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Ottawa **L5**

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Ottawa steers autonomous vehicle innovation

L5 Testing Facilities at the heart of the CAV ecosystem



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Invest Ottawa is establishing a living lab in the city to test connected vehicle technology and associated applications. The Ottawa L5 Autonomous Vehicle (AV) test environment, the first integrated AV test lab of its kind in North America, is built around mobile broadband network based on 4G/LTE and 5G. The site, which incorporates all the elements of a typical city environment, is intended to serve as a kind of innovation hub, bringing together a rich ecosystem of smart city players to pioneer the next-generation of urban transport infrastructure.



In addition to being Canada's capital, Ottawa is a major center for high-tech research, and the nation's premier site for AV innovation with more than 90 companies, post-secondary institutions and other organizations contributing technology and expertise to developing the connected autonomous vehicle (CAV) ecosystem. Many leading tech firms have significant R&D and business operations in the greater Ottawa area, including leadership in many of the foundational technologies essential to CAV development, including telecommunications networks, cybersecurity, sensors and LIDAR.

The goal of Ottawa L5 is to enable and accelerate the safe development, validation and implementation of self-driving technology, a market currently valued at \$54.23 billion (2019), and projected to reach more than \$556 billion by 2026 according to Allied Research. This initiative also supports Invest Ottawa's broader mission to deliver economic development programs that increase entrepreneurial momentum, wealth and jobs in the city of Ottawa.

Challenges

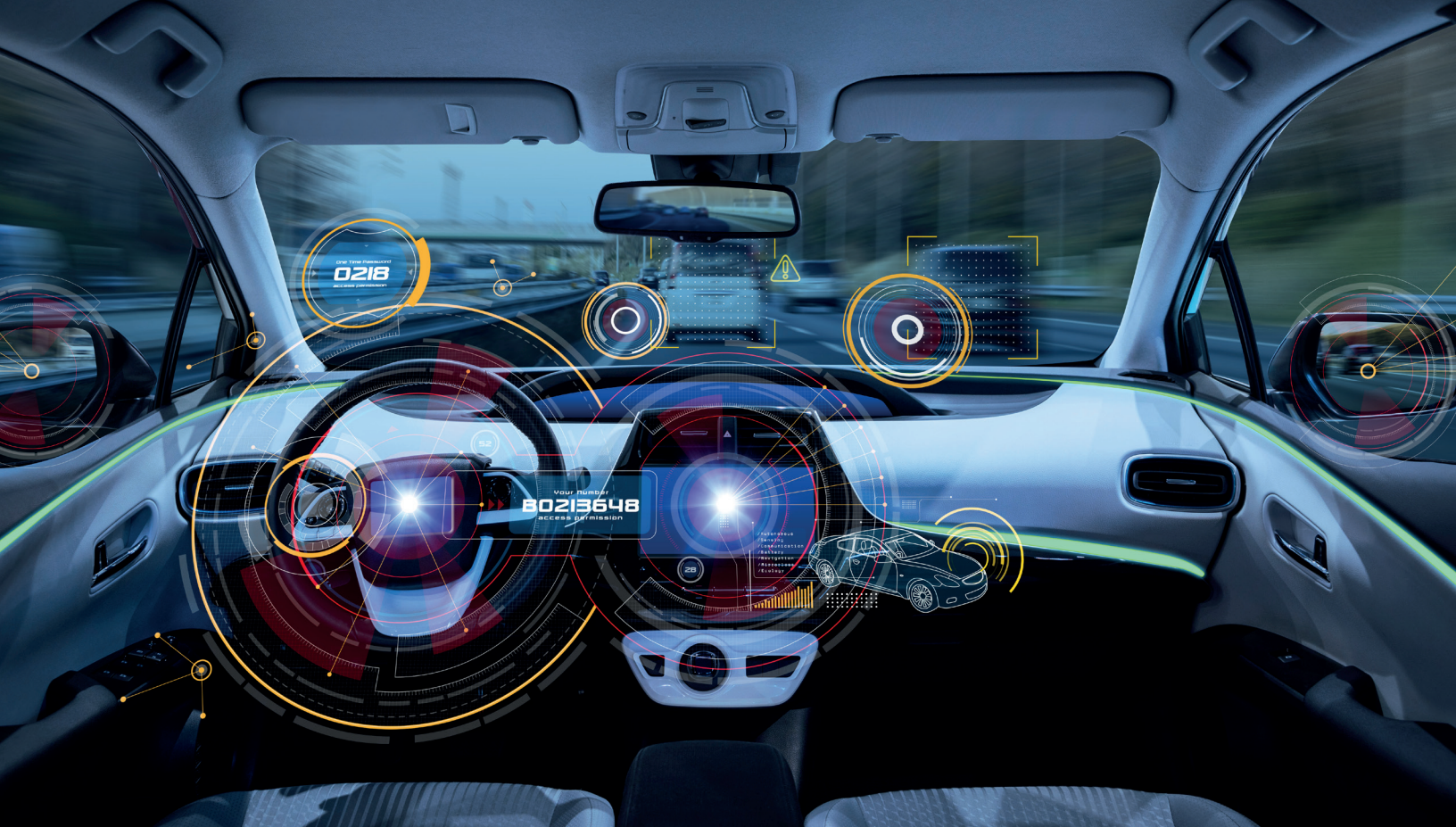
- Establish world-class, integrated testing grounds for the safe implementation of CAVs including automobiles, trucks, buses and Unmanned Aerial Vehicles (UAVs)/drones
- Enable vehicle-to-everything (V2X) technology testing, validation and demonstration on a private test track in a complex, simulated urban setting
- Provide the full range of wireless communications capabilities including 4G/LTE, 5G, global positioning system (GPS) enhanced with real-time kinematics (RTK), dedicated short range communications (DSRC) and Wi-Fi
- Support four-season testing in a range of weather conditions in a controlled, secure city environment, incorporating key elements such as public transport, pedestrian and bicycle traffic and UAV activity

The solution

- An end-to-end 4G/LTE and 5G-ready mobile broadband network based on the Nokia Digital Automation Cloud platform, featuring integrated edge computing
- Nokia AirScale small cell portfolio, supporting indoor and outdoor 4G/LTE, 5G and Wi-Fi connectivity to deliver comprehensive mobile and fixed wireless coverage
- Nokia 7210 Service Access Switch (SAS) to provide mobile backhaul capabilities using IP/MPLS technology
- Nokia Group Communications (NGC) to support both push-to-talk (PTT) and push-to-video (PTV)
- Integration with third-party devices and applications (from partners including Current by GE, SmartCone, Sierra Wireless and Sonim) via Nokia Digital Automation Cloud's open API framework
- Professional services including design, engineering, integration and project management

Benefits

- Plug and play platform allows the instant creation of private, high-performance wireless broadband network supporting the latest mobile communications standards
- Utilizes both lightly and fully licensed spectrum to address the broadest range of use cases and performance requirements, cost-effectively
- End-to-end, highly robust cybersecurity capabilities
- Simplifies operations with zero touch provisioning, advanced service assurance, service activation, and troubleshooting features along with end-to-end SLA management
- Private network and secure testing area creates an ideal proving ground for safe and productive pre-commercial development, testing, validation and demonstration of CAV technologies in a city-like environment
- Facility provides a foundation for the establishment and promotion of a strong CAV technology ecosystem for the city of Ottawa



Challenges

As part of its mission to promote Ottawa as a hotbed of high-tech innovation and a leading center for CAV development and commercialization, Invest Ottawa saw the need for a location where CAV-related technologies could be put through their paces to ensure their readiness for commercial market introduction. The organization also recognized that this testing regime needed to expand well beyond vehicles themselves to incorporate the full CAV ecosystem including roadside infrastructure (such as sensors and machine control technologies), adjacent technologies such as drones, and a wide array of devices and applications.

The outcome of this effort is Ottawa L5, a fenced and gated private campus covering 1,866 acres and featuring 16 kilometers of paved roads dedicated to CAV testing. The largest secure testing facility in Canada, the site incorporates all of the physical characteristics of a modern city neighborhood, including smart traffic intersections, pedestrian cross walks, one-way streets, bike lanes, left turn lanes, stop signs, parking lots, street lights and speed bumps.

As a smart transportation test bed, the site also includes a broad array of technologies for sensing and monitoring, including: high-definition cameras; sensors for tracking temperature, humidity, barometric pressure, wind speed and direction and other weather-related data; and road pavement temperature (to check for icy conditions).

Gathering, analyzing and sharing data from all of these sources requires a sophisticated and ubiquitous communications network.

To address this need, the entire Ottawa L5 site offers comprehensive wireless coverage, provided by a private network infrastructure capable of supporting DSRC (a technology similar to Wi-Fi that's designed for short range, high-speed wireless communication between vehicles and infrastructure), GPS/RTK, 4G/LTE, Wi-Fi and 5G – essentially all of the leading-edge, commercial wireless communications technologies available today.

Similarly, the site features advanced mobile backhaul technology to eliminate any communications bottlenecks and help ensure extremely high-speed, high-capacity connections. Coupled with multi-access edge computing (MEC) technology, which brings compute, analytics and storage capacity to the edge of the network, the system is designed to support applications requiring extremely low latency, including many that are essential for safe and efficient CAV operations.

One of the key objectives of Ottawa L5 is to provide a means to evaluate services requiring connections between vehicles and roadside infrastructure, other vehicles, pedestrians and a wide variety of smart devices, collectively known as V2X. Services being explored include traffic



The Ottawa L5 private test track features 16 kilometers of paved roads that provide proving grounds for CAV technologies in connected and secure environments.

flow analysis and prediction using advanced RF signature detection sensors, and early warning systems for on-road conditions, again employing a range of sensor technologies.

Linking all of these systems and applications is absolutely essential to the mission of Ottawa L5.

Why Nokia?

As one of the world's leading providers of mobile broadband networks, Nokia is a natural fit to address the unique challenges presented by the Ottawa L5 project. Nokia is ideally suited to the challenge of designing, deploying and managing a comprehensive, end-to-end wireless network capable of addressing all of the requirements of Ottawa L5. Both highly secure, yet open, the turn-key solution from Nokia provides a perfect foundation to support the introduction of components and technologies from a wide array of partners, helping facilitate the establishment of a strong vendor ecosystem.

Nokia is also an important player in Ottawa's vibrant high-tech community. Nokia's facility in Kanata is a major innovation center for the company, hosting more than 2500 employees engaged in research, development, product management and a host of other critical functions. As a result, Nokia is able to provide substantial on-site expertise and project management support, with local staff close at hand and available to provide ongoing assistance and consultation.

As important, given the safety and security concerns around CAV operations, it is absolutely essential that the Ottawa L5 facility can meet very demanding cybersecurity criteria. Fortunately, Nokia has an unmatched track record when it comes to the provision of end-to-end security capabilities across the entire network footprint. This was also an important factor in the selection of Nokia for this project.

The solution

For the Ottawa L5 project Nokia has supplied a private end-to-end wireless broadband network employing 4G/LTE, 5G and Wi-Fi technologies. The network is built around the Nokia Digital Automation Cloud, an easy to use, plug and play platform that enables the instant creation of a private network. Integrated edge computing capabilities help to ensure exceptional performance for low latency, high capacity applications.

Radio connectivity is delivered using elements of the Nokia AirScale small cell portfolio, which offers a wide variety of form factors, addressing a broad array of indoor and outdoor deployment scenarios. It also supports a wide range of radio technologies and frequency bands, ensuring comprehensive coverage for both fixed and mobile applications.

Mobile backhaul and data transport requirements at the site are provided by the Nokia 7210 Service Access Switch (SAS), high-throughput, high-density access and aggregation routers. This feature-rich yet compact platform is ideal for delivering IP/MPLS and Carrier Ethernet capabilities in metro access networks.

To support communications between teams on-site engaged in testing activities, the Nokia Group Communications solution offers an innovative push-to-video feature, and includes a rich set of industry-specific functions such as traditional push-to-talk and alert



messaging to improve operational efficiency. This high-performance application suite supports a wide range of LTE handsets and other connected devices including ruggedized units suitable for use in all weather conditions.

The solution for Ottawa L5 also incorporates third-party devices and applications from a variety of leading partners, including: smart poles from Current by GE, which support smart street lighting along with a range of sensors and connectivity platforms, SmartCone, 4G/LTE wireless modems by Sierra Wireless, 4G/LTE handsets from Sonim. These are all seamlessly interconnected using Nokia Digital Automation Cloud's open API framework.

Nokia's Global Services organization is responsible for design, engineering, integration and project management services for the project.

The benefits

The new wireless broadband network provides Ottawa L5 with a variety of advantages. The site is able to support a wide array of testing capabilities for participants in the CAV ecosystem, including conceptual and feasibility testing, component and integration testing, controlled system testing and controlled public road and real public road scenarios. These capabilities are all offered in a highly secure, safe, managed environment, offering a 360 degree view across various performance parameters.

The facility also supports the broadest range of CAV use cases, from autonomous trucks and shared passenger shuttles, cars and other personal vehicles, smart city applications such as those associated with intelligent transportation systems (ITS) and adjacent CAV applications and technologies.

Because it is located in Ottawa, which is a true 4-season environment, Ottawa L5 makes it possible to test many different types of vehicles and technologies in the broadest variety of weather conditions – snow, extreme cold, ice, heavy rain, fog, high winds and hot, sunny days, Ottawa has it all. This helps to ensure that components and applications tested here can be used with confidence in any environment or climate.

The network infrastructure deployed at the Ottawa L5 location takes a multi-layered approach to identifying, analyzing and combating cybersecurity threats. In practice, this means that clients can evaluate a wide range of potential risks and attack vectors in a tightly controlled environment, giving them critical data they can use to address vulnerabilities prior to commercial introduction.

Ottawa L5's platform for interoperability, data collection and analytics gathers information from a variety of sources including sensors, vehicles, cameras and more, and provides a range of tools for real-time data analytics as well as for testing of specific use cases. The platform also facilitates interoperability between different applications and data stacks, and supports sharing across applications and infrastructure through the use of standardized communications protocols and interfaces.

Shawn Sparling, head of Nokia's Transportation, Energy and Public Safety business for Canada, said: "We are entering an era of profound transformation where automation will be brought about by the digitalization and connection of everything and everyone, with the goal of enhancing quality of life in safer, healthier and more sustainable communities. It is initiatives like the Ottawa L5 CAV test facility that are playing a critical role in building and testing the ecosystem needed to address the extremely demanding requirements of the burgeoning CAV market, as well as bringing broad innovation to cities.

The range of communications technologies in use at Ottawa L5 ensures that every type of V2X scenario can be implemented and analyzed, including vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) – for both roadside and municipal equipment – and vehicle-to-network (V2N). The most advanced GPS/RTK technology available delivers precise and accurate location information for mapping, maneuvering and object avoidance testing.

Perhaps most important, the Ottawa L5 project builds on Ottawa's reputation as a leading center for high-tech innovation, and cements the city's position as one of the world's premier locations for CAV research, development and commercialization, and serving as a magnet for companies, investment and talent in this key emerging market.

Looking ahead

The intent behind Ottawa L5 is to provide the most realistic possible testing environment for CAV activities, incorporating a wide variety of potential interactions between different kinds of vehicles, people and urban infrastructure in the broadest array of settings and scenarios.

Because these scenarios can change almost continuously, the Ottawa L5 site is designed to accommodate the introduction of new technologies or applications smoothly and seamlessly. New scenarios could include the introduction of UAVs, or drones, employed for tasks such as emergency delivery of medical supplies or components for field maintenance of city infrastructure.

Invest Ottawa established a strong set of partners, such as Nokia, that are helping to drive the development of the CAV ecosystem in the region. Over time, Ottawa L5 is expected to serve as a center of gravity around the development and testing of new capabilities, pulling in new ecosystem participants and fostering R&D both by local players as well as those outside of the region looking to take advantage of its best-in-class capabilities.

"This successful collaboration demonstrates the strong working relationship between Nokia, Invest Ottawa and all partners in this expansive ecosystem. It also highlights Nokia's contribution as a developer of high-performance networks, which are essential to smart city and smart mobility solutions, and Nokia's enduring commitment to the Ottawa region," Sparling added.

Summary

Invest Ottawa's autonomous vehicle testing environment, Ottawa L5, provides an unmatched set of capabilities to test key elements of the CAV ecosystem in a safe, secure, 4-season and city-like setting. A wireless broadband network from Nokia and a set of best-in-class partners is at the heart of these capabilities, providing the high-speed, high-capacity data connections needed to link the huge number and variety of sensors, connected devices and applications employed at the site. The network also offers edge cloud computing capabilities to support services that require extremely low latency, an essential requirement for any CAV system.

Ottawa L5 is Canada's leading center for CAV testing, and enhances the city's position as one of the world's premier locations for autonomous vehicle research and development. "This project cements Ottawa's increasingly strong position in the global autonomous vehicle ecosystem," Kelly Daize, Director Connected and Autonomous Program, Invest Ottawa said. "Ottawa L5 is not only supporting the growth and success of local companies, it is also helping attract new businesses, new investments and new talent to the region."

This successful collaboration demonstrates the strong relationship between Nokia and Invest Ottawa. It also highlights Nokia's position as a strong partner for the development of sophisticated networks, smart city/smart mobility solutions and the associated ecosystem needed to address the extremely demanding requirements of the burgeoning CAV market in terms of performance, reliability and security.

"Ottawa is leading the way into the future of autonomous vehicles," said Kelly Daize from Invest Ottawa. "We are proud to have Nokia as a partner on this important journey."

For more on Nokia's solutions for smart cities, please visit networks.nokia.com/industries/smart-city.

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About Nokia

We create the technology to connect the world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry's most complete, end-to-end portfolio of products, services and licensing. From the enabling infrastructure for 5G and the Internet of Things, to emerging applications in virtual reality and digital health, we are shaping the future of technology to transform the human experience.

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