

The Ministry of Transportation is working to implement Connected Vehicle Technology in Ontario. This two part article will first define the general concepts of Connected Vehicle Technology and will be followed with more details on how MTO is actively involved in the concept research.

My Wireless Co-Pilot! Ontario to lead the World in Connected Vehicle Technology

Ontario is positioning itself to be the leading jurisdiction for the development and use of Connected Vehicle technology. In 2009, the Ontario Ministry of Transportation (MTO) partnered with The [Networked Vehicle Association](#) (NVA), an organization of Canada's top technology and business firms, to begin planning Ontario's "implementation of Connected Vehicle technology. The ministry is leading research efforts with partnering universities, and is creating and supporting the development of common international standards.

What is a Connected Vehicle?

The Connected Vehicle concept proposes to use advanced telecommunications to wirelessly connect drivers, vehicles, mobile devices, infrastructure, and roadside devices, to provide a range of traveller safety services that improve mobility and productivity. Information collected from a Connected Vehicle would be delivered wirelessly to telecommunications infrastructure, to be aggregated and then delivered in real-time to travellers and road authorities. Travellers would be able to select personal preferences for delivered information, including driving conditions, speed limits, and road and traffic conditions.

Ontario's Current Intelligent Transportation System

At present, MTO has highway traffic condition data available for major urban freeways on Ontario's highway network. MTO's COMPASS system is used to manage the highest traffic portions of Ontario's transportation network. [COMPASS](#) incorporates traffic cameras, monitoring equipment embedded in the roadway, and a dedicated communications network to access roadway information to monitor and analyse road and traffic conditions. Based on COMPASS information, the ministry can respond to changing conditions accordingly.

Improvements with the Connected Vehicle System

In future, with Connected Vehicle technology, MTO will have data for most of the province's key roads, including municipal arterials. This technology will assist road authorities in coordinating detours and making better use of available highway capacity for routing vehicles around congestion. For instance, when an incident occurs on a major route, MTO and local municipalities can coordinate a bypass for traffic on adjacent routes, significantly reducing traffic impact.



The Connected Car is an entirely new concept for vehicles within which consumers will be able to access network and cloud-based applications, putting on-demand entertainment, "infotainment", diagnostics, navigation, and much more at their fingertips. *This video used with permission from NXP, Netherlands, 2011. [Video transcripts are available.](#)*

Connected Vehicle technology will also allow the ministry and other road authorities to use all available road network capacity. The technology also has the potential to reduce environmental impacts by routing large trucks around congestion, and avoiding hilly routes. Reduced congestion, travel times, and collisions are expected to result in lower emissions and fuel consumption, making the movement of people and goods more sustainable and effective. The United States Department of Transportation has suggested that the Connected Vehicle system has the potential to reduce the 82 percent of collisions involving unimpaired drivers.

What is required to realize the Connected Vehicle Concept?

Several technological and business advancements are required to actualize the Connected Vehicle concept:

- **Vehicle Technology**

Technology is being developed to collect smartphone and in-vehicle information such as a vehicle's location, destination, and speed. This information is provided by drivers who elect to share their location information. Driver global positioning and in-vehicle systems provide road authorities the information necessary to determine general traffic conditions and estimate travel times. Road authorities could then proactively deliver >

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alternate route information to drivers who would no longer need to rely on overhead message signs to receive highway information.

As Connected Vehicles evolve, in-vehicle systems will be able to detect road surface conditions. For example, future in-vehicle systems for antilock brakes, traction control, and all-wheel drive computers could identify road conditions more quickly and more accurately than road sensors. The information from these systems would be sent into the wireless network for road condition monitoring and would factor into traffic condition and travel time information. It is anticipated that driver access to a rich stream of road information will significantly influence a driver's actions and route choices.

• Communications Technology

A strong telecommunications infrastructure is needed to connect all of this wireless information. Today's third generation cellular networks are capable of delivering many of the applications useful to travellers. However, certain safety applications require instantaneous delivery of messages between vehicles or to roadside devices such as traffic signals. In such cases, the Wireless Access in Vehicular Environment (WAVE) service is expected to provide fast and accurate network service. WAVE is a secure broadband Local Area Network, much like WiFi, but expressly for the use of real-time safety applications. WAVE-based products have already been developed and are being tested in large scale pilots in the United States.

Fourth generation wireless network technology also shows potential for the real-time delivery requirements of future safety applications. This technology is known as Long Term Evolution, or LTE. Cellular service providers in Canada are already developing high-bandwidth, low-latency networks that effectively extend internet connection to every device within a vehicle. For example, an LTE network has the ability to simultaneously support the unique IP addresses of in-vehicle backseat entertainment systems, and a driver's information technology system.

Connectedness could include other transportation modes, such as walking and cycling. For instance, when pedestrians are at intersections, their connected smartphones could alert nearby drivers to their presence through the telecommunications network.

• Applications and Driver Awareness

With GPS, in-vehicle systems, and mobile broadband communications in place, many safety applications are already available to drivers. While preparing for the Connected Vehicle workshop with Ontario industry in April 2011, MTO reviewed 80 proposed connected vehicle applications and identified 65 existing applications that could be used with current technology. MTO is collaborating with university research

partners to investigate ways of delivering the information provided by these applications to drivers in a useful and integrated way that is informative without being distracting.

• Business Model Development

Sustainable business models for the private sector must be developed to bring Connected Vehicles to fruition in Ontario. MTO is working to foster private sector investment by collaborating with the automotive industry, the information communication technology industry, and Ontario universities through the [Connected Vehicle Interest Group of the Intelligent Transportation Systems Society of Canada](#). The Society is an association of research institutions, software and hardware providers, and government agencies dedicated to improving the movement of people and goods in Canada through the use of technology.

Meeting of the Minds

In April 2011, MTO and ITS Canada's Connected Vehicle Interest Group held a workshop to advance Connected Vehicle activities in Ontario. Participants included: Ontario Provincial Police; Canadian Police Research Centre; global wireless equipment providers including Alcatel-Lucent and Ericsson; national wireless service providers including Bell and Rogers; the Auto Parts Manufacturers Association of Canada; global automobile manufacturers; telematics equipment providers; global software companies; Ontario based start-ups in Connected Vehicles; Ontario universities; and Ontario-based global systems integrators in intelligent transportation systems.

The workshop primarily focussed on how public and private entities will work toward realizing the concept. The ministry's role in creating and supporting common internationally recognised standards was a key discussion point. Workshop findings will contribute toward Ontario's Connected Vehicle development and investment strategy, while addressing Ontario's transportation challenges.

Looking Ahead

Through a series of follow up meetings throughout the summer of 2011, MTO has been developing some collaborative projects that can be achieved quickly to demonstrate the value of the Connected Vehicle, while promoting Ontario technologies. •

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As an introduction to MTO's involvement with the Connected Vehicle concept, the October 2011 Road Talk article "My Wireless Co-Pilot!" covered the general concepts of Connected Vehicle Technology. Part two below, details MTO's involvement in research and the evaluation of many new software products to be tested in Ontario before introducing Connected Vehicles to the market.

Putting Our Cars to Bed Ontario to host a Test-Bed for Connected Vehicle Technology

In 2009, the Ontario Ministry of Transportation (MTO) partnered with [The Networked Vehicle Association](#) (NVA), an organization of Canada's top technology and business firms, to begin planning a Connected Vehicle test-bed in Kanata, near Ottawa. The test-bed will be a real life environment used to evaluate many new software applications and solutions being developed in Ontario to improve mobility, productivity, sustainability, and road safety for the public. The initiative will include a world-class Centre of Excellence focussed on bringing the new applications to a world market. A demonstration of new products will start in September 2011. The ministry is leading research efforts with partnering universities, and is creating and supporting the development of common international standards.

The test-bed's Ottawa location takes advantage of Alcatel-Lucent and Ericsson 4G wireless facilities. An Ontario test-bed enables the domestic industry to develop applications and provides a local, low cost location for moving them to market. The test-bed will initially focus on first responders, such as emergency vehicles. MTO staff is leading the research team operating on an NVA research grant from the Canadian Police Research Centre to pilot the test-bed for first responder applications.

University Research on Connected Vehicles for Test Bed Trials

MTO is leading a research program, in partnership with Ontario research universities, to bring the Connected Vehicle to reality. Work already underway includes:

- The University of Guelph is developing a tool that simulates traffic operations faster than real time. This tool will help road authorities predict situations and redirect traffic.
- Ryerson University is working on a strategy to improve the communications network to avoid information overload in the network that could occur if every vehicle received and transmitted wireless information. They are also developing smart device applications.
- The University of Waterloo is studying the relationship between electric vehicles and Intelligent Transportation Systems to identify ways to manage the transportation system while maximizing opportunities for green vehicles.
- The University of Toronto is continuing to evolve cloud computing, which provides on-demand data through a computer network. To do this, the University is investigating ways to manage communications and computing platforms that Connected Vehicles will use.



The [ngConnected Program](#)'s LTE Connected Car is an entirely new mobile platform concept for vehicles within which consumers will be able to access network and cloud-based applications, putting on-demand entertainment, "infotainment", diagnostics, navigation and much more at their fingertips. This video used with permission from ngConnect, 2011. [Video transcripts are available.](#)

- Carleton University is developing a "cognitive vehicle" research program focussed on how to best deliver information to drivers without overwhelming them.
- Wilfrid Laurier University is examining the business implications of the Connected Vehicle by conducting a preliminary assessment of the opportunities, requirements, and stakeholder impact of commercializing the Connected Vehicle concept.
- McMaster University is studying the implications of the Connected Vehicle for future transportation management. As the Connected Vehicle concept could begin to be used to manage road networks within the next five years, changes to Ontario university curricula could be needed to prepare future graduates.

The Ontario Advantage

Ontario has a long record of using innovation to address transportation challenges, starting with the first traffic signal control systems and more recently, the world's first high-speed, non-stop fully electronic tolling system on Highway 407. MTO has developed several industry-first applications and services related to the [COMPASS](#) freeway management system, including >

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managing congestion across the express and collector lanes on Highway 401. Along with a history of innovation, Ontario is a leader in the automotive software industry, wireless communications, digital media, and mobile web applications. Ontario also has strong technical skills and a multicultural society with global connections. MTO anticipates global community interest in the Kanata Connected Vehicle test-bed which will promote Ontario business and academia to world markets.

Looking Ahead

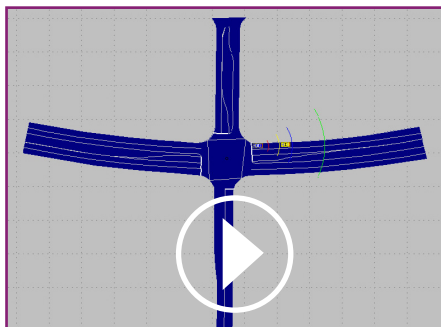
Using Ontario as the test-bed to evaluate the software products in a real-life environment is the last piece in the Connected Vehicle's development cycle. A survey of Networked Vehicle Association members in the telecommunications and automotive sectors indicates strong interest in the test-bed. National and international corporations recognize the value of Connected Vehicle technology and have indicated that the technology developed in Ontario has potential for a global market. ●

For more information, please contact: Stephen Erwin, Head, Intelligent Transportation Systems Policy, Planning and Programming, and Networked Vehicle Test-Bed Research Chair, at (416) 235-4676, or at Stephen.Erwin@ontario.ca

For more information on connected vehicle activities and other companies in this field, please refer to ConnectedVehicle.ca.

Ontario Companies developing Connected Vehicle related Software:

[G4 Apps Inc.](http://G4AppsInc.com), an Ontario company based in Oakville, is working on applications including real-time collision avoidance; warning of traffic signal violations; and predicting the wait time at border crossings based on real time information from vehicles approaching or waiting at the border. G4 Apps provides these services today on smartphones and is engaged with automobile manufacturers for inclusion in vehicles' systems.



This video demonstrates how in-vehicle systems can communicate between vehicles and identify hazardous conditions. This in-vehicle system detects the stopped vehicle ahead, and based on road conditions and relative vehicles speeds, provides increasing levels of alerts to the driver as they enter different hazard zones depicted by the coloured lines.



This video demonstrates an in-vehicle system notifying a driver of real-time traffic delays before the driver reaches the overhead messaging sign on the highway. Videos used with permission from G4, 2011.



Video demonstrating adaptive speed control. A car from the right lane swerves in front of a car in the passing (left) lane. As this occurs, the car behind is slowed down by its in-vehicle monitoring system to increase the space between it and the other vehicle. The left screen is an animation showing what this would look like on a highway. The right screen is a controlled demonstration with real vehicles, using a car sitting on a dynamometer while other vehicles are overtaking it. This video used with permission from TNO, 2011.

The Waterloo, Ontario based company [Intelligent Mechatronic Systems, Inc.](http://IntelligentMechatronicSystems.com), specializes in the research, development and production of innovative and progressive solutions in the areas of automotive safety, telematics and mobile media. The company's solutions include: iLane, an in-vehicle platform that provides drivers with hands-free access to on-demand content and time-sensitive information; Prompt™, a voice-activated dispatch solution that enables taxi and limousine drivers to conduct their job entirely hands-free via simple voice commands such as sign-in, receive job information, accept/decline jobs and provide estimated time of arrival information; and DriveSync™, a turn-key telematics platform which enables a variety of solutions including usage-based insurance offerings, fleet monitoring, vehicle tracking, and government programs. ●