



Transport
Canada

Transports
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AN INTELLIGENT TRANSPORTATION SYSTEMS (ITS) PLAN FOR CANADA:

EN ROUTE TO INTELLIGENT MOBILITY

November 1999

Canada

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EXECUTIVE SUMMARY

Over the last two years, the Minister of Transport, the Honourable David Collenette, has outlined a framework to bring Canada's transportation system into the 21st Century – one that encourages the best use of all modes of transportation and builds on partnerships with all jurisdictions and with all players in the transportation sector. This framework aims to make Canada's transportation safe, efficient, affordable, integrated and environmentally friendly. The framework has four objectives:

- i. to promote transportation safety - which will always be the top priority;
- ii. to support trade and tourism through more productive and "smarter" transportation systems;
- iii. to improve our quality of life by promoting more sustainable transportation systems; and
- iv. to sustain strategic investment in transportation.

The purpose of this document is to put forward a plan to advance these objectives as they pertain to the ground transportation system and its interfaces with other modes. This plan is consistent with the federal government's vision for building a dynamic economy for the 21st Century to ensure that Canada remains the best place in the world in which to live. As stated in the October 12, 1999 Speech from the Throne: "In the global, knowledge-based economy, the advantage goes to countries that are innovative, have high levels of productivity, quickly adopt the latest technology, invest in skills development for their citizens, and seek out new opportunities around the world."¹ The Government of Canada is committed to building a better environment for economic growth and enhanced productivity, and a higher quality of life for all Canadians. Strategic investments to encourage trade and improve Canada's knowledge and physical infrastructures will ensure that we have the capacity to move people and goods safely and efficiently.

Canada's ground transportation system is essential to the country's economic and social well-being. It supports interprovincial and international trade and tourism. It connects the country from coast to coast and with the United States, our major trading partner. And, it supports both the "old" economy characterised by large shipments of natural resources and the "new" economy which relies heavily on just-in-time performance and integrated logistics systems. More productive and smarter transportation necessarily implies that

¹ Governor General of Canada, Speech From the Throne to Open the Second Session of the Thirty-Sixth Parliament of Canada, October 12, 1999.

*The best possible
transportation for
Canada and
Canadians:*

- ✓ *safe*
- ✓ *smart*
- ✓ *strategic*
- ✓ *sustainable*

Innovation and integration are essential to intelligent mobility

we must find ways to use our existing ground transportation infrastructure as efficiently as possible.

Advances in smart technologies or intelligent transportation systems (ITS) can play a valuable role in this regard. These systems provide the transportation industry with innovative and effective tools to improve upon the traditional way of doing business. Through their ability to bring together system users, vehicles and infrastructure into one integrated system, ITS enables these elements to exchange information for better management and use of available resources. ITS are helping to smooth the flow of traffic and improve mobility on congested corridors while making them safer. They are improving intermodal transfers and speeding the processing of travelers and goods across international borders. These systems are increasing productivity by improving the efficiency and reliability of transport operations for users, service providers and system operators. And, Canada is home to some of the leading companies in this dynamic field.

While Transport Canada, and other federal departments, may not be the major users of intelligent transportation systems, the federal government can serve the public interest by creating the frameworks and environment in which the development and deployment of ITS can flourish across all modes. By advancing the application of intelligent transportation systems, the federal government is delivering on its mandate to ensure safe, efficient, affordable, integrated and environmentally friendly transportation for all Canadians. The federal government is also responding to calls from the provinces and the private sector to provide strategic leadership through a national ITS program and to develop an overall transportation technology strategy for equitable implementation across Canada. No other jurisdiction or entity is as well suited to developing an ITS plan for Canada that promotes innovation and integration as the route to intelligent mobility.

The sections that follow present the federal government's plan to stimulate the development and deployment of intelligent transportation systems in Canada to maximize the use and efficiency of existing infrastructure and to meet future mobility needs more responsibly. The plan focuses on three streams of activity:

- i. building awareness of and demonstrating the potential of how wide-spread use and interoperability of intelligent transportation systems across Canada and North America can enhance safety and mobility and support interprovincial and international trade and tourism;
- ii. supporting strategic deployment and integration of intelligent transportation systems across urban and rural areas and on inter-city and international corridors; and
- iii. strengthening Canada's ITS industry to take advantage of growing global

market opportunities.

This ITS plan provides the leadership and support necessary to advance the application and compatibility of ITS technologies to make Canada's multimodal ground transportation system safe, integrated, efficient and sustainable. The plan outlines five pillars of activity:

1. Partnerships for Knowledge – *The Essential Building Block*

Partnerships among all levels of government, the private sector, Intelligent Transportation Systems Society of Canada (ITS Canada), academia, and consumers are essential for the deployment of ITS across Canada and building knowledge of their benefits.

2. Developing Canada's ITS Architecture – *A Solid Foundation*

The ITS architecture will ensure that products and services are seamlessly integrated. The architecture is the communications and information backbone that unites key ITS technologies, enabling them to communicate with each other. It also identifies the standards needed to support interoperability across technologies, modes, and jurisdictions.

3. A Multimodal ITS Research and Development (R&D) Plan – *Fostering Innovation*

Transport Canada, in partnership with the private and public sectors and academia, will prepare a five-year R&D plan to support private sector innovation and technology development.

4. Deployment and Integration of ITS Across Canada – *Moving Forward*

The federal government will provide support for strategic ITS deployment and integration to lever complementary public and private sector investment in model applications.

5. Strengthening Canada's ITS Industry – *Global Leadership*

In order to position Canada's ITS industry to take advantage of growing international markets, the federal government will work with the provinces and private sector to develop export opportunities for Canadian ITS firms. An export development strategy will be prepared in partnership with ITS Canada to promote Canadian expertise to the world.

We see this plan providing the necessary impetus for accelerating the development, deployment and integration of ITS applications across Canada. However, it is only the first step in a much longer journey aimed at integrating the ground transportation system into the knowledge economy. And, we recognize that the federal government cannot deliver this plan alone -- we need to forge new partnerships among all levels of government, the private sector, academia and the Canadian public.

Canada's ITS Plan:
A partnership for advancing the application of smart technologies for safe, integrated, efficient and sustainable transportation

This plan therefore is an invitation to all those who share in the common goal of safe, more productive and smarter transportation, to join us in making this vision a reality. To make this plan as relevant as possible for all concerned, it will be a living strategy that will evolve over time. As such, comments and ideas on this document and the pillars of the plan are appreciated and encouraged.

1. INTRODUCTION

Rapid changes in technology and the proliferation of the information age are having profound impacts on society and the economy. Choices related to how, when, where and why we travel are influenced by technology and are now greater than ever before. We rely heavily on the ground transportation system and take for granted that it will enable us to travel wherever we need to go in a safe, timely and predictable manner. Use of the ground transportation system is greater than ever before, and escalating growth in travel and shifts in travel patterns point to the need to improve the management and operations of the existing system. To ensure the high level of mobility demanded by today's global society and scheduled economy, there is a need to modernize and optimize the ground transportation system, in part by taking advantage of the advances brought on by the information revolution.

To this end, the future of Canada's ground transportation system must be connected to the knowledge economy through investments in innovation. As for other sectors of the economy, investments in knowledge and innovative technologies are key to enhancing the long-term productivity, efficiency and sustainability of Canada's transportation system. The application of new and emerging technologies known as Intelligent Transportation Systems can go a long way in addressing the many challenges confronting transportation in Canada. In the same way that the information highway is transforming our society and economy, ITS can transform the way in which we build, manage and operate the ground transportation system.

2. ADDRESSING TRANSPORTATION CHALLENGES

Canada's national transportation infrastructure is one of our most valuable assets. The World Economic Forum which ranks all countries in terms of competitiveness, recently rated Canada's transportation system as one of the best in the world. However, we need to maintain and modernize this infrastructure to support Canada's continued competitiveness and prosperity in an increasingly global and interconnected world. We also need to ensure that our transportation system is safe, efficient and sustainable for the long term.

To keep Canada's transportation system among the best in the world, there are several challenges that need to be addressed:

- i. **Congestion in densely populated corridors:** growing urban congestion is perhaps the biggest challenge. Although urban transportation falls under municipal and provincial jurisdictions, the increasing congestion in our cities directly affects the performance of our national and international

The information revolution is underway and it is changing the lives of all Canadians

transportation networks. There is a need for greater integration of the various urban and inter-city transportation modes and all levels of government and transportation stakeholders have to work together to make that happen.

- ii. **Environmental pressures, especially climate change:** approximately 26 per cent of the Green House Gas (GHG) emissions in Canada are attributed to transportation, with roughly a 50 per cent distribution between urban and inter-city transportation². Furthermore, approximately 78 per cent of urban transportation emissions come from passenger transportation, with the remaining 22 per cent coming from freight movement within urban areas. It is estimated that roughly 90 per cent of all inter-city transportation emissions are generated by automobile use. It is clear that any strategy for reducing GHG emissions from the transportation sector will need to address urban and inter-city passenger transportation.
- iii. **Competing pressures for limited financial resources:** governments recognize that as part of a national transportation strategy, there is a need to set infrastructure priorities for future maintenance and modernization. Limited resources are forcing governments to evaluate the level of infrastructure required to meet the needs of users in a way that is financially, socially and environmentally sustainable. Increasingly governments are resorting to innovative financing mechanisms such as public-private partnerships and user-pay concepts to finance new infrastructure requirements.
- iv. **Preserving and improving existing infrastructure to accommodate growing demand:** Canada currently has close to 18 million registered vehicles and a similar number of licensed drivers on our roads. Current trends suggest that private-vehicle traffic will grow between 50 and 100 per cent over the next 25 years³. Canada's existing network is not designed for such an increase in traffic, and even if we could afford to build the new infrastructure required, the environment would not be able to sustain it.
- v. **Ensuring the safety of our transportation system:** Transport Canada is committed to making our transportation system one of the safest in the world. Although highways and drivers fall under provincial jurisdiction, Transport Canada is responsible for national road-safety policy, federal motor-vehicle safety regulation, enforcing safety standards and related research. Ninety-five per cent of all transportation related deaths occur on

² Public Works and Government Services Canada, *Climate Change - Transportation Table, [Solicitation No. T8013-8-0205/W], GHG Reduction Benefits of the Deployment of Intelligent Transportation Systems on Canada's Road/Highway Network, Final Report*. June 14, 1999.

³ Transport Minister David Collenette, *Speech to the Van Horne Institute, Calgary, Alberta*. January 29, 1998.

our roads. Accordingly, Transport Canada is working actively with the provinces and territories on an initiative called “Road Safety 2001”, which is aimed at making Canada’s roads among the safest in the world by year 2001.

- vi. **Providing services to clients and customers more effectively and efficiently:** while the safety and sustainable development of the system is vital, efficient and effective service to the users of the system is equally important. This would include reducing congestion on our urban and inter-city network of roads, quicker response to accidents and incidents, implementation of faster toll collection systems on roads and bridges, faster and more efficient regulatory compliance measures for commercial vehicles on highways and at border crossings, enhanced information about alternative transportation options, improved intermodal transfers, collecting and sharing information for improved decision-making, etc.

These challenges are complex and intertwined and there is no one magic solution. As well, it is necessary that all parties involved in the operation and management of the transportation system play a role in addressing these challenges in order to achieve the common national objectives of efficient, integrated, safe and environmentally responsible transportation in Canada.

ITS technologies are innovative and effective tools for addressing transportation challenges in a cost efficient manner. These technologies have the potential to improve safety, efficiency and mobility and to optimize the use of existing capacity, thereby deferring the need for costly capital expansion. ITS technologies make it possible for businesses to improve their productivity and competitiveness and for governments to implement a number of regulations and processes more economically and effectively. They also promote the building of new partnerships among governments and with the private sector and academia.

3. WHAT ARE INTELLIGENT TRANSPORTATION SYSTEMS?

Intelligent Transportation Systems include the application of advanced information processing (computers), communications, sensor and control technologies and management strategies in an integrated manner to improve the functioning of the transportation system. These systems provide traveler information to increase the safety and efficiency of the ground transportation system for passengers and freight in both urban and rural areas and inter-city and international corridors, including border crossings. ITS also provide valuable, real-time information to system operators such as transit systems, commercial vehicle fleets, and emergency and security vehicle fleet operators. These applications bring system users, vehicles and infrastructure together into

The adoption and application of innovative technologies is the key to success in the global knowledge-based economy

one integrated system that enables the exchange of information for better management and use of available resources.

In order to better understand how ITS is changing the transportation system, and how technologies can be used to accomplish this, it is important to look at the potential functions of ITS within each of the four key components of the system: the vehicle, the user, the infrastructure, and the communication system.

i. **The Vehicle**

ITS technologies allow the vehicles in the system to be located, identified, assessed and controlled. The ability to locate a vehicle on a map is key to successful fleet management and to providing in-vehicle navigation and routing advice. The ability to identify (assess and classify) a vehicle without stopping or slowing it permits more efficient and cost-effective enforcement of regulations, toll collection and user-pay applications, and facilitates border crossings, assessment of vehicle size, weight and other vehicle-related safety requirements, tracking of freight or critical cargo movements, data collection, and other related functions. Finally, enhanced automated control functions on vehicles can help improve the safety and efficiency of the transportation system.

ii. **The User**

ITS offers navigation, provision of traveler information and monitoring capability to system users. Navigation capabilities can include in-vehicle navigation, route guidance and, where ITS monitoring infrastructure is installed, dynamic route guidance in response to changing traffic conditions. Traveler information provides motorists with information and advisories on traffic and infrastructure conditions as well as available services. ITS abilities to monitor driver performance and conditions in order to detect fatigue, inattention, or other circumstances that might otherwise result in an accident, could help to provide a safer and more comfortable environment.

iii. **The Infrastructure**

ITS provides monitoring, detection, response, control and administration functions in this domain. The monitoring function can apply to such applications as weather and environmental conditions, as well as to traffic conditions and data collection. The monitoring of vehicles detects rate of flow of vehicles on a road (i.e. congestion), incidents, and vehicles at certain locations such as traffic signals, interchange points on highways or at-grade rail crossings. Response capabilities include responding to emergency and hazardous material incidents and management of both planned and unexpected events. Control functions refer to the kinds of activities that are now done with traffic signals and other such devices.

Finally, the administration function relates to regulatory enforcement or toll/user pricing implementation.

iv. **The Communications System**

Integrated communication is what makes ITS work. The ability to exchange information between the above three functions in the system provides the necessary linkages to allow for the gathering of data that can be processed into intelligence, and can then be used to determine and activate appropriate command and control actions.

Appendix A, a primer on ITS, provides additional details on the evolution of ITS and available ITS products and services. Table 1 of the Appendix describes existing ITS capabilities bundled under the following seven categories:

- v. Travel and Transportation Management;
- vi. Travel Demand Management;
- vii. Public Transportation Operations;
- viii. Electronic Payment;
- ix. Commercial Vehicle Operations;
- x. Emergency Management; and
- xi. Advanced Vehicle Control and Safety Systems.

Table 2 provides an inventory of ITS applications already in use across Canada.

4. BENEFITS OF ITS

The potential benefits of ITS applications are considerable for all concerned including users and providers of services, the public sectors and the public at large. There are benefits, for instance, for users in congested urban areas as well as those in rural communities. The key benefits of ITS technologies are improved safety of the transportation system, reduced congestion and improved mobility, enhanced economic productivity, reduced travel time and government, traveler and operator costs, improved energy efficiency and reduced impacts on the environment. Examples of some of these benefits, based on ITS projects implemented in Canada, the U.S., Europe and Japan, are outlined below.

- i. Increased safety:
 - Canadian experience with Toronto's COMPASS Freeway Traffic Management System, which monitors traffic on sections of Highway 401, demonstrates that traffic incident and congestion measures have reduced the duration of incidents from occurrence to clearance from 86 to 30 minutes; and the average delay per incident has been reduced by

*ITS save lives,
time, money and
the environment*

537 vehicle hours. By displaying incident messages when incidents occur, approximately 200 accidents have been prevented per year resulting in \$10 million savings in resources.⁴

- U.S. experience demonstrates a reduction in the number of accidents of between 15 and 62 per cent. Specifically, the FAST-TRAC project in Oakland, Michigan, resulted in an 89 per cent reduction in left-turn accidents, a 27 per cent reduction in total injuries and a 100 per cent reduction in serious injuries. The Guidestar TMS project in Minneapolis has resulted in a 25 per cent reduction in accidents, a 35 per cent increase in average rush hour speed and freeway capacity increased by 22 per cent⁵.
- Fulton County, Georgia reduced average fire response times from 7.5 to 4.5 minutes.

ii. Time savings and operational efficiencies:

- COMPASS Freeway Management System reduced overall delay by 5.3 million vehicle-hours per year and fuel usage by 11.3 million litres per year.
- Japanese experience demonstrates that traffic management measures are saving up to 11 per cent in annual fuel consumption⁶.
- Computer-aided dispatch for plows saved Indiana US\$ 14 million per year in operating costs and equipment.
- The electronic toll collection system (PIKEPASS) in Oklahoma reduced operating costs at each staffed toll booth from \$176,000 to \$16,000 per year.
- Traffic queue dwell times in New York City toll lanes have diminished from 15 minutes to under 30 seconds since the introduction of the E-Z Pass toll system.

iii. More reliable transportation:

- Applications of ITS have resulted in a 12 to 23 per cent increase in

⁴ Lam, Joseph, [The Second APEC Urban Transport Forum - Session III: The Application of ITS in Urban Transport] ITS Applications in Canada Urban Transport. September 29 - October 3, 1997.

⁵ Intelligent Transportation Society of America, Intelligent Transportation Systems Action Guide: Realizing the Benefits. 1996.

⁶ ITS International, March/April 1998, Issue 15. Route One Publishing Ltd., London, U.K.

transit system on-time performance with passenger waiting time reduced by up to 50 per cent. For example, Kansas City, Missouri improved on-time performance of transit buses by 12 per cent while reducing fleet size 9 per cent.

- Electronic fare payment systems, where available, have gained patron popularity of up to 90 per cent. These systems have increased fare collection by 3 to 30 per cent.

iv. Enhanced economic productivity:

- It is estimated that the COMPASS System saves commercial vehicle operators \$55 million annually and has generated \$20 million in exports per year since 1993.
- The U.S. Department of Transportation (DOT) estimates that the deployment of ITS can save taxpayers 35 per cent on infrastructure investment and reduce systems' life-cycle costs over the next decade by 25 per cent or \$30 billion.
- By 2015, the United States estimates ITS investment will have generated US\$ 350 billion in direct economic benefits and 600,000 jobs.

v. Reduced environmental impacts:

- COMPASS Freeway Management System has reduced emissions by 3,100 tonnes per year.
- A recent study commissioned by the Transportation Climate Change Table for the National Climate Change Process on the impact of seven ITS applications on GHG emissions estimated annual reduction in GHG in year 2010 at 763 kt. This reduction represents 0.5 per cent of the total GHG output attributed to transportation in 1995. The associated reductions in fuel consumption are estimated at close to 300 million litres.⁷

vi. Reduced accidents in rural areas with 911 and other emergency vehicle management services, crash avoidance systems, advanced weather advisory capabilities, etc.

⁷ Public Works and Government Services Canada, Climate Change - Transportation Table. [Solicitation No. T8013-8—0205/W] GHG Reduction Benefits of the Deployment of Intelligent Transportation Systems on Canada's Road/Highway Network, Final Report. June 14, 1999.

- vii. New and increased market opportunities for suppliers and users.
- viii. Reduced paper burden and operational costs with improved system efficiency from automated functions and electronic transactions.
- ix. Improved monitoring and management of flows and incidents involving hazardous goods.
- x. Improved operational and compliance efficiencies for regulatory agencies, enabling them to focus on non-compliant operators.
- xi. Improved data collection on traffic flows, goods carried, carriers, drivers and freight loads for economic, trade and regulatory authorities, facility administrators, and transportation providers, enabling more effective policy planning, infrastructure design and operations management.

5. AN ITS PLAN FOR CANADA - VISION AND SCOPE

Intelligent transportation systems are shaping the future of transportation

To capture these opportunities, there is a need to accelerate the deployment and use of these systems in all modes across the country. It is with this intention that Transport Canada has initiated the development of this ITS Plan for Canada to provide the much needed impetus for accelerating deployment and integration of ITS applications. The ITS Plan presented in this paper will help realize the above benefits and ensure that intelligent transportation systems are a key component of Canada's ground transportation system for the 21st century.

The vision for the future of ITS in Canada is twofold:

- i. To create an environment that will stimulate the collaborative development and deployment of ITS across urban and rural Canada to improve safety and maximize the use and efficiency of the existing multimodal ground transportation system by:
 - reducing highway incidents, fatalities and time lost due to congestion;
 - making the economy more productive by expediting the flow of just-in-time distribution of goods and facilitating electronic business transactions, i.e. electronic commerce;
 - improving mobility through congested corridors and easing connections at intermodal transfer points;
 - assisting travelers with the planning of their trips to optimize savings in

cost and time;

- providing operators and service providers with information necessary to make better decisions about allocating limited resources and maximizing throughput to increase their competitiveness;
 - expediting regulatory compliance of commercial vehicles at inspection stations and providing mechanisms for their efficient clearance on the roadside and at border crossings;
 - automating the administration of regulatory and inspection processes to make them more economical and effective;
 - improving data collection for more effective policy planning and operational management; and
 - improving the quality of the environment as well as the quality of life in both rural and urban areas.
- ii. To make the Canadian ITS industry a leader in ITS technologies by positioning it to meet future Canadian needs and to compete in the growing global market place.

The ITS plan comprises three streams of activity:

- i. building awareness and demonstrating the potential of how wide-spread use and interoperability of intelligent transportation systems across Canada and North America can enhance safety and mobility and support interprovincial and international trade and tourism;
- ii. supporting strategic deployment and integration of intelligent transportation systems across urban and rural areas and on inter-city and international corridors, including border crossings, to maximize the use and efficiency of existing infrastructure and meet future mobility needs more responsibly; and
- iii. strengthening Canada's ITS industry to take advantage of growing global market opportunities.

The following sections will outline:

- the mission of this plan and specific objectives for ITS development and deployment;
- the importance of cooperation and partnership among all stakeholders;

- the design of an ITS architecture for Canada and the dynamic development of standards and protocols;
- an R&D Plan for ITS and mechanisms for its development and implementation;
- a plan to support the deployment and integration of ITS across Canada; and
- how the public and private sectors will work together to promote Canadian expertise and exports.

6. MISSION: EN ROUTE TO INTELLIGENT MOBILITY

The mission of this ITS Plan is to provide leadership and guidance for advancing the application and interoperability of intelligent transportation systems across Canada to make the national multimodal ground transportation system safe, integrated, efficient and sustainable.

The implementation of this plan is dependent on extensive cooperation and coordination between various players in the public and private sectors.

7. OBJECTIVES

This plan is guided by the following objectives in support of the mission:

- i. **Improve the safety of Canada's ground transportation by:**
 - a) providing travelers and drivers with current and real-time information on traffic and weather conditions to increase the operational safety of commercial and passenger vehicles;
 - b) quickly responding to and clearing emergencies, accidents and incidents to decrease fatalities and the number and severity of collisions, injuries, and property damage; and
 - c) mitigating the potential adverse safety impacts of ITS devices, especially those on board vehicles, on driver performance.

Technological knowledge is the main source of economic growth and improvement in the quality of life

OECD, 1996

- ii. **Increase operational efficiency and capacity of the ground transportation system by:**
 - a) improving the management of traffic flows, vehicle operations, and inspection functions;
 - b) reducing congestion, bottlenecks and other delays; and
 - c) encouraging better use of all available modes of transportation for passengers and freight.

- iii. **Reduce energy and environmental costs associated with ground transportation by:**
 - a) decreasing fuel consumption and harmful emissions by improving traffic flow;
 - b) increasing the use of more environmentally sustainable transportation by improving public transport operations;
 - c) assisting travelers in planning trips, and providing information to help them avoid congestion, accidents, incidents, etc.;
 - d) providing pre-clearance capability at inspection stations and border crossings to minimize the number and duration of stops; and
 - e) improving the delivery of maintenance activities to minimize harmful damage to the physical environment.

- iv. **Enhance productivity and competitiveness by:**
 - a) supporting trade and tourism through better mobility and easier access to goods, services and employment;
 - b) reducing operational, regulatory, financial, and other costs to system users, operators and public agencies;
 - c) ensuring interoperability of ITS applications within Canada and North America;
 - d) making better use of existing facilities; and
 - e) improving the interfaces and transfers between modes.

- v. **Improve the collection of information and data for policy making, planning, program management and evaluation, traffic operations, enforcement and congestion monitoring by:**
 - a) promoting the implementation of traffic monitoring systems, including geographical information systems, that collect data on traffic volumes and flows, travel time, congestion, vehicle classification, weigh-in-motion, freight and commodity flows, emissions and safety-related indicators;
 - b) encouraging the sharing and use of data collected by traffic monitoring equipment as input to decision-making for the provision of better service to all users; and
 - c) establishing partnerships between governments, jurisdictions and the private sector to facilitate the timely exchange of information and ensure that security, privacy and confidentiality issues are addressed.

- vi. **Enhance personal mobility, convenience and security of the ground transportation system by:**
 - a) making information on available services, traffic conditions, schedules and routings widely available to travelers for planning trips and while en route; and
 - b) improving the quality of life in rural areas through the deployment of advanced technologies such as rural 911 services, collision avoidance on resource roads, advanced weather advisory capabilities, etc.

- vii. **Create opportunities for Canadian companies in the global market place by:**
 - a) creating a domestic market in which the Canadian ITS industry can demonstrate and showcase its capabilities and products;
 - b) ensuring compatibility of ITS technologies within Canada, North America and internationally;
 - c) promoting the innovative use of private resources and public-private partnerships and international alliances; and
 - d) fostering federal-provincial partnerships to promote Canadian expertise.

- viii. **In general, create an environment in which the development and deployment of ITS will flourish in Canada by:**
- a) ensuring adequate knowledge of ITS applications in transportation planning and operations;
 - b) developing ITS skills and knowledge in the academic and work environment;
 - c) promoting cooperation and partnerships between and among governments, academia and the private sector;
 - d) encouraging technological innovation through strategic support for the multimodal research and development of future ITS applications; and
 - e) providing the necessary leadership, frameworks and technical support to advance the deployment and integration of ITS across in Canada.

8. PILLARS OF THE ITS PLAN

Canada's ITS plan is built upon the following five interconnected pillars:

- i. Partnerships for Knowledge - *the essential building block*.
- ii. Developing Canada's ITS architecture - *a solid foundation*.
- iii. A multimodal ITS Research and Development (R&D) Plan - *fostering innovation*.
- iv. Deployment and Integration of ITS Across Canada - *moving forward*.
- v. Strengthening Canada's ITS Industry - *global leadership*.

THE 1st PILLAR: PARTNERSHIPS FOR KNOWLEDGE - THE ESSENTIAL BUILDING BLOCK

To successfully develop and implement this ITS Plan, various partners will need to play a critical role. Partnerships with all levels of government in Canada, the private sector, including ITS Canada, suppliers of ITS technologies, and operators of transportation services and systems, academia and our North American counterparts are essential for the widespread deployment of ITS across Canada. These partnerships are also the most effective means for building awareness and disseminating knowledge about the potential of and

Partnerships - the essential building block for success

issues associated with ITS.

As owners, operators and regulators of important components of the ground transportation system, the provinces, territories and municipalities are key players in shaping and implementing this plan, especially in the acquisition, deployment, operation and maintenance of many of these systems. As demonstrated in Table 2 of the Appendix, the provinces and municipalities have already deployed numerous ITS applications. Ontario is recognized as a world leader in the deployment of ITS applications such as the Highway 401 COMPASS Freeway Traffic Management System and the Highway 407 Electronic Toll Route. Other provinces including Nova Scotia, New Brunswick, Quebec and Saskatchewan have recently implemented new ITS applications that are contributing to the operation and management of their highway facilities.

The federal government is very supportive of these innovative projects and will explore partnership opportunities with the provinces, territories and municipalities for joint planning and deployment initiatives of national interest. The provinces can also make important contributions to research and development activities and, as Team Canada partners, in strengthening and promoting the Canadian ITS industry.

The private sector is essential to the successful application of ITS across all ground transportation modes. The private sector includes the providers and operators of transportation services which will be key users of ITS technologies; professional societies; industry associations; and suppliers of ITS technologies. The private sector suppliers will have primary responsibility for the development and marketing of technologies and services including ITS products, computer software products, consulting, systems integration, communications and facilities management.

Engaging academia in research and development projects, planning and deployment activities will help ensure that in the future we have the necessary capacity to advance and support the development and deployment of ITS in Canada.

Consumer groups and the general public will make important contributions in determining the success of ITS and which products and services help to improve their travel experiences and quality of life.

Efforts will continue among federal partners, the provinces, our North American counterparts, and the private sector to encourage and support the deployment of ITS technologies along east-west and north-south rail and highway corridors, at the busiest Canada-U.S. border crossings, and other international gateways where efficient transfers from the air and marine modes to ground transportation are critical. As well, Canada will continue to foster international partnerships for

advancing ITS research and development, standards development, and technology transfer activities, and for sharing knowledge on state of the art deployment initiatives.

The federal government will provide leadership through the development and implementation of this plan and its various components. Additionally, the federal government will support strategic investments to demonstrate the benefits and accelerate deployment of ITS across the country. The federal government's efforts will be led by Transport Canada in partnership with Industry Canada, the Department of Foreign Affairs and International Trade, Environment Canada, Fisheries and Oceans Canada, National Research Council Canada, Communications Research Centre Canada, Natural Resources Canada, and the Canada Customs and Revenue Agency.

Transport Canada - Intelligent Transportation Systems Society of Canada Partnership

Transport Canada has entered into an arrangement with the Intelligent Transportation Systems Society of Canada (ITS Canada), facilitated by a three-year contribution agreement, whereby the association will undertake the role of principal private-sector technical advisor and partner to Transport Canada in the development of this ITS plan and the national architecture described below. ITS Canada is a non-profit professional society whose goals are to foster the growth of ITS applications, promote government-industry cooperation and strengthen Canada's ITS industry. Membership includes both public and private sector individuals and corporations and academics. This partnership will go a long way towards ensuring that Canada has a dynamic and robust intelligent transportation systems industry to take advantage of growing domestic and global market opportunities.

Under this arrangement, ITS Canada will be responsible for the following undertakings:

- i. Developing a five-year strategic business plan for ITS Canada outlining how it will support Transport Canada's efforts and ensure the Society's long term sustainability by, among other activities, expanding and broadening its membership.
- ii. Investigating partnership opportunities for joint initiatives with organizations having an interest in ITS.
- iii. Assessing the existing capacity within Canadian universities to support the development and deployment of ITS by identifying the skills and educational requirements needed to meet future industry and user needs.
- iv. Representing Canada on APEC and other international fora dealing with

aspects of intelligent transportation systems.

- v. Reviewing Canadian participation in international standards development committees/activities and developing a plan to ensure that Canadian interests are well represented at these activities.
- vi. Reviewing and providing technical advice and recommendations on all aspects of the development and implementation of the ITS plan, including the Canadian ITS architecture, the research and development plan, and the deployment plan.
- vii. Developing and producing, in collaboration with the Department of Foreign Affairs and International Trade, Industry Canada and Transport Canada, an ITS export development strategy for targeted countries of commercial interest to ITS Canada members, and participating in trade missions that will promote the Canadian ITS industry.
- viii. Organizing national and regional meetings, symposia and conferences in support of expanding Canadian business, academia and public agencies' knowledge of ITS.
- ix. Recommending to Transport Canada ITS-related studies and projects that may be of mutual interest and benefit.

THE 2nd PILLAR: DEVELOPING CANADA'S ITS ARCHITECTURE - A SOLID FOUNDATION

Simply put, an ITS architecture is the communications and information backbone that supports and unites key ITS technologies, enabling them to work together and communicate with each other. It describes the interaction among various physical components of the transportation system, such as the travelers, vehicles, devices on the infrastructure, and control centres.

The architecture will provide the framework for integrating multiple ITS applications across agencies, jurisdictions and systems and for ensuring that products and services are compatible. This framework will describe the system operation and how ITS components interact and work together, i.e. what each component does and what information is exchanged among components to achieve total system goals. The architecture will be open, with its documentation publicly accessible, to encourage innovation and competition among suppliers and to lower acquisition costs. As well, it will be modular to facilitate and accommodate the introduction of new technologies and system capabilities over time. Much like a personal computer system, the architecture defines the functions of various components – modems, printers, scanners – and specifies how they will be interconnected to work together regardless of make, model or price.

*Canada's ITS
architecture - the
foundation for
integration*

The architecture will also identify the standards needed to ensure that ITS components will operate in a consistent and predictable way to facilitate compatibility and interoperability across technologies, modes and national and global jurisdictions. These standards will help accelerate ITS development and deployment and shape industry's product development decisions and users' procurement plans. Common standards will ensure greater access to international markets and boost consumer confidence by assuring customers that new and existing systems can be integrated and upgraded with ease.

Transport Canada will contract with the private sector to develop an ITS architecture for Canada, and to provide an assessment of the current state of the development of ITS standards in Canada and the future direction for their completion. The contracted work will involve the following steps:

- i. A conceptual design that will meet the functional needs of ITS user services and the information/data flow between these functions. Specific issues to be addressed include:
 - a) Differences with the U.S., European and Japanese architectures and their impact on Canadian ITS deployment and export potential; and
 - b) Identification of high priority standards, their development within the International Standards Organization Transport Committee (ISO-TC204) and other international standards committees, and adoption in Canada and within NAFTA.
- ii. Discussions and consultations with stakeholders, which will serve as a starting point to identify their needs, issues of concern, and their role in architecture development and ITS deployment.
- iii. It is very likely that the U.S. National ITS Architecture will hold significant advantages in the Canadian context. However, a detailed comparison will be undertaken to reveal consistencies and differences between the preferred ITS architecture for Canada and those adopted by other nations. A comprehensive review of the significant differences between the Canadian and other architectures such as U.S., Europe, Japan and Asia-Pacific will yield the gaps that need to be filled if the Canadian ITS industry is to remain competitive in the world market.
- iv. Once architecture developments in other regions are clearly defined and understood, the building blocks for a Canadian ITS architecture will be identified. The elements of the architecture and its development will be based on experience of others to form a flexible framework architecture covering ground transportation and the interfaces between modes.

- v. After the architecture is defined, the standards will be developed based on architecture interfaces and data flows, identifying information that cuts across standards activities. This knowledge will allow standards organizations to be aware of overlapping activities and their effective coordination. Identification and adoption of critical standards such as dedicated short-range communications (DSRC) across NAFTA boundaries has significant impact on the delivery of ITS in North America and, more importantly, in Canada.
- vi. Standards development is of interest to nearly all organizations involved in the deployment of ITS. It is anticipated that product developers, communications providers, private service providers and public sector agencies will play an equal role in standards development activities. It is to Canada's advantage to participate in international standards development work through close interface with the U.S., Europe, Japan and other APEC economies.
- vii. An implementation plan for the Canadian architecture and related standards activities, identifying development and deployment requirements and the roles of Canadian public sector agencies and private sector firms, will be presented.
- viii. A number of Canadian issues will be taken into consideration. These include: ITS architecture for mid-size cities and rural areas; appropriate radio frequency allocations for ITS throughout Canada; standards that allow interoperability across North America; treatment of existing legacy systems; as well as language, environment, metric measures and legislation that are specific to Canada.

THE 3rd PILLAR: A MULTIMODAL ITS R&D PLAN - FOSTERING INNOVATION

The need to support technology research and development is an ongoing challenge cited by the ITS industry. In a rapidly evolving technology environment, which is the hallmark of ITS, it is important that central governments provide technology support to help ITS suppliers continue to adapt and develop new technologies. The G-7 countries that have a national ITS strategy have dedicated funding for R&D as an essential element and emphasize demonstrations as the key vehicle for showcasing ITS capabilities. These governments have spent billions of dollars in partnership with their industries in developing and demonstrating various ITS technologies. Canada needs to find a way to accomplish the same goal, even if on a much more limited scale.

Over the last decade, Transport Canada, through its Transportation Development Centre (TDC), has conducted and supported a variety of

Research and development fosters technological innovation

multimodal research and development projects to demonstrate the potential and feasibility of ITS. TDC has also coordinated Canadian ITS standards development activities and supported the development of new ITS applications now operational in Canada and internationally. This R&D support has been a catalyst for the growth of a small but dynamic ITS industry in Canada. The government appreciates the importance of R&D for innovation and recognizes that an examination of priorities for future activities is timely. Technical focus will be essential in this respect.

In addition to the work by TDC, Transport Canada's Road Safety Directorate has been conducting safety and human factors research to understand the influence of on-board information, control and communication systems on driver performance/behaviour, with a view towards developing a scientific basis for national policies, vehicle regulation and other interventions. It also chairs the International Harmonized Research Activities (IHRA) Working Group on ITS, an intergovernmental initiative aimed at harmonizing international policies based on a shared understanding of the risks and benefits of ITS.

To build on and advance this ongoing research, Transport Canada will prepare a five-year plan of ITS technology research and development activities. The potential benefits of the R&D plan will be assessed through analysis and evaluation in terms of safety, security and efficiency. By working with partners from the private and public sectors and academia, an assessment and evaluation of the new ITS technologies will be undertaken. Through its participation at workshops, industry will be encouraged to support the R&D plan and follow up with the deployment and marketing of products and services that better meet both the social and economic needs of Canadians, and their own corporate goals.

ITS Canada will be an important partner in helping to define priorities and thrusts for such efforts. Transport Canada will also explore opportunities for partnerships with other federal government laboratories and agencies with expertise and technologies applicable to the ITS field.

Under this multimodal R&D plan, the following activities will be conducted:

- i. A technology intelligence service will be established to investigate and report on new technologies that claim to have significant social and economic benefits. The primary focus will be on intelligent transportation systems that use sensors, communications and computer systems to provide innovative capabilities for transportation.
- ii. A multimodal workshop on ITS technologies and applications will be organized for participation by all interested parties. Presentations on selected new technologies and applications including priorities for R&D proposals will be solicited from the participants. The resulting program for

research, development and demonstration will be published and used to attract cooperative funding and launching of R&D projects.

In keeping with Transport Canada's mandate to promote transportation safety, research into ITS safety is essential for ensuring that Canadians derive the maximum benefits from new technologies, and that attendant safety risks are minimized.

A number of safety concerns have been raised, especially with respect to on-board devices. Inappropriate use of technology can increase driver errors, which can have serious adverse safety impacts. Ultimately, the safety impact of a given ITS application will depend largely on the extent to which the system supports users' needs and is compatible with human capabilities and limitations. It is essential that all users understand the potential safety consequences of ITS technologies being developed and implemented. As the use of ITS evolves, there is a need to investigate such safety concerns and develop measures to minimize the potential risks associated with new technologies. To ensure these safety issues are addressed, the R&D plan will also include the following activity:

- iii. Elaboration of a plan of research to expand the scope of work undertaken by Transport Canada in identifying and exploring safety and human factors issues associated with ITS functions, modes of operation, performance levels or product features.

Transport Canada will continue to work in partnership with other countries and the private sector to understand the safety benefits and risks associated with on-board ITS and to develop internationally accepted procedures (including methods and criteria) for the evaluation of the safety of in-vehicle applications with respect to human performance and behaviour. This research will contribute to product design and integration guidelines and standards that lead to safer human-machine interfaces, and consumer information.

THE 4th PILLAR: DEPLOYMENT AND INTEGRATION OF ITS ACROSS CANADA - MOVING FORWARD

As stated earlier, the vision of Canada's ITS plan is to stimulate the deployment of these systems across urban and rural Canada to maximize the use and efficiency of existing infrastructure and to meet future needs more responsibly. To this end, Transport Canada will provide limited funding to accelerate the deployment, integration and interoperability of intelligent transportation systems across all modes. Transport Canada will establish a deployment plan to guide and manage deployment activities supported by the federal government.

This deployment plan will address the role of the federal government in

facilitating the deployment and integration of systems by other jurisdictions and/or private sector entities. Broadly speaking, the role of the federal government will be to focus attention on the opportunities for and benefits of deployment for all modes; provide seed funding to lever complementary public and private sector investment; and contribute to the testing of the model applications that would be transferable in applicability and encourage further deployment by others. The deployment plan will outline the types of projects that the federal government will support in both urban and rural areas and define the criteria that will be used in assessing candidate proposals. The deployment plan will encourage proposals that serve local, national and industry needs. As the plan evolves, it will identify ongoing activities supported by the federal government, coordinate activities involving multiple agencies, and define future direction and activities.

Under this deployment plan, proposals will be selected for funding, through competitive solicitation. Successful proposals shall be consistent with the objectives of this ITS Plan, the national architecture and predetermined eligibility criteria. The plan will encourage inter-provincial and international cooperative agreements, partnerships, or other arrangements intended to promote regional and intermodal cooperation, planning, and shared project implementation for ITS.

Eligible projects could involve one or more partners including the provinces, municipalities, the private sector (transportation providers and ITS suppliers), academia, federal departments or U.S. states and agencies. The proposed projects should meet documented needs, focus on the integration of ITS applications and strengthen institutional ties across jurisdictions, modes and operating agencies. The deployment plan will allow flexibility so that initiatives can be as useful and responsive as possible to client needs. The federal government's share of funding for eligible projects shall not exceed 50 per cent of the total cost, and preference may be given to those proposals involving multiple stakeholders and requiring smaller federal contributions. The number of projects funded will depend on and be shaped by the availability of funds for the deployment plan in a given year. A selection committee shall be established to review and evaluate proposals to determine their eligibility for funding.

A condition of federal government support for any proposal will be the requirement to submit a short and concise evaluation, after the project is completed, reporting on how the objectives were met, outcomes achieved and the lessons learned. As the results of projects become available, they will be summarized and publicized by Transport Canada to serve as guidance material for future deployment activities, and to assist in evaluating the effectiveness of ITS standards on system performance, interoperability and functionality.

THE 5th PILLAR: STRENGTHENING CANADA'S ITS INDUSTRY - GLOBAL LEADERSHIP

Given Canada's established capabilities in communications and information technologies, we have the potential to build an ITS industrial infrastructure that could provide significant ongoing benefits to the country's economy. In order to achieve this objective, there is a need to bring together stakeholders from the three levels of government, the private sector and the academia to work in partnership to ensure that Canada takes its rightful place in this potentially lucrative global market.

Opportunities in the Global Marketplace

According to an extensive joint study⁸ carried out by Transport Canada and Industry Canada, the potential global annual sales for ITS products and services could reach almost US \$19 billion by 2001, US \$43 billion by 2006, and US \$66 billion by 2011. Cumulative sales between 1996 and 2011 were estimated to exceed US \$430 billion. The study further estimated the Canadian share of this huge market at over US \$1.2 billion by 2001, US \$2.9 billion by 2006, and US \$4.7 billion by 2011. Based on these estimates Canada's cumulative share of global markets for the years 1996 to 2011 could exceed US \$28 billion. It should be noted that these opportunities would result in the creation of thousands of knowledge-intensive, high paying jobs in Canada. Furthermore, most of these sales would be for export markets.

In a 1996 study, ITS America predicted a cumulative global ITS market in excess of US \$400 billion by 2010. According to this study, the U.S. is expected to spend US \$200 billion, with anticipated spending in Europe and Japan at US \$100 billion each.

A similar study⁹ carried out in the U.S. estimated the U.S. markets for ITS products and services over the 20 year period to 2015 at over US \$425 billion, broken down as follows:

- i. "Public Market" at over US \$75 billion for infrastructure driven public investment to address congestion and safety needs.
- ii. "Private Market" estimated at over US \$350 billion for investments in rapidly growing market for in-vehicle systems such as Traveler Information, Navigation and Collision Warning/Intelligent Cruise Control Systems.

European studies estimate their ITS market over a 20 year period (1997-2016) at US \$200 billion. The Japanese market also demonstrates huge potential, as

⁸ Joint Transport Canada/Industry Canada study, Strategy for Developing an ITS Industrial Base in Canada; TP 13230E. 1995-96.

⁹ Joint Electronics Industries Association (EIA) and ITS America study, Forecasting the market potential of ITS into the 21st Century. February 1997.

they are proceeding with implementation of ITS applications at a very rapid pace through provision of infrastructure by the government and simultaneous product development by the private sector, particularly by the automobile manufacturers. It must, however, be recognized that the Japanese market has been very difficult to penetrate by foreign companies.

Promoting Canadian Expertise

In order to position Canadian ITS, communications and information technology industries to take advantage of these vast potential markets, the federal government will work with the provinces and the private sector to develop export opportunities for Canadian ITS firms.

Industry Canada, the Department of Foreign Affairs and International Trade and Transport Canada will lead the federal government's activities in supporting ITS market development efforts. Working cooperatively with the private sector, an export development strategy will be prepared to promote Canadian expertise to the world. This strategy will focus on gathering business intelligence, product marketing and identifying partnership opportunities for Canadian industry. The federal government will play an important and proactive role in helping Canadian ITS companies to build both domestic and offshore alliances. Offshore alliances in particular will be essential to penetrating local markets for technology.

ITS Canada can play a major role in providing a strong interface between government and the ITS industry. The federal government will seek to develop a strong partnership with ITS Canada and the provinces for the development and promotion of the ITS industry in Canada.

9. MILESTONES

Work on a number of areas described in the five pillars is currently underway. Progress on these along with the future milestones is outlined below.

i. Partnerships for Knowledge

To build awareness of ITS, Transport Canada and ITS Canada are convening information sessions across Canada. Two sessions have already taken place (Vancouver and Calgary) and others are being planned for Atlantic Canada, Quebec and Ontario.

The Federal-Provincial-Territorial Council of Ministers Responsible for Transportation and Highway Safety has recognized the opportunities for ITS to improve transportation productivity, efficiency and safety, and the need for

*Promoting
Canadian
expertise to the
world*

national and continental interoperability and coordinated planning for deployment of ITS. Ministers have directed officials to work together towards the development of a national planning framework for deployment of ITS that builds on the initiatives put forward in this plan. This joint effort is expected to get underway in the Fall of 1999.

ii. The Canadian ITS Architecture and Related Standards

Transport Canada has already commissioned the work for the development of the Canadian ITS architecture to a private sector contractor. Widespread consultations will be undertaken by the contractor during the Fall of 1999. The final report defining the proposed Canadian architecture, a plan for implementing and updating the architecture, and recommendations for standards development work are expected to be completed before the end of 1999.

At the completion of this work, a national workshop will be held to discuss, with all stakeholders, the Canadian architecture and its implementation and proposed work on the development of standards.

iii. The Multimodal ITS R&D Plan

Transportation Development Centre of Transport Canada will undertake the development of this plan. TDC will convene a workshop with stakeholders to discuss their needs and priorities and the future direction for ITS R&D. This workshop will be held in the Winter of 2000.

Once the R&D plan is completed, consideration will be given to its implementation.

iv. Deployment and Integration of ITS Across Canada

Transport Canada is in the process of developing the deployment plan, which is expected to be completed by the end of 1999. Proposals from interested parties across Canada will then be invited through a formal solicitation process. Applicants will be informed of the requirements and deadline for submission of proposals. It is anticipated that proposals could be considered for limited funding by the Spring of the year 2000.

v. **Strengthening Canada's ITS Industry**

Co-sponsorship of the 6th ITS World Congress

The ITS World Congress provides an excellent venue for showcasing to the world Canadian expertise and products. The federal government, led by Minister Collenette and Transport Canada, is very supportive of this prominent international event and we will have a Government of Canada exhibit booth to showcase the federal government's interest in and support for ITS. The booth will feature exhibits by Transport Canada, Industry Canada, Environment Canada, Fisheries and Oceans Canada, National Research Council Canada, Natural Resources Canada, and the Canada Customs and Revenue Agency. Transport Canada is a major co-sponsor of the Congress, providing travel to outdoor exhibits and simultaneous interpretation services. In March 1999, Minister Collenette hosted a reception for the diplomatic community to encourage attendance at the World Congress by foreign delegates.

The World Congress will also benefit from the support of and feature exhibits by provincial and municipal governments and Canadian ITS companies.

Partner in Trade Team Canada Initiatives

Canada has been a leading player in a number of areas such as toll collection technologies, weigh-in-motion systems, traffic sensors and control technologies and communication systems for ITS applications. As partners in Trade Team Canada, Transport Canada, the Department of Foreign Affairs and International Trade and Industry Canada will play an active role in promoting and developing the export potential of the Canadian ITS industry. These departments, along with representatives from Ontario and ITS Canada, recently participated in an outgoing mission to Chile and an incoming and return mission to Dallas, Texas.

ITS Canada has also been active in promoting Canadian ITS companies in various countries. ITS Canada not only participated in the three missions mentioned above but has led industry missions to China and Malaysia. As well, ITS Canada was a member of the Team Canada delegation to the World Road Congress (PIARC) which convened in Kuala Lumpur, Malaysia October 3-9, 1999.

10. CONCLUSION

This document advances a plan to promote and support the development and deployment of intelligent transportation systems in Canada. While this is a modest effort, it is an important step in the right direction. This plan should provide the impetus for further innovation and new applications that will make Canada's ground transportation system safe, smart, strategic, and sustainable. More significantly, by taking advantage of the advances brought on by the information revolution, this plan prepares ground transportation for the challenges of the global knowledge economy. However, the plan's ultimate success will depend on all partners working together toward the common vision of intelligent mobility.

As we proceed with implementation of the plan, we will begin to reap the benefits of improved mobility and increased productivity and safety. The ground transportation system will become more reliable and predictable, better integrated and more environmentally friendly. This smart and innovative system will enhance national competitiveness and prosperity and improve the quality of life for all Canadians. In the end, it is these measures that will determine the true success of this plan.

We are confident that this plan will improve ground transportation in Canada and encourage greater public-private cooperation. Over the coming years Transport Canada will report on the success and lessons learned to ensure that as many as possible will be able to share in and benefit from these experiences.

INTELLIGENT TRANSPORTATION SYSTEMS: A PRIMER

Material for this Appendix has been extracted from:

1. Transport Canada/Industry Canada Study: Strategy for Developing an ITS Industrial Base in Canada; TP 13230E. December 1996
2. Transport Canada Study: Review of ITS Architecture within the Canadian Context - Ties Contract #T8200-6-6575/003/XSD. May 1999

1. Introduction to ITS

Intelligent transportation systems include the application of advanced information processing (computers), communication and electronics (sensing and control) technologies and management strategies – in an integrated manner – providing traveler information to increase the safety and efficiency performance of ground transportation systems for passengers and freight both in urban and rural areas. ITS also provide useful, real-time information to system operators.

ITS technologies are changing the way in which we build, design, manage, and operate our transportation system. The application of these leading-edge technologies are proving to be an effective means for making existing transportation systems safer, more productive, more reliable and environmentally friendly without having to physically alter the current infrastructure. ITS have the potential to increase the capacity of existing infrastructure at a fraction of the cost of constructing new facilities. Further, ITS make it possible to implement a number of government regulations and processes more economically. ITS technologies cannot solve all ground transportation problems, however, coupled with demand management techniques and some degree of infrastructure expansion, they provide a practical and effective alternative to the traditional way of doing business. Through their ability to bring together the road user, the vehicle and the infrastructure in one integrated system, ITS enables these elements to exchange information for better management and use of available resources.

ITS applications contribute to improving safety, mobility and service levels, reducing energy and environmental impacts, and enhancing productivity. The potential benefits generated from their implementation are considerable, including time savings, vehicle operating cost reductions, more reliable transportation, safer highways, avoided transportation infrastructure costs, reduced emissions and more pleasant driving experience.

2. ITS Products and Services

Like any rapidly evolving area, ITS has a lexicon that is changing as quickly as the technology evolves. Originally termed IVHS - for Intelligent Vehicle Highway Systems - the new ITS term was coined to incorporate the obvious concerns for intermodality and interaction with other modes. European organizations originally favoured the terms “Road Transport Informatics” (RTI) and “Advanced Transport Telematics” (ATT), and most recently, the Japanese have turned to the term Vehicle, Road and Traffic Intelligence Systems (VERTIS). All of these designate the same set of technologies that we refer to here as ITS.

As ITS first evolved in North America, the domain was divided into six functional

areas as noted in the table below.

Initial ITS Functional Areas Designations

DESIGNATION	FUNCTIONAL AREA NAME
ATMS	Advanced traffic management systems
ATIS	Advanced traveller information systems
AVCS	Advanced vehicle control systems
CVO/AFMS	Commercial vehicle operations / Advanced fleet management systems
APTS	Advanced public transit systems
ARTS	Advanced rural transportation systems

These functional areas have now evolved into what the U.S. ITS architecture categorizes into seven “Service Bundles” comprising 30 distinct “user services” or ITS products. The table at the end of this section summarizes these bundles, their constituent user services and their functionality. Regardless of the terminology used, they provide a good means of classifying and grouping the kinds of actual products and services that are now beginning to appear in the ITS marketplace. A brief discussion of each of the bundles is provided below. Once the Canadian ITS architecture is developed, these bundles will be revisited to reflect the user services of particular interest to Canada.

i. **Travel and Transportation Mangement:**

The services provided under this heading collect and process real-time information about the ground transportation system and use this both for providing commands to traffic control devices, and for disseminating intelligence regarding infrastructure and other conditions within the system to the traveller. They may take their inputs from detectors (in the infrastructure or on masts) which indicate such things as the presence of vehicles, their speeds, headways, and other parameters that permit a determination of how efficiently traffic is moving. Existing signal installations are also capable of providing data on vehicle presence and flow, and recent experiments have shown that vehicles moving in the traffic stream can also transmit information regarding speeds and delays back to a central control centre. Closed circuit television (CCTV) cameras may also be used to provide direction visual information to control centre operators.

Real-time data collection and surveillance are primary characteristics of the services provided in this bundle. In this way, corrective actions can be taken in time to provide the efficiencies of capacity use that are sought. The integration of various subsystems is also important, enabling many different data inputs to be brought together to provide a better overall picture of network conditions. While the means to provide the linkage between the driver and the control centre exists using conventional means

(traffic signals etc.), more and more emphasis is being placed on providing advice to the driver regarding conditions in order that they may take the actions that they deem most appropriate for their situation.

The user services provided under this bundle are described below:

- En route driver information: provides driver advisories and in-vehicle signing for convenience and safety.
- Route guidance: provides travelers with simple instructions on how to best reach their destinations.
- Traveler services information: provides a “business directory” or “yellow pages” of service information.
- Traffic control: manages the movement of traffic on streets and highways, ports, airports and intermodal facilities.
- Incident management: helps public and private organizations quickly identify incidents and implement a response to minimize their effects on traffic.
- Emissions testing and mitigation: Provides information for monitoring air quality and developing air quality improvement strategies.
- Highway–Rail Intersection: helps avoid accidents at railway crossings.

ii. **Travel Demand Management:**

This bundle of services is intended to support policies and strategies that are aimed at reducing vehicle demand by developing and encouraging modes of travel other than the single occupancy vehicle. Building on information collected and processed by the Travel and Transportation Management services and the Public Transportation Operations services, this set of services achieves its goal by providing information required to implement effective demand management strategies at the operational level, by providing pre-trip information on multiple modes of travel to individuals before they undertake their trip, and by helping travelers find ride-sharing opportunities.

The user services provided under this bundle are:

- Demand management and operations: supports policies and regulations designed to mitigate the environmental and social

impacts of traffic congestion.

- Pre-trip travel information: provides information to travelers for selecting the best transportation mode, departure time and route.
- Ride matching and reservation: makes ride-sharing easier and more convenient by assisting both users and service providers in maximizing the use of their vehicles.

iii. **Public Transportation Operations:**

These services are intended to help improve both the service and efficiency of public transit companies. By providing improved information to public transit users both at the pre-trip planning stage, and during the trip itself, they can help improve the reliability and attractiveness of public transit as a travel mode.

They can also help enable specialized paratransit services which render transportation systems more widely accessible. From a management standpoint, the services will provide improved monitoring of bus usage, vehicle location and driver performance measures tools which can help public transit fleet managers plan and carry out their work more effectively. The services will rely on a variety of technologies, including AVI (automatic vehicle identification), GPS (for vehicle location), information display technologies, and cashless payment technologies such as smart cards.

Public transit operations services have several key characteristics. Like the Travel and Transportation Management bundle, they require real-time information for many of their functions if the systems are to be useful to passengers. Data links with a centralized control centre are essential to vehicle positioning, routing and scheduling. Traveler information of relevance offered under the services of this bundle might include: automated next-stop information on vehicles; transfer point and times information; routing and scheduling information at stations; and real-time “next vehicle” information at stations.

The services included under the public transportation operations heading include:

- Public transportation management: automates operations, planning and management functions of public transit systems.
- En route transit information: provides information to travelers using public transportation, after they begin their trips.

- Personalized public transit: provides flexiblyrouted transit vehicles to offer more convenient and more accessible customer service.
- Public travel security: creates a secure environment for public transportation patrons and operators.

iv. **Electronic Payment:**

This single-service bundle supports the deployment of many other services, both inside and outside the transportation domain. Both public and private sectors will take advantage of the systems included in this service.

Electronic payment will help to promote intermodal travel by providing a common electronic payment medium for a wide variety of transportation services including tolls, transitfares, and parking. A number of technologies are available to support this service including the current leading contender, “smart cards”. It is highly likely (and has been demonstrated in Europe) that such systems could be expanded to include a much wider range of consumer goods and services, and in fact could provide a real alternative to today’s credit/bank cards.

- Electronic payment services: allows travelers to pay for transportation services electronically.

v. **Commercial Vehicle Operations:**

The purpose of the CVO bundle of services is to improve the safety and efficiency of commercial vehicle operations. They offer these benefits through two distinct mechanisms; improvements in fleet management tools and techniques for the carriers themselves; and improved and more efficient regulatory enforcement techniques for government agencies. Already, fleet management tools involving satellite-based fleet tracking, centralized computer-aided dispatching, and in-vehicle voice/data links between trucks and their home offices have allowed trucking companies to progress substantially in terms of making better use of their available fleet and dispatch resources. At the regulatory level, pilot programs such as the Heavy Vehicle Electronic License Plate (HELP) and ADVANTAGE – 75/AVION have demonstrated the practicality of such technologies as automatic vehicle identification and weigh-in-motion for the purposes of enforcing truck size and weight regulations without having to make vehicles stop. Communications technologies obviously play a central role in such applications.

Some of the applications involve the use of in-vehicle sensors to monitor both vehicle functions (engine conditions and use, speeds, distances, etc.) and driver alertness (eye movements, etc). Electronic identification tags (transponders) allow individual identification of vehicles and

roadside/vehicle communication of this and other relevant regulatory information. Data links are obviously also an essential element, as are voice communications.

Deployment of ITS technologies is already well underway in this domain, in particular with respect to the fleet management and dispatch functions which are critical to the effective management of resources. The user services foreseen under this bundle are:

- Commercial vehicle electronic clearance: facilitates domestic and international border clearance, minimizing stops.
- Automated roadside safety inspection: facilitates roadside inspections.
- On-board safety monitoring: senses the safety status of a commercial vehicle, cargo and driver.
- Commercial vehicle administrative processes: provides electronic purchasing of credentials and automated mileage and fuel reporting and auditing.
- Hazardous material incident response: provides immediate description of hazardous materials to emergency responders.
- Freight mobility: provides communication between drivers, dispatchers, and intermodal transportation providers.

vi. **Emergency Management:**

Emergency services such as police, fire and specialized rescue operations can use the services under this bundle to improve both response time and management of resources under their control. The primary characteristics of the applications in this bundle include knowledge of vehicle location, communications, and response. The services include:

- Emergency notification and personal security: provides immediate notification of an incident and an immediate request for assistance. Incidents can include both driver/personal security requests and automatic collision notification. Both services generally involve the automatic provision of vehicle location with the signal. In the case of collisions, the nature and severity of the crash may also be provided to responding personnel.
- Emergency vehicle management: reduces the time it takes for a

vehicle to get to an incident through such techniques as more effective fleet tracking and management, route guidance, and signal priority/pre-emption for emergency vehicles.

vii. **Advanced Vehicle Control and Safety Systems:**

The common goal of these services is to improve vehicle safety. In the short-term, all of the services (except the automated highway application) depend on autonomous in-vehicle technologies to do their jobs. Ultimately, infrastructure-based sensors will probably be used to supplement and improve many of these systems. In fact, these systems can be thought of as generally progressing through three stages or levels of development: autonomous systems, cooperative driving systems, and automated functions. In an autonomous system, the devices do not depend on external communications or control signals to accomplish their tasks. In cooperative driving, however, they act as an “automated co-pilot” which can, on occasion, warn the driver of impending situations or supplement the driver’s actions to a degree. Finally, in fully automated systems, vehicle control may be entirely relinquished by the driver to the system at certain times, or the systems may take over complete control automatically under appropriate conditions. Advanced vehicle control and safety systems will normally require sophisticated in-vehicle sensors and electro-mechanical control systems, in addition to vehicle-to-vehicle, and roadside-to-vehicle two-way communications capabilities.

The services incorporated under this bundle include:

- Longitudinal collision avoidance: helps prevent head-on, rear-end or backing collisions between vehicles, or between vehicles and other objects or pedestrians.
- Lateral collision avoidance: helps prevent collisions when vehicles leave their lane of travel.
- Intersection collision avoidance: helps prevent collisions at intersections.
- Vision enhancement for crash avoidance: improves the driver’s ability to see the roadway and objects that are on or along the roadway.
- Safety readiness: provides warnings about the condition of the driver, the vehicle and the roadway.

- Pre-crash restraint deployment: anticipates an imminent collision and activates passenger safety systems before the collision occurs, or much earlier in the crash event than is currently feasible.
- Automated highway system: provides a fully automated, “hands-off” operating environment.

There are two other evolving bundles of ITS users services that are of particular interest to the Canadian transportation environment:

- Rural Applications, which are targetted at improving the safety, mobility, travel information and quality of life in smaller urban and rural areas. Some of the categories of services under the rural bundle include: incident detection; traffic management; road/weather information systems; detection/MAYDAY services; and transit, travelers and tourist information.
- Intermodal Applications, which facilitate the efficient movement and effective intermodal transfers of passengers and freight with better utilization of all modes of transportation. Some of the services in this bundle are common to those found in the travel and transportation management, electronic payment, conventional vehicle and transit operation bundles.

As these are further developed, they will be reflected in the ITS architecture and other documents.

Table 1

ITS USER SERVICE BUNDLES¹⁰			
USER	DEPLOYMENT FEATURES		
SERVICE	FUNCTION 1	FUNCTION 2	FUNCTION 3
TRAVEL AND TRANSPORTATION MANAGEMENT			
En Route Driver Information	General in-vehicle display of static sign information along with driver advisories for current congestion, incident, conditions, etc.	Sign information tailored to current conditions and driver advisory information filtered/tailored to meet driver's specific needs	Sign information tailored to vehicle and current conditions along with predictive driver advisories integrated with route guidance service
Route Guidance	Autonomous route guidance supplying static directions	Real-time route guidance based on current conditions	Coordinated real-time route guidance to achieve network-wide optimization
Traveler Services Information	Fixed "Yellow pages" service optimized for traveler queries	Mobile service providing information based on location/need (e.g. gas stations in range)	Integrated electronic reservation/payment service
Traffic Control	Enhanced freeway control	Enhanced network control	Integrated area-wide control
Incident Management	Automated incident detection. May rely on traffic monitoring, direct reports, or both	Automated detection, verification, response plan recommended to operator	Complete incident management automation. Minimal man-in-loop operator control
Emissions Testing and Mitigation	Roadside pollution assessment	Area-wide pollution monitoring	Integrated area-wide air quality strategies
Highway-Rail Intersection	Standard traffic control devices at highway-rail intersections	Coordination with railroads to enhance traffic management	Immobile vehicle detection and emergency notification

¹⁰ U.S. Department of Transportation, The National ITS Architecture, A Framework for Integrated Transportation into the 21st Century. Version 2.0

ITS USER SERVICE BUNDLES¹⁰			
USER	DEPLOYMENT FEATURES		
SERVICE	FUNCTION 1	FUNCTION 2	FUNCTION 3
TRAVEL DEMAND MANAGEMENT			
Demand Management Operations	Demand monitoring and public awareness information	High occupancy vehicle (HOV) and parking facility administration	Dynamic user fee based on time, route, number of passengers, emissions, etc.
Pre-Trip Travel Information	Real-time information available to travelers at home, office, etc.	Integrated data for all modes available in one repository	Route, time, and mode recommendations made
Ride Matching and Reservation	Match private vehicle owners/operators with potential riders	Include commercial transit providers as match options	Include support for ride-share financial transactions
PUBLIC TRANSPORTATION OPERATIONS			
Public Transportation Management	Centralized schedule monitoring and management	Add off-line analysis/planning and personnel management support	Integrated with traffic control to enhance real-time schedule adherence capability
En Route Transit Information	Current route/schedule information available. Limited interaction	Integrated multimodal information with decision support	Integrated with electronic payment service (ticket/fare card purchase)
Personalized Public Transit	Reservation-based rider request capability	Vehicle assignment with optimized vehicle schedule	Real-time vehicle assignment
Public Travel Security	Physical security, surveillance, screening, and alarm systems	Driver/traveler-initiated silent alarm (vehicle-based)	Alarms capability integrated with personal communications services
ELECTRONIC PAYMENT			
Electronic Payment Services	Electronic toll collection	Electronic fare collection/electronic parking payment	Integrated electronic payment service supporting all modes

ITS USER SERVICE BUNDLES¹⁰			
USER	DEPLOYMENT FEATURES		
SERVICE	FUNCTION 1	FUNCTION 2	FUNCTION 3
COMMERCIAL VEHICLE OPERATIONS			
Commercial Vehicle Electronic Clearance	Use historical data and WIM to preclear carriers with annual registration	Extended service which preclears those with temporary permits	Vehicle and driver condition automatically monitored and considered in preclearance
Automated Roadside Safety Inspections	On-line access to historical safety records for identified vehicles	Vehicle-based diagnostics collected and monitored	Driver status and condition monitored and considered
On-Board Safety Monitoring	Safety monitoring with automated driver notification	Extended to supply notification to carrier	Extended to supply notification to enforcement agencies
Commercial Vehicle Administrative Process	Electronic purchase of annual credentials from base state	Add purchase of temporary credentials/permits from other states	Automated mileage and fuel reporting
Hazardous Material Incident Response	Enforcement and HAZMAT response teams provided with cargo information	Operational focal point to coordinate with other agencies	Real-time HAZMAT incident response coordination
Freight Mobility	Fleet location and status monitoring	Integrated route guidance	Specific specialized fleet capabilities
EMERGENCY MANAGEMENT			
Emergency Notification and Personal Security	Motorist initiated distress signal	Automated distress signal initiated by vehicle collision	Content added to message for special uses (e.g. HAZMAT)
Emergency Vehicle Management	Vehicle dispatch support	Route guidance directing driver to the scene	Integration with traffic control to optimize travel times
ADVANCED VEHICLE CONTROL AND SAFETY SYSTEMS			
Longitudinal Collision Avoidance	Driver warning of potential longitudinal collisions	Temporary partial control in collision avoidance situation	Full control, integration with lateral control service
Lateral Collision Avoidance	Blind spot warning and/or partial control	Lane holding warning and/or partial control	Full control, integration with longitudinal control service

ITS USER SERVICE BUNDLES¹⁰			
USER	DEPLOYMENT FEATURES		
SERVICE	FUNCTION 1	FUNCTION 2	FUNCTION 3
Intersection Collision Avoidance	Signalized intersection violation (e.g. run red light) detection and control override	Potential intersection collision warning/ partial control	Fully automated intersection control
Vision Enhancement for Crash Avoidance	Independent vision enhancement service	Integrated with in-vehicle signing/ other collision avoidance services	
Safety Readiness	Enhanced vehicle condition monitoring	Unsafe road conditions monitoring	Impaired driver monitoring and control override
Pre-Crash Restraint Deployment	Sensor-based detection and restraint deployment	Vehicle to vehicle coordination and restraint deployment	Personalized restraint based on occupant characteristics
Automated Highway System	In-vehicle collision-avoidance precursors to AHS	Minimum roadside intelligence	Fully automated vehicle operations

3. WHERE IS CANADA NOW?

While ITS may sound rather futuristic, they are here now. Many real systems, products and services are already at work in Canada. Canada has been a leading player in the ITS arena for many years and it continues to develop its niche in this fast-growing industry.

Some of the first ITS developments occurred in Canada, including the world's first computer-controlled traffic signal system in Toronto. Over the years, many other ITS applications have been implemented and planned by a multiplicity of public and private sector organizations. Some of the most recognized include the Highway 401 COMPASS Freeway Traffic Management Systems, the Highway 407 Electronic Toll Route, Advantage I-75/AVION motor vehicle safety compliance system on Highway 401, and the NATAP (North American Trade Automation Prototype) automated border clearance test projects at the Peace and Ambassador Bridges.

Transport Canada through its Transportation Development Centre, has for several years conducted and funded a variety of industry-oriented research and development projects to demonstrate the potential and feasibility of intelligent transportation systems. TDC has also coordinated ITS standards development

activities and supported the development of new applications such as the ground transportation (taxi) management system now in operation at Toronto's Pearson and Winnipeg Airports, among others. Transport Canada, together with Industry Canada, has also conducted several studies in support of the development of an ITS architecture for Canada and prepared a strategy for the development of an ITS industrial base in Canada.

The table below provides an inventory of ITS initiatives across the country.

Table 2

ITS DEPLOYMENT ACROSS CANADA BY PROVINCE¹¹		
SYSTEM	SYSTEM DESCRIPTION	ITS USER SERVICE BUNDLE
British Columbia		
Route 123 AVL Demonstration Project, Vancouver	Demonstration project using global positioning system (GPS)-based automatic vehicle location with differential correction to provide real-time monitoring for 12 buses	Public Transportation Operations
Route 123 Signal Pre-emption Demonstration Project, Vancouver	Demonstration project using active & conditional signal pre-emption based on bus schedule adherence. There is a bus-to-roadside communications using infrared transponders and roadside to intersection communications by radio link.	Public Transportation Operations
George Massey Tunnel Reversible Lanes, Vancouver	Lane control signals used to manage peak hour flow traffic in the four lanes tunnel. Three lanes in peak direction during peak hours.	Travel and Transportation Management
Lions Gate Bridge Reversible Lanes, Vancouver	Lane control signals on the three lanes bridge. Two lanes in peak direction during peak hours.	Travel and Transportation Management
Pitt River Bridge Reversible Lanes	Lane control signals on the four lanes bridge to manage peak hour flow. Three lanes in peak direction during peak hours.	Travel and Transportation Management

¹¹ Transport Canada, *Review of ITS Architecture within the Canadian Context. Final Report*. May 11, 1999. Ties Contract # T8200-6-6575/003/XSD.

ITS DEPLOYMENT ACROSS CANADA BY PROVINCE¹¹		
SYSTEM	SYSTEM DESCRIPTION	ITS USER SERVICE BUNDLE
Heavy-Vehicle Electronic License Plate (HELP) Crescent Weigh Station Bypass, Texas to British Columbia	Automatic identification and processing of commercial vehicles for pre-clearance at inspection stations using DSRC technology.	Commercial Vehicle Operations
Alberta		
Automatic Vehicle Counts and Weights Retrieval	An ongoing project to develop automated system to track the number of commercial vehicles and their weights through static and mobile weigh stations.	Commercial Vehicle Operations
FM radio broadcast Highway Radio Advisory System	Trial project to provide up-to-date road information including winter advisories and construction activities.	Travel and Transportation Management
Motorist Advisory Changeable Message Signs	Two changeable message signs for road advisory, from Edmonton to Calgary, on an as required bases.	Travel and Transportation Management
Calgary LRT Transit priority systems	Traffic pre-emption provided for LRT traveling at-grade.	Public Transportation Operations
SCOOT Traffic Signal Control, Red Deer	Traffic adaptive signal control system for real-time adjustments to signal timing to optimize traffic flow.	Travel and Transportation Management
Saskatchewan		
Saskatchewan Wheat Pool Central Tire Inflation (CTI) Technology	Trailers used for grain handling are equipped with CTI technology allowing operators to control tire pressure automatically to reduce stress on road surfaces and improve traction. The trucks are monitored through a global positioning system called SOO-AVL.	Commercial Vehicle Operations

ITS DEPLOYMENT ACROSS CANADA BY PROVINCE¹¹		
SYSTEM	SYSTEM DESCRIPTION	ITS USER SERVICE BUNDLE
Automated Truck Monitoring System	This new system will employ a GPS and advanced communications to track and identify vehicle location and road usage.	Commercial Vehicle Operations
Manitoba		
FM radio broadcast Highway Radio Advisory System	Provides up-to-date road information including winter advisories and construction activities on the TransCanada Highway from Winnipeg to Portage La Prairie.	Travel and Transportation Management
Winnipeg International Airport Ground Traffic Management System	Automated commercial vehicle dispatching system for terminal curb passenger pickup using DSRC technology.	Commercial Vehicle Operations
Mid-Continent ITS Planning and Deployment Study	This study will develop plans, system architecture and coordinated ITS CVO applications between and among federal agencies, states, provinces, metropolitan planning organizations, and economic development agencies along the North American International Trade Corridor.	Commercial Vehicle Operations
Ontario		
COMPASS Freeway Traffic Management System	Traffic, incident, and emergency management on Highway 401 in Toronto, Burlington Skyway, and Queen Elizabeth Highway using closed circuit TV, loop detectors, and changeable message signs.	Travel and Transportation Management Emergency Management
SCOOT Traffic Signal Control, Toronto	Traffic adaptive signal control system for real-time adjustments to signal timing to optimize traffic flow.	Travel and Transportation Management

ITS DEPLOYMENT ACROSS CANADA BY PROVINCE¹¹		
SYSTEM	SYSTEM DESCRIPTION	ITS USER SERVICE BUNDLE
RESCU Corridor Traffic Control	Provides traffic management, traveler information and incident detection and response management along the Toronto Lakeshore corridor.	Travel and Transportation Management
Highway 407 ETR	75 km of electronic toll collection highway using transponder and licence plate reading to process toll charge.	Electronic Payment Travel Demand Management
Toronto Transit Priority System	Allows transit vehicle pre-emption for four streetcars and two bus routes.	Public Transportation Operations
Automated Vehicle Identification in Ontario (AVION), Highway 401 from Windsor to Whitby	Automatic identification and processing of commercial vehicles for pre-clearance at inspection stations using DSRC technology.	Commercial Vehicle Operations
Lester B. Pearson International Airport Ground Traffic Management System	Automated commercial vehicle dispatching system for terminal curb passenger pickup using DSRC technology.	Commercial Vehicle Operations
Toronto Transit Commission Communication System	A full scale AVL and communication system that provides vehicle location for all buses and street cars.	Public Transportation Operations
Trapeze Para Transit Scheduling System	Trapeze provides real time vehicle scheduling and routing system. Software was developed in Ontario.	Public Transportation Management
Ottawa transit automatic vehicle location (AVL) system	In the process of acquiring a GPS-based AVL system.	Public Transportation Operations
London transit automatic vehicle location (AVL) system	In the process of acquiring a GPS-based AVL system.	Public Transportation Operations

ITS DEPLOYMENT ACROSS CANADA BY PROVINCE¹¹		
SYSTEM	SYSTEM DESCRIPTION	ITS USER SERVICE BUNDLE
Intelligent Transportation Border Crossing System	Michigan-Ontario-New York Commercial vehicle pre-clearance systems using transponders are in place at the Peace Bridge Crossing at Fort Erie, and the Ambassador Bridge Crossing at Windsor.	Commercial Vehicle Operations
Advanced Road Weather Information System	System provides the ability to target winter maintenance through the use of atmospheric data gathering and road condition remote sensing system.	Travel and Transportation Management
Smartstations	Inspection stations along Trafalgar Road using WIM equipment.	Commercial Vehicle Operations
Combocard Smart Card, Ajax and Burlington	System uses smart card for fare payment on buses.	Electronic Payment
Quebec		
Freeway Traffic Management, Montreal	Traffic, incident, and emergency management on the A-720, A-40, A-25 highways using closed circuit TV, loop detectors, variable message and mobile signs.	Travel and Transportation Management Emergency Management
Louis-Hippolyte Lafontaine Tunnel Bridge	Tunnel beneath the St. Lawrence Seaway and a bridge across the southern branch of the river. Traffic, incident and emergency management using closed circuit TV, and lane control signals.	Travel and Transportation Management Emergency Management
Ville-Marie Tunnel	Traffic, incident and emergency management in tunnel beneath downtown Montreal using closed circuit TV, lane control signs.	Travel and Transportation Management Emergency Management

ITS DEPLOYMENT ACROSS CANADA BY PROVINCE¹¹		
SYSTEM	SYSTEM DESCRIPTION	ITS USER SERVICE BUNDLE
Outaouais Transit Automated Vehicle Location (AVL) System, Hull	GPS-based AVL system for fleet management and contactless smart cards for payment of fares.	Public Transportation Operations
Quebec City Bridge	Lane control signal used to manage traffic and variable message signs for motorist advisories.	Travel and Transportation Management
Champlain and Jacques Cartier Bridges, Montreal	Lane control signal used to manage traffic and variable message signs for motorist advisories.	Travel and Transportation Management
Nova Scotia		
Highway 104 Electronic Toll Collection (ETC)	45 km stretch of road in Halifax. Toll system using DSRC and cash.	Electronic Payment
Dartmouth Bridge ETC, Halifax	Installation of electronic toll collection through automatic vehicle identification system.	Electronic Payment
SCOOT Traffic Signal Control, Halifax	Traffic adaptive signal control system for real-time adjustments to signal timing to optimize traffic flow.	Travel and Transportation Management
New Brunswick		
Fredericton-Moncton Electronic Toll Collection	Toll plaza supporting both transponder-equipped and fare payment options.	Electronic Payment
Saint John Harbour Bridge ETC	Installation of electronic toll collection through automatic vehicle identification system.	Electronic Payment
Prince Edward Island		
Confederation Bridge, Bridge between New Brunswick and Prince Edward Island	Toll system includes toll collector and self serve lanes with cash, credit and debit payment options. Traffic and incident management are provided by emergency telephone, video surveillance, variable speed signs, changeable message signs and weather monitoring components.	Electronic Payment Travel and Transportation Management

ITS DEPLOYMENT ACROSS CANADA BY PROVINCE ¹¹		
SYSTEM	SYSTEM DESCRIPTION	ITS USER SERVICE BUNDLE
Newfoundland		
St. John's Transit Automatic Vehicle Location (AVL) System	In the process of acquiring a GPS-based AVL system.	Public Transportation Operations