ENCQOR 5G
MISSION ACCOMPLISHED

FINAL ACTIVITY REPORT

MARCH 31, 2023

ENCQOR 5G

INNOVATION ENCQOR

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AT THE HEART OF 5G

ENCQOR 5G

ENCQOR had set up a 5G testbed network to allow companies of all sizes, IT professionals, public and private sector researchers, and graduate students to rapidly access a state-of-the-art 5G development and testing platform for the prototyping of products and services.

ENCQOR 5G had 5 innovation centres in Quebec and Ontario, located in Quebec City, Montreal, Ottawa, Toronto, and Waterloo respectively.

With potential speeds of up to 10 gigabits per second, increased network capacity and ultra-low latencies in the millisecond range, 5G will be critical to bringing a whole new generation of products and services to market, including connected and autonomous vehicles, remote health systems, virtual solutions, smart cities, and new Internet of Things (IoT) applications.

ENCQOR: THE EMERGENCE AND BLOSSOMING OF NEW 5G TECHNOLOGIES IN CANADA

A blossoming of innovative projects

355 projects funded
33 SME collaborative projects with partners among funded projects
294 individual SME projects
15 collaborative SME adoption projects

Strong participation by researchers and developers

860 participating SME
432 funded participants
490 non-funded iPaaS participants/users

A place to learn, discover and share... around the world

1023 student internships (including co-op)
535 participants in ENCQOR training courses
513 participants in events organized by ENCQOR
18 academic institutions involved in ENCQOR research projects
56 separate research projects funded by ENCQOR and ENCQOR/Mitacs
18 collaboration agreements signed with industrial and public-sector partners
3 international collaboration agreements: Europe, UK, USA

Significant economic benefits

275 new SME jobs created by ENCQOR
5 698 jobs directly impacted by ENCQOR (used), SME + partners
34 657 * direct and indirect jobs over 5 years
$3.6B *: impact on Quebec+Ontario GDP
187 products new or improved by ENCQOR projects
62 products or services commercialized thanks to ENCQOR

** Study conducted by Nordicity Group*

A MESSAGE FROM THE CHAIRMAN OF THE BOARD

Germain Lamonde
Chairman of the Board
ENCQOR Innovation

The ENCQOR 5G program is already at an end. Six years that have created and mobilized a vast and innovative 5G ecosystem in Canada. Thanks to the commitment of all the partners involved in the program, we can now declare “mission accomplished”.

As we had hoped at the outset, ENCQOR has been the catalyst that has enabled some 860 SME in Quebec and Ontario to make their first entry into the world of 5G. Thanks to the 5G test bed and ENCQOR’s various support programs, many of these SME have been able to develop, test and market innovative solutions that take advantage of the new possibilities offered by 5G technology. These are remarkable spin-offs for the competitiveness of our companies.

5G innovation in a multitude of sectors
The fields of activity of the SME that participated in the ENCQOR program are numerous, and include multimedia, virtual and augmented reality, transportation, smart cities, manufacturing, mining, agriculture and information technology.

This great sectoral diversity reminds us that almost no area of economic and social activity escapes the digital transformation propelled by new technologies, where 5G, by offering a disruptive solution in terms of smart connectivity, enables the deployment of a multitude of new uses and applications linked in particular to the Internet of Things, artificial intelligence, cybersecurity and quantum.

Anchor partners and academia: a substantial contribution to the advancement of our knowledge of 5G
The active participation of the program’s five anchor partners - CGI, Ciena, Ericsson, IBM and Thales - has also generated substantial spin-offs for the development of our 5G know-how in Canada. Overall, over the past 6 years, the anchor partners have invested tens of millions of dollars in research and development, creating or maintaining some 1,800 high-quality jobs at their facilities in Quebec and Ontario.

It is also important to underline the invaluable contribution of the academic community to the success of the ENCQOR program. No fewer than 18 academic institutions in Quebec and Ontario have collaborated with ENCQOR over the past few years on special projects and through internship programs that have enabled the founding partners and several SME to count on the invaluable assistance of young graduate and post-graduate developers. In all, through internship programs at the Ontario Centre of Innovation (OCI) and Mitacs in Quebec, several hundred students will have participated in ENCQOR’s work, under the guidance of dozens of supervising professors.

A MESSAGE FROM THE CHAIRMAN OF THE BOARD

Germain Lamonde
Chairman of the Board
ENCQOR Innovation

A strong commitment to 5G

In addition, with the support of OCI in Ontario and Prompt and ADRIQ in Quebec, ENCQOR was an extremely dynamic lever for mobilization, exchange and discussion, thanks to a large number of webinars, bootcamps and other physical and virtual events. These forums, maintained on a virtual basis during the pandemic, enabled SME, academics and large corporations to share their experience, innovations and knowledge in 5G, and collectively advance our expertise in this field.

As we draw up very positive results for the ENCQOR program, I'd like to thank all our anchor partners for their support and commitment over the past six years. I'd also like to thank our three government partners - the Quebec, Ontario and federal governments - for their trust and support, which are essential to the program's success.

And finally, I'd like to take my hat off to all those entrepreneurs who have had both the boldness and the vision to make the leap into the world of 5G in recent years, by taking advantage of the resources offered by the ENCQOR program. The leadership and dynamism of our entrepreneurs, who employ 90% of the country's entire private sector workforce, are creators of wealth and indispensable architects of our collective prosperity.

Of course, we still have a long way to go in Canada to achieve our digital transformation, which will now have to focus on the vertical adoption of new intelligent connectivity technologies in several key sectors of our economy. But we can certainly say today that the ENCQOR program will have delivered the expected results. It has been a fruitful hotbed of collaboration and innovation, giving rise to a vast, dynamic and innovative 5G ecosystem in the country, which is now just waiting to build on its momentum.

A MESSAGE FROM THE GENERAL MANAGER

Pierre Boucher
General Manager
ENCQOR 5G

MISSION ACCOMPLISHED

At the end of a six-year program, we can proudly say «mission accomplished» for ENCQOR 5G.

First and foremost, the program has succeeded in achieving its objectives of developing a world-class collaborative platform to accelerate the transition to 5G technology. ENCQOR 5G has mobilized a vast ecosystem of SME, industry and government players, as well as university researchers in Quebec and Ontario, to help create and commercialize disruptive new products, processes and services.

Six years ago, 5G research and development in Canada was in its infancy. One of our challenges at the time was to awaken Canadian companies to the strategic importance of this new connectivity solution for their productivity and competitiveness, both in Canada and internationally. It was a kind of kick-off for 5G in this country, which was heard by other players in Canada, who have also since gradually launched various 5G development initiatives.

A long road travelled

ENCQOR has come a long way since its early days. As of March 31, 2023, some 860 companies from a multitude of sectors in Quebec and Ontario, more than 1,000 student interns, dozens of researchers, stakeholder communities including cities, museums, construction sites, farmers, carriers, multimedia players and wireless service providers had taken part in one form or another in the program.

Through the program, participants had the opportunity to develop and test new 5G solutions using ENCQOR's state-of-the-art testbed. ENCQOR's infrastructure offered a pre-commercial 5G technology environment not yet available on the market, through 5 innovation centers established in Quebec City (*Institut Intelligence et données*), Montreal (Centech), Ottawa (Invest Ottawa), Toronto (MaRS) and Kitchener (Communitech). ENCQOR was the first public 5G millimeter-wave network in Canada, enabling users to test applications requiring higher bandwidth and lower latency.

ENCQOR's innovation centers also acted as hubs for animating and disseminating knowledge about 5G to thousands of participants and subscribers, through newsletters, webinars, bootcamps and various technology demonstration events. Hundreds of SME took part in these dynamic learning and exchange activities on 5G, which continued during the pandemic through innovative virtual approaches and means.

Pan-Canadian and global visibility

ENCQOR also reached a new milestone by signing memorandums of understanding with 6 telecommunications service providers. Thanks to these agreements, ENCQOR 5G and the signatory companies were able to work closely with SME in Quebec and Ontario to develop innovative solutions and services using ENCQOR 5G's pre-commercial test platform.

ENCQOR has also signed international collaboration agreements with 5G IA in Europe, PAWR in the United States and Catapult in the United Kingdom. Futhermore, research carried out under the ENCQOR program has generated dozens of scientific publications in which ENCQOR is specifically named. ENCQOR has also taken part in several business forums and publications. In addition, since the advent of ENCQOR, international conferences on 5G have been held in Canada, such as the IEEE Future Networks Conferences and the 5G World Forum.

A MESSAGE FROM THE GENERAL MANAGER

Pierre Boucher
General Manager
ENCQOR 5G

A collaborative success

The significant positive impact of ENCQOR 5G is largely attributable to the program's collaborative model, in which the expertise of the five anchor partners - CGI, Ciena, Ericsson, IBM and Thales - was combined with the knowledge and expertise of the academic community. All in all, ENCQOR was able to count on the collaboration of 18 academic institutions, which, as part of the program, supported a large number of SME in the implementation of various 5G technology development projects. Other promising projects have also been carried out through close collaboration between ENCQOR's anchor partners and certain Canadian universities.

The academic community's contribution also took the form of some 1,240 student internships throughout the program, enabling SME and anchor partners to carry out various 5G research and development initiatives. These internship programs, which also involved dozens of supervising professors, also enabled students to gain valuable work experience in a highly strategic field that promises to expand rapidly.

As part of these internship programs, several students have also lent a helping hand to the 5G R&D work of the anchor partners. ENCQOR has also enabled these industrial partners to maintain some 1,800 high-quality jobs as 5G researchers and developers over the first five years of the program.

From pre-commercial to technology adoption

Having taken their first steps into the world of 5G in recent years, Canadian businesses are now mature enough to move on to the next stage, which will see the widespread integration and adoption of new smart connectivity solutions and technologies over the next few years.

As a cross-cutting technology, 5G+ has become an essential lever for Canadian businesses to remain competitive and hold their own in the face of international competition. This digital shift in the Canadian economy is an essential ingredient in ensuring Canada's future prosperity.

ENCQOR'S PROJECT PARTNERS

The ENCQOR project was a $400 million transformative partnership that brought together five world leaders in digital technologies (Ericsson, Ciena Canada Inc., Thales Canada Inc., IBM Canada, and CGI) and the following implementation partners: Prompt, ADRIQ, and the Ontario Centre of Innovation (OCI).

This partnership is made possible in part through funding from the Government of Canada, the Government of Quebec and the Government of Ontario.

ANCHOR PARTNERS

ERICSSON ciena THALES IBM CGI

GOVERNMENT PARTNERS

Canada Ontario Québec

COORDINATION PARTNERS

ADRIQ prompt OCI

ENCQOR 5G DIGITAL INNOVATION HUBS

CENTECH

Dedicated to high-tech (deep tech) companies with high growth potential, Centech is a world-class business incubator based in Montreal. Centech is a non-profit organization open to everyone and offers two support programs for startups: the ACCELERATION program (12 weeks), then the strongest potential is selected to get into the PROPULSION program (24 months). Centech performs particularly well in the fields of medical technology, manufacturing, telecoms and microelectronics and other intelligent objects. In 2019, Centech was recognized by UBI Global as one of the most successful university incubators in the world.
Centech

INSTITUTE INTELLIGENCE AND DATA

Inaugurated in January 2020, IID (Institute Intelligence and Data) at Université Laval brings together the driving forces of research and innovation in artificial intelligence and data valorization in the greater Quebec City area. From fundamental to applied research, including major ethical issues, IID members, collaborators and associate researchers are actively working today to develop methods, technologies and practices that will support the Quebec of tomorrow.
IID

INVEST OTTAWA

Invest Ottawa is the lead economic development agency for knowledge-based industries in Canada's Capital, facilitating economic growth and job creation in the City of Ottawa. Guided by a vision to help realize Ottawa's full potential as a globally recognized, innovative and future-ready city, and the best place to learn, work, live, and play, Invest Ottawa delivers venture development and global expansion programs and services that catalyze the growth and success of entrepreneurs and firms.
Invest Ottawa

COMMUNITECH

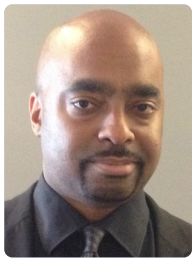
Communitech was founded in 1997 by a group of entrepreneurs who came together to help one another build successful companies to help ensure the future prosperity of Canada. They created an organization to support the entire "Community of Tech" to help companies start, grow and succeed.
Communitech

MaRS DISCOVERY DISTRICT

MaRS, a centre based in Toronto, supports over 1,200 Canadian science and tech companies that are tackling some of society's greatest challenges, providing them with tailored resources at every stage of their growth, from startups to scale-up. We focus on the four sectors — cleantech, health, fintech and enterprise software — where the potential is greatest to build high-impact companies that strengthen the economy.
MaRS

TESTIMONIALS FROM OUR ANCHOR PARTNERS

Peter Warren
Vice President
Global Industry Lead,
Energy & Utilities



Peter Barnes
Consulting Delivery Utilities

CGI

WITH ENCQOR, CGI HAS BROUGHT SOME OF ITS SOLUTIONS TO 5G SPEED

CGI believes it has reaped several benefits from its participation in the ENCQOR 5G program. These benefits have been measured in terms of the company's business positioning, as well as new product development.

"By contributing to the success of the ENCQOR 5G program, CGI has established relationships with 5G players in North America and Europe, to collaborate on initiatives including the intersection of 5G and Space operations. The ENCQOR program has had solid international exposure and recognition"explains Peter Warren, Vice President Global Industry Lead, Energy & Utilities, at CGI.

For his part, Peter Barnes, Director, Consulting Delivery Utilities at CGI, emphasizes the distinctive character of ENCQOR, which has allowed for a very fruitful collaboration between major industry players. "Bringing together five multinationals around the same table to collaborate on advancing 5G research allows for exceptional synergies. It's a unique model," he says, referring to the five anchor partners of ENCQOR, which includes, in addition to CGI, Ciena, Ericsson, IBM and Thales.

New product development

The Montreal-based multinational is developing technologies to improve the efficiency and safety of workers at large electricity providers. The systems developed by CGI, with the contribution of 5G, aim to monitor the state of an electrical network to the nearest millisecond, and to alert operators to the slightest unusual event or sign of malfunction.

"CGI's participation in the ENCQOR 5G program provided the company with the opportunity to create additional products and services related to enabling a mobile workforce with 5G-capable technology. Use of the higher bandwidth and lower latency available in a 5G ecosystem permits increased situational awareness and safety for field personnel as they conduct emergency operations. The ability to attach large objects to work orders, including detailed maps, asset information and the real time state of electric distribution networks ensures that field workers are armed with the necessary tools to rapidly restore service and efficiently perform maintenance and construction work," says Mr. Barnes.

CGI's technology aims to track thousands of workers on a power grid in real time as they move around, assigning them tasks and virtually assisting them in their maintenance operations through augmented reality. Yet these actions require the transfer and sharing of a phenomenal amount of data and very low latency — something that 5G is finally making possible.

ENCQOR: a promising initiative for the Canadian economy

For CGI, there is no doubt that a program like ENCQOR 5G generates significant benefits for the Canadian economy and can provide a springboard for SME wishing to make the leap into the 5G digital world.

"Programs such as ENCQOR 5G are very important to the Canadian economy. To ensure the continued competitiveness of the Canadian innovation sector, public-private partnerships such as ENCQOR 5G provide small and medium enterprises with access to technology and expertise that they would not otherwise be able to exploit. As the pace of technological evolution continues to accelerate, investment in dynamic companies with fresh perspectives on the various business sectors that 5G addresses will prevent stagnation from taking hold", explains Mr. Warren.

He adds that with the global pandemic and its associated economic impact, it's necessary to maintain programs such as ENCQOR that incentivize innovation and investment in new technologies related to 5G.

"The adoption of 5G in fields such as medicine, logistics and energy brings about benefits that affect all Canadians. ENCQOR's public-private partnership program has provided funding, networking and visibility opportunities for small and medium enterprises that they otherwise might not have had access to. In order to maintain the pace of discovery and innovation, continuation of programs such as ENCQOR is a key" concluded Peter Warren.

TESTIMONIALS FROM OUR ANCHOR PARTNERS

Stephen Alexander
Ciena's Head
of Technology

David Elkaim
Ciena's Vice President of Global Business Operations and Head of the Montreal site

ENCQOR 5G: A TREMENDOUS 5G KNOWLEDGE SPRINGBOARD

For Stephen Alexander, Ciena's Head of Technology, ENCQOR 5G has enabled the company and all program participants of 5G. If ENCQOR had not existed, it would have taken us many more years to reach our current level of 5G expertise and know-how. ENCQOR has been a tremendous accelerator of our understanding of 5G," notes Alexander.

The senior Ciena executive notes that 5G goes far beyond connectivity itself. "Most people perceive 5G as a connectivity network, and that it's all about speed. But 5G is much more than that. 5G creates a larger solution environment," he says, which will be able to leverage the integration and use of cloud and edge cloud, among other things.

ENCQOR: a lever for Ciena's credibility in the 5G space

David Elkaim, Ciena's Vice President of Global Business Operations and Head of the Montreal site, believes that the ENCQOR program has been instrumental in building Ciena's credibility in the 5G space. "Our participation in this program has greatly strengthened our brand and credibility in the 5G world. It has given us content leadership, the ability to showcase our portfolio of solutions, where we believe the 5G value proposition lies, and respond, in real life, to RFPs."

He also considers ENCQOR to have provided an exceptional collaborative environment for all categories of attendees. "What was unique about ENCQOR was the opportunity to engage in a co-development framework with the academic community and SME. In the program, the academic community and companies were able to address real-life challenges by integrating research elements related to network analysis, machine learning, network self-optimization and smart grid automation. This work has allowed us to advance our knowledge significantly in these different areas."

Developing collective knowledge in 5G

Stephen Alexander notes that this collaborative work between ENCQOR, its partners and the academic community will also have important spin-offs for the future. "We have seen a work force come from the academic community, in addition to the staff working in SME, students who are versed in 5G technology, who understand the language, who understand what 5G can do and how it can be used. That will be invaluable to the country."

Mr. Elkaim adds: "We have built a pool of very talented people, many of whom have joined our company or other companies in the ecosystem. Our work with ENCQOR has also allowed us to identify the missing knowledge and skills that we have been able to acquire externally or develop internally."

Targeting the most promising verticals

Over the next few years, both Ciena executives believe that efforts should be focused on adopting 5G technologies in sectors that are both ready to move to this stage and for which the benefits will be the greatest.

"ENCQOR 2.0 will need to have a very focused approach. We will need to direct our energies to verticals that can immediately take advantage of already tested and proven 5G capabilities and features, such as edge computing, bandwidth and low latency." Elkaim is thinking of the autonomous vehicle, telemedicine and security sectors, among others."

In conclusion, reminds Mr. Alexander, there is still a lot of work to be done on the heels of the accomplishments made in the ENCQOR program. "While we have learned a lot over the past 5 years about the tremendous benefits of 5G, how we will be able to use 5G, and how businesses will be able to move forward with their digital transformation, there is still a pretty steep learning curve ahead. There's still a lot of work to be done to bring it to the level that we want, to understand in depth how a business can come in and interconnect with 5G and the cloud and achieve their digital transformation for the benefit of the company. We are still in the early stages of 5G deployment."

TESTIMONIALS FROM OUR ANCHOR PARTNERS

Jeanette Irekvist
President of Ericsson Canada

Marcos Cavaletti
Senior Advisor and Head of Ottawa site for Ericsson

ERICSSON

ENCQOR: A PROGRAM WITH MULTIPLE BENEFITS ACCORDING TO ERICSSON

For Ericsson, the benefits of the ENCQOR 5G program have taken many forms over the past few years, benefiting both large and small businesses. In doing so, it has enabled Canadian 5G expertise to advance significantly. As an anchor partner, Ericsson has provided much of the equipment used in the ENCQOR network. At Ericsson, more than 2,000 out of its approximately 3,000 employees worked specifically on 5G during the ENCQOR program.

“Ericsson has a long history of R&D in Canada and this work has already contributed significantly to our global leadership in 5G. We are proud to continue to bring our innovative work to the ENCQOR 5G network, which has now introduced more than 800 small and medium-sized enterprises (SME) in Quebec and Ontario to world-class 5G technology and next-generation networks such as autonomous 5G,” said Jeanette Irekvist, President of Ericsson Canada.

“5G is still in its infancy. As we work with SME and our customers to develop new applications and solutions, we are learning what new features or capabilities we need to develop and make available. The partnerships and collaborations made possible through ENCQOR are essential to evolving standards and technology. In other words, we have spent a lot of time understanding the implications and opportunities associated with this new technology. Now we need to move from proof of concept to 5G adoption,” says Marcos Cavaletti, Senior Advisor and Head of Ottawa site for Ericsson.

Developing 5G talent and expertise

Cavaletti notes that ENCQOR’s collaborative approach has also been used for developing talent in 5G, with input from the academic community. “We need more people with expertise in 5G in Canada,” specifies Cavaletti.

For Jeanette Irekvist, a program like ENCQOR allows our companies, with the support of the academic community, to make technological advances that will allow them to remain relevant in an increasingly competitive world. “The ENCQOR 5G program allows SME and researchers to pursue disruptive innovations at an early stage, thereby promoting the competitiveness of the Canadian economy.”

“We can no longer develop this type of technology in isolation. ENCQOR provided an environment where you can have partners and stakeholders from different sectors. It’s a successful model and we’ll need it in the future to continue to succeed,” adds Marcos Cavaletti.

A technology that can be applied in several sectors

According to Ericsson executives, 5G technology will have applications in many industries, such as transportation, mining, factory automation and healthcare. “In healthcare, for example, you could bring equipment and care to the patient instead of having the patient go to the hospital,” Cavaletti illustrates.

Ericsson believes that 5G technologies can also help many companies reduce their emissions and take a more sustainable approach.

Furthermore, the solutions that will be developed in Canada, will not only be useful to Canadian companies, but can also be exported to international markets.

A collaborative approach that will continue to be necessary

For Ericsson, it will be important for Canada to continue to be able to rely on programs similar to ENCQOR, where the expertise and strengths of many different players from the private sector and academia are brought together.

“We look forward to continuing our work within the growing ecosystem created by ENCQOR and supporting the search for new uses or adoptions of 5G in various industries in Canada,” concluded Mrs. Irekvist.

TESTIMONIALS FROM OUR ANCHOR PARTNERS

Stéphane Tremblay
Site Location Executive
of IBM Bromont

IBM

THE ENCQOR PROGRAM HAS BEEN VERY BENEFICIAL FOR IBM BROMONT

Actively involved in ENCQOR 5G, IBM Bromont gives a very positive assessment of its participation in this program. “It has been very beneficial for IBM Bromont. The program has had a significant impact on our business, in addition to helping us significantly in our technological development work related to 5G and photonics,” says Stéphane Tremblay, Site Location Executive of IBM Bromont, a major employer in the Eastern Townships, whose facilities are on the cutting edge of technology.

Tremblay explains that the program “helped accelerate our development, generate data on our new processes and convince our customers that we had a new technology that was ready for commercialization.” This has helped IBM Bromont stand out as a leader and win a major contract with Ranovus, a company that provides photonic interconnect solutions for data centers and communications networks.

Bringing «light» to microprocessors

IBM Bromont specializes in the manufacture of microprocessors and hard encryption systems. As part of its work with ENCQOR, IBM Bromont is developing a device that will allow the optical signal to be linked as directly as possible to the microprocessors. Combined with 5G, this photonic technology should allow an exponential increase in data processing capacity.

Currently, the last ‘link’ that connects fiber optic networks to microprocessors is composed of traditional electronic materials, which creates a bottleneck that significantly reduces the amount of data that can be routed to the microprocessors. “The idea is to bring the last connection segment over optical media. For example, right now your TV is connected to a fiber optic cable. But inside, the signal still has to go through traditional circuits to get to the microprocessors. That’s what we want to change,” says Stéphane Tremblay, “Coupled with 5G, bringing light and photons to the microprocessors increases the bandwidth considerably. It’s a disruptive technology. It’s not yet at the stage of large-scale commercialization, but more and more customers are interested. Clearly, we’re headed there.”

ENCQOR: a talent attraction and innovation driver

IBM Bromont’s executive also notes that his company’s participation in the ENCQOR program has helped attract new talent and boost its technology development work. “Our work with ENCQOR has attracted high caliber external developers who would not have come otherwise. It has also given new impetus to our industrial chair with the University of Sherbrooke, by adding an optoelectronics component. These are direct consequences of the ENCQOR initiative, which probably would not have happened without this program,” he specified.

For Tremblay, there is no doubt that there must be a follow-up to ENCQOR. “A new phase to the ENCQOR program is a must for Quebec and Canada. It is absolutely essential. To commercialize new 5G technologies on a large scale, there is still a lot to do. We must demonstrate the reliability of these new solutions, and continue to develop the components and materials that will enable us to obtain even more robust solutions. It must continue to evolve on several levels,» he concludes.

TESTIMONIALS FROM OUR ANCHOR PARTNERS

Christopher Pogue
Thales Canada's President and CEO

THALES

ENCQOR 5G: AT THE HEART OF THE DIGITAL TRANSFORMATION OF BUSINESSES IN CANADA

According to Thales Canada's President and CEO, Christopher Pogue, the ENCQOR 5G program has been a valuable lever to date for the digital transformation of businesses in Canada. This is true for SME as well as larger companies such as multinationals.

"With ENCQOR, we 'democratize' access to innovation and technological infrastructures. It's not only for large companies, but also for small and medium-sized companies. That's one of the things that really excites me about what we're doing with the ENCQOR program," says Pogue.

He reminds us that SME make up a large portion of Canada's GDP and it is critical that they compete on a national, North American and global level. "With ENCQOR, we are experimenting with a number of things that will allow SME to move quickly through this new digital reality."

Significant benefits for Thales

For Thales, ENCQOR has enabled the company to make important developments in some strategic areas, such as ground transportation, cybersecurity and critical decision systems (used in the defense community).

"Through ENCQOR, Thales can collaborate with SME that are often very innovative. We also interact with larger companies with whom we share information in a unique way and develop solutions that we could not have imagined before."

Overall, adds Christopher Pogue, ENCQOR allows an entire ecosystem "to test and experiment with solutions that, when the conditions are right, can be brought to market on a larger scale with less risk, building on know-how and skills that have already been perfected. This is what ENCQOR is all about."

A new digital railway

For the Thales executive, the ENCQOR effort is comparable to the work done in Canada in the 19th century to build the railroad that connected the country from coast to coast. "Today, our new railroad is essentially our digital infrastructure. It is as important as the railroad was when Canada was born."

Many areas of the country, especially those outside of major centers, will have a great need to be connected to this new digital infrastructure, Pogue notes. This, he says, will allow businesses in these regions to participate in this new emerging global economy without having to leave their current physical locations.

"In addition to having a significant geographic reach, continues the Canadian president of Thales, this digital infrastructure that ENCQOR is helping to build must also be able to vertically integrate a greater number of sectors and fields of activity. In this spirit, in the future, if there is to be a continuation of the ENCQOR program, it will have to be able to evolve significantly towards the adoption of new 5G technologies to generate these vertical impacts."

"We need to move from a mode where ENCQOR is a sort of government initiative, which was initially critical to making it a success, to a new phase where adoption itself will determine how 5G should fit within the Canadian innovation ecosystem. It will need to become less of a government-driven initiative and more driven by the market and commercial interests of stakeholders," concludes Pogue.

SECTORIAL BREAKDOWN OF SME PARTICIPATING IN THE ENCQOR 5G PROGRAM

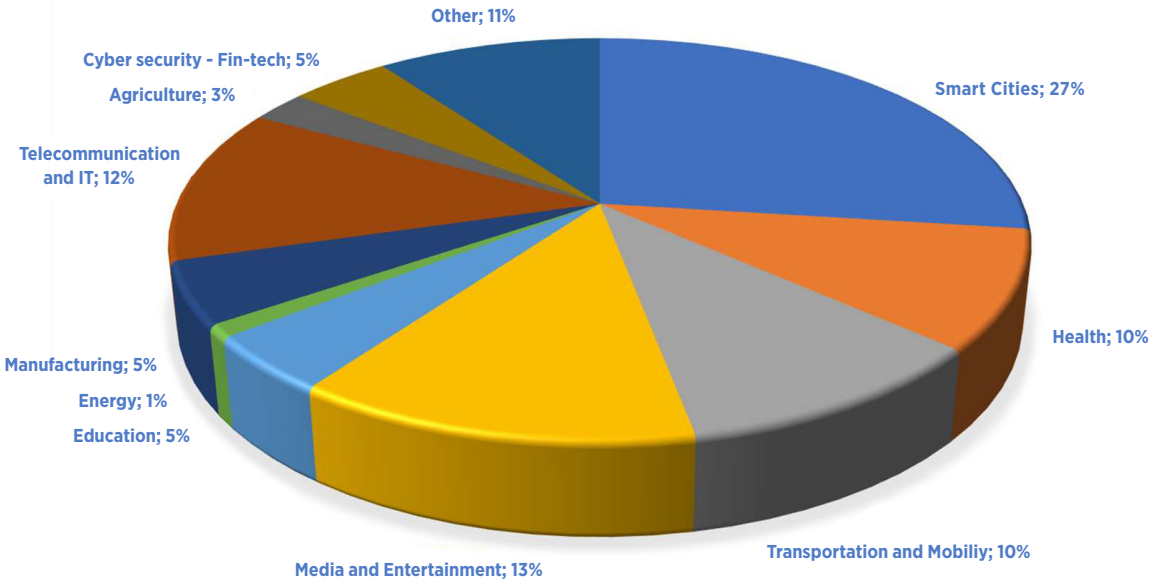
ENCQOR: SMES AND PROJECTS FLOURISH IN THE WORLD OF 5G

Over the six years of the ENCQOR 5G initiative, some 860 SME in Quebec and Ontario will have taken part in the program, either through funded projects or through free access to ENCQOR's state-of-the-art 5G testbed.

As can be seen in the illustration below, the SME that have participated in the program come from a multitude of sectors, including smart cities, telecommunications, multimedia, transportation, healthcare, advanced manufacturing, education and agriculture. This rich variety of fields illustrates the broad, multi-sector scope of smart connectivity solutions. In this respect, 5G is a truly cross-cutting technology, in the same way as, for example, artificial intelligence, quantum or cybersecurity.

The 860 SME participating in the ENCQOR 5G program also benefited from numerous information and mobilization activities offered throughout the program, notably through the five ENCQOR 5G innovation centers established in Quebec City, Montreal, Ottawa, Toronto and Kitchener. These activities included webinars, bootcamps and regular newsletters.

SME per sector - ENCQOR 5G
(N=860)



TESTIMONIALS FROM SME

SME at 5G SPEED

HALION

HALION AIMS TO CREATE A COLORFUL INTERACTIVE DIGITAL WORLD USING 5G

Halion, a Kitchener-based company launched in 2017, has developed a new solution that can be used to make interactive outdoor public signage using 5G, tint car windows and even potentially replace your smartphone screen.

This solution is based on the creation of an innovative liquid ink, composed of new nanomaterials, capable of rapidly changing color intensity. The color change is triggered by an electric field applied to the ink. Very little energy is required to change color, and even less to maintain it.

Halion is targeting three main markets: displays (through windows or glass surfaces), electronic device screens and automotive glass.

High-performance, interactive displays using 5G

In practical terms, Halion's solution can be applied as a transparent film to surfaces, such as a window or any other glass surface, indoor or outdoor. The film transforms these surfaces into a touchscreen which can be controlled from an electronic device.

"Our solution allows for displaying information, images and high resolution colour videos. You can interact with the screen by touch, just as you would with a regular touchscreen. To deliver these features on large outdoor surfaces, you need 5G," says Ryan Marchewka, CEO and one of the two co-founders of the company, which was created with his partner Matt Lavrisa, CTO.

And because of the materials Halion uses, display content and colors remain easily visible even when it's very sunny, which is a big advantage for outdoor display.

"We wanted to develop a technology that offers an easy-to-read, low-power display like the one found in Kindle devices. However, these devices only work in black and white and are slow. Current displays on common electronic devices are energy intensive and perform poorly in daylight. Our technology combines the strengths of both solutions: low power consumption, speed and an easy-to-read touchscreen with clear, crisp colors even in daylight."

Matt Lavrisa
CTO

Ryan Marchewka
CEO

TESTIMONIALS FROM SME

SME at 5G SPEED

HALION

Validation of 5G technology

The project with ENCQOR 5G allowed Halion to test its solution with a 5G network for the first time. “On large outdoor areas, which need to be controlled remotely, we need 5G. There is a need for a network that can transmit a large volume of data in real time, to make interaction functions possible and to be able to quickly change the information, images and videos that are presented on the screen,” Marchewka points out.

The project with ENCQOR confirmed that Halion’s solution can work well with 5G connectivity, for display, interaction and control. «We now know that 5G can enable our technology to work well on larger outdoor surfaces. For us, it was absolutely essential to be able to verify these technological aspects, since the connected device ecosystem and large outdoor display markets of the future will be powered by 5G.”

Other promising applications

Halion also believes that its technology could eventually serve as an advantageous alternative to the current screens on our smart phones, smart watches, tablets or computers. In this use case, Halion’s technology would be integrated directly into the device’s screen instead of being applied as a self-adhesive film.

Halion’s tinting solution could also be used to tint glass windows and sunroofs in buildings and vehicles. Discussions are currently underway between Halion and major players in these industries. “We are at the proof-of-concept stage. We still need to do some work to improve the reliability of our solution and to meet industry specifications. We believe that we will have validated samples with customers next year, which could bring us closer to full-scale commercialization, which could take place within 2 to 3 years.”

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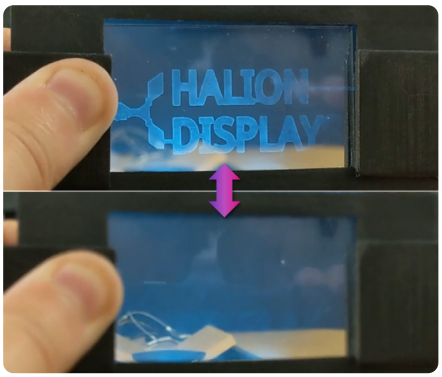


TESTIMONIALS FROM SME

SME at 5G SPEED

Georges Gyenizse
Founder of the company

IPTOKI
EMPOWERING ▸ YOUR IDENTITY

IPTOKI LAUNCHES A FIRST COMMERCIAL VERSION OF ITS INNOVATIVE IDENTITY AUTHENTICATION SOLUTION

Iptoki has reached a major milestone in its development by launching a first commercial version of its identity authentication solution based on innovative behavioral biometrics technology in September 2022.

The Montreal-based company, founded in 2018, has developed an identity authentication system, for which the first version can be used with smartphones. Unlike current biometric approaches that rely on facial recognition or fingerprinting, Iptoki's solution measures certain behaviors in order to perform identity authentication.

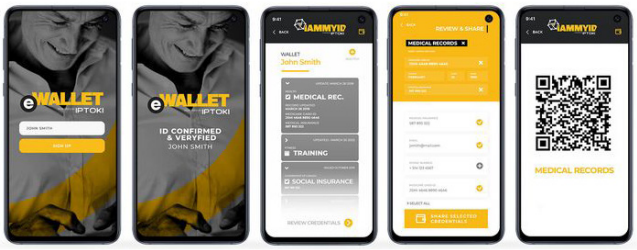
"We are working on measuring four behaviors in particular: gait, motion (the way the person moves the phone in space), gestures (the way they slide their fingers across the phone screen) and keyboard interaction (touch pressure, typing speed and certain habits such as correcting their spelling). The measurement of these behaviors is done with the help of censors, artificial intelligence and algorithms," explains Georges Gyenizse, founder of the company.

A more secure authentication solution

The solution developed by Iptoki aims to be more secure than physiological biometric approaches. "It is quite easy to fool a facial recognition system, even with a simple selfie. Fingerprints can also be reproduced quite easily. It is much more difficult to imitate behaviors, such as gait or body language. Although very reliable, Iptoki's technology is not intrusive and does not require any particular action from the phone user (passive verification).

The first version of Iptoki's solution integrates two authentication modes, namely gait and keyboard interaction. The other two behaviors, gestures and motion, will be integrated in later versions.

Iptoki's solution does not use geolocation, which can be an invasion of privacy. "To confirm the identity of the phone user in connection with a specific activity, such as someone making a withdrawal from an ATM, blockchain technology is used. This makes it possible to capture only the precise moment of the transaction, in a given location, and to authenticate the identity using the biometric signatures recorded in the blockchain. Unlike GPS, the user's movements are not tracked, before or after the transaction.



TESTIMONIALS FROM SME

SME at 5G SPEED

IPTOKI
EMPOWERING ▸ YOUR IDENTITY

An important project with ENCQOR

As part of its development, Iptoki partnered with Ericsson to carry out an important project within the ENCQOR 5G program. “This project was very important to advance our technology and validate its effectiveness. With the help of this multinational, we built a virtual management environment to simulate a transaction, using 5G and edge cloud computing. 5G was necessary to enable real-time processing of data through our algorithms and the blockchain where biometric signatures are stored. This experiment was very successful.

In this case, two people with only their phones in their hands were able, in an augmented reality environment, to make the sale and purchase of medieval objects and complete the entire transaction relying exclusively on Iptoki’s authentication technology.

Creation of new permanent positions

In the wake of this project, Iptoki has created five new permanent positions, including cloud, algorithm optimization in a production context, machine learning optimization and data science specialists.

Iptoki’s solutions have begun to be tested on smartwatches and could eventually be used on a variety of popular electronic devices.

Large potential market

Iptoki is targeting specific markets, including the financial, supply chain and recreation/tourism sectors. The company is confident that it will be able to realize sales in the near future, following the signature of an agreement to carry out a proof of concept with a large multinational. “If all goes well, this agreement could lead to a major commercial contract for Iptoki. This is a Fortune 500 company in the IT industry, whose needs could be very significant,” concluded Mr. Gyenizse.

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TESTIMONIALS FROM SME

SME at 5G SPEED

CHARGELAB

Zak Lefevre
CEO and co-founder of the company

Ehsan Mokhtari
Chief Technology Officer and co-founder

CHARGELAB'S SOLUTION POWERED BY 5G

Founded in 2016 and based in Toronto, ChargeLab develops software solutions for operating electric vehicles (EV) charging stations. The applications developed by ChargeLab are aimed at both operators of electric chargers and their users. EV charger operators include building owners, property managers, charging networks, and fleet depots. Their users are EV drivers, including private cars as well as fleet cars, trucks, and buses.

The company has completed a development project with ENCQOR 5G to ensure that ChargeLab's technology is fully ready for the arrival of 5G and to reap the maximum benefits.

Making the operation and use of electric charging systems efficient and easy

ChargeLab positions itself as a developer of solutions that aim to make both the operation of electric charging stations efficient and easy. Both for the managers of these systems and EV drivers.

"We are developing solutions that allow organizations such as a municipality or a public transit company with a large fleet of electric buses to efficiently operate and manage a network of multiple charging stations. We also work directly with EV charger manufacturers so that our solution can be better integrated into their equipment at the design stage," explains Zak Lefevre, CEO and co-founder of the company, which was created with his business partner Ehsan Mokhtari, Chief Technology Officer.

The tools developed by ChargeLab also aim to make the experience more friendly for EV drivers. "While most providers require EV drivers to download a dedicated app and load a balance onto their 'EV charging wallet', we have a more frictionless approach at ChargeLab," added Mr. Lefevre, "Drivers scan a QR code on the front of our chargers and are immediately brought to a web app where they can fully transact with the charger without any wallet balance or app download. For power users, we also provide native apps that match or beat our competitors' solutions".

Five market segments

The company defines its market into five main segments: fleet, public (such as municipalities), workplace, multi-family, and single-family.

For certain market segments, including fleets, ChargeLab has also developed a magnetic card based on Radio Frequency Identification Technology (RFID) that allows users to pay for a charge by tapping the card directly on the station. This payment option can be particularly useful for fleet managers or large employers.

ChargeLab's operating software can be tailored to meet the specific needs of their customers. For example, it will be possible to specify the parameters for the use of RFID cards based on the role or work schedule of a certain group of employees. These same types of settings can also be configured in ChargeLab's mobile application.

TESTIMONIALS FROM SME

SME at 5G SPEED

CHARGELAB

A 5G powered solution

For ChargeLab, the arrival of 5G sparked various reactions. There was the potential for significant benefits, but at the same time, there was a need to ensure that the technology the company was developing was compatible with this new, high-performance mode of connectivity.

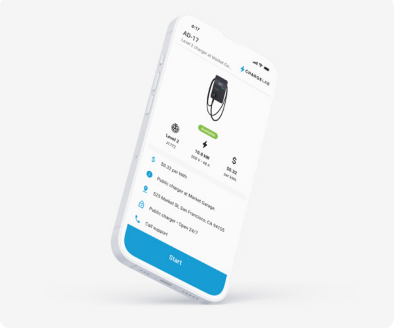
For these reasons, ChargeLab decided to put forward a project as part of the ENCQOR 5G program to evaluate the impact of 5G on the solutions developed by the company. “Our solution is based on connectivity. It was important for us to ensure that our software was 5G compatible and could take advantage of it. The project with ENCQOR allowed us to identify potential technological issues and to make the necessary adjustments so that our products could be 5G ready, and that this could become a competitive advantage,” says Mr. Lefevre.

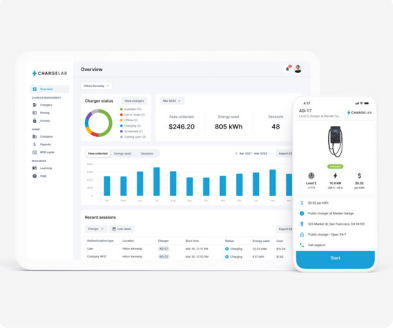
5G: a connectivity technology well-suited to the urban environment

With 5G, the performance of ChargeLab’s solution will be more enhanced in urban environments, where there are many barriers to the effectiveness of current networks, such as concrete structures. “With 5G, we will be able to have much more reliable connectivity with charging stations that are located in less accessible places, such as underground parking lots,” explains Mr. Lefevre.

5G will also offer other important benefits for ChargeLab. “In everything we do, the security and reliability of our network is of utmost importance to our customers. 5G, a robust technology with advantageous cybersecurity properties, will help us greatly in this regard. These are assets that will set ChargeLab apart from the competition. Already, our customers are very positive that we have a technology platform that can leverage the strengths of 5G.”

ChargeLab, which has nearly 50 employees, already has more than 100 customers. The ENCQOR project kick-started the creation of ChargeLab’s team dedicated to the development of solutions embedded within the stations built by the manufacturers. While this team began with half a full-time position, it now requires the collaboration of three full-time professionals.





TESTIMONIALS FROM SME

SME at 5G SPEED

INDRO ROBOTICS

INDRO ROBOTICS SETS SIGHT ON THE FUTURE WITH 5G

InDro Robotics is a company specializing in the development of drones (UAV) as well as unmanned (remotely controlled) ground vehicles (UGV) with innovative features and capabilities.

The company, founded in 2015 operates a R&D center based in Ottawa. The company also has facilities in Vancouver and the United States. InDro Robotics also plans to open a new facility in the UK in the near future. The company markets a wide range of UAV and UGV.

The solutions developed by InDro Robotics are intended for a wide range of sectors, including agriculture, infrastructure and construction monitoring, traffic monitoring, and mining.

Beyond the Visual Line of Sight

As part of the ENCQOR 5G program, InDro Robotics, with the help of Ericsson, a founding partner of ENCQOR, conducted a major project at its Ottawa facility to push the limits of its technology. The project had two compopossible to add a third camera that can be remotely controlled and oriented in the desired directions at any time by its operator.

“The two systems that we developed together allow a drone to be controlled from a great distance with instant access to information and images from anywhere in the world. Our solution enables the operator to see well beyond the visual line of sight and collect information from locations hundreds of kilometres away from the drone control site. Typically, drones are manually controlled and can only travel short distances while remaining within the operator’s sight,” explains Philip Reece, founder and president of InDro Robotics.

As a direct result of the project with ENCQOR, four new full time equivalent positions of technologist and engineer were created within the company. These four people are still employed by InDro Robotics.

Philip Reece
founder and president of
InDro Robotics

TESTIMONIALS FROM SME

SME at 5G SPEED

INDRO ROBOTICS

New systems

The new software defined radio system developed by InDro Robotics and Ericsson has some highly innovative features. In particular, it has the ability to communicate verbally in an automated manner over aviation frequencies to communicate its position and intentions, receive instructions and take action if required. InDro Robotics works closely with various control and regulatory agencies, including Transport Canada and the Canadian Space Agency.

The second system, which represented the largest portion of the work done with Ericsson, provides a sophisticated solution to transmit data and images instantly to control centres through high-performance 5G connectivity. “The person controlling the drone can be sitting in an office anywhere in the world and can choose, through our web server-hosted application, to share access to information or images, or both, to others, no matter where they are.”

To enable drones to navigate long distances, they need to be equipped with the new software defined radio system and have the second system connected to a secure 5G network, Reece notes. Both are necessary to ensure the drone’s proper operation and the safety of the drone and surrounding airspace.

Promising commercial prospects

InDro Robotics’ technology is marketed as two distinct products: the InDro Commander, which integrates diverse devices and equipment in a box on top of the drone (including the graphics processing unit, the router and the modem) and the InDro Pilot, the software that allows the operator to manage the information and the images he receives, thanks to a state-of-the-art user interface. It should be noted that this new technology developed by InDro Robotics could also have applications for its ground vehicles.

“We have ongoing discussions with three potential buyers of our technology, in addition to our partner Ericsson. We are very confident that our solution has significant advantages and benefits that will attract the interest of many players in different industries,” concludes Mr. Reece.

TESTIMONIALS FROM SME

SME at 5G SPEED

IDEO CONCEPTS TAKES GIANT STEPS FORWARD

IDeo Concepts founder David Rancourt believes that the projects carried out as part of the ENCQOR 5G program have enabled his company to make great strides in a short period of time on a variety of fronts.

IDeo Concepts, a Quebec City-based company founded in 2013, has developed a flagship solution, the Myterex platform, which collects and analyzes data in real time, optimizes processes and issues alerts.

Through its participation in the ENCQOR program, IDeo Concepts worked on two projects. The first was with a long-time client, Nirvana, which specializes in the manufacturing and installation of heat pumps for heating pools. The second project was carried out with Nordikeau, a company that developed an innovative water management platform for the municipal sector.

A more robust and efficient system thanks to 5G

With Nirvana, IDeo Concepts tested a new connectivity solution to enable the migration of the Myterex system used by Nirvana from a Wi-Fi network to a 5G or LTE network. This type of connectivity allows Nirvana's management system to be more stable and robust than the one traditionally on Wi-Fi.

"As a result of this work, our Myterex solution has advanced tremendously. The 5G/LTE version will allow our customer and partner Nirvana to undertake their expansion projects with confidence, as the new version of the system is much more stable and requires less intervention and support from their customers," highlights Rancourt.

Another important benefit offered by the new 5G version of Myterex is the ability to use edge computing for data processing and management. "With this solution, information can be processed and managed without delay directly in the 5G antenna. This allows alerts to be issued quickly, which can prevent more serious mechanical failures, such as the failure of an overheating compressor."

Nirvana's management system, which takes various measurements such as water temperature (at the inlet and outlet of the heat pump), water pressure circulating through the heat pump, and ambient outdoor temperature, helps identify potential problems, facilitate maintenance and repairs.

David Rancourt
IDeo Concepts founder

TESTIMONIALS FROM SME

SME at 5G SPEED

IDeo concepts

Nordikeau Project

IDeo Concepts also worked closely with the company Nordikeau to conduct a comparative analysis of the use of 5G versus LORA (Long Range) to ensure the functioning of the Nordicity platform, an innovative system developed by Nordikeau for water management.

The solution developed by Nordikeau collects and analyzes real-time data from municipal water management systems to optimize processes and maintain desired water oxygenation levels.

“Our work has allowed us to define and confirm the best approaches for Nordikeau to adopt to ensure the connection of the various sensors of its Nordicity system. For example, in cases where 5G is not available in a given region, we were able to establish that the company will be able to reliably and securely use a local LORA network, which will be connected to a 5G gateway to ensure data transmission to the Nordicity platform. Nordikeau now has a clear and proven path to deploy its technology, even in areas with less connectivity infrastructure, while continuing to reap the benefits of 5G.

Pilot project with Olymel

As a result of the knowledge and expertise gained from projects with Nirvana and Nordikeau, IDeo Concepts has put forward a very promising pilot project with the company Olymel in the summer of 2022. “Our work with ENCQOR has allowed us to reduce by four the time it took to develop our solution for Olymel”.

This project involved testing and using IDeo Concepts’ Myterex solution, at select Olymel facilities in various work and refrigeration areas, to measure temperature and humidity in real time iusing sensors connected to 5G networks, or LTE if 5G was not available.

“The results of this project were very interesting. These real-time measurements could potentially allow Olymel to better manage its temperature control and refrigeration systems, and thus save significant energy. By maintaining the temperature and humidity close to targets at all times in the production line, Olymel believes that this could also contribute to providing more consistent properties to its products”.

In the wake of the projects carried out under the ENCQOR 5G program, IDeo Concepts has created three new engineering positions within its team, which now numbers 10 employees. David Rancourt believes that the projects carried out with Nirvana, Nordikeau and Olymel could soon boost IDeo Concepts’ development. “This work has allowed us to strengthen or establish close business ties with dynamic and innovative partners, which indicates very good things for IDeo Concepts’ future,” concluded Mr. Rancourt.

TESTIMONIALS FROM SME

SME at 5G SPEED

SENTIOM™

LEVERAGING INNOVATIVE DIGITAL PROCESSES AND THE POSSIBILITIES OFFERED BY 5G
SENTIOM IS REINVENTING APPROACHES TO APARTMENT BUILDING SECURITY

Based in Montreal and founded in 2018, Sentiom's mission is to develop innovative solutions to better control and reduce security risks for apartment buildings. Two main risks threaten the integrity of buildings as well as the safety of their occupants: water damage and fire.

Over the past few years, Sentiom has developed a promising new approach to prevent water damage in apartment buildings. This new technological solution is based on an amalgam of water valve controllers and water leak detectors, all linked to an integrated control system providing real-time measurements and alerts, and the ability to intervene very quickly.

"We designed a dashboard that provides real-time information on various events. The system can issue alarms when the situation is serious, or warnings or notifications when incidents are less serious," explains Mathieu Lachaîne, Chief Technology Officer at Sentiom.

Sentiom's system was developed with water damage prevention in mind. So, in the buildings where the solution has been installed, water valves are closed by default, instead of being constantly open as is the case in most buildings or at home. "For example, when the occupant of a dwelling enters the bathroom at night, motion detectors detect his or her presence and automatically unlock the toilet and tap valves. When the occupant leaves the bathroom, the valves close again automatically," explains Mr. Lachaîne.

Première rangée, deuxième à partir de la droite :
Mathieu Lachaîne
Chef de la technologie, Sentiom, en compagnie des membres de son équipe.

TESTIMONIALS FROM SME

SME at 5G SPEED

SENTIOM™

Integrating fire systems using 5G connectivity

More recently, Sentiom has teamed up with a partner, Incendia, to develop a system that can provide integrated management of water damage and fire prevention solutions. In doing so, the technological challenges have become more considerable, particularly given the large number of devices to be installed, monitored and controlled in real time in buildings that are closed environments, hardly conducive to the installation of wired networks.

So Sentiom, and its partner Incendia, turned to ENCQOR and 5G's support to meet these challenges. The first challenge was to be able to connect hundreds of devices (sensors; water, smoke or heat detectors; valve locking systems; etc) in real time within an integrated control and monitoring system relying on 5G high-speed connectivity.

This new, much larger and more complex integrated water/fire system also had to be able to meet the various Sentiom and Incendia safety standards, including the requirement to be able to operate autonomously, even in the event of an Internet or power failure. The system also had to be able to be managed locally or remotely, with approaches based on edge computing and cloud computing. Another major technical challenge was the need to ensure redundancy of all installed devices in the event of failure or breakdown.

The environment offered by ENCQOR, in particular its 5G test bench, enabled Sentiom to test and validate the performance and smooth operation of its technology based on the immense capabilities of intelligent connectivity.

Project in a 75-unit apartment building

This 5G project was successfully carried out in a 75-unit apartment building in the Martin Matte network of homes for people suffering from physical and cognitive impairments as a result of traumatic brain injury. Some 750 devices of all kinds were installed in this building. Thanks to the system installed by Sentiom and its partner Incendia, the building is now safer and promote greater independence for occupants. This will also be true for retirement homes, another market targeted by Sentiom.

"Our solutions enable us to design intelligent, sustainable and safe buildings. In this way, we can say that our approach is benevolent not only for the most vulnerable, but also for the general population, who also live largely in apartment buildings. Of course, this digital transformation of buildings, by generating a significant reduction in the risk of fire and water damage, also has positive spin-offs for the owners of these buildings, particularly in terms of their deductibles and insurance costs. The same applies to municipal fire and emergency services, for whom many major incidents will be avoided. In short, it's a win-win situation,» sums up Mr. Lachaîne.

With staff shortages, an overburdened healthcare system and an aging population, Sentiom believes that the digital transformation of buildings will be part of the solution, helping to prevent disasters and improve the autonomy of seniors and other vulnerable people

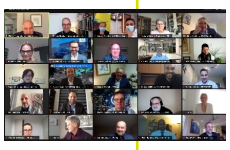
5G EXCHANGE AND MOBILIZATION ACTIVITIES IN QUEBEC

ENCQOR 5G EVENTS IN QUÉBEC 2021-2022

April 13, 2021
NumériQc Week
Prompt presents the ENCQOR 5G program to event participants.

April 14, 2021
ADRIQ Innovation Clinic
AIOT Canada and ADRIQ (innovation clinic) joint webinar: When AI meets the Internet of Things (IoT) for manufacturers

April 15, 2021, May 26, 2021 and November 2, 2021
Lunch and Learn Collision Lab at Centech | 5G for your startup
Presentations by Niosense, ATEK and Latence Technologies

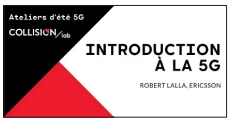


April 16, 2021
5G Round Table with Minister Pierre Fitzgibbon
Exchange and discussion event between the Minister of the Economy and Innovation, Pierre Fitzgibbon, ENCQOR 5G players and 6 SME participating in the program.

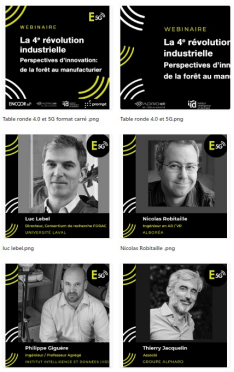
May 14, 2021, June 4, 2021, August 6, 2021, September 10, 2021, October 8, 2021, November 5, 2021, December 3, 2021, January 7, 2022, February 4, 2022 and March 11, 2022
Coffee breaks - ENCQOR 5G
Informal meetings on zoom meeting where companies were invited to ask questions about the ENCQOR 5G program.

May 18, 2021
ADRIQ 5G Info Blitz
Meeting with Harold Dumur, founder of OVA. How the ENQCOR 5G program has enabled OVA, a Quebec SME, to propel its activities and expansion.

June 11, 2021, June 17, 2021, June 29, 2021, July 9, 2021
Centech 5G Summer Workshops: the importance of 5G
Presentations by Ericsson, Bell, Accedian and OVA.



June 18, 2021
Round Table | Industry 4.0 and 5G: innovation perspectives, from forest to manufacturing
Discussion between industry and research players to take the pulse of data-driven innovation, AI and 5G in the sphere of Industry 4.0 and its many fields of application.
The panelists were:
- Thierry Jaquelin, Partner, Alphard Group
- Luc Lebel, Director, Consortium de recherche FORAC, Université Laval
- Marina Villarroel, Director of International Projects, Alboréa



July 13, 2021
ENCQOR 5G Augmented and Virtual Reality Bootcamp
Put forward the opportunities of 5G within the experiential industry.
Approach new Quebec SME.
IpaaS (ENCQOR's 5G network)

September 15, 2021
CCMM presentation on 5G
Chambre de commerce du Montréal métropolitain (CCMM) event with the participation of Paul Baptista, site manager for Ericsson in Montreal, anchor partner company of ENCQOR 5G.

5G EXCHANGE AND MOBILIZATION ACTIVITIES IN QUEBEC

ENCQOR 5G EVENTS IN QUÉBEC 2021-2022

October 7, 2021
5G presented to participants in the Acceleration program (Centech)
ENCQOR 5G presentation at CENTECH offered to Accélération program participants (from Centech)

November 02, 2021
Forum on the impact of 5G
JIQ - Action TI: Forum on the impact of 5G on businesses and citizens.
A look at the ENCQOR 5G experience.

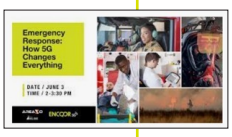
November 18, 2021 and March 17, 2022
Private event - CENTECH ENCQOR 5G
Invitation-only event for a technology visit to Centech, the innovation center of the ENCQOR 5G program.
Participants were made aware of 5G capabilities and the various funding and/or subsidy programs offered by Prompt Innovation, as part of the ENCQOR 5G program.

November 30, 2021
Presentation on 5G in collaboration with the *Val d'Or CDI*
Presentation given in collaboration with the *Centre de développement industriel de Val d'Or* as part of a visit to CENTECH in Montreal.

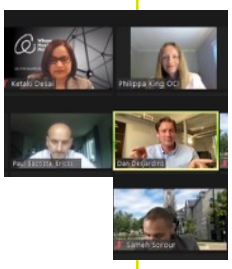
February 23, 2022
Presentation at the IFeelVirtual metaverse at Centech/broadcast in 5G and face-to-face, online and in the ENCQOR 5G metaverse.
Presentation offered in collaboration with John Abott College.

5G EXCHANGE AND MOBILIZATION ACTIVITIES IN ONTARIO

ENCQOR 5G EVENTS IN ONTARIO 2021-2022



June 3, 2021
Panel on emergency response: how 5G changes everything
Event held at Invest Ottawa/Ontario Innovation Centre featuring a panel that addressed the impacts of 5G in emergency management



September 14, 2021
ENCQOR 5G presentation at the CCECE
As part of the Canadian Conference on Electrical and Computer Engineering (CCECE), presentation of the ENCQOR 5G program via a panel featuring Ericsson (anchor partner of ENCQOR 5G), SME participating in the program and the Ontario Innovation Centre.

September 28, 2021
Webinar on augmented and virtual reality by ENCQOR 5G
Presentation of the new capabilities of the ENCQOR 5G test bed in the fields of augmented, virtual and mixed reality, with the participation of two of the program's anchor partners (Ericsson and Ciena), OVA and NVIDIA.

HIGHLIGHTS OF THE YEAR 2021-2022

PERIOD FROM APRIL 1, 2021 TO MARCH 31, 2022

ENCQOR 5G AND ERICSSON DEPLOY AUTONOMOUS 5G NETWORK TO DRIVE INNOVATION AND EDGE APPLICATIONS

APRIL 14, 2021

The ENCQOR 5G network is now capable of serving edge applications with one-way latency tolerances of less than five milliseconds, a critical advance for the success of future innovations such as autonomous driving, robotics and public safety. Latency is the delay between a user's action and the response to that action from the

DESPITE THE PANDEMIC, ENCQOR 5G MAINTAINS ITS MOMENTUM AND PASSES THE 600 SME MARK

APRIL 27, 2021

ENCQOR 5G is proud to announce that over 600 SME have now joined the program since its launch in 2017. Participating SME are using ENCQOR 5G network solutions to modernize and transform a wide variety of sectors, including multimedia and entertainment, transportation, smart cities, healthcare, manufacturing, agriculture and mining. ENCQOR 5G is an initiative led by a consortium of five anchor partners (CGI, Ciena, Ericsson, IBM and Thales), the provincial governments of Quebec and Ontario, and the Canadian government.

5G PROJECTS LIVE FROM THE *CAPITALE-NATIONALE:* QUEBEC CITY'S ENCQOR INNOVATION SITE SHOWCASES FIVE INNOVATIVE SME FROM THE REGION

MAY 4, 2021

On the heels of the announcement that more than 600 SME in Quebec and Ontario have now taken part in the ENCQOR 5G program in recent years, the team at Quebec City's ENCQOR 5G innovation site takes the opportunity today to highlight the initiatives carried out by five Quebec City-area companies - Flyscan, ABC Dust, Dimonoff Services Amotus, AYE3D and Groupe Alphard - that have benefited from the cutting-edge infrastructure available at the Quebec Metro High Tech Park to work with 5G.

HIGHLIGHTS OF THE YEAR 2021-2022

PERIOD FROM APRIL 1, 2021 TO MARCH 31, 2022

ENCQOR 5G MAKES ITS VOICE HEARD DURING CONSULTATIONS ON THE 2022 QUEBEC RESEARCH AND INNOVATION STRATEGY

MAY 25, 2021

As part of the consultations on the Quebec strategy to support research and investment in innovation by the Quebec Ministry of Economy and Innovation, ENCQOR 5G has submitted a brief to highlight the importance of 5G technologies for Quebec's (and Canada's) long-term prosperity, the competitiveness of our economy and the development of SME.

As ENCQOR pointed out in our brief, the program has already enabled significant advances in 5G development and innovation in Quebec over the past few years (which is also true in Ontario), thanks to the work accomplished by ENCQOR and its partners. ENCQOR is based on a collaborative model that brings together the strengths of large corporations (notably the program's five anchor partners: CGI, Ciena, Ericsson, IBM and Thales), academia and SME. Over 600 SME in Quebec and Ontario, operating in a wide variety of sectors, have signed up to ENCQOR to date. This is a remarkable level of mobilization, with few equivalents anywhere.

ENCQOR 5G AND COLLÈGE DE MAISONNEUVE SIGN COLLABORATION AGREEMENT TO OFFER NEW 5G TRAINING COURSE

JUNE 9, 2021

ENCQOR 5G is proud to announce that it has recently signed a collaboration agreement with Collège de Maisonneuve to offer a new training program on 5G technology, all to promote the sharing of knowledge and expertise in the field of 5G.

The aim of the collaboration agreement is to offer a new training program in the fields of 5G, the Internet of Things, artificial intelligence and communication networks, among others. The ENCQOR 5G platform will be used for training at Collège de Maisonneuve, fostering links between future IT professionals and companies looking to attract 5G talent.

ENCQOR 5G ENDS THE FIRST HALF OF THE YEAR ON A HIGH NOTE, REACHING THE 700 SME MARK

JULY 5, 2021

Despite the challenges posed by the pandemic during the first six months of 2021, ENCQOR 5G is delighted with the strength of its mid-year results, having notably reached the milestone of 700 SME committed to the program in Quebec and Ontario.

This is another important milestone in the deployment of ENCQOR 5G, testifying to the program's impact and success in mobilizing SME to develop and test new 5G solutions. As a result, ENCQOR 5G is gradually weaving a vast web of innovative companies across Canada, helping to drive the digital transformation of our economy.

HIGHLIGHTS OF THE YEAR 2021-2022

PERIOD FROM APRIL 1, 2021 TO MARCH 31, 2022

ADRIQ ANNOUNCES 5G ADOPTION PROJECT WITH THE TECHNOLOGICAL ARTS SOCIETY AS PART OF THE ENCQOR 5G PROGRAM

JULY 15, 2021

The Association pour le développement de la recherche et de l'innovation du Québec (ADRIQ) is proud to announce a 5G technology adoption project with the Society for Arts and Technology (SAT).

"5G can propel innovation to the highest level, in every unimaginable field. The Society for Arts and Technology is proving that this is possible in the arts sector, by considerably improving the performance of its Scenic solution," says Pascal Monette, President and CEO of ADRIQ.

ADRIQ ANNOUNCES 5G ADOPTION PROJECT WITH NIOSENSE AS PART OF ENCQOR 5G PROGRAM

JULY 22, 2021

The Association pour le développement de la recherche et de l'innovation du Québec (ADRIQ) is proud to announce a 5G technology adoption project with Niosense.

"Companies of all horizons, whatever their size, can be accompanied in the adoption and integration of 5G technology with the support of ADRIQ. Combining technological, industrial, logistics and public players, this new 5G adoption project developed by Niosense and its partners Jakarto Cartographie 3D and Blue City Technology aims to demonstrate that the use of open 5G components will make it possible to take into account the dense and complex mobility environments of cities to reduce traffic light GHG emissions and transport-related pollution," says Pascal Monette, President and CEO of ADRIQ.

THALES PARTNERS WITH OSCP TO DEVELOP TECHNOLOGY FOR AUTONOMOUS TRAINS

AUGUST 27, 2021

Thales, a global technology leader and founding partner of ENCQOR 5G, has teamed up with a Montreal-based technology start-up to help shape the future of autonomous rail technology. Supported by the ENCQOR 5G program, the partnership between Thales and One Silicon Chip Photonics (OSCP) aims to test a high-performance fiber-optic inertial sensor system on an autonomous train platform.

HIGHLIGHTS OF THE YEAR 2021-2022

PERIOD FROM APRIL 1, 2021 TO MARCH 31, 2022

ADRIQ ANNOUNCES 5G ADOPTION PROJECT WITH AUTONOM AS PART OF ENCQOR 5G PROGRAM

SEPTEMBER 3, 2021

ADRIQ (Association pour le développement de la recherche et de l'innovation du Québec) is proud to announce a 5G technology adoption project with Autonom.

"It's always a source of pride for ADRIQ to be able to support a new 5G adoption project in Quebec. Thanks to the functionalities of 5G, the social and economic impacts of the innovation developed by Autonom and its partners will be positive from every point of view, from access to education, business creation, remote health and entertainment," said Pascal Monette, President and CEO of ADRIQ.

ADRIQ ANNOUNCES 5G ADOPTION PROJECT WITH IDEO CONCEPTS AS PART OF ENCQOR 5G PROGRAM

SEPTEMBER 3, 2021

ADRIQ (Association pour le développement de la recherche et de l'Innovation du Québec) is proud to announce a 5G technology adoption project with IDeo Concepts.

"Energy efficiency is a subject of particular interest to ADRIQ. It is therefore with great excitement that ADRIQ announces a new 5G adoption project, developed by IDeo Concepts, which will revolutionize the field of industrial refrigeration by reducing energy consumption through the use of 5G technology," says Pascal Monette, President and CEO of ADRIQ.

ADRIQ ANNOUNCES 5G ADOPTION PROJECT WITH OHRIZON AS PART OF ENCQOR 5G PROGRAM

SEPTEMBER 30, 2021

The Association pour le développement de la recherche et de l'innovation du Québec (ADRIQ) is proud to announce a 5G technology adoption project with OHRIZON. As a partner in the ENCQOR5G program, ADRIQ supports Quebec companies in all sectors of activity in adopting and integrating 5G technology. The solutions and tools developed by OHRIZON are one such project.

"OHRIZON, an expert in augmented reality since 2015, uses artificial intelligence to make knowledge and trades accessible to all. Soon, with 5G, collaborative learning, optimized training sessions and data accessibility will experience a revolution."

OHRIZON's ambition is to offer companies innovative solutions and high-performance tools for training employees and welcoming new talent. Using cognitive sensors and data analysis, OHRIZON measures the effectiveness and acceptance of its innovations.

HIGHLIGHTS OF THE YEAR 2021-2022

PERIOD FROM APRIL 1, 2021 TO MARCH 31, 2022

ADRIQ ANNOUNCES 5G ADOPTION PROJECT WITH PROTEUS VR AS PART OF ENCQOR 5G PROGRAM

OCTOBER 5, 2021

The Association pour le développement de la recherche et de l'innovation du Québec (ADRIQ) is proud to announce a 5G technology adoption project with Proteus-VR.

"In addition to its laboratories, its training offering for healthcare workers involves the use of virtual patients of unprecedented realism. To do this, the application needs to communicate with two servers (multi-player and VR streaming) via cloud computing. Currently, the network platform is optimized for cloud computing, which means long latency times. In addition, Proteus VR is unable to further develop its platform due to the limitations of mobile VR and AR devices. With the 5G testing and development offered by ADRIQ and ENCQOR 5G, Proteus VR wants to learn how to harness the very high speed and low latency of 5G to the benefit of an ultra-efficient platform."

ENCQOR 5G REACHES 800 SME MILESTONE

JANUARY 13, 2022

In December 2021, ENCQOR passed the milestone of 800 SME, companies operating in fields such as transportation, autonomous vehicles, mining, manufacturing, agriculture, smart cities, telecommunications and augmented reality. These are just some of the sectors that demonstrate the wide range of possible applications for 5G, and the impact this technology will have on businesses and the economy.

TELESAT AND ENCQOR 5G JOIN FORCES TO TRANSFORM AND ACCELERATE THE DEPLOYMENT OF NEXT-GENERATION 5G NETWORKS IN CANADA

JANUARY 13, 2022

Telesat (NASDAQ and TSX: TSAT), one of the world's largest and most innovative satellite operators, and Canada's ENCQOR 5G, have announced a new strategic partnership. With a shared commitment from public and private sector industry leaders to develop 5G technology, the investment and collaboration in an ultra-high-speed communications infrastructure will not only enable further development and innovation in 5G and next-generation digital communications technologies, but also stimulate economic growth in Canada and deploy Internet connectivity across the country, including in rural and urban areas.

In collaboration with the ENCQOR 5G program, Telesat will conduct demonstrations, trials and pilot projects that will advance 5G connectivity, particularly for industries operating in rural areas. This includes the use of the ENCQOR testbed, satellite assets, as well as national and international 5G infrastructure. The partnership will also enable Telesat and ENCQOR 5G to collaborate with other industries, universities and organizations across Canada and around the world.

HIGHLIGHTS OF THE YEAR 2021-2022

PERIOD FROM APRIL 1, 2021 TO MARCH 31, 2022

LATENCETECH CHOSEN TO MEET A HIGH-LEVEL TECHNOLOGICAL CHALLENGE LAUNCHED BY ENCQOR 5G AND ONE OF ITS ANCHOR PARTNERS

FEBRUARY 9, 2022

LatenceTech has been chosen to take up a high-level technological challenge launched by ENCQOR 5G and one of its anchor partners. This challenge concerns the monitoring and detection of anomalies related to the ultra-low latency of 5G networks when used in an industrial 4.0 context. The project will be carried out in collaboration between LatenceTech and the partner's relevant R&D teams.

MONTREAL SOFTWARE DEVELOPMENT FIRM BESLOGIC READY TO CONQUER THE 5G UNIVERSE IN QUEBEC

MARCH 29, 2022

Montreal software development firm Beslogic is pleased to announce a number of significant achievements in the Adaptive slicing for intelligent network automation (ASINA) project, developed in collaboration with Ciena and with financial support from the ENCQOR 5G program.

This technological research project, developed with the contribution of Concordia University professor Brigitte Jaumard's team, aims to segment the 5G network into different spheres, or "virtual slices" (network slicing). For several years now, Beslogic and Ciena have been working closely together on the optimization of various technologies, including their Blue Planet platform.

ENCQOR 5G PROGRAM HIGHLIGHTS 2017-2021

PERIOD FROM MARCH 2018 TO SEPTEMBER 2020

ENCQOR 5G OFFICIALLY LAUNCHED IN THE PRESENCE OF REPRESENTATIVES OF THE THREE PARTICIPATING GOVERNMENTS

MARCH 18, 2018

Official launch of the ENCQOR 5G program, with a total budget envelope of $400 million. The announcement is made by the federal Minister of Innovation, Science and Economic Development Canada, Navdeep Bains, the Deputy Premier of Quebec, the Minister of Economy, Science and Innovation and the Minister responsible for Digital Strategy, Dominique Anglade, and the Ontario Minister of Research, Innovation and Science, the Honourable Reza Moridi.

In the center, the federal Minister of Innovation, Science and Industry, Mr. Navdeep Bains, accompanied on his left by the Quebec Minister of the Economy, Science and Innovation and Minister responsible for the Digital Strategy, Ms. Dominique Anglade; and on his right, Ontario's Minister of Research, Science and Innovation, Reza Moridi.

Federal Minister of Innovation, Science and Industry Navdeep Bains at the official launch of the ENCQOR 5G program.

FIRST CALL FOR ADOPTION PROJECTS

SEPTEMBER 27, 2018

ENCQOR 5G's first call for projects, for the submission of pre-commercial 5G projects and 5G adoption projects.

QUEBEC SUPPORTS THE CITY OF MONTREAL IN 5G DEPLOYMENT

JUNE 17, 2019

François William Croteau, head of the Smart City, information technologies, innovation, higher education and organizational performance, announces measures surrounding the deployment of 5G technology in Montreal. As part of this action plan, the Quebec government calls for collaboration between the City of Montreal, ENCQOR 5G and the Laboratoire Urbain 5G.

ENCQOR 5G PROGRAM HIGHLIGHTS 2017-2021

PERIOD FROM MARCH 2018 TO SEPTEMBER 2020

ENCQOR 5G TEST BENCH GOES LIVE THROUGH ITS FIVE INNOVATION CENTERS

JULY 3, 2019

ENCQOR 5G officially announces that its five innovation centers - Quebec City Intelligence and Data Institute), Montreal (Centech), Ottawa (Invest Ottawa), Toronto (MaRS) and Kitchener (Communitech) - are open and operational. This brings ENCQOR's 5G testbed into operation on this strategic corridor linking some of the major cities in Quebec and Ontario.

MINISTER FITZGIBBON PARTICIPATES IN A DEMO DAY AT CENTECH

OCTOBER 28, 2019

Quebec's Minister of the Economy and Innovation, Pierre Fitzgibbon, takes part in a major 5G demonstration event at Montreal's Centech. On this occasion, several SME participating in the ENCQOR program have the opportunity to present their work on developing 5G solutions and to exchange directly with Minister Fitzgibbon and numerous players from industry and the telecommunications sector.

At center, Pierre Fitzgibbon, Minister of the Economy and Innovation, accompanied on his left by Pierre Boucher, ENCQOR 5G General Manager.

The Minister of Economy and Innovation, Mr. Pierre Fitzgibbon, addressing participants at the ENCQOR Demo Day on October 28, 2019.

ENCQOR 5G PROGRAM HIGHLIGHTS 2017-2021

PERIOD FROM MARCH 2018 TO SEPTEMBER 2020

ENCQOR 5G AGREEMENT WITH SIX TELECOM PROVIDERS

FEBRUARY 20, 2020

ENCQOR 5G announces the signing of the Memoranda of Understanding with six Canadian telecommunications service providers. These companies are (in alphabetical order): Bell, Cogeco, Ecotel (Ambra Solutions), Rogers, Telus and Videotron. Through these agreements, ENCQOR 5G and the signatory companies will work closely with SME in Quebec and Ontario to develop innovative solutions and services using the 5G pre-commercial test platform offered by ENCQOR 5G.

ADRIQ JOINS ENCQOR 5G FOR ADOPTION PROJECTS

MARCH 3, 2020

ADRIQ (Association pour le développement de la recherche et de l'innovation du *Québec*) and ENCQOR 5G are pleased to announce the signing of a collaboration agreement that aims, among other objectives, to foster the adoption of 5G technology by Quebec companies and institutions. Under this agreement, ADRIQ will manage the dissemination, application and selection processes for adoption projects with participating companies and institutions.

CALL FOR PROJECTS COVID-19

APRIL 9, 2020

ENCQOR 5G launches a technology challenge to SME in Quebec and Ontario to develop innovative 5G solutions to help Canada be more resilient in the face of situations such as the COVID-19 pandemic. Although not restricted to specific fields, the solutions sought can be applied to healthcare and education, or to different sectors of the economy, such as transportation, manufacturing, agriculture and smart cities.

AGREEMENT BETWEEN ENCQOR 5G AND MITACS: 400 STUDENT INTERNSHIPS

APRIL 27, 2020

ENCQOR 5G and Mitacs are pleased to announce a partnership agreement that will support the development of a competitive 5G innovation ecosystem in Canada. Through this agreement, Mitacs will help connect 400 interns and supervising professors with Quebec small and medium-sized enterprises (SME) and industry at large to develop several projects under the ENCQOR 5G program. Overall, the agreement with Mitacs will ultimately enable 1,090 internships to be carried out as part of the program between 2020 and 2022.

ENCQOR 5G PROGRAM HIGHLIGHTS 2017-2021

PERIOD FROM MARCH 2018 TO SEPTEMBER 2020

ENCQOR REACHES 400 SME MILESTONE

JUNE 19, 2020

ENCQOR 5G reaches the milestone of 400 SME registered and participating in the program. This new milestone demonstrates the high level of interest in the potential and possibilities of 5G technology among Quebec and Ontario companies operating in a wide range of sectors, despite the constraints imposed by COVID-19.

CONCORDIA UNIVERSITY, ENCQOR 5G AND ERICSSON JOIN FORCES TO CREATE THE INDUSTRIAL RESEARCH CHAIR IN CLOUD AND EDGE COMPUTING FOR 5G AND BEYOND

JUNE 26, 2020

Concordia University, ENCQOR 5G and Ericsson are proud to announce the creation of a new Industrial Research Chair (IRC) in cloud and edge computing for 5G and beyond. The objective of the new chair will be to increase the performance of the 5G network by leveraging cloud and edge computing, as well as artificial intelligence. The creation of this new cutting-edge research team, which will have a five-year mandate, was made possible by a total investment of $2.7 million.

IRISTEL SIGNS COLLABORATION AGREEMENT WITH ENCQOR 5G

OCTOBER 9, 2020

ENCQOR 5G is pleased to announce the signing of a new collaboration agreement with Iristel, an innovative telecommunications player based in Markham, Ontario, with operations across Canada. Through this agreement, Iristel will have access to ENCQOR's 5G testbed to carry out various technological development works and test new solutions using 5G technology.

ENCQOR 5G REACHES 500 SME MILESTONE

MARCH 18, 2021

ENCQOR 5G is proud to announce that over 500 SME have participated in the program since its launch in 2017. The achievement of this remarkable new milestone underscores ENCQOR's strategic importance and impact in the development and testing of new 5G technologies in Canada. With over 500 SME involved in the program, ENCQOR will have created a dynamic, diverse and innovative 5G ecosystem in just a few years, helping to propel the development of this technology in Canada.

ENCQOR 5G: A CONTRIBUTION RECOGNIZED BY THE SCIENTIFIC COMMUNITY

ACCORDING TO A STUDY BY THE IVEY BUSINESS SCHOOL AT WESTERN UNIVERSITY

THE ENCQOR 5G PROGRAM HAS MADE A SIGNIFICANT CONTRIBUTION TO HIGHLIGHT THE KEY SUCCESS FACTORS FOR PUBLIC-PRIVATE PARTNERSHIPS IN RESEARCH AND INNOVATION IN CANADA

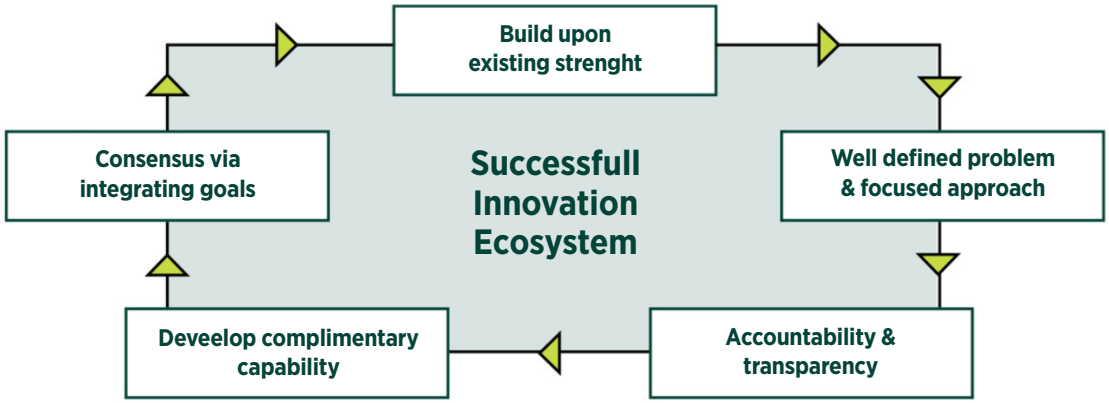
UA study of the ENCQOR 5G program completed in November 2021 by the Ivey Business School at Western University identified key success factors for public-private research and innovation partnerships in Canada.

The case study was conducted by Professors Evangeline Philos, Romel Mostafa and Stephanie Scanlan, who are associated with the Lawrence National Centre for Policy and Management at the Ivey Business School at Western.

For the study's authors, the ENCQOR 5G program has been a collaborative research and innovation success initiative through winning practices and approaches that fostered:

- synergies among the anchor partners;
- the contribution of experienced coordinating partners;
- the commitment and personal leadership of different private and public sector participants in the program;
- the alignment of the program with the innovation policies and priorities of different involved governments;
- an approach that builds on established players and existing infrastructure rather than starting from scratch;
- and maintaining a good balance between accountability and operational agility.

The authors of study conclude that the ENCQOR 5G program - as well as a review of other industry clusters' activities - provides a framework for successful public-private innovation partnerships in Canada. These key findings are shown in the diagram below.



ENCQOR 5G: A CONTRIBUTION RECOGNIZED BY THE SCIENTIFIC COMMUNITY

ACCORDING TO A COMPREHENSIVE STUDY CONDUCTED BY THE CIRANO GROUP

ENCQOR 5G HAS GENERATED SIGNIFICANT POSITIVE SPINOFFS FOR SME AND ORGANIZATIONS PARTICIPATING IN THE PROGRAM

According to a study finalized in January 2023 by the CIRANO group on the ENCQOR 5G adoption projects component, the program has generated significant benefits for participating SME and organizations, particularly in terms of research and technological development.

The study conducted for ADRIQ was based on a three-phase approach: a review of the literature on 5G and its applications and the development of an analytical framework for evaluating 5G-related projects; a survey of participating companies and organizations, particularly through interviews; and a final component containing findings and recommendations.

Key findings

CIRANO's key findings include that the vast majority of companies and organizations that participated in the ENCQOR 5G program believe they have achieved their technological objectives. The sectors in which successes have been particularly notable are smart cities, smart buildings, education and entertainment.

On the economic and business front, CIRANO notes that companies were still struggling to assess the impacts on their revenue or productivity at the time of the interviews, but that they had improved their ability to innovate and had benefited from greater visibility with their customers.

The SME and organizations interviewed also praised the support received through the ENCQOR 5G program, particularly from ADRIQ. On the other hand, the SME pointed out that the links with the anchor partners of ENCQOR 5G, and with telecommunications companies, have been limited. This would be an area for improvement in a possible new phase of the ENCQOR program.
Project leaders also expressed confidence in the social and economic benefits of their innovations, although these benefits were still difficult to assess.

VALUABLE ACADEMIC SUPPORT FOR 5G DEVELOPMENT

Recommendations: Create a permanent organization for 5G promotion

Based on the analysis of the ENCQOR 5G experience, CIRANO makes eight recommendations in its report, including the creation of a permanent organization dedicated to driving and supporting the 5G and smart connectivity innovation ecosystem. Below is a summary of the various recommendations submitted by CIRANO:

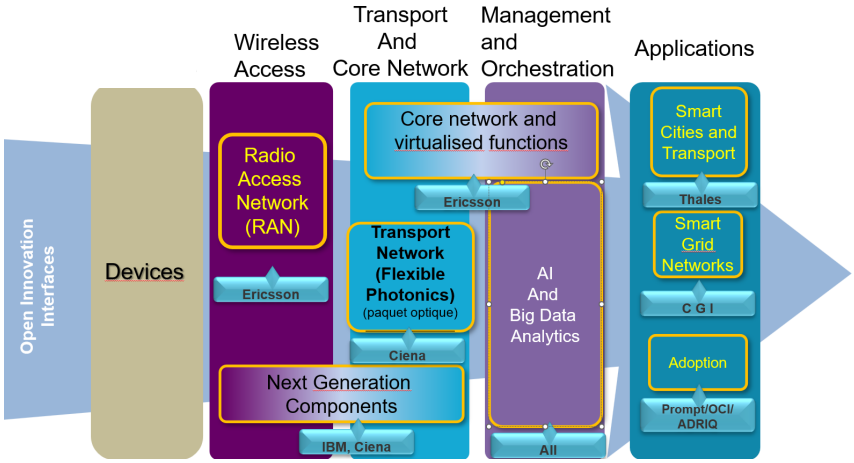
1) Enhance the use cases of the ENCQOR 5G program;
2) Encourage a strengthening of the support links of the initial ENCQOR 5G partners with the project participants;
3) Document end-user experience to identify and find solutions to potential issues;
4) Establish a concerted long-term talent strategy around scalable connection technologies;
5) Establish an awareness strategy for the responsible development and adoption of 5G technology and its applications;
6) Identify success criteria for selecting projects, companies, or pipelines to ensure the success and added value of funded projects;
7) Establish a permanent organization whose mission would be to animate the Quebec ecosystem around connectivity technology, by reuniting all the stakeholders involved;
8) Establish a pan-Canadian advisory committee or commission to address key issues in the development and adoption of 5G.

CIRANO concludes that «initiatives aimed at supporting adoption projects and strengthening the ecosystem for 5G and its technologies should be pursued; Quebec undoubtedly has the technical, economic and human assets to prosper and acquire a leading reputation in these areas."

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

ENCQOR's founding partners have carried out significant research and development activities (more than $275M) on 5G technologies, a significant part of which has been reflected in an open innovation platform available on demand IpaaS for users (*Innovation Platform as a service*).

ENCQOR Partners R&D : architecture



The R&D program of ENCQOR partners has been structured according to the architecture of 5G mobile networks, which includes:

The **device** (**"*Device*"** in the picture), such as a smartphone, tablet, router, etc., is also known as user equipment.

The **Radio Access Network (RAN)** which uses radio frequencies to provide wireless connectivity to devices.

The ***Central Network*** (CN) (**"*Cloud Computing and Virtualized Functions*"**), which ensures coordination between the different parts of the access network and also provides connectivity to the Internet.

The **Transport Network** (**"*Flexible Photonics*"**), which provides connectivity between the RAN and CN.

These different functions of the 5G network require a new generation of optoelectronic components (**"*Next Generation Components*"**) to support the new capabilities of 5G.

AI ("*Artificial Intelligence and Big Data Analytics*"**) is increasingly used throughout the network to ensure optimal performance.** AI and machine learning are used with core network management and orchestration as well as in individual base stations to **optimize traffic and load balancing.**

5G is designed to be highly **flexible** and deliver the **best performance** to a wide range of applications. To enable and support the wide range of use cases, such as **"*Smart Grids*"**, **"*Smart Cities*"** and other applications (**"*Ownership*"**), the 5G network architecture requires that the various functions described above be flexibly placed within the network.

This consequently creates scenarios in which parts of the RAN and CN functions are **geographically co-located**. In addition, **network intelligence is usually spread** across the entire network.

As a result, there **are many deployment possibilities**, making all RAN and CN components even more critical to network performance.

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

1. RADIO ACCESS NETWORK (RAN) - ERICSSON

Ericsson Canada has a strategic R&D center for the development of Radio Access technologies for the Ericsson portfolio of mobile solutions which were critical building blocks of the ENCQOR program.

5G is about connecting things through enabling new use cases. A 5G radio access network (RAN) relies on a fully coordinated multi-layer network with low-band, mid-band, and high-band spectrum to provide wireless connectivity to devices and deliver the best network performance.

This enables new 5G use cases such as: cloud gaming, augmented and virtual reality, autonomous vehicles, and very high-speed fixed wireless access.

In order to provide these use cases, the radio access network consists of antennas, radios, baseband units, and RAN software to enable connectivity and mobility. View https://www.ericsson.com/en/ran

Ericsson's R&D focused on the following aspects of the access network (RAN):

- 5G New Radio (NR): The R&D Ericsson Canada performed contributed to the implementation of the 5G New Radio standard on the Ericsson Radio Access portfolio to enable global 5G Ericsson Mobile Technology Solutions. This included system analysis, HW design, SW design, Integration, Test and Verification, Studies for next generation RAN technologies were also performed. An example of a study performed is RAN Resource Partitioning which is critical for enabling RAN. Slicing: see https://www.ericsson.com/en/network-slicing/ran-slicing

  Carrier Aggregation: This R&D contributed to the development of a solution that combines radio spectrum to give users access to more bandwidth, and successfully increases the user's peak throughput. It has been proven to significantly increase coverage and capacity.
  See: 5G carrier aggregation for better deployment - Ericsson

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

- Ericsson Spectrum Sharing,(ESS) This R&D has contributed to an innovation that enables the dynamic sharing of radio spectrum between technologies on the same band, enabling spectrum sharing between 4G and 5G. Operators can deploy 5G with minimal impact on existing user experiences, while increasing efficiency, enhancing service assurance, and dramatically improving performance and mobility. See 5G Spectrum Sharing - Increase your 5g Coverage - Ericsson
- Advanced Antenna Systems using massive multiple-input and multiple-output (MIMO) technologies to enable better access and coverage for 5G devices. This R&D contributed to a Massive MIMO radio solution that consists of an antenna array tightly integrated with the hardware and software required for transmitting and receiving radio signals, and signal processing algorithms to support the execution of Massive MIMO features. Compared to conventional systems, this solution offers much greater adaptability and steerability, in terms of adapting antenna radiation patterns to rapidly varying traffic conditions, and multi-path radio propagation. In addition, multiple signals can be simultaneously received or transmitted with different radiation patterns. See https://www.ericsson.com/en/reports-and-papers/white-papers/advanced-antenna-systems-for-5g-networks. A pre-commercial version of these MIMO radios has been installed in the ENCQOR sites and are part of iPaaS.
- 5G Small Cell systems for indoor use. This R&D contributed to the Radio Dot System solution, which redefines the concept of indoor small cells with the indoor radio system, addressing a wider range of indoor environments with a common solution. The system has a clear operational benefit for the operator, as well as for IT managers, CIOs, building owners and managers who may be responsible for multi-site and campus businesses where buildings can vary greatly in size and user traffic. See https://www.ericsson.com/en/small-cells and 5G Indoor coverage - Small Cell Solutions - Ericsson The Radio DOT Solution and indoorsmall cells has been implemented in ENCQOR sites and are part of iPaaS.

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

2. TRANSPORT NETWORK (FLEXIBLE PHOTONICS) - CIENA

Ciena has conducted more than $110M in R&D in the field of data transport networks as part of the ENCQOR program.

This investment is accompanied by another injection of $2M in funding to various educational institutions: the universities of Waterloo, Toronto, and Ottawa, Western, Carleton as well as ETS, École Polytechnique de Montréal, Concordia University, Université du Québec en Outaouais, McGill University, Université du Québec à Montréal, Dawson College, and CRIM. The work focused on the following themes:

- Software engineering applied to the development of flexible photonics systems.
- Project multi-institutions SOF (*Self-Optimizing Fabric*)
- Prediction of transmission resource usage
- Use of flexible network slicing
- Advanced optical and photonic transmission circuits
- Use of artificial intelligence for adaptive systems.

5G is not limited to wireless technologies, as most of the data that flows between the mobile device and the data centers, where the content is hosted, passes through wired fiber-optic data transport networks. Ciena's R&D for these transport networks relies on open, automated, and adaptive networks to meet current and future requirements of 5G networks.

R&D for transport networks was carried out along the following lines:

- R&D contribution for next-generation optical routers (the 6500 family and Wavelogic routers) to support, among other things, the OTN (*Optical Transport Network*) protocol at speeds of up to 800 Gigabit per second over Ethernet (protocol used for the Internet) (800GbE)
  See https://www.ciena.com/insights/what-is/What-is-Optical-Transport-Networking-OTN.html.
  For 6500 Family routers, see 6500 Family of Packet-Optical Platforms - Ciena.
  A pre-commercial version of these routers has been installed in ENCQOR's innovation sites.
  Wavelogic was announced in 2023 and can withstand flow rates of 1.6 Tb/sec.

- R&D contribution on adaptive IP, which combines segment routing with management, control, and planning (MCP) applications using artificial intelligence and *software-defined networks.*
  This R&D results in integration with Ciena's automation and network management platform, Blue Planet, see https://www.blueplanet.com/. This improves performance, facilitates deployments, and reduces power, space, and total cost of ownership.
  See https://www.ciena.com/products/manage-control-plan/adaptive-ip-apps and https://www.ciena.com/insights/adaptive-ip. A pre-release version of the MCP has been made available to iPaaS users through the *Ciena Emulation Cloud*. See https://developer.ciena.com/

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

- R&D contribution on the Edge Cloud, edge computing. Edge Cloud is a cloud ecosystem encompassing storage and compute assets located at the edge—close to applications and users—and interconnected by a scalable, application-aware network that can detect and adapt to changing needs securely and in real time. It focuses on providing fast and efficient IT response for latency-sensitive or data-intensive applications. It is based on a cloud-based, software-defined architecture with *open application programming interfaces* (APIs) and virtualized components, which can be located either on the corporate premises, at the remote end (cell sites, CO, local hubs) or at the near edge (regional data centers). See https://www.ciena.com/insights/articles/5g-and-edge-cloud-joining-forces-to-fuel-next-generation-applications.html. Advanced work has been done on the Edge Line System which is used for edge routers used in the Edge Cloud. A pre-release version of these routers (the 5170) as well as an Edge Compute platform have been made available to iPaaS users.

3. NEXT GENERATION COMPONENTS - IBM

IBM has invested more than $2.5 million in research and development of next-generation components through the ENCQOR program.

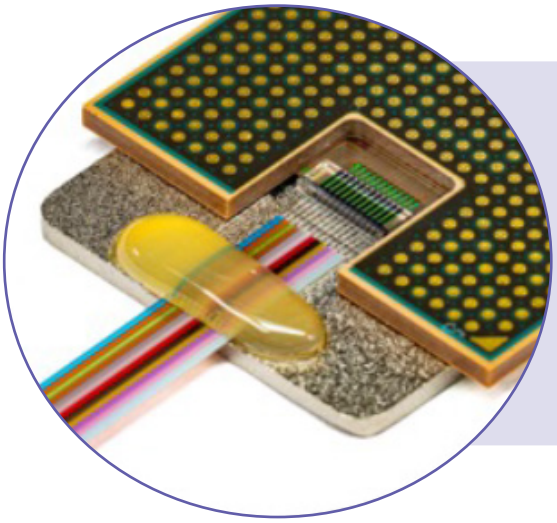
The emergence of 5G infrastructure is putting pressure on component providers to offer increased data bandwidth with aggressively efficient and cost-competitive solutions, while being scalable in performance. IBM's R&D efforts in Bromont as part of ENCQOR focused on microelectronic assembly, combined with innovative photonic packaging technologies (photonic devices make it possible to establish a fluid transmission gateway between optical and electrical signals).

In recent decades, the microelectronics industry has greatly automated assembly and used manufacturability-supporting design to minimize costs and offer high-volume products. It is on this know-how that IBM's R&D has been based to develop new photonic assembly technologies. Depending on the objective of high-bandwidth parameters, silicon photonics, in a single optical signal mode with the ability to multiplex signals (transmission of several signals at once) on the same device, is the perfect choice. Energy efficiency can be achieved by assembling the optics to electronic operation directly on the module. The name recognized in the industry is '*co-packaged optics*'. See https://www.youtube.com/watch?v=Um9oa6DPq1M (webcast on youtube on co-packaging given in 2020 with the participation of IBM Bromont).

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

Photonic assembly R&D was based on two innovative processes for directly connecting optical signals to the photonic-like semiconductor. These two joining processes are 1) edge coupling using fiber matrices in V-shaped grooves, and 2) adiabatic type coupling (method to avoid energy loss) using polymeric tape. These two assembly processes are options depending on the type of module and the source of manufacture of the photonic semiconductor. They are developed with a passive alignment method using high-volume automated assembly tools.

Part of the R&D has also aimed to increase the *manufacturability* of these processes and to demonstrate adequate reliability results. Particular attention has been paid to integrating these new processes with all microelectronic assembly processes allowing the manufacture of fully functional modules.
The synergy of integration of photonic and microelectronic assembly processes represents a significant challenge for the assembly of modules required by the 5G infrastructure.



The ENCQOR program has fostered collaboration between the various stakeholders.

An example of collaboration with Ciena;

Joint development of an Optical Sub Assembly module.

IBM has also developed certain fundamental aspects of optoelectronic packaging with the Université de Sherbrooke through a research chair.

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

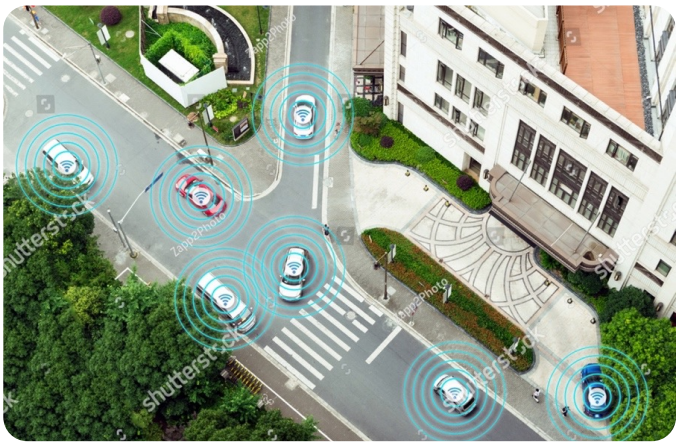
4. THALES: INNOVATIVE WORK IN THE FIELD OF SMART CITIES

Thales has invested more than $25M in R&D to “leverage” its cutting-edge R&D investments to support the development of 5G technology; Secure ultra-high-speed data movement to support the evolution of our world-class urban transportation solutions, connectivity capabilities and big data analytics.
See: https://www.thalesgroup.com/fr/canada/press-release-news/les-gouvernements-canadiens-

4.1 Autonomous vehicles

5G technology will enable secure, ultra-high-speed data transfer to support the evolution of world-class urban transportation solutions, connectivity capabilities and cloud big data analytics.

In this context, Thales has carried out R&D to test and demonstrate the analysis of real-time data in support of autonomous vehicles, in particular to reduce the response time of the autonomous vehicle to obstacles, even under the harsh conditions we know in Canada.



In an autonomous vehicle, each sensor collects data related to the various functions necessary for driving. Initially, Thales’ research project focused on *perception* functions such as: vehicle geolocation, recognition and positioning of objects, neighbouring vehicles, obstacles, road tracking, etc. Performing all these functions in real time requires too much computing power to be executed on the computer available in the vehicle, no matter how powerful. The team therefore iteratively tested the possibility of offloading certain computing functions to the edge computing and even to the cloud.

To do this, the first phase of the project was an evaluation of the functions that edge computing could support based on the data (volume, frequency) and computation time required, using theoretical information such as simulation.

The results of this work have shown great promise. Using data on transmission speed and latency, collected using a 5G phone, the research team was able to validate the real-world performance of the technology and train artificial intelligence models. As a result, the research team was able to exploit the data collected to generate new cases and expand the *test dataset* synthetically.

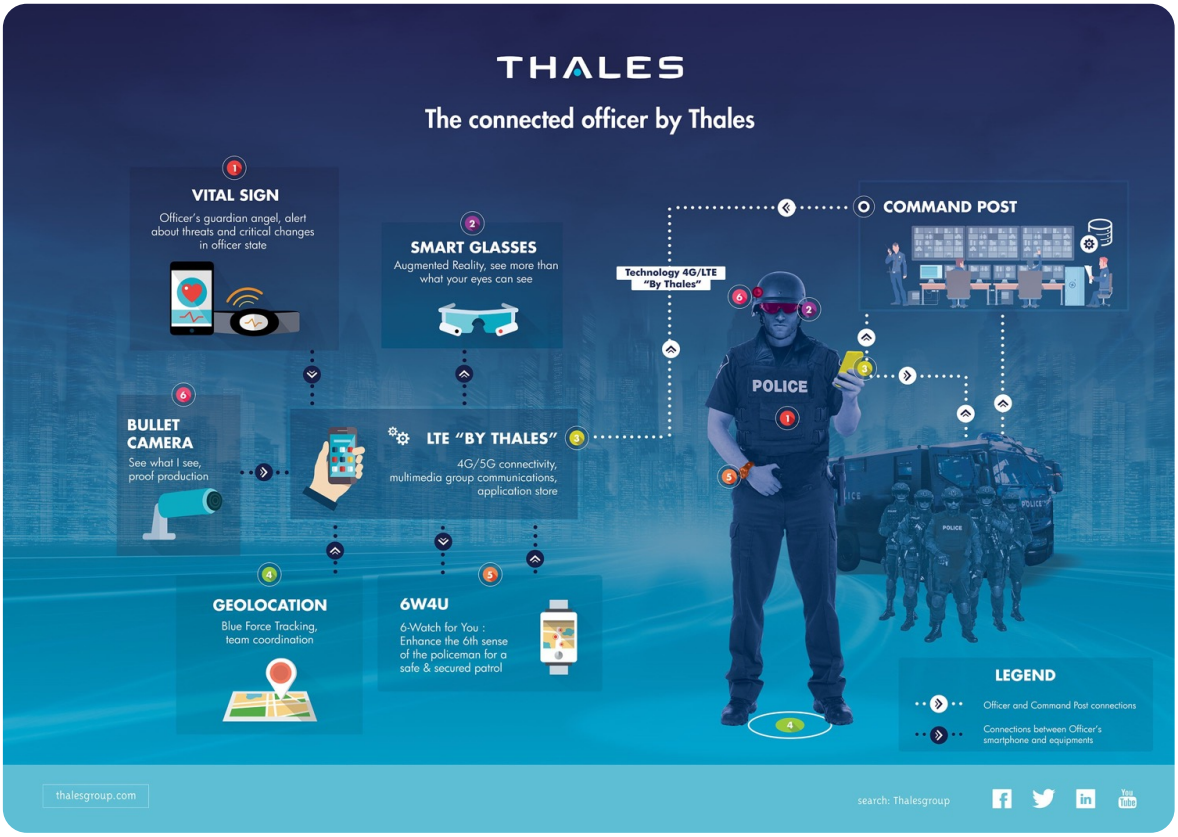
Thanks to this work of modeling fictitious environments and “*what-if*” prediction, the team was able to obtain predictions on the performance of the 5G connected vehicle in uncaptured contexts (weather, traffic, obstacles, breakdowns, etc.) in order to evaluate the performance and safety of the vehicle in such situations. These results will be validated across the 5G network by integrating sensors typically necessary to drive an autonomous vehicle (cameras, GPS, IMU, LIDAR, etc.) and by using location services based on an image to confirm the GPS position.

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

4.2 Connected police officer

The implementation of the platform made it possible to support the implementation of an operational case around the concept of the connected police officer in order to provide a police operations centre with an unprecedented capacity to monitor first responders in the context of crisis management in urban theatre. Deployed police officers carry sensors to have real-time tracking of their biometric data. This system allows, thanks to its low latency, to support the command center in decision-making.

The platform also makes it possible to view the video feed of cameras in the field and to collect information through the detection of key elements via artificial intelligence and the high bandwidth of the 5G network. Whether in an operational context when the critical situation is deployed in the field or in a training context, the platform makes it possible to exploit and highlight some of the operational possibilities now possible with a dedicated 5G band to support public safety activities.



ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

4.3 Automated signaling for urban rail transport

The Toronto-based Thales team has been doing R&D to integrate 5G into urban rail signaling systems. This technology is used in metro systems among others. By enabling higher peak data speeds in a massive network while reducing latency and increasing reliability, the team performed R&D to apply 5G in scenarios of driverless and more frequent, fast time response, fail-safe autonomous systems, and environmental benefits.

Thales also used ENCQOR's iPaaS testbed in Ottawa to gain real-world insights and improve its 5G solutions.

In addition, Thales, and One Silicon Chip Photonics (OSCP) have entered into an R&D partnership to develop sensing and navigation capabilities that can be deployed in semi-autonomous and autonomous vehicles in urban and mainline rail environments. As part of this partnership, the companies have developed a prototype inertial measurement unit (IMU) that will be tested on board the Thales train's autonomy platform. When combined with 5G capabilities, the integrated IMU will allow Thales to track the location of the autonomous train platform even when operating in complex areas where global navigation satellite systems cannot provide adequate performance for navigation.
See Autonomous rail technologies to be enhanced by optical inertial sensor (railwaypro.com)
Supported by the ENCQOR 5G program, the partnership between the two companies tested a high-performance optical inertial sensor system on an autonomous train platform. Thales has been one of ENCQOR's five global technology leaders, providing access for small and medium-sized enterprises to showcase their 5G innovations and technologies alongside industry leaders.

To see an example of the results of this R&D, see https://www.thalesgroup.com/en/worldwide-transport/urban-mobility/magazine/what-does-5g-mean-metros

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

5. SMART GRID NETWORKS – CGI

More than $10 million in R&D for the advanced dispatch system thanks to 5G

CGI's R&D has focused on developing 5G-enabled technologies that will improve the efficiency and safety of workers at major electricity providers. CGI-developed systems monitor the status of a power grid to the millisecond, and will notify network operators of any unusual event.

CGI's R&D also focused on the ability to track thousands of workers in an electrical grid as they move in real time, assign them tasks, and virtually assist them in their maintenance operations through augmented reality. However, these actions require the transfer and sharing of a phenomenal amount of data and very low latency times – which 5G allows.

6. CORE NETWORK AND VIRTUALIZED FUNCTIONS - ERICSSON

Ericsson, anchor partner of ENCQOR, performs research and development on standards, evolution, functions, and applications that make use of the core network for 5G.

In addition, engagement in research with École Polytechnique, McGill University, École des technologies supérieures, Concordia University and UQAM. In addition, a research chair with Concordia University has been established, in collaboration with Ericsson.

5G Core (5GC) is the heart of a 5G mobile network. It establishes reliable, secure connectivity to the network for end users and provides access to its services. The core domain handles a wide variety of essential functions in the mobile network, such as connectivity and mobility management, authentication and authorization, subscriber data management and policy management, among others. 5G Core network functions are completely software-based and designed as cloud-native, allowing higher deployment agility and flexibility on multiple cloud infrastructures.

The R&D of the 5G Core requires continuous evolution to track and follow the international standardization. Network architecture also evolves to allow for more flexible, elastic, and resilient networks to meet the requirements of very demanding use-cases. Constant demand for new services and functionality while striving to reduce the cost of ownership is the desired outcome of our R&D.
See: https://www.ericsson.com/en/press-releases/6/2021/4/encqor-5g-ericsson-deploy-standalone-5g-network-to-drive-innovation-edge-applications

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

7. BIG DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE

The advent of 5G introduces new challenges for the maintenance and use of the 5G network, due to its complexity and increased capabilities of innovative services for its users. Integrating big data and artificial intelligence (AI) techniques into 5G networks is one way to tackle these complexities.
To this end, ENCQOR 5G was able to support the R&I of partners according to the following axes:

- Strategic Partnerships
- A generic reasoning and data monitoring platform by Thales in Quebec City
- A self-optimized matrix for the 5G era by Ciena (SOF)
- Various AI Application Works on 5G Networks - Ericsson

Strategic Partnerships for Big Data and Artificial Intelligence
Partnership with the Institute of Intelligence and Data (IID)

Taking advantage of Thales Québec's relationship with IID (Université Laval), ENCQOR 5G, Prompt and IID announced in September 2020 the conclusion of a strategic partnership between IID and Prompt for the management of its innovation site in Québec City. This partnership has led to the development of various initiatives combining artificial intelligence, data science and 5G.

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

7.1 Thales - Generic platform for reasoning and data tracking

From: https://www.thalesgroup.com/fr/group/innovation/news/innovation-ouverte-lexemple-canadien and : https://www.thalesgroup.com/fr/monde/groupe/magazine/intelligence-augmentee-et-systemes-critiques

Thales' work has focused on different data fusion techniques, science and cognitive engineering applied to decision support systems, human-machine collaboration, collaborative autonomy, and modeling and simulation.

To this end, R&D efforts by the Thales Digital Solutions team in Quebec (https://www.thalesgroup.com/fr/amerique/etats-unis/solutions-numeriques-amerique-du-nord) have made it possible to develop a generic and flexible platform for monitoring in-theatre data and decision support. This work has led to the integration of different technological modules that can be used for data tracking and decision-making applications for first responders. These modules include:

- Storage infrastructure
- Generic sensors
- A generic reasoning engine
- A new ontology
- A treatment of digital vision
- Deep learning
- Machine learning

This work may be part of Thales' augmented intelligence program described in an interview given by Thales Québec:
Excerpts from Thales' augmented intelligence page https: //www.thalesgroup.com/fr/monde/groupe/magazine/intelligence-augmentee-et-systemes-critiques

BEGINNING EXCERPTS

The accelerated digital revolution has given us a glimpse of the potential and risks of artificial intelligence (AI). In regulated sectors such as aerospace, transport and defence, technologies must be certifiable, explainable, and trustworthy, without removing human responsibility for critical decisions. Hence the development of a new strategy – augmented intelligence – which consists of using AI to solve ever more complex problems, but giving a central role to the human being.

...

Augmented intelligence is a combination of technologies, such as data fusion, deep learning, and external cognitive sensors. It is not an autonomous technology, but rather an aid, a "humanized" AI that expands human potential, as many other forms of collective work already do.

...

END EXCERPTS

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

To support Thales' vision of augmented intelligence, the work supported by ENCQOR has made it possible to have:

- The establishment of a generic and flexible platform for monitoring data from the theatre of operation (editor's note: first responders) and decision support.
- The global integration of the various technological building blocks developed within the framework of the ENCQOR project.
- The integration of generic sensors requiring little energy and capturing massive data in the 5G storage infrastructure.
- The use of this storage infrastructure to enable potentially delayed high-speed processing.
- The authorization of treatments based on configurable pre-labeled data sampling techniques for quality of service, and the prioritization of complex tasks with high volume.
- The integration of the generic reasoning engine on the platform, accompanied by a newly created ontology, makes it possible to deliver machine learning, deep learning, and mass vision processing capabilities compatible with the capabilities of the 5G medium.

The global integration of the tools studied as part of the mobilizing project for the referral and management of outgoing 5G transmissions, as well as for the explainability and robustness of prediction models for perception tasks in critical systems with the ambition to deliver a mechanism for auditing transactions and explanations of conclusions drawn by reasoners in order to evaluate performance and demonstrate resolution results for situations never before previously observed.

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

7.2 A Self-optimizing fabric (SOF) for the 5G era by Ciena

As part of the ENCQOR program, Ciena has begun the early development phases of the major applied research project *Seft Optimizing Fabric* (SOF). This project consisted of different components and involved different partners.

These efforts have resulted in the establishment of an international research ecosystem in collaboration with Mitacs and École des technologies supérieures. This ecosystem includes:

- Stanford University (Platform Lab) and the University of Ottawa
- Humanitas, Menya Solutions et Tria Networks
- Equipment/servers installed in our 5G innovation lab in Montreal with implementation of the DevOps development environment.

As part of this initiative, Ciena provided universities and SME partners with direct access to a state-of-the-art technology laboratory. The company also hired several graduate students who had the opportunity to do hands-on learning in an industrial environment with experts from Ciena's R&D center in Montreal.

As part of Ciena's Adaptive Network™ vision, which combines programmable capability, intelligence and automation, the SOF research ecosystem explores how SOFs can respond to the complexity of distributed intelligence on separate systems collaborating on common tasks while maintaining mission separation.

An example of an application of this could be mobile eSports in which mixed reality applications, edge delivery platforms and network interconnectivity work in unison to provide optimal quality of the gaming experience with seamless continuity across multiple and varied media.

SOFs have enabled the evolution of the ENCQOR 5G corridor through self-optimized structures towards identifying and verifying the practical uses of 5G, artificial intelligence and cloud technologies, all supported by the principles of the Adaptive NetworkTM vision.

The SOF project continued with the development of information models and templates to enable the application of 'self-optimizing multi-agent intelligence'. This work is the result of combined efforts with Menya, Humanitas, Tria and several other university projects. Ciena's goal is to continue the development of SOF beyond ENCQOR. This investment will result in the development of a prototype with automated software that will be available for implementation within a few years.

To learn more about SOFs,
see https://www.ciena.com/insights/white-papers/a-self-optimizing-fabric-for-the-5g-era-wp.html

ENCQOR 5G ANCHOR PARTNERS R&D ACTIVITIES

7.3 Ericsson - Application of AI on 5G networks

AI is transforming industries across the globe, and telecom is no exception. AI is creating business value in terms of improved performance, higher efficiency, enhanced customer experience as well as creating new business models and use cases for 5G, IoT and enterprise. This is the context for our R&D efforts in AI and we use it to cut through the complexity, address requirements of new technologies and use cases, increase network performance, and enable network automation and enhance trust and security of these networks. See Ericsson unveils Global Artificial Intelligence Accelerator in Montréal

7.4 Other AI applications

5G application research using AI in areas such as:

- autonomous vehicles (Thales, Ericsson)
- urban traffic management (Thales)
- smart buildings (Ericsson)
- drones (Ericsson, Thales)
- Health (Ciena with Humanitas)

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