: the exclusion of the aftermarket sector from the VII “scene”. Efforts are currently being made to move forward on this perceived research vacuum. SafeTrip-21, a “partnership of federal, state, and local governments and agencies, the private sector and academia” launched a \$12 million test-bed in California in May 2008. The purpose of this test-bed is to evaluate the ability to deliver some VII through mobile devices and other communication platforms^{iv}.

2.0 ITS lessons from Alaska

UNB researcher Trevor Hanson conducted the data collection initiatives, including: travel to the National Rural ITS Conference in Anchorage, AK from September 3-5, 2008. Selected photos profiling the Alaskan transportation experience are located in Section 8.0. A list of subject matter experts is located in Section 9.0.

The extreme geography and climate of Alaska necessitate unique solutions for its transportation challenges. It has a population of approximately 670,000^v with approximately half living in and around the City of Anchorage. The capital city of Juneau, as well as other smaller centres, is only accessible by air and water. Travelling to other towns and cities is possible by road and railway, though there are extensive distances between centres.

2.1 Challenges facing rural and remote deployments

The severe winter weather and minimal daylight during the winter poses many challenges to remotely deployed ITS. For example, at Turnagain Pass off of the Seward Highway, an off-the-grid Road Weather Information Station (RWIS) has been deployed to support the weather information needs of the Alaska DOT. While a solar panel is employed, it is unable to furnish sufficient power to keep the RWIS operating, therefore it is complemented through the use of a large propane-fed generator. This solution minimizes power interruptions and overcomes the challenge of remote power supply and minimal solar generation capabilities in winter.



**Figure 1: RWIS at Turnagain Pass on the Seward Highway.
Pole-mounted sensors (L), propane generator and solar panel (R)**

The Glenn Highway travels north from Anchorage to the communities of Palmer and Glennallen. The Glenn Highway is the route for traffic travelling to and from Canada. Due to significant bridge construction and associated delays, variable message signs are

employed to provide advance warning to motorists of the delays. In this example, a power supply was available (Figure 2).



Figure 2: Variable message sign in remote area on Glenn Highway

The highway travelling through Palmer connecting to Wasilla functions primarily as a community main street, with several signalized intersections. The lack of adequate sight distance coming from the Glenn Highway to the first of the several signalized intersections likely precipitated the installation of a changeable sign to advise motorists of an upcoming stop situation (Figure 3).



Figure 3: Changeable message sign near Palmer

2.2 Maximizing efficient use of infrastructure

Alaska's proximity to Asia contributed to its strategic military importance during the Second World War. This led to the construction of a 2.5 mile rail tunnel from the port of Whittier to connect with the Alaska Railroad to Anchorage, which reduced the shipping distance for military equipment to the base in Anchorage from the continental United

States⁵. After the Second World War, rail traffic using this tunnel steadily declined, while the demand for vehicular access to Whittier by train increased. It was not considered feasible to construct a second tunnel to serve vehicle traffic exclusively, therefore in 1998 construction began on refitting the tunnel to accommodate rail and vehicular traffic.

During certain times of the day, the tunnel is reserved for railroad use only. For the remainder of the day, the tunnel permits one way travel by vehicles. Traffic flow direction changes every 30 minutes. The interior of the tunnel has been modified so that vehicles can drive on a smooth surface (Figure 4). The system is managed by a control centre which keeps in constant communication with the Alaska Railroad so that the tunnel can be switched over for railroad use when necessary. The control centre indicates when vehicles may enter the tunnel (following a lead pace vehicle). The tunnel is instrumented with cameras and speed sensors, as well as state-of-the-art fire detection and suppression systems.

The lesson from this initiative is that ITS can be used to maximize the use of a multimodal transportation asset while enhancing safety and efficiency. A costly tunnel construction was avoided.



Figure 4: Whittier Tunnel. Toll gates (L), Tunnel interior (R)

⁵ <http://www.dot.state.ak.us/creg/whittiertunnel/history.shtml>

3.0 ITS lessons from Finland

Trevor Hanson met with representatives for various transportation agencies in Helsinki, Finland from October 23 - 25, 2008. Selected photos profiling the Finnish transportation experience are located in Section 8.0.

Finland shares many commonalities with New Brunswick, including a being a smaller jurisdiction within a larger union (5.3 million people⁶ within the larger European Union of 822 million people⁷), an extensive rural transportation network, winter climate, extensive forestry sector, and relatively few urban centres. In addition, New Brunswick operates in a bilingual environment (French and English), and while Finland is also officially bilingual (Finnish and Swedish), much information is available in English and occasionally in Russian.

Finland is considered a world leader in telecommunications (Nokia, the cellular phone company is headquartered here). The experience in telecommunications has translated well to advancements in ITS, especially in the field of Rural ITS. Finland also employs ITS technology within its municipalities. Though charged with separate responsibilities, there is significant coordination between agencies responsible for traffic and incident management, traveller information, operations and maintenance, and research and development.

3.1 *Finnish Road Administration initiatives*

Finnra is the Finnish Road Administration⁸ which is responsible for the planning, procurement, customer services, and other technical services relating to roads and highways in Finland. They also have developed and maintain four traffic management centres (TMC) across Finland. Each TMC has a specialty. Turku's centre maintains important ferry information. Tampere specializes in border crossing information. These urban areas (100,000 people) are far smaller than the typical North American city with a TMC, yet they are an integral component of Finland's transportation system. Information is collected on roads with AADT of 5000 and up. One of Finnra's strengths is quality management, which is a by-product of its substantial data collection efforts.

Finnra has also been creating partnerships with Destia Road Management in terms of identifying what are free information services to the public and what should be charged. Destia is responsible for the maintenance of 70% of Finland's road network. Tenders for this contract are awarded every 5-7 years. Destia provides road information every four hours to the Finnish Road Administration.

The Finnra TMC in Helsinki is working towards automatic enforcement of speeding violations. It has speeding cameras throughout Helsinki, though not all are active since

⁶ http://www.stat.fi/tup/suoluk/suoluk_vaesto_en.html

⁷ http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-081/EN/KS-SF-08-081-EN.PDF

⁸ <http://www.tiehallinto.fi>

they are being used as a deterrent. Incident management is undertaken 24/7. The purpose of the TMC is to monitor traffic in Helsinki, including tunnel traffic. A public education campaign was necessary to ensure openness and transparency with the public.

Finnra also employs variable speed limits throughout Finland. While variable speed limits have many legal issues surrounding them, they have been mostly overcome due to significant effort. “Fuzzy logic” (or adaptive) speed limits have to be designed as such from the very beginning. There are challenges with demonstrating the value and cost/benefit for some of the technology. Algorithms for changing speed limits automatically are based on a combination of weather and traffic. They have an advanced protocol of incident management. Information is always up-to-date. The TMC also manages the public complaints protocol – (e.g. is the issue valid, perhaps the standard is incorrect?). They are working towards multiagency cooperation and have maintained good links with the media.

3.2 Profile of Destia Road Management

Destia provides road information every four hours to the Finnish Road Administration. The centre operates 7 months of the year and employs two staff members during the winter. Information that is collected includes friction demand, which is measured manually and phoned in. If friction is less than 0.3, Destia has two hours to remedy the situation or they are assessed a penalty. Destia has a responsibility to keep roads open; the policy is not to close roads.



Figure 5: Trevor Hanson (L) with Eerio Mikkola, manager Destia

Road conditions are assessed visually and electronically using a nationwide inventory of 300 road weather information stations with mounted cameras. Data are transferred by General Packet Radio Service (GPRS) at a cost per unit data instead of connection time (as per modems). Typical camera refresh cycle is 10 – 20 minutes, though this can be changed. One issue with the RWIS is that in rural areas there are no lights next to the station making it difficult to assess road condition. Cameras should have some light next to them to assist with this procedure.

All of Finland’s RWIS network, including those operated by other companies, can be viewed by each maintenance company. When a road user complaint arises, it is logged in a database by Finnra and made available to Destia. Destia is responsible for identifying which of the complaints falls under its jurisdiction and to report back to Finnra how they plan to resolve the issue (they click a button marked “starting” when work begins). This database, while labour intensive, provides a feedback mechanism for the public, a communications medium for Finnra and its contractors, and a record for maintaining quality assurance. Destia uses text messages to communicate with its employees. Destia

also shares road weather information with its competitors as they are truly only competitors at time of contract tender.

3.3 VTT Technical Research Centre of Finland initiatives

VTT Technical Research Centre of Finland the biggest multi-technological applied research organisation in Northern Europe⁹. It employs over 2700 people with a budget of 232 million Euros. It is also a European leader in ITS, coordinating three major national Finnish research and development programmes between 1998 and 2007^{vi}.



Figure 6: VTT Technical Research Centre of Finland

Discussions with Dr. Risto Kulmala, ITS Research Professor, and Mr. Risto Oorni, Researcher, determined that Finland faces some of the same transportation challenges as in rural Canada: many roads, low density, not big issues with congestion, and the concept of “empty road” management. Much of the emphasis has been on mobile systems. Some of the projects have included

intelligent variable speed limits, weather monitoring stations, and floating vehicle data collection (friction and environmental data, heavy vehicle as mobile sensors). They do not report any legal issues or problems relating to variable speed limits, though neighbouring Sweden has been reluctant to introduce them. In some cases, vehicles sped up rather than slowing down. Enforcement of these limits is difficult as Finland now operates over 300 km of variable speed limit roads. These speed limits are determined on a rule-based system: “good”, “adverse”, and “risky”. In each case, limits are dropped in 20 km/h intervals. Warning signs provide reasons for the speed reduction, not just the weather.

Finland has experimented with animal detection systems but has yet to find a satisfactory system. Infrared sensors have issues during rain, video detection needs lighting, and motion sensors have a lot of false alarms. Possibly a combination of all three systems may improve detection. “Night vision” is another alternative, but people compensate by driving faster. Finland is also researching the use of speed limiters to improve speed compliance. Research needs include developing a database of speed limits and retrofitting vehicles.

In North America, the emergency phone number is 911, while in Finland it is 112. In three years, it is expected that vehicles will have a standard option in all European vehicles of having 112 dialled automatically after an accident, with the number of occupants also forwarded to emergency authorities. By 2011-12, “Ecall” will be a standard option.

⁹ <http://www.vtt.fi/?lang=en>

Road user charging is the next step for Europe. The only way to impact user behaviour is to have a reward or a negative consequence. It is expected that the Netherlands will have a national solution for road user charging by 2012.

There are issues with market penetration of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). It is a slow process. Government should have a role in this technology because of the public benefit: healthcare benefits, benefits to insurance companies. There are challenges with carmaker technology – high end vehicles have it, but lower end does not. In Finland, car import taxes are quite high meaning that vehicle turnover is low. The concept is to use “nomadic” or aftermarket solutions, such as cellphones. There is a need for open “in-vehicle telematics” program that involves industrial players.

A possible business model includes the use of Public-Private-Partnerships (PPP). One area of success for VTT is in quantifying and qualifying the benefits and costs of ITS deployment. One tool includes Evaserve (www.evaserve.fi), a meta-tool for evaluation and development of information services.

3.3.1 VTT research into rural rail systems



Figure 7: VTT researchers Ari Virtanen (L) and Risto Öörni (R)

Finland also has an extensive rural rail network and consequently, enhancing safety at rural grade crossings is a priority. Researchers Risto Öörni (right) and his colleague Mr. Ari Virtanen (left) have pioneered a Global positioning systems (GPS)-based in-vehicle warning system for rural railway grade crossings (herein referred to as “the test-bed”).

Mr. Öörni indicated that Finland is a signatory of the 1968 Vienna Convention on Road signs and Signals¹⁰, a requirement of all member states of the European Union¹¹. This convention ensures uniformity in road signage, rules and regulations, including signals and

signage for level crossings.

The test-bed track runs for 50 km from the communities of Hanko to Hyvinkää via Karjaa (Figure 8). There are 10-20 trains per day on this line. It is envisioned as part of the expanded test-bed that 150 cars using passive crossings will be instrumented, as well as 100 locomotives or rail busses. It is expected to begin testing in early 2009. There is consideration of using mail delivery vehicles as participants. Demographic information is collected in a database, though the name database is destroyed.

¹⁰ <http://www.unece.org/trans/conventn/crt1968e.pdf>

¹¹ <http://register.consilium.europa.eu/pdf/en/08/st03/st03652.en08.pdf>



Figure 8: Geographic scope of Finnish rail grade crossing research

Global positioning systems (GPS) are the enabling technology of this system, and there must be a wireless communication network present. There is consideration of using an aftermarket device, such as a cellphone or other low-cost option, and using that as compensation for participating in the study. Considerable background work is needed to identify each position of a level crossing, which also requires the use of a digital map of the rail network.

There is currently no feedback communication to the locomotive driver if the message was received by the vehicle. The research team did not believe this is a necessary feature of the system. The motivation of the research is that this system will provide enhanced safety compared to having no crossing protection presently.

There are two major differences between the rail network in Finland and in Canada (aside from the gauge). There is only one rail operator in Finland and rail usage is primarily for passengers though it is open to freight. The passenger rail system in many areas consists of a rail “bus”, which is just one rail vehicle, and the primary candidate for this system. Because the test-bed relies on positional information, systems need to be installed on all locomotives, however, it is unclear whether more may be needed for long freight trains, like the kind assembled in Canada.

The technology appears to work well in as demonstrated in a video. GPS data are sampled at the rate of 1 point every 5 seconds, though there are issues with data latency (if the GPS unit on the train is not powered, it can take up to 12 minutes to reacquire a signal when power is reapplied). In this model, a train’s route must be known so that “ghost trains” are removed from the system. A ghost train occurs when a train approaches a junction but its proximity to another crossing on the approach causes a false activation of the system. If the route of the train is not known, a 1.2 km warning area is established around crossings.

The test-bed has certain requirements:

- Communication infrastructure and wireless access

- Centralized database for rail information (crossing inventory)
- Centerline railway and road data

VTT is open to international collaboration with Canada in ITS. VTT appears receptive to allow Canadian researchers to set up a similar proof-of-concept test-bed for in-vehicle warning systems for passive grade crossings in Canada. VTT staff are highly professional and knowledgeable of the state-of-the-art rural ITS developments and would make excellent research collaborators.

3.4 Research at the Helsinki University of Technology



Figure 9: Helsinki University of Technology

The Helsinki University of Technology (left) is located a short walk from VTT. The expertise of this department is in telematics and technology and human factors. Projects have included research relating to crosswalks, driver simulation, and behavioural studies. One rural-related project included erecting medians on two-lane highways. Their experience has shown this is a successful remedy to head-on collisions. They also have researched road maintenance communication and driver warnings.

4.0 Stakeholder survey

Tailored stakeholder surveys were distributed to organizations in Canada and the United States through ITS Canada and ITS America with the purposes of identifying a general rural ITS research direction.

Respondents were asked to identify their organization's level of interest in seven different technologies that could provide safety and mobility information to drivers in rural and low-density areas. "Level of interest" was categorized into: *None, Little, Moderate, High, Very High, Don't Know*.

Level of Interest in technology

Responses to the "Level of Interest" were aggregated and weighted:

"None" and "Little" – 0 points

"Moderate" – 1 point

"High" – 2 points

"Very High" – 3 points

The cross product of number of responses and the weighting were summed, then arranged highest to lowest to identify priority. Results by organizational type are in Section 9.3.

4.1 Summary results

The responses from each organization are summarized in the following table.

Table 1: Priority of information need (Summary results)

Information need	None	Little	Moderate	High	Very High	Points
Upcoming real time highway conditions (weather/traffic)	1	0	4	7	4	30
Highway speed limits that change based on weather condition or traffic congestion	2	1	4	6	3	25
Presence of animals on the road	2	3	3	4	4	23
Bridge capacity warnings/no through trucking warning	3	2	3	3	4	21
In-vehicle warning of a train approaching a crossing (rural area)	4	3	3	2	4	19
Alternate route information for when a train is blocking a crossing	4	4	5	2	1	12
Parking facilities and number of available spaces in an urban area	4	4	5	2	1	12

Each one of these information needs can be satisfied with some type of ITS deployment (and many are in large urban centres), however, there is currently no platform that would investigate the applicability of potential technologies in the rural and low-density context. Operational evaluations, proof-of-concepts, pre-deployment, operational evaluations, and pilot projects include. are needed to demonstrate that deployments that could save lives and time in rural and low-density settings, yet be affordable for rural and low-density jurisdictions.

Based on the results of the discussions with subject matter experts, review of ITS lessons in Alaska and Finland, and the stakeholder surveys, the following are presented as research directions for a Centre of Expertise in rural ITS. All of the following research directions present opportunities for both in-vehicle and wayside advisories and are presented in order of stakeholder interest.

4.2 Research directions with broad-based stakeholder interest

Research directions with broad-based stakeholder support and interest have been defined as those with at least half of survey respondents indicating a “high” to “very high” interest in a particular transportation technology.

4.2.1 Real-time weather and traveller information

It is reasonable to conclude from the stakeholder surveys that research efforts into real time traveller information technology applications would be of interest to the vast majority of stakeholders. While considerable efforts have been undertaken across Canada to enhance this (including the national RWIS initiative and “511”, the national weather and traveller information phone number), there continues to be a gap between the available information and the dissemination to the public. Currently provincial transportation agencies act as data intermediaries, however, the future needs of the motoring public will require more direct access to available traveller information. A public-private partnership may be a solution.

In addition, there is a requirement to coordinate this information between jurisdictions, especially the inclusion of smaller metropolitan areas (approximately 100,000 people or fewer). The rural and low-density ITS research in Canada, as well as the RWIS and 511 initiatives in New Brunswick have been undertaken without the inclusion of municipal governments, though there are many areas of rural and low-density even in New Brunswick cities. The Finnish experience of Traffic Management Centres (TMC) in cities the size of the larger cities in New Brunswick with information exchange between multiple agencies can be a model for Canada. An operational evaluation of this model should be investigated and should be piloted in New Brunswick. This will require significant architecture development and evaluation of technical and institutional interoperability.

4.2.2 Intelligent variable speed limits

The concept of variable speed limits appeared to be of interest to the bulk of stakeholders, yet no jurisdiction in Canada employs them. “Intelligent” variable speed limits, those

which are responsive to condition, have been deployed in Finland with positive results, yet there is a need to study the technical and legal implications in the Canadian context. The advancements in this field suggest that the adoption of this technology by jurisdictions with severe weather disruptions will be inevitable.

4.2.3 Detection of animal road obstructions

Research regarding the presence of animals on the road is of primary interest to provincial agencies, universities and the vehicle user group. Recall that researchers in Finland have expended significant effort on this file and report little success with the use of state-of-the-art technologies. However, the researchers also indicate that a combination of these technologies may prove successful, therefore represents a potential research area.

4.3 Research directions with more selective stakeholder interest

Research directions with more selective stakeholder interest have been defined as those with at least half of survey respondents indicating a “moderate” to “very high” interest in a particular transportation technology. These research directions also have broad-based stakeholder support and interest, but the need may not be universally shared by responding stakeholders (e.g. municipalities with no railway operations).

4.3.1 Bridge capacity warnings/no through trucking warning

This research direction could be a very valuable tool to enhance travelling efficiency for commercial vehicle operators while also protecting transportation infrastructure. This direction also lends itself to an in-vehicle and wayside warning system.

4.3.2 In-vehicle warning of a train approaching a rural crossing

It is important to note that “In-vehicle warning of a train approaching a crossing (rural area)” has significant interest from those jurisdictions where trains regularly operate. In addition, stakeholders believe pilot tests should focus on commercial vehicles, motorists, school busses, and farm equipment.

The majority of stakeholders believe that vehicle ignoring active signals and not yielding the right of way at passive crossings are the biggest railway safety issues. Since there are no signals at passive crossings, providing some type of warning to drivers would clearly enhance safety. The aforementioned approach for in-vehicle grade crossing warnings being piloted in Finland appears to have excellent potential, but it also appears to be a solution to address an issue specific to the rail context in Finland. The technology platform would be valuable to test in the Canadian context, but further research is required to determine the applicability of this model.

The resulting literature and case studies presented in the April 2008 UNBTG report to Transport Canada indicated that wireless and CVIS-enabled technologies, in conjunction with positioning technologies such as Global Positioning Systems (GPS) and Radio-Frequency Identification (RFID), holds potential to enhance rail grade crossing safety. In

addition, the site visit to Finland determined that the anticipated enabling technology is a cellular phone.

While the interest from stakeholders is high, challenges remain regarding the best way to move forward on developing this system. The opinions of the railway experts responding to the survey suggest that a locomotive-based system will face the same challenges as those faced in VII (IntelliDrive): for the system to be fully effective, all vehicles will need to be equipped – including track maintenance equipment. This presents a significant commercial opportunity for the system development if it results in a low-cost, reliable, effective, and acceptable system can be achieved. It is not clear from this initial survey whether a locomotive-based or wayside-based system will best serve the safety needs. As with VII, the locomotive-based approach presents substantial challenges since it may be decades before all vehicles would be equipped with the technology. The wayside-based system may result in a warning system that results in the same incurred cost as an active warning system.

A greater understanding is needed between the nature of the advisory and interpretation by the motorist (human factors). For example, in rural areas where there may be only one or two trains per day, would it be sufficient for the motorist to be warned that a train is within X kilometres of their vehicle? Would this result in the same level of vigilance and attention at a passive crossing as a system that mimics the timing and alarm of an active warning system? Depending on the level of precision of detection, it may be possible to make use of the manual block system employed by central dispatch to provide location information.

4.3.2.1 Opportunities for testing and research

The existence of low-cost, off-the-shelf wireless and CVIS-enabled applications for rural and low-density rail grade crossings does not yet exist. The satellite-based system developed at VTT in Finland offers significant promise, yet would need to be adapted for the Canadian context. However, one system does offer potential for research applications, and there is interest from the developer to supply a system at no charge for testing by UNB.

The ProTracker Track Walker/Worker – Train Operator Early Alarm System consists of a train mounted transceiver and a personal pocket device worn on a workers arm. As the train approaches a construction zone, the worker is alerted visually and audibly by the personal device. In addition, the train device has an indicator that displays the distance between it and the personal device.

Conceivably, the devices could be modified to provide warning at a rural passive crossing. It is a fairly simple system in that it consists solely of a signal broadcast and a receiver. The users of the rural crossing would need to have the receiver. One challenge of this system is that all trains and maintenance equipment will be required to have the device installed.

4.4 Specialized research directions for commercialization

Specialized research directions are those that have “high” or “very high” interest from select stakeholders:

- Alternate route information for when a train is blocking a crossing
- Parking facilities and number of available spaces in an urban area
- Over-height sensors for commercial vehicles

In addition, there are other specialized projects that could be investigated with support from the interested stakeholders:

- Alternate route information for motorists and commuters during construction season
- Notification of residents and motorists of on-street parking bans during snow storms
- Signal pre-emption for emergency vehicles in the central business district.

4.5 Caveats

- The results from the stakeholder surveys are not statistically significant. However, the 17 respondents present valuable perspectives from a spectrum of high-level stakeholders in Canada and New Brunswick., therefore their input should be seriously considered.
- In two cases, provincial transportation agencies submitted two surveys. Given that provincial agencies are large organizations with many divisions that can have different responsibilities, inclusion of multiple surveys from these organizations seems appropriate.
- In some cases “Level of interest” may be independent of need, therefore caution should be used before discounting a research idea completely due to perceived lack of organizational interest. It may be that the research has yet to be completed that would demonstrate the need. In addition, it is possible that the organization itself has yet to develop an internal policy regarding new technological advancements.

4.6 Requirements for enabling technologies

A test-bed focused on CVIS-enabled technologies should also include the development of applications that make use of off-the-shelf components. In addition, the trend in the U.S. and Finnish examples is to make use of aftermarket devices. Cellular phones and mobile mail platforms (e.g. Blackberries) appear to be the most opportune platforms to use as an interface technology. Many of these devices have GPS capabilities, have user-friendly interfaces, and are already widely distributed throughout North America. Estimates suggest there are over 2 billion cell phones in use world wide¹².

¹² <https://www.cia.gov/library/publications/the-world-factbook/fields/2151.html>

The lack of cell phone coverage in the most rural areas is a cause for concern when a device such as this is used for real-time safety applications. A wayside device is likely needed at critical points to ensure the messages are relayed and received.

A Centre of Expertise would bring together the researchers, stakeholders and developers needed to ensure an effective test-bed is developed. Once developed, the test-bed would support the applied research and development activities of the Centre of Expertise.

5.0 Framework for a Centre of Expertise

The following section outlines a proposed framework for a Centre of Expertise and test-bed in rural ITS, with a focus on applications that support the safety, security, efficiency, and environmental sustainability of rural and low-density transportation gateways, corridors, and connectors. UNBTG believes that this Centre of Expertise needs to be appropriately branded and proposes the name “Canadian Centre for Rural Intelligent Transportation Systems” or CCRITS (pronounced “Secrets”). While the terms “VII (IntelliDrive) & CVIS” are appropriate in describing a research focus, it is not believed that the terms are in broad enough usage within the transportation industry to warrant their inclusion in the title of the Centre of Expertise.

5.1 Vision

The Canadian Centre for Rural Intelligent Transportation Systems (CCRITS) is proposed to be an independently managed, but UNB-affiliated, Centre of Expertise devoted to applied research and development in Rural Intelligent Transportation Systems and their engineering and policy applications. It is proposed to be sustained through operating and research funding from the government of Canada, the Province of New Brunswick, and other public and private sector and academic partnerships. CCRITS also includes focus on wireless solutions that enhance transportation safety, security, efficiency, and environmental mitigation in rural and low-density environments. Currently, it appears that only the largest jurisdictions are taking advantage of the promise of ITS. A solution is needed that makes ITS accessible to rural and low-density areas: **CCRITS is that solution.**

5.2 Mission

The mission of CCRITS is to be a Canadian and world leader in the promotion, development and deployment of financially and technologically accessible ITS in rural and low-density jurisdictions. Through the use of a test-bed, CCRITS can lead or assist in operational evaluations, proof-of-concepts, pre-deployment, and pilot projects of technology and processes that would hasten the uptake of ITS by rural and low-density jurisdictions, leading to enhanced safety, security, efficiency and environmental mitigation.

5.3 Action areas

CCRITS will address four important action areas focused on employing wireless and CVIS-enabled ITS applications: safety, security, efficiency and environmental mitigation in rural and low-density areas. This also appears consistent with the European direction for research in VII/CVIS.

Applied research and development (R&D) requires intensive investment of human capital, with the goal of developing new or enhancing existing products, services, and processes. Successful R&D requires long term investment, both financially and from researchers. Those jurisdictions that ensure adequate investment in R&D consistently

reap the benefits. Enhancing R&D will be integral to helping New Brunswick achieve self-sufficiency. CCRITS will be important on the national and international stages as national and global economic challenges require new approaches to doing more with less. Rural and low-density areas are equally as deserving as urban areas for technology that can save lives, money, time and help the environment, yet without CCRITS leading the charge, many areas will not have the opportunity to learn about and benefit from this technology.

5.4 Concept of Operations – Proposed

The most recent Rural ITS Research agreement has produced some recommendations for best practices for the development of new Rural ITS Research, which are reflected in the proposed concept of operations.

CCRITS will be staffed by a full-time project manager and a full-time researcher, with close involvement from the UNB Transportation Group (UNBTG) faculty and graduate students. Administrative support will be initially provided through the UNB Department of Civil Engineering. Office and lab space is available from several areas including the UNB Department of Civil Engineering, the Fredericton Knowledge Park, and the National Research Council Centre for E-business on the UNB campus. A technician will also be required. Technical support will be provided by the New Brunswick Department of Transportation, Transport Canada, and interested NB municipalities, local governments and transportation infrastructure and service providers. UNBTG has long-standing working relationships with numerous regional transport operators, including railways and trucking companies.

CCRITS should be supported through an up-front committal of cash funding. This will be from the Province of New Brunswick¹³ and the Government of Canada¹⁴, possibly in the form of a research contract for an initial 5-year period. This could also be through the various government innovation granting agencies. Research contracts with those in the transportation industry will also be pursued.

5.5 Administrative best practices

The lessons learned from the previous agreement have been developed into some best practices for the administrative arrangements for a new research agreement. The new centre will change from an expense-reimbursement model to a fully-funded model. Efforts will also be made to reduce red tape and simplify administrative processes.

5.5.1 In-kind contributions

CCRITS will need to be cash-funded for it to successfully operate as a stand-alone Centre; however, efforts will be made to secure in-kind contributions for equipment and administrative resources where possible. It is expected that in-kind human resources will also be made available from various project partners. Accounting for in-kind equipment

¹³ This could include various government departments or the NB Innovation Fund

¹⁴ This could include Transport Canada, ACOA, or the Atlantic Innovation Fund

contributions has proven to be straight-forward. It is recommended that accounting for in-kind human resource contributions be simplified in favour of full or partial secondments, or upfront time committals.

5.5.2 Financial submission packages

It is anticipated that an upfront allocation of funding will greatly simplify the administration of the program. In that case, it is recommended that financial reporting be undertaken annually instead of quarterly.

5.5.3 Centre administration

Administration of each project will remain with the CCRITS managing director, and may include a steering committee of active (day-to-day involvement) and passive (funding agencies, technical advisors) participants. The role of the steering committee will be to help develop project scope and to review the final reports.

5.6 Deliverables

There are three main types of deliverables associated with this centre:

The first deliverable type consists of technical reports and publications based upon the applied research work and operational evaluations. CCRITS will be the primary source of information dissemination on Rural ITS in Canada, including participating in national and international conferences on Rural ITS and wireless-enabled applications, peer reviewed journals, Transport Canada technical publications, and local and national associations. CCRITS will also work to elevate the profile of Rural ITS among small municipalities, including delivering or hosting seminars.

The second consists of training Highly Qualified Personnel (HQP). The goal for HQP would be on average one Master of Science in Engineering graduate per year for the initial 2- year period, increasing to two per year by year 3. The centre would also provide professional work experience for graduate students during the summer months. As many research projects as possible will be equivalently sized, corresponding to the level of effort associated with a Master of Science in Engineering thesis.

The third, and most important deliverable, is to build on the first two deliverables to develop or adapt technology and processes resulting in commercialization opportunities that satisfy the underserved market in transportation technology and management in rural and low-density locations.

5.7 Estimated costs

The most recent agreement (ending in 2008) was for \$1 million in cash and in-kind support. Project costs ranged as low as \$6,000 to a high of over \$200,000, with an average total cost of \$110,000 (cash and in-kind) per project.

Initial estimates suggest that annual operating costs will be \$300,000 for a full-time researcher/project manager, two graduate students, office space and office equipment, technical and administrative support. Research costs, which can include a technician,

equipment, installation, travel, and promotions are estimated at \$200,000 cash expenses, with additional in-kind support. The total cost for five years is estimated at \$2.5 million, at \$500,000 per year, cash expenses.

5.8 *Summary of potential research partners*

The following consists of the following organizations and individuals contacted through this research initiative which indicated interest in participating in a research effort with UNB potentially leading to a centre as described above:

- Canadian Automobile Association (Maritimes)
- City of Campbellton, NB
- City of Fredericton, NB
- Integrated Tracking Solutions, AB
- Ministry of Transport, Québec
- Ministry of Transportation, Ontario
- New Brunswick Department of Transportation
- Saskatchewan Ministry of Highways and Infrastructure (Operations)
- Town of Grand Bay-Westfield, NB
- Transport Canada
- University of British Columbia
- University of Calgary
- VTT Technical Research Centre of Finland

There are some other organizations which indicated they would like to be project mailing lists.

While there are no private sector transportation organizations that have indicated interest in participating in this particular research effort, it may be too early within the project development for them to consider involvement. Once a Centre of Expertise is established, funds committed, and projects developed, private sector involvement will be more likely to procure.

6.0 Conclusions and recommendations




Based on reviews of Alaskan and Finnish rural ITS experience, combined with stakeholder surveys and other discussions, a dedicated research effort in rural ITS focused on wireless technologies and CVIS is needed. The Canadian Centre for Rural ITS (CCRITS) is a Centre of Expertise and test-bed that will meet that need. This effort is expected to have broad-based local, national and international interest and support from government, private sector, and academic stakeholders. There are significant opportunities for national and international collaborations and partnerships, as well as developing highly qualified personnel. In addition, small and mid-sized municipalities present opportunities for collaboration and stand to significantly benefit from a rural ITS program that includes them.





7.0 Next steps

The research direction proposed in this report provides sufficient focus to begin the next steps and is “shovel ready”. The most critical next step is securing sufficient funding for the research effort as described in the proposal for CCRITS. UNBTG is developing a proposal for CCRITS for the New Brunswick DOT as well. Without a funding commitment from the principal players, the New Brunswick provincial government and federal government, it will not be possible to move forward in this effort. Once the base funding of \$500,000 per year (cash expenses) has been committed, it will be possible to secure the involvement of other project partners.

Following the funding commitment, a committee (federal/provincial/university) could be struck to lay the groundwork for the development of the Centre of Expertise. This will include: scoping out early-winner research projects into graduate-level thesis components; identification of the Centre project manager; office set up; and other administrative tasks. The Centre of Expertise should also consider an open call for proposals within six months of its inception. Discussions should regularly take place between the potential local, national and international collaborators. It may also be opportune to build on the initial positive discussions with VTT to support a visiting researcher there in the summer (July/August 2010) and/or at the Helsinki University of Technology to gain valuable experience in this field.

8.0 Selected photos

Transportation and technology in Finland	
	<p>Kamppii Station – Main downtown shopping centre and transportation hub for local, express and intercity busses, as well as the Helsinki Metro. It is a short walk from here to the Grand Central station and tram network. Busses pick up and discharge passengers underground. The fare is valid for a certain length of time for all public transport in Helsinki, including busses, trams, trains, ferries and the Metro.</p>
	<p>Kamppii Station - Busses park in front of these doors after discharging passengers upstream. Red “X” turns green and doors unlock. Smart cards are swiped at reader either side of door. LCD screen announces upcoming busses by the minute. Tickets can be purchased on the bus. People can board all modes without presenting a ticket, but can face a fine of 80 Euros if a valid ticket not presented when requested.</p>
	<p>Kamppii Station – Accessibility is accommodated here by raised metal pieces in the floor that provide a tactile direction to the bus stops for those with visual impairments. It is also handy for tourists as the metal bars provide a trail to follow from each part of the station.</p>

	<p>Kampii Station – This is the Helsinki Metro. It runs northeast from the downtown. Trains run every few minutes. It is accessed by escalators from the main floor where the bus station is.</p>
	<p>Destia Ltd. Weather information management for 70% of Finland's road network is undertaken through this workstation that employs two workers in the winter, one for the rest of the year.</p>
	<p>Destia Ltd. Weather and traffic cameras for road condition information.</p>
	<p>Finnish National Meteorological Institute. Destia maintains a small office within this complex.</p>



Finnra Traffic Management Centre.

This centre manages the dissemination of traffic information for Helsinki and environs, including two new motorway tunnels. Cameras are strategically located throughout the road network and displayed to workers in this centre.



Tram system.

Helsinki has numerous low-speed, electrically powered trams running throughout the city. In some areas trams have specific right of way, in others, it shares the roadway with automobiles. All trams meet at the Grand Central railway station.







Pasila Station.





Constructed to relieve congestion at the Grand Central station, it is approximately 2-3 minutes travel time north of downtown Helsinki. These are long distance and commuter trains that travel south to Grand Central station.







Parking ITS:

Simple use of ITS for identifying available parking lots. If parking lots are full, a red line appears striking out the highlighted "P".

	<p>Suomenlinna Ferry: Connects Helsinki to the popular world heritage site, Suomenlinna Island. Helsinki transit pass includes access to the ferries. Advanced traveller information provides real time details at terminal about arrival times of the next ferry.</p>
<p>Alaska and Environs</p>	
	<p>Whittier Tunnel: Variable message sign providing information to drivers in queue at tunnel.</p>
	<p>Whittier Tunnel: Triangular-shaped building is actually the entrance to the tunnel. Note the traffic light co-located with the cross bucks.</p>
	<p>Port of Whittier: Whittier is a major cruise ship port, though the town itself is not very large. Note the numerous boats moored near the cruise ship. These would be brought through the tunnel.</p>

	<p>Whittier Tunnel: This is one of several “safe spots” located in the tunnel in case of emergency. There is an exclusive air supply, radio, as well as food and water.</p>
	<p>Whittier Tunnel. The tour bus is parked in the emergency pull-off lane. Sufficient room exists for vehicles to continue in the travel lane, but none were permitted entry during the site visit.</p>
	<p>Whittier Tunnel Control Room: Constant communication is maintained between the railroad, maintenance crews, and emergency responders via this room.</p>
	<p>Seward Highway: Photo taken from RWIS location. Note the rumble strips at the edge of the climbing lane.</p>

	<p>Turnagain Pass RWIS: Another perspective of the Turnagain Pass RWIS on the Seward Highway.</p>
	<p>Alaska Railroad: Includes passenger and freight operations throughout Alaska.</p>
	<p>Alaska Railroad and grade crossings: Typical T-intersections of passive crossings along this highway north of Anchorage (Alaska Railroad parallels highway)</p>
	<p>Mount McKinley (Denali): Highest peak in North America</p>

9.0 Appendices

Appendices include: Catalogue of subject matter experts; Profile of European ITS initiatives

9.1 *Catalogue of subject matter experts*

During the course of this research, numerous individuals and organizations were engaged. The following is list of individuals, their titles and organization that provided input that helped to formulate this report. The list includes individuals met during the course of the National Rural ITS Conference in Anchorage, Alaska, the intelligence gathering exercise in Helsinki, Finland, respondents to the stakeholder surveys, and other individuals who lent their expertise in Rural ITS to assist in this project.

National Rural ITS Conference

- Bill Gouse, VP Programs, ITS America
- Heather Young, Director of Transportation Information Programs, ITS America
- Chris Lane, Director of Programs, ITS America
- Stephen Albert, Director, Western Transportation Institute
- Nick Ward, Senior Research Scientist –Human Factors, Western Transportation Institute
- Pam McDermid, Green Light Transportation System, BCMOT
- Scott Nodes, Assistant State Engineer, Arizona Department of Transportation, Member, Enterprise Group
- Pete Costello, Senior Manager, Public Sector, INRIX
- Lisa Ballard, President, Current Transportation Solutions
- Aletha Goodine, Transportation Program Specialist, USDOT Federal Transit Administration
- Benjamin McKeever, ITS program manager, RITA, ITS Joint Program Office
- Roy Czinku, International Road Dynamics
- Taek Mu Kwon, Electrical and Computer Engineering, University of Minnesota
- John Hansen, President, 2ITS Help
- Scott Belcher, President, ITS America
- Shelley Row, Director, ITS Joint Program Office
- Jeff Roach, Aviation Planner, Alaska DOT
- Members of the Enterprise Group

Intelligence gathering from Helsinki, Finland

- Mr. Risto Oorni, Researcher, VTT (Technical Research Centre of Finland)
- Dr. Risto Kulmala, ITS Research Professor, VTT
- Mr. Ari Virtanen, Researcher, VTT
- Ms. Virpi Antilla, Head, Finnra Traffic Management Centre
- Dr. Tapio Luttinen, acting chair of the Transportation Engineering department at the Helsinki University of Technology

- Mr. Eerio Mikkola, Destia's Road Weather Management Centre.

Stakeholder survey respondents

- Tim O'Reilly, Manager, Pedestrian and Traffic Services, City of Saint John, NB
- Darren Charters, Traffic Engineer, City of Fredericton, NB
- André Bernard, City Engineer, City of Campbellton, NB
- Bruce Gault, Works Commissioner, Town of Grand Bay-Westfield, NB
- Gary Howard, Vice President, CAA (Maritimes)
- Tom Lockhart, President, Integrated Tracking Solutions Inc., Calgary, AB
- Nancy Lynch, Assistant Director, New Brunswick Department of Transportation
- Robb Francis, Rail Safety Officer, New Brunswick Department of Transportation
- Heather McClintock, Head, Intelligent Transportation Systems, Ministry of Transportation, Ontario
- Louis Ferland, Director, Ministry of Transport of Quebec
- Sukhy Kent, Director Design and Traffic Operations, Saskatchewan Ministry of Highways and Infrastructure
- Allan Churko, Regional Executive Director, Saskatchewan Ministry of Highways and Infrastructure
- W. P. (Wally) Hidinger, Manager, Transportation Planning and Programming, Government of Yukon, Dept of Highways and Public Works
- Dale Hein, Manager Signal Design, CN, Network Operations, Engineering, Signals and Communications
- Daniel Lafontaine, Chief Engineering – Grade Crossings, Transport Canada
- Luc Massé, Chief, Signals & Communications, Transport Canada – Rail Safety
- Ata M. Khan, Professor, Carleton University, Ottawa, ON
- Lina Kattan, Assistant Professor, Urban Alliance Professorship in Transportation Systems Optimization, University of Calgary
- Victor Leung, Professor, Dept. Electrical and Computer Engineering, University of British Columbia

Other individuals

- Dr. Barry Pekilis, Transport Canada
- Pierre Bolduc, Transport Canada
- Heather Navarra, ITS Canada
- Peter Bartek, Protran1 (technology vendor)
- Dr. Chris Barkan, Railroad Engineering Program, University of Illinois, Urbana-Champaign

9.2 Profile of VTT and European ITS, V2V, V2I initiatives

VTT (Technical Research Centre of Finland) is heavily involved with several European ITS and VII (IntelliDrive) research efforts. Three highly relevant initiatives are presented here.

COOPERS¹⁵ is a European initiative analogous to the VII (IntelliDrive) initiative in the U.S. and stands for CO-OPERative systems for intelligent Road Safety. It is a four-year initiative that began in February 2006 and a total budget of 16,800,000 €. Highlights of the program are presented here. Detailed information can be garnered from the COOPERS website.

The vision of COOPERS is:

“Vehicles are connected via continuous wireless communication with the road infrastructure on motorways, exchange data and information relevant for the specific road segment to increase overall road safety and enable cooperative traffic management.”¹⁶

The purpose of COOPERS is to “to define, develop and test new safety related services, equipment and applications using two way communications between road infrastructure and vehicles from a traffic management perspective.”¹⁶

COOPERS research and work areas:

1. Roadside data acquisition
2. Traffic control center – TCC applications
3. Road side transmitter
4. On board unit
5. Information services

While the program is primarily focused on deployments in high density urban motorways, there are lessons to be applied in terms of approaching VII (IntelliDrive)/CVIS in rural areas, namely, focusing following a similar five category research and work area process. Figure 10 is a graphical representation of the envisioned system and the communication linkages.

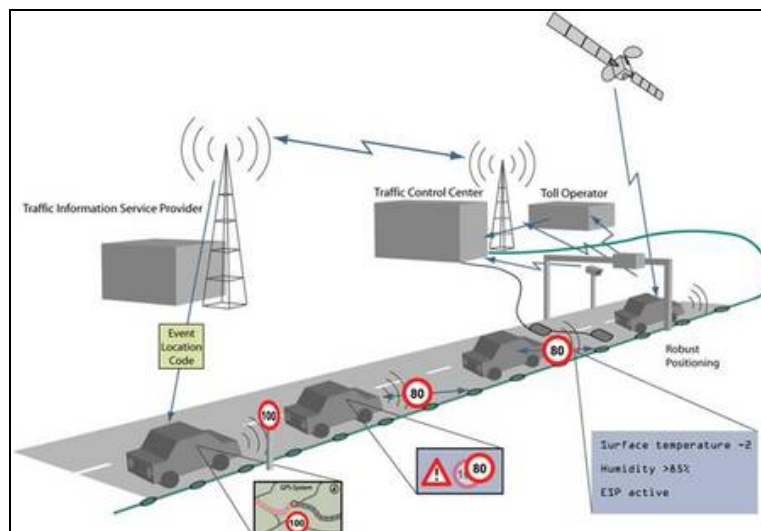


Figure 11: Graphical representation of system and communication linkages

¹⁵ <http://www.coopers-ip.eu/index.php?id=8>

¹⁶ http://www.coopers-ip.eu/fileadmin/_temp_/COOPERS_Project_Presentation_082007.pdf

Test sites exist in Germany, the Netherlands, Belgium, France, Switzerland, Italy and Austria.

COOPERS also has developed four advisory panels to facilitate stakeholder participation.

- Policy Advisory Panel
- Infrastructure Operator Panel
- Safety Research Panel
- Industry and Components Supplier Panel

The Cooperative Vehicle-Infrastructure System (CVIS)¹⁷ is a program administered through ITS Europe with the goal of designing, developing, and testing technologies needed “to allow cars to communicate and network directly with the roadside infrastructure.” The kind of information transmitted includes: speed limits and other road sign information; approaching emergency vehicles; and other urgent messages. The program is slated to end in January 2010 and includes test sites in France, Germany, Italy, Netherlands/Belgium, Sweden and the UK. Its research efforts are organized into: safety, security, efficiency and environmental activities.

Safespot is another European cooperative research program with approximately 50 partner agencies in the consortium, including research organizations, automakers, government transportation agencies, private sector data providers, and telematics companies¹⁸. Safespot presents several use cases developed on a “user-centred” design approach. These cases include (from Safespot):

- Intersection Safety
- Lane change manoeuvre (alerts of vehicles in blind spots)
- Safe Overtaking application (alerts when vehicle tries to pass another when a third vehicle is already performing the manoeuvre)
- Head on collision warning (prevents passing during unsafe situations)
- Rear end collision (warnings due to speed differential)
- Speed limitation and safety distance
- Frontal Collision Warning (warning of collision with static obstacle)
- Road condition status (Vehicle to Infrastructure)
- Curve warning (rural areas)
- Vulnerable Road User Detection and Accident Avoidance

9.3 Survey results by organizational type

Surveys were received from the following transportation agencies:

- New Brunswick Department of Transportation (2)

¹⁷ http://www.its-europe.org/en/activities/efficiency__environment/cvis.htm

¹⁸ <http://www.safespot-eu.org/objectives.html>

- Ministry of Transport of Quebec
- Ministry of Transportation , Ontario
- Saskatchewan Ministry of Highways & Infrastructure (2)
- Government of Yukon, Dept of Highways and Public Works

Respondents were asked to identify their organization’s level of interest in seven different technologies that could provide safety and mobility information to drivers in rural and low-density areas. “Level of interest” was categorized into: *None, Little, Moderate, High, Very High, Don’t Know*.

Level of Interest in technology

Responses to the “Level of Interest” were aggregated and weighted:

“None” and “Little” – 0 points

“Moderate” – 1 point

“High” – 2 points

“Very High” – 3 points

The cross product of number of responses and the weighting were summed, then arranged highest to lowest to identify priority.

Table 2: Priority of information need (Transportation Agencies)

	Weighting					
	0	0	1	2	3	
Information need	None	Little	Moderate	High	Very High	Points
1. Upcoming real time highway conditions (weather/traffic)			1	4	2	15
2. Presence of animals on the road		1	1	2	3	14
3. Highway speed limits that change based on weather condition or traffic congestion			3	3	1	12
4. Bridge capacity warnings/no through trucking warning		2	1	1	3	12
4. In-vehicle warning of a train approaching a crossing (rural area)	1	1	1	1	3	12
5. Alternate route information for when a train is blocking a crossing	1	2	3		1	6
6. Parking facilities and number of available spaces in an urban area	2	4	1			1
Other: Overheight warnings				1		

Based on the surveys returned, the greatest information need for drivers in rural and low-density areas as perceived by provincial transportation agencies is “Upcoming real time highway conditions (weather/traffic)”. This appears consistent with provincial and national efforts to develop a national weather and traveller information service (accessible through the phone number 511 in some provinces and territories) and the growth in web-based weather information dissemination. While some have the same

score, the lack of “None” and “Little” level of interest responses for variable speed limits suggest it has priority over the equivalently scored items. It is interesting to note that variable speed limits received favourable responses from all responding jurisdictions, yet no Canadian jurisdiction currently employs them on a provincial-wide basis. Efforts have primarily been from a research perspective and in limited pilot projects.

It is clear, however, that the agencies did not believe “alternate route information for blocked crossings” and “availability of parking facilities in an urban area” were of equivalent priority to Needs 1-4. Other than “Overheight warnings” there were no additional technologies presented by the agencies.

Participation in a Centre of Expertise and Test-bed in CVIS in Rural and Low-density Transportation Safety, Efficiency, and Mobility Applications

The survey asked transportation organizations to assess their potential level of involvement in a Centre of Expertise at the University of New Brunswick:

- Five respondents could offer in-kind participation of staff and operations
- Three would consider financial support of the research effort
- Five would consider participation on project steering committees
- Six would like to be on the project mailing list
- One does not want to be involved at this time

Additional comments included:

- “Interested in the research you are planning. May be interested in participating in various ways.”
- “I would like to understand what other projects the UNB COE is working on and participate in them where appropriate.”

These results suggest that there is broad-based support and interest from transportation organizations across Canada for research in support of rural and low-density transportation applications.

9.3.1 Results from municipalities in NB

Surveys were received from the following New Brunswick municipalities:

- City of Campbellton (pop 7,000)
- City of Fredericton (pop 50,000)
- City of Saint John (pop 70,000)
- Town of Grand Bay-Westfield (pop 5,000)

Municipalities in New Brunswick were presented a slightly different survey than the one forwarded to provincial transportation agencies and ITS Canada/America members. They were asked to identify transportation issues faced by their municipality from a list which included, for example, “Rush hour delays and localized traffic bottlenecks” and “Congestion due to seasonal or special events”. They were also asked about which

vehicle user groups should be targeted for a pilot test of technology to provide in-vehicle warning of a presence of a train.

Municipalities were also asked to identify their organization's level of interest in seven different technologies that could provide safety and mobility information to drivers in rural and low-density areas. "Level of interest" was categorized into: *None, Little, Moderate, High, Very High, Don't Know*. Priority was developed based on the same methodology applied for the provincial agency survey.

Table 3: Priority of information need (Municipalities)

	0	0	1	2	3	
Information need	None	Little	Moderate	High	Very High	Points
1. Upcoming real time highway conditions (weather/traffic)			3	1		5
2. Highway speed limits that change based on weather condition or traffic congestion	1	1	1	1		3
2. Bridge capacity warnings/no through trucking warning	2		1	1		3
2. Parking facilities and number of available spaces in an urban area	1		3			3
3. In-vehicle warning of a train approaching a crossing (rural area)	2	1	1			1
3. Alternate route information for when a train is blocking a crossing	2	1	1			1
3. Presence of animals on the road	1	2	1			1

Similar to the provincial agencies, the four New Brunswick municipalities (ranging in population from 5000 – 70000) collectively appear to have real-time traveller information as the top priority. Variable speed limits, bridge capacity warnings, and information on the availability of parking in the urban areas appear to be of interest. The major difference is that animal detection information is of little interest to the municipalities. There is one of the four municipalities which does not have railways operating within its boundaries, however, there is little or no interest in this information need by the other three municipalities.

While only a select few municipalities in New Brunswick were profiled, their responses provide valuable insight into the proliferation of ITS and other transportation technologies for smaller metropolitan areas and smaller cities and towns. The municipalities are in different stages of technology deployment, though all are open to using some kind of transportation technology to enhance service delivery.

The two smaller municipalities currently do not employ any ITS, though both would consider partnering to pilot wireless technology to aid in delivery and management of municipal road services if funding was available. One of those municipalities also indicated they would consider an ITS strategic plan.

The two larger cities employ more advanced traffic control systems as well as having larger road maintenance areas. One city is implementing an Automatic Vehicle Locator (AVL) system to track many types of municipal vehicles, including plough trucks and their routing. The other city is currently undertaking a city-wide traffic study where several ITS opportunities are being identified and researched, including: variable message signs, red light cameras, variable speed signs in school zones, and red light warning systems.

One city has identified three opportunities for employing ITS: alternate route information for motorists and commuters during construction season; notification of residents and motorists of on-street parking bans during snow storms; and signal pre-emption for emergency vehicles in the central business district.

9.3.2 Results from universities

Three universities across Canada responded to the survey: Carleton University, University of Calgary, and University of British Columbia (UBC). All of these universities have research interest in ITS.

Table 4: Priority of information need (Universities)

Information need	None	Little	Moderate	High	Very High	Points
1. Highway speed limits that change based on weather condition or traffic congestion	1			1	1	5
1. Upcoming real time highway conditions (weather/traffic)	1			1	1	5
1. Parking facilities and number of available spaces in an urban area	1			1	1	5
1. Bridge capacity warnings/no through trucking warning	1			1	1	5
2. Alternate route information for when a train is blocking a crossing	1			2		4
2. Presence of animals on the road	1			2		4
3. In-vehicle warning of a train approaching a crossing (rural area)	1		1	1		3
Other: Wireless technology to enable the above					1	-

While UBC did not have a specific interest in the technology that could provide the information need, they are highly interested in researching wireless technology that can enable the provision of the information. It is envisioned that all three of the universities could potentially be research collaborators.

Additional comments included:

- “This subject is worthy of further research.”
- “We welcome research collaborations on how wireless technologies can be best applied or enhanced to support VII in the rural environment.”

9.3.3 Results from vehicle user group

The Canadian Automobile Association (CAA) Maritimes responded to a specially tailored survey. There appears to be high interest in in-vehicle warnings of trains approaching, variable speed limits, real-time traveller information, and presence of animals on the road.

Table 5: Priority of information need (Vehicle user group)

Information need	None	Little	Moderate	High	Very High	Points
1. In-vehicle warning of a train approaching a crossing (rural area)					1	3
1. Highway speed limits that change based on weather condition or traffic congestion					1	3
1. Upcoming real time highway conditions (weather/traffic)					1	3
1. Presence of animals on the road					1	3
2. Parking facilities and number of available spaces in an urban area				1		2
3. Alternate route information for when a train is blocking a crossing			1			1

9.3.4 Results from private sector respondent

One private sector organization responded to the survey: Integrated Tracking Solutions Inc. from Alberta.

Table 6: Priority of information need (Private sector)

Information need	None	Little	Moderate	High	Very High	Points
1. Highway speed limits that change based on weather condition or traffic congestion				1		2
1. Upcoming real time highway conditions (weather/traffic)				1		2
2. Parking facilities and number of available spaces in an urban area			1			1
2. Presence of animals on the road			1			1
2. Bridge capacity warnings/no through trucking warning			1			1
3. In-vehicle warning of a train approaching a crossing (rural area)		1				0
3. Alternate route information for when a train is blocking a crossing		1				0

The company appears willing and interested in partnering in research. Its expertise is primarily in tracking devices and using that information to provide real-time information. Discussions with Integrated Tracking Solutions have identified two potential research areas: school bus tracking and the tracking of newly licensed drivers.

9.4 Views on VII (IntelliDrive)/CVIS

Participants responding to the ITS Canada-distributed survey (n=8) were also asked to evaluate the potential of Vehicle Infrastructure Integration (VII) and/or Cooperative Vehicle Infrastructure Systems (CVIS) in addressing the safety and mobility information need. “Potential” was categorized into: *None, Little, Moderate, High, Very High, Don’t Know*.

Table 7: Views on VII/CVIS

Information need	None	Little	Moderate	High	Very High	Don’t Know	Points
Upcoming real time highway conditions (weather/traffic)			1	3	3	1	16
Bridge capacity warnings/no through trucking warning	1		1	1	4	1	15
Parking facilities and number of available spaces in an urban area	2	1		1	3	1	11
Presence of animals on the road		1	2	3	1	1	11
In-vehicle warning of a train approaching a crossing (rural area)		1	1	3	1	2	10
Alternate route information for when a train is blocking a crossing	1	2		2	2	1	10
Highway speed limits that change based on weather condition or traffic congestion			3	2	1	2	10
Other: Presence of construction work					2		6
Other: Presence slow maintenance vehicle					1		3

Using the same scoring system as the previous survey, most respondents believed VII/CVIS has “high” or “very high” potential in information relating to real-time highway conditions and bridge capacity warnings. VII/CVIS for variable speed limits, while earning a lower score than real-time highway conditions, had 7/8 respondents indicating it had a minimum of “moderate” potential (1/8 did not know).

9.4.1 Rural rail grade crossings

In addition to rural ITS research directions, respondents provided input on rural rail grade crossings research. Surveys regarding railway research directions were received from:

- Transport Canada (2)
- New Brunswick Department of Transportation (2)
- City of Campbellton, NB
- Town of Grand Bay-Westfield, NB
- City of Saint John, NB

- CN Railway
- Ontario Ministry of Transport
- Quebec Ministry of Transport
- Saskatchewan Ministry of Highways & Infrastructure (2)
- Carleton University
- University of British Columbia
- University of Calgary
- Integrated Tracking Solutions (Calgary)

Respondents were asked what the most common safety challenges are relating to railway interaction with non-rail transportation users in Canada. The challenges are presented in descending order beginning with the most popular choice (n=16):

- Vehicles ignoring or disobeying active warning systems (12)
- Vehicles not yielding right-of-way at passive crossings (11)
- Vehicles not yielding right-of-way at Private/farm crossings (9)
- Trespassers and vandalism (8)
- Malfunction of active warning system (5)

In addition, respondents provided additional challenges:

- Delays due to switching (2) – *Note, this was only provided as a choice to municipalities*
- Confusion to highway users by nearby standing train, most importantly if more than one track (1)
- Pedestrians & presence of grade crossings with more than one track (1)
- Compliance with cross bucks (1)
- Poor sight lines (1)

It is clear that the most widely held safety challenge involves the lack of compliance by drivers. Trespassers and vandalism is mentioned by more than half of respondents. The active warning system itself is not as widely perceived as a safety challenge, though it was mentioned by a third of respondents. The additional challenges, while not mentioned by each respondent, represent important considerations in addressing the safety challenges. Two of the three municipalities surveyed that have railways operating in their jurisdiction reported “delays due to switching” as a challenge.

Some respondents were asked which road user groups should be included in pilot tests that evaluate a low-cost wireless device that provides drivers a warning of a train approaching an unsignalized railway crossing. The user groups are presented in descending order beginning with the most popular choice (n=8):

- Trucks hauling dangerous goods (5)
- Short haul and resource-based commercial vehicles (4)
- Long haul commercial vehicles (4)
- Motorists (4)

- School busses or other bus (3)
- Farm machinery and construction vehicles (3)
- Motorcyclists (0)

Enhancing the grade crossing safety for commercial vehicles appears to be the most popular opportunity for employing collision avoidance technology. The transport of dangerous goods (TDG) represents a low-risk, high-consequence situation at grade crossings, and is the most popular choice. Other situation generally regarded as low-risk, high-consequence includes school busses and farm machinery at crossings. No respondent indicated “motorcyclists” as a potential user group. Given the seasonal use of motorcycles, it is likely considered a minimal risk.

Views on the installation of warning components on locomotives or hi-rail or installing components on the wayside

Surveys specific to the railway industry were received from Transport Canada, CN Rail and the New Brunswick DOT. The perspective offered by the respondents is very valuable in determining a research direction. A synopsis of comments is included below:

A main challenge regarding enhancing rural grade crossing protection using wireless technology involves the location of the warning infrastructure. Conventionally, warning systems are triggered by the completion of a track circuit, however the cost and power requirements of this system limits its applicability in rural areas. Pilot systems, such as the GPS/Cellphone-based system in Finland, require a special system to be installed in the locomotive.

One perspective involves the use of 5.9 GHz DSRC transceivers onboard locomotives (which is the enabling technology in VII/CVIS). The locomotive would broadcast its location as well as local intersection geometry data. It would require that the software onboard the locomotive be loaded with each local intersection geometry data and broadcast this information while in the vicinity of the crossing to be picked up by an approaching vehicle.

Another perspective suggests that a locomotive-based system could only work safely in practice if all locomotives are equipped with the technology. Locomotives can move distances and are generally not captive to a region; railway can lease locomotives from another railway; a railway can detour on another host railway. Until such time as all locomotives would be equipped with a device, or unless the device is portable and there are strict rules to ensure the device is on-board, risk may be high to have a locomotive without the device.

A third perspective also highlights this issue, since some railways may have thousands of locomotives and several thousand pieces of work equipment and hi-rail equipped vehicles. In addition, there is the challenge of having a locomotive-based system since the length of the train will likely be variable and not all accidents involve vehicles striking the head end of the train.

10.0 References

ⁱ Sharafsaleh, M, VanderWerf, J, Misener, J, and Shladover, S, 2008. Implementing Vehicle–Infrastructure Integration: Real-World Challenges. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2086, Transportation Research Board of the National Academies, Washington, D.C., 2008, pp. 124–132.

ⁱⁱ Hanson, T., 2008. ITS for small-midsized cities: The next frontier? ITS Canada Newsletter, September 2008

ⁱⁱⁱ USDOT, 2008. VII Initiative 2008, ITS Research Results. US Department of Transportation, Washington, D.C.

^{iv} USDOT, 2008. VII Initiative 2008, ITS Research Results. US Department of Transportation, Washington, D.C.

^v Census of the United States, 2009. 2007 Estimates for Alaska. Available URL: <http://quickfacts.census.gov/qfd/states/02000.html>

^{vi} VTT, 2008. Scientific Activities in Transport Telematics.