

NEXT
2015 **SNAPSHOT**



Our strategy is summarized by the 5 C's, which you will see highlighted in this book:

CONNECTIVITY
COMMUNITY
COMPUTING
CONTENT
CLOUD

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Thunder Bay

Timmins

Kirkland Lake

New Liskeard

Sudbury

North Bay

Ottawa

Sault Ste. Marie

Manitoulin Island

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Kingston

Belleville

Borough

Oshawa

Toronto

Oakville

St. Catharines

Welland

Waterloo

Hamilton

London

Sarnia

Chatham

Windsor

— ORION Network
● ORION Points-of-Presence

LETTER FROM THE CHAIR

What is your journey?

Whether you're connecting researchers with colleagues around the world, introducing students to the digital resources they need, uniting analysts with data to improve health care, or jointly modelling an idea for a new invention, ORION is there.

ORION's journey includes three major infrastructure opportunities that we've been working on:

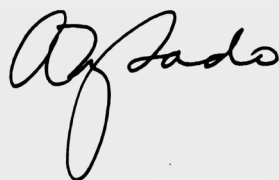
- **Connectivity:** Our socioeconomic impact study shows that ORION's connectivity is vital for Ontario. We are looking at ways to expand the network's reach and improve performance.
- **Computing:** ORION already connects all of the major academic high-performance computing facilities in Ontario, but we're working even more closely with Compute Ontario to coordinate advanced computing efforts.
- **Content:** Research data and online learning require more digital infrastructure. We're partnering with our community and industry to facilitate solutions for shared services of data-intensive initiatives that address data sovereignty and security.

I'm excited about opportunities that will dramatically improve our network footprint and capacity, build stronger intelligent communities, as well as increase our Nebula cloud offerings. As just a taste of what awaits in support of all our diverse communities, we've launched our shared Internet service: a simplified, affordable, full-suite connectivity solution.

The conversation and the journey continue in 2016. We look forward to hearing from you as we continue to think about what's **next**.

ANNE SADO

Chair, Board of Directors, ORION
President, George Brown College



LETTER FROM THE PRESIDENT

Why did we choose "Next" as the theme for our report to you? Because we're thinking about what's ahead for ORION and its community.

Over the past five years, ORION has been transforming itself in order to help our community transform themselves. This year, as part of ORION's Nexus strategy project, we consulted over 500 stakeholders across the province to better understand how ORION can ensure the sustainability of digital infrastructure for Ontario's research, education and innovation ecosystem.

The answers have laid a solid foundation for the future. Every day, our team of just over 20 men and women rise to the challenge of keeping ORION humming – to maintain the network, work toward the common needs of our community, and set new ambitious targets. I have the utmost confidence that this dedicated team will continue to achieve these goals to keep Ontario on the leading edge of innovation.

DARIN P.W. GRAHAM, PhD
President and CEO, ORION



BOARD OF DIRECTORS

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Alcatel-Lucent Canada



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President and CEO, ORION

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JEFF GRIEVE

Executive Director, Western
University; Executive Director,
LARG*net



KAREN GROSE, PhD

Vice President, Digital Education,
TVO



Algoma University *Sault Ste. Marie*
 Brock University *St. Catharines*
 Carleton University *Ottawa*
 Lakehead University *Thunder Bay*
 Laurentian University *Sudbury*
 McMaster University *Hamilton*
 Nipissing University *North Bay*
 OCAD University *Toronto*
 Queen's University *Kingston*
 Royal Military College of Canada *Kingston*
 Ryerson University *Toronto*
 Trent University *Peterborough*
 University of Guelph *Guelph*
 University of Ontario Institute of Technology *Oshawa*
 University of Ottawa *Ottawa*
 University of Toronto *Toronto*
 University of Waterloo *Waterloo*
 University of Windsor *Windsor*
 Western University *London*
 Wilfrid Laurier University *Waterloo*
 York University *Toronto*



Baycrest Centre for Geriatric Care *Toronto*
 Centre for Addiction and Mental Health *Toronto*
 Hospital for Sick Children *Toronto*
 Institute for Clinical Evaluative Sciences *Toronto*
 London Health Sciences Centre *London*
 Michener Institute for Applied Health Sciences *Toronto*
 Mount Sinai Hospital *Toronto*
 Northern Ontario School of Medicine *Sudbury-Thunder Bay*
 Ontario Institute for Cancer Research *Toronto*
 Ontario Telemedicine Network *Toronto*
 Public Health Ontario *Toronto*
 Southlake Regional Health Centre *Newmarket*
 St. Joseph's Health Care *London*
 Sunnybrook Health Sciences Centre *Toronto*
 University Health Network *Toronto*



Algonquin College *Ottawa*
 Cambrian College *Sudbury*
 Centennial College *Toronto*
 Collège Boréal *Sudbury*
 Conestoga College *Kitchener-Waterloo*
 Confederation College *Thunder Bay*
 Durham College *Oshawa*
 Fanshawe College *London*
 Fleming College *Peterborough*
 George Brown College *Toronto*
 Georgian College *Barrie*
 Humber College *Toronto*
 Lambton College *Sarnia*
 Loyalist College *Belleville*
 Mohawk College *Hamilton*
 Niagara College *Welland*
 Northern College *Timmins*
 Sault College *Sault Ste. Marie*
 Seneca College *Toronto*
 Sheridan College *Oakville*
 St. Clair College *Windsor*
 St. Lawrence College *Kingston*



Algoma District School Board *Sault Ste. Marie*
 Algonquin and Lakeshore Catholic District School Board *Napanee*
 Brant Haldimand Norfolk Catholic District School Board *Brantford*
 Conseil Scolaire Catholique Providence *Windsor*
 Conseil Scolaire Public du Grand Nord de l'Ontario (CSPGNO) *Sudbury*
 District School Board of Niagara *St. Catharines*
 Greater Essex County District School Board *Windsor*
 Hastings and Prince Edward District School Board *Belleville*
 Kawartha Pine Ridge District School Board *Peterborough*
 Keewatin-Patricia District School Board *Dryden*
 Lakefield College School *Lakefield*
 Lakehead District School Board *Thunder Bay*
 Lambton Kent District School Board *Chatham*
 Limestone District School Board *Kingston*
 London District Catholic School Board *London*
 Near North District School Board *North Bay*
 Niagara Catholic District School Board *Welland*
 Northwest Catholic District School Board *Fort Frances*
 Peterborough, Victoria, Northumberland and Clarington Catholic District School Board *Peterborough*
 Provincial Schools Branch *Ministry of Education*
 Rainbow District School Board *Sudbury*
 Rainy River District School Board *Fort Frances*
 Simcoe County District School Board *Midhurst*
 Simcoe Muskoka Catholic District School Board *Barrie*
 St. Clair Catholic District School Board *Wallaceburg*
 Superior North Catholic District School Board *Terrace Bay*
 Thames Valley District School Board *London*
 Thunder Bay Catholic District School Board *Thunder Bay*
 Toronto District School Board *Toronto*
 Waterloo Region District School Board *Waterloo*
 Windsor-Essex Catholic District School Board *Windsor*
 York Region District School Board *Aurora*



Centre for Biologics Research (Health Canada) *Ottawa*
 Compass for Success *York Region*
 Contact North | Contact Nord *Sudbury-Thunder Bay*
 Hamilton Public Library *Hamilton*
 Innovation Park at Queen's University *Kingston*
 Laboratory for Foodborne Zoonoses (Public Health Agency of Canada) *Guelph*
 MaRS Discovery District *Toronto*
 National Research Council *London*
 Natural Resources Canada *Ottawa*
 Perimeter Institute for Theoretical Physics *Waterloo*
 Research Data Centres Program *Statistics Canada*
 Robarts Research Institute *London*
 Royal Ontario Museum *Toronto*
 SNOLAB *Sudbury*
 TFO (Groupe Média TFO) *Toronto*
 TVO *Toronto*
 Waterloo Summit Centre for the Environment *Huntsville*



HPCVL (High Performance Computing Virtual Laboratory) *at 4 member institutions*
 SciNet *at the University of Toronto and 5 affiliated research hospitals and institutions*
 SHARCNET (Shared Hierarchical Academic Research Computing Network) *at 18 participating institutions*

A robust digital infrastructure is the foundation for effective collaboration. It drives innovation, accelerates science and helps speed up the delivery of scientific discoveries and products to the marketplace. ORION is helping to ensure that Ontario's digital infrastructure meets the needs of our innovators and researchers, so they can improve quality of life and make important contributions to the prosperity of our province.

— Reza Mordji, Minister of Research and Innovation

“Connecting communities to one another — and across Ontario's research, education and innovation sector — is essential to advancing prosperity. ORION's digital infrastructure is helping our homegrown talent soar to new heights.”

— Kathleen Wynne, Premier of Ontario

WHAT WE STAND FOR

ORION is dedicated to **CONNECTING** and supporting every research, education and innovation organization in Ontario.

We are recognized for providing the **LEADERSHIP** and critical infrastructure that allows our users to collaboratively engage in making Ontario a global leader in innovation.

With one of the world's **FASTEST** research and education networks, we enable our users to be connected to a world of possibilities.

By **LINKING** users through our network to the outside world, we deliver value-added capabilities that enhance and support the pursuit of knowledge, social impact and economic outcomes every day.

CONNECTIVITY

CREATING TOMORROW'S INTELLIGENT COMMUNITIES

In the Internet of Things (IoT), devices need connectivity to send data they collect to repositories for analysis and then to institutions where people can make data-powered decisions. With connectivity like ORION, the gateway to discovery is opened, enabling data to be transformed into meaningful innovations to improve our quality of life.

It's another day in an intelligent community: your family is planning to visit Grandma at the hospital. You drop into the local library and use the 3D printer to make her a personalized gift. Connectivity enables you to find, customize and send the 3D schematic to the library printer. Then, as you're driving to the hospital, your connected car finds, books and pays for a parking spot. Connectivity enables the hospital's parking system to communicate with the city's parking database and feed this information to the city's

app, but it also allows them to charge it to your next utility bill, as your account preferences indicate. Next, as you embrace Grandma, you notice a device on her shirt, which monitors her movements and other vitals. Through connectivity, this device sends relevant data to an advanced computing research facility for analysis, then back to her caregivers – who are prompted to early interventions before Grandma even needs help, improving her health while reducing the associated costs.

This is the Internet of Things (IoT), where connectivity enables millions of sensors and devices to produce technological advances for society. And this future is not so far away. In fact, in York Region it arrived in October 2015, when an ORION Point-of-Presence (PoP) was installed at Southlake Regional Health Centre, connecting the centre to a 10-gigabit-per-second (Gbps) optical fibre network.

The PoP will act as a gateway for York Region, supporting intelligent community growth, using IoT to transform life and work. "The ORION PoP is a key component of the broadband strategy outlined in our Economic Development Action Plan," York Region chairman and CEO Wayne Emmerson said. "It will significantly enhance research and collaboration capabilities, which in turn will foster innovation and economic development across York Region."

In addition, the Southlake PoP will enable collaboration between the centre's researchers and their colleagues – whether they are in another part of the community or around the world – allowing them to exchange vast amounts of data in real time. For instance, Southlake's health care business incubator, CreateIT Now, partners with Seneca College, York University, Venture Lab and the Town of Newmarket. The incubator supports new ventures by providing them with access to resources like connectivity so that ventures, researchers and users can all collaborate on health care solutions via a powerful network.

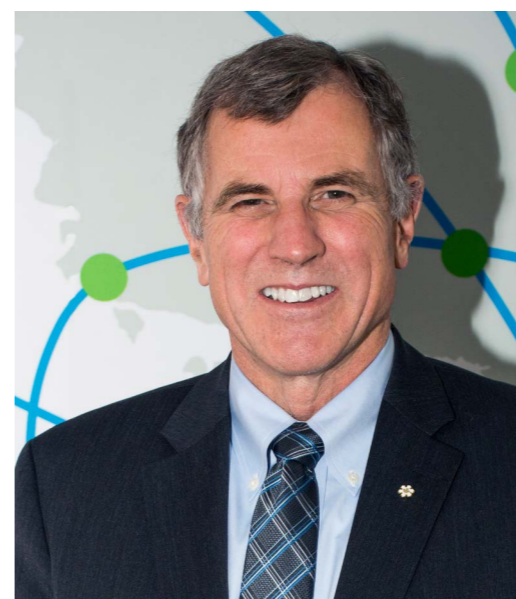
In fact, it was out of CreateIT Now that the medical device worn by Grandma was invented – it's designed to track movement to prevent bedsores, and soon to be introduced at Southlake (and marketed to the wider medical community). For now, data collected from the device will be shared within Southlake, but, through ORION, it can also be made available to researchers anywhere medical innovation requires it. "Our clinical team gave the developers a lot of feedback on the device," said Gary Ryan, Southlake's chief innovation officer. "And they were able to re-engineer the product and come back with something that is ready for a real-world trial."

While York Region and Southlake have kick-started their journey, other communities are planning to follow suit. York Region hopes to inspire leaders across the province – including other community hospitals – to introduce similar networks and help advance the boundaries of medical and health sciences.

When it comes to describing the potential of the 21st century, Southlake's CEO Dave Williams put it best: "With this speed and bandwidth at our fingertips, our imagination is no longer limited by our connectivity."



Gary Ryan, chief innovation officer at Southlake Regional Health Centre, shows parts of ORION's new fibre optic connection installed at Southlake.



Dave Williams, president and CEO of Southlake Regional Health Centre: The PoP has the potential to enhance regional economic development, supporting an intelligent community.

Southlake

EXPANDED CONNECTIVITY FOR YORK REGION

ORION has expanded its reach in York Region with the installation of a new Point-of-Presence (PoP) at Southlake Regional Health Centre, ORION's first such PoP installation in a medical facility.



ORION's connectivity expands the potential impact of health research, such as the Artemis Project, a neonatal research project harnessing advanced computing, led by Dr. Carolyn McGregor.



Dignitaries present at the PoP launch include (L-R): Gary Ryan of CreateIT Now; ORION President and CEO Darin Graham; the Honourable Minister of Research and Innovation Reza Mordji; Southlake Regional Health Centre President and CEO Dr. Dave Williams; Mayor of Newmarket Tony Van Bynen; and York Region Chairman and CEO Wayne Emmerson.

CONNECTIVITY

CLOUD PRESERVING HISTORY WITH SCHOLARS PORTAL

Ontario's university students, faculty and researchers have access to hundreds of terabytes of research data, e-journals, e-books, statistics and geospatial data through the online Scholars Portal service, which ensures that these rich resources will be preserved and accessible – and the cloud makes it all possible.

In the First World War pilots flew dangerous missions over European battlefields with a singular goal: to photograph the trenches. These images were then turned into hand-drawn maps for use as military intelligence. McMaster University has assembled a collection of more than 1,350 trench maps and 580 photos and – in commemoration of the 100th anniversary of the start of the Great War – digitized these artifacts and made them available online for geographers and researchers to accurately study our history.

McMaster has had an impressive collection of First World War maps for decades, but its holdings became internationally renowned when the university purchased the Western Front collection of English historian Peter Chasseaud. Students, faculty and researchers across Ontario can access these maps from McMaster University Library's digital archives. The collaboration between McMaster and Scholars Portal ensures this rare and historically important resource is preserved and available in the future.

As a service of the Ontario Council of University Libraries, which serves 21 university libraries, Scholars Portal allows universities to do much more than share information: it is also a digital preservation network which ensures that material uploaded in 2015 will be just as available in 2085 and beyond. "Scholars Portal is certified as a trusted digital repository under ISO 16363," said Amaz Taufique, assistant director, systems and technical operations, Scholars Portal. "This designation means we are dedicated to preserving material we hold in perpetuity."

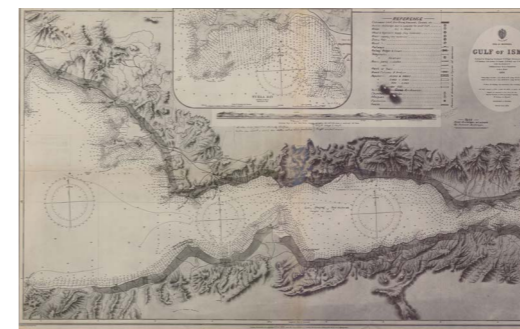
All of this work – digital access and preservation – is linked via the Ontario Library Research Cloud (OLRC). This cloud service network connects five nodes located at the University of Guelph, University of Ottawa, Queens University, University of Toronto and York University. When data is uploaded by someone at one university, it gets replicated three times across the nodes in the network. A distributed storage network is an essential part of any digital preservation system: if one node in the network is compromised, one of the other nodes immediately begins to replicate the data. "The OLRC allows us to put those files out onto a closed, shared network where they are safe from man-made or natural disasters," said Dale Askey, associate university librarian, library and learning technologies, McMaster University. "OLRC creates possibilities with regard to preservation, which McMaster will be exploring for valuable resources like the trench map collection."

Underneath the OLRC lies the reliable connectivity provided by ORION and the bandwidth that is essential to successful uploading of large format, high-resolution files. Each node in the Scholars Portal OLRC network has 10Gbps of connectivity through ORION, and other universities across the province are moving in the same direction. McMaster, for instance, recently upgraded to 10Gbps because moving multiple gigabyte files through a small channel can take a very long time. "Before ORION, it would take us weeks to upload files and the longer it takes to do a transfer, the more opportunity there is for damaged files," Askey said. "Sometimes it was simply faster and safer to dump data on a hard drive and get on the GO Train ourselves. Now, we can do it within days from our offices."

University libraries are a rich source of material that can't be found anywhere else, including McMaster University's collection of World War I trench maps. By tapping into ORION's powerful connectivity, researchers are now able to access crucial information from our past to create a more enlightened future. "Digital preservation is about replicating true and unaltered assets," Askey said. "It's not just copying data but protecting artifacts that are integral to our history."



Dale Askey, associate university librarian at McMaster University



World War I trench map, courtesy of McMaster University Library digital archives

Leadership AWARDS

Scholars Portal is one of three outstanding innovation initiatives that won an ORION Leadership Award in 2015. Every year at the THINK Conference, ORION spotlights three brilliant individuals across the research, education and innovation sector for their excellent contributions to Ontario's knowledge economy.



INNOVATION AWARD

Allison Crawford
Centre for Addiction and Mental Health

Kathryn Anthonisen of CANARIE presents Allison Crawford with the Innovation award.



K-12 AWARD

Dino Miele
District School Board of Niagara

Bill Mantel of the Ontario Ministry of Research and Innovation; and Economic Development, Trade and Employment presents Dino Miele with the K-12 award.



HIGHER EDUCATION AWARD

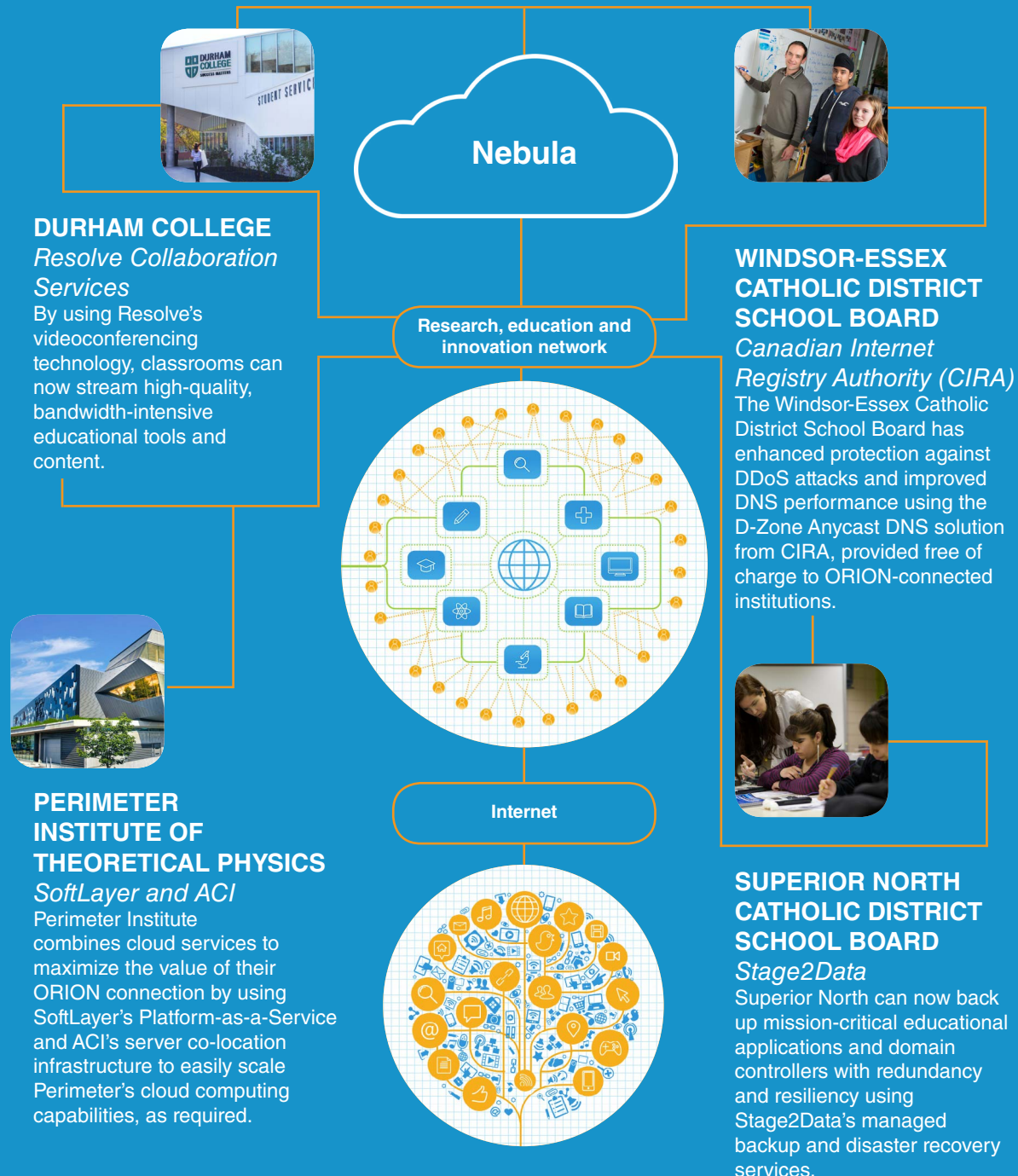
Alan Darnell
Scholars Portal

Bill Summers of Colleges Ontario presents Alan Darnell with the Higher Education award, accepted by Amaz Taufique.

CLOUD SOLUTIONS:

NEBULA

ORION's Nebula of cloud services offers our community a complete suite of valuable tools. Delivered over the ORION pipe, connected users can access a variety of best-of-breed, scalable and cost-effective Nebula services, enabling greater capacity and performance.



2015 EVENTS

ORION's events are carefully curated to offer the latest developments among the research, education and innovation community in Ontario. Why? Because ORION takes care of its community, and continues to create meaningful events that offer thought leadership and fruitful networking – simply put, it's a meeting of the minds.

ADVANCED COMPUTING WORKSHOP MARCH 5

Ontario's advanced computing experts and researchers gathered for a day to explore research computing in the cloud. With keynote speakers from Compute Ontario, RackForce, Cybera, IBM/SoftLayer, Ontario Centres of Excellence, and more, the public and private sector community shared insight and lessons learned about accelerated uptake of cloud computing in research.

THINK CONFERENCE: CREATE POSSIBILITIES APRIL 21

THINK is our annual event for the province's research, education and innovation community. This year brought together the biggest crowd yet. Attendees discussed hot topics in disruptive education, cloud-based research and collaboration, as well as how municipalities, universities, school boards and hospitals can work together to create intelligent communities. Facebook's Alfredo Tan and Dr. Dave Williams of Southlake Regional Health Centre inspired the audience, who were also the first to meet the winners of the 2015 ORION Leadership Awards.

REGIONAL ROADSHOWS

ORION has hit the road! Our team is visiting regions across Ontario to bring together community players, such as municipalities, universities, school boards and hospitals, to help intelligent communities leverage ORION to create even more possibilities. To request a roadshow in your area, contact Brad Gray (brad.gray@orion.on.ca).

SPONSORED EVENTS

As a committed community partner, ORION is proud to support the following events – because only together can a community transform challenges into solutions.

Higher Education

- Advancing Learning Conference
- CANHEIT Conference
- Colleges Ontario Higher Education Summit
- Lambton Mobile Summit
- OCCCIO Conference
- OUCC 2015

K to 12

- CONNECT 2015
- ECNO Conference 2015
- Minecraft Niagara Hackathon
- OASBO Conference
- OASBO-ICT: Bring IT Together
- OCSOA AGM
- Les Tablettistes

Research and Innovation

- 2015 AMCTO Conference
- 2015 MISA Ontario Conference
- CANARIE National Summit 2015
- Compute Ontario Research Day
- Hacking Health
- HPCS 2015
- Intelligent Community Forum
- Waterloo Innovation Summit
- Café Mathématique



Nebula Webinars: Watch for ORION monthly webinars to learn more about our Nebula partners' software/solutions.

COMMUNITY

BRIDGING THE DIGITAL DIVIDE FOR SCHOOLS

How do we support the education of the next generation and help shape the innovators of tomorrow? By making sure that every student in Ontario has equal access to technology and connectivity. ORION's Nexus K-12 Teacher Survey, part of our ongoing community consultations (see sidebar for more about Nexus), is helping us discover how to support teachers with e-learning and technology.

Manitoulin Secondary School (MSS) sits on the picturesque shores of Manitoulin Island, nestled in the curve of Lake Huron's northern channel. The location is beautiful and serene, but paradise comes with some very real challenges, including access to digital resources. MSS mathematics and science teacher Heather Theijsmeijer, frustrated that the digital divide was adversely affecting her students, decided to do something about it.

Heather Theijsmeijer responded to ORION's Nexus K-12 Teacher Survey, which was designed to discover how to support educators across the province with technology. "I saw a survey on Twitter wanting to know more about how teachers in Ontario were looking to use technology in their classrooms," Theijsmeijer explained. "I thought, 'What the heck, this is something I'm passionate about.'"

Theijsmeijer, like many Ontario teachers, knows that educational technology is a powerful student motivator. In fact, according to the Ontario Ministry of Education, the use of tablets as a learning resource in schools increased in this province by 20% in 2014. Why? Teachers point to two key benefits that come with being part of a connected school community: expanded content and the ability to respond to a range of learning abilities.

Hundreds of teachers across the province responded to ORION's Nexus K-12 Teacher Survey, detailing just how crucial connectivity and reliable digital infrastructures are to the classroom. Theijsmeijer's entry won the day and she was awarded enough UbiSlate tablets for her entire class. "Before ORION got involved the only computers available to our students were old desktops," Theijsmeijer said. "I was honest about our situation, writing that we don't need big things, we just want to get our kids online." Theijsmeijer reports that the tablets were a huge and welcome surprise: "They put us on the pathway to connectivity."

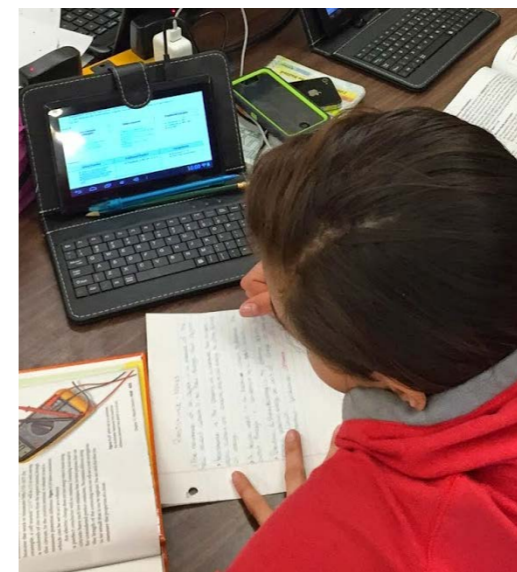
How did Theijsmeijer's grade nine science class put these new tablets to use? Together, they came up with a special project: finding comparisons between electricity usage in Canada and other countries. The students created a survey, shared it via social media, and were astonished to receive more than 600 responses from 40 countries.

Their teacher says that becoming a connected classroom was helpful in ways she hadn't anticipated. "We used the devices to track the data as it was coming in, but also to do research," Theijsmeijer said. "The students would choose a country, gather the data on a Google Sheet and compare their findings. And then if they didn't know much about a country from which we got responses – Romania, for instance – they'd look it up and learn even more."

With access to knowledge and digital literacy now only a click away, students like these – located in rural and non-centralized schools – are as empowered as their urban counterparts when it comes to creating, sharing and consuming meaningful content. "We're grateful for this opportunity, as it definitely changed the class and my students' attitude toward learning," said Theijsmeijer. "Thanks to these devices, they discovered there's a whole world out there looking to engage with them."



Heather Theijsmeijer: Manitoulin Secondary School mathematics and science teacher



Students take learning into their own hands with the new UbiSlate tablets, provided by ORION.

ORION Nexus K-12 Report: What We Learned

Heather Theijsmeijer is one of hundreds of K-12 teachers in Ontario who responded to ORION's Nexus K-12 Survey, which invited them to tell us how connectivity impacts blended learning in their classrooms. The outcomes of this report informed ORION's overall strategy initiative, the Nexus Project. Harnessing this insight, ORION is committed to better support the work of teachers.

TEACHERS WANT:

- 1 Efficient, reliable access to learning resources, including more and upgraded devices.
- 2 Simplified implementations of blended learning.
- 3 Accessible tech support to ensure classroom tech is fully operational and used to full capabilities.
- 4 Partnerships with edtech providers to provide more blended learning options.

COMPUTING

MAPPING THE UNIVERSE IN 3D

Research and education institutions in Ontario need networks that can keep pace with their vision of the future. ORION connects these researchers to the advanced computing resources that are essential to their work.

At first glance, the picture looks like no more than a swirling mass of colours dancing across a computer monitor, and could easily be mistaken for a work of contemporary art.

In fact, it's a 3D map of the cosmos that spans nearly two billion light years and is the most complete picture of our cosmic neighbourhood to date. The detailed spherical map charts the approximate direction, speed and distance of galaxy clusters based on decades of data gathered from telescopes sitting right here on earth.

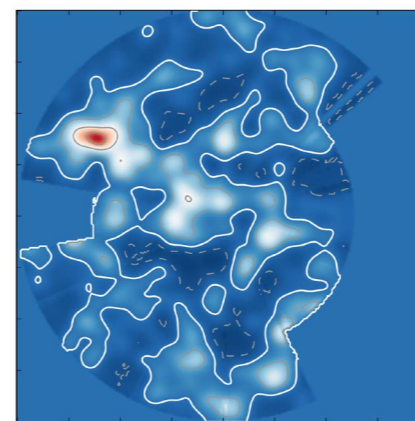
"The galaxy distribution isn't uniform and has no pattern," said map co-creator Mike Hudson, a professor in the department of physics and astronomy at the University of Waterloo and an affiliate member of the Perimeter Institute for Theoretical Physics. "It has peaks and valleys much like a mountain range." And the colourful display? Light blue and white regions represent large concentrations of galaxies and superclusters appear as red. The 3D map also documents unexplored areas, allowing astrophysicists to more easily predict the universe's expansion.

With billions of galaxies all expanding at different speeds, the challenge of tracking them is hard to fathom. Hudson likened the mapping project to measuring an extremely large loaf of raisin bread baking in the oven, with the raisins spreading ever farther apart as they're baked. "It's not quite perfectly uniform, and it's that imperfect uniformity that we're studying by making these maps," Hudson said. "Our goal was to understand how lumpy the universe is, and how that affects the overall expansion of the universe."

First published online in the esteemed *Monthly Notices of the Royal Astronomical Society* research journal, this groundbreaking map was the result of a collaboration between the University of Waterloo and the *Institut d'Astrophysique de Paris* of the National Centre for Scientific Research of France. This global research collaboration was facilitated by CANARIE, Canada's National Research and Education Network (NREN), which connects Canada to international R&E networks. "It's been a huge effort," said Hudson. "Different groups have spent years looking at different parts of the sky, and we collected all of that data."

The success of the project also hinged on the team's access to a network of high-performance computers made available by SHARCNET via the ORION network. "The 3D map took over 48 CPU years of computing time, and since each CPU year is 8,760 hours, the map took over 420,000 CPU hours to complete," SHARCNET's technical manager John Morton explained. SHARCNET's four data centres made it possible to shave years off of the task of collecting, sharing and storing data – if the team had done the same work on desktop computers, it would have taken approximately 10 times as long to complete.

What does the 3D map mean to science and to the rest of us? "We're closing in on the mystery of the peculiar motions of the universe, dark matter, and the link between the two," Hudson concludes. "We hope that the map will lead to a greater understanding of how matter is distributed in the universe and provide key insights into how the universe is formed."



A cross-section of the 3D map of the nearby universe with the Milky Way galaxy in the centre. From side to side, the map spans nearly two billion light years. White or red sections identify regions with many galaxies.
Credit: Mike Hudson/University of Waterloo.



Mike Hudson: map co-creator, physics and astronomy professor at the University of Waterloo

Power UP

SHARCNET,
SciNet
and HPCVL

are high-performance computing projects and facilities that are connected by the **ORION** network and support

\$2.45 billion

in research annually in Ontario.

COMPUTING

CONTENT

COLLEGE GOES THE DISTANCE

Ontario's digital frontier includes distance learning, which provides greater opportunities to remote communities across the province. Thanks to a partnership between Contact North | Contact Nord and ORION, students can access rich content from Ontario's best universities and colleges.

In June 2015, Jessica Taylor celebrated her graduation from Confederation College's Early Childhood Education Diploma program... right in her hometown of Ginoogaming First Nation, a small community in northwestern Ontario.

Taylor is one of a growing number of people earning degrees and diplomas online. She tried out university in Thunder Bay, a four-hour drive away. Although she got good grades, she missed her family and community too much. So, she decided to stay home and enrol in an online program to further her career opportunities.

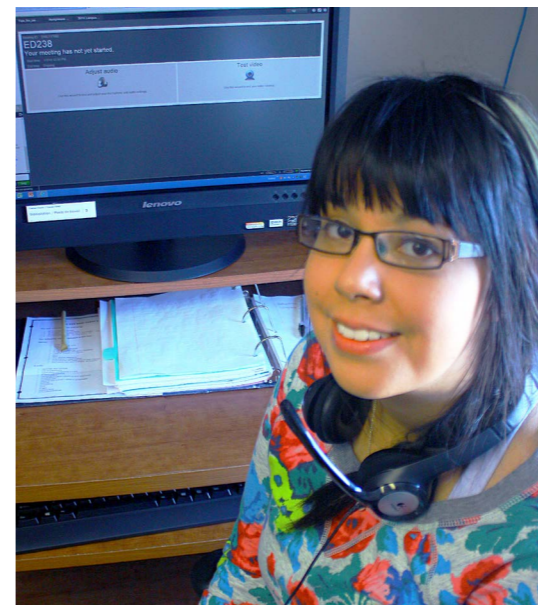
For students like Taylor, "going to school" no longer means leaving the community. Contact North | Contact Nord is Ontario's distance education and training network, providing 112 online learning centres where Ontario residents can access courses to get a degree, diploma or certificate or upgrade their skills through online learning with personalized support in their community. Through partnerships with Ontario's 24 public colleges, 22 public universities and 250 literacy and basic skills and training providers, students can choose between 1,000 online programs and 18,000 online courses they can complete at a distance. Each centre provides quiet spaces for working, connecting with other students, and taking supervised exams. "I liked online learning. I can work at my own pace, not in a huge classroom with hundreds of people," Taylor said.

Online learning is not just convenient for people like Taylor living in the North. It's a critically important tool to enhance economic development and preserve communities. Helping young people learn 21st-century skills will mean that they can stay and be employed in their communities, rather than moving away to other parts of Canada.

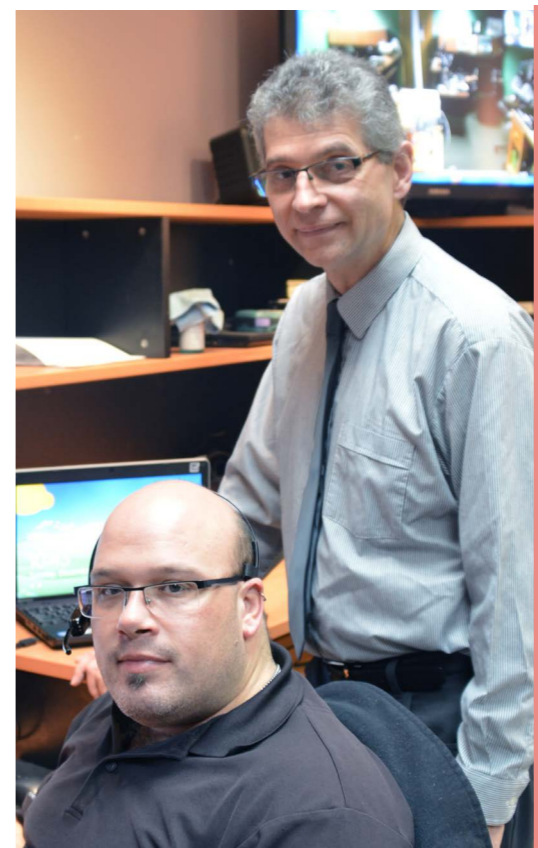
Contact North | Contact Nord delivers connectivity to the communities it serves, including Ginoogaming First Nation, while ORION connects Ontario's post-secondary institutions to Contact North | Contact Nord's hubs in Thunder Bay and Sudbury.

"ORION's 1 Gbps connection to Contact North gives us the capacity to host our audio, video and web conferencing distance delivery platforms for students to connect to their programs and courses," said Paul Porlier, director of information technology and web services at the Contact North | Contact Nord Sudbury Operations Centre. In addition to ensuring ultra-fast access to educational content, Porlier emphasizes ORION's reliability. "ORION provides everything we need, including resiliency. If their backbone connection goes down, they have a backup for that."

Ensuring that each and every community in Ontario has reliable access to rich educational content is a big task. ORION will continue to work with partners like Contact North | Contact Nord to bring greater opportunity to these diverse learners, enabling students to learn any time, anywhere.



Jessica Taylor, who completed her Early Childhood Education diploma remotely at Confederation College, thanks to Contact North.

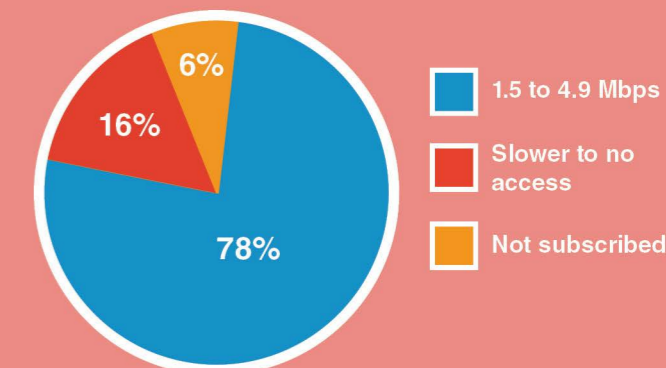


Paul Porlier, director of information technology and web services at Contact North with Daniel Séguin, information technology specialist

Crossing the DIGITAL DIVIDE

Compared to 99% of large population centres in Ontario that experience 16 to 50 Mbps of broadband, there is still significant room for improvement in remote and rural areas. ORION strives to continually support greater access to and quality of connectivity throughout Ontario, including the North.

THE NEED FOR SPEED IN RURAL ONTARIO*



* According to the Canadian Radio-television and Telecommunications Commission (CRTC).

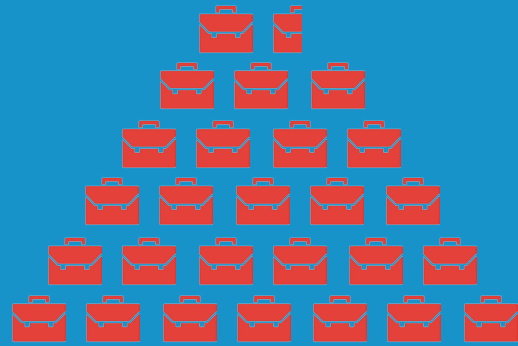
CONNECTED

ECONOMY

 = 4,000 JOBS

106,000 JOBS

DIRECTLY DEPEND ON ORION FOR THEIR RESEARCH-RELATED ACTIVITY



MORE THAN **1 IN 10** PEOPLE IN ONTARIO RELY ON ORION

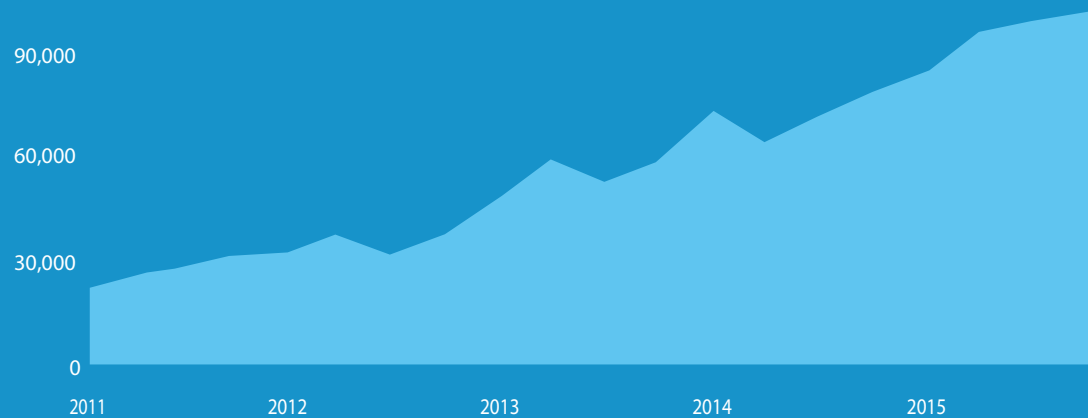
IMPACT ON GDP

Research-related activities on the ORION network directly contribute to Ontario's GDP

\$4.4 BILLION, which is part of the total **\$8.7 BILLION** contribution to the Canadian economy.



38% AVERAGE INCREASE IN TOTAL BACKBONE UTILIZATION ANNUALLY



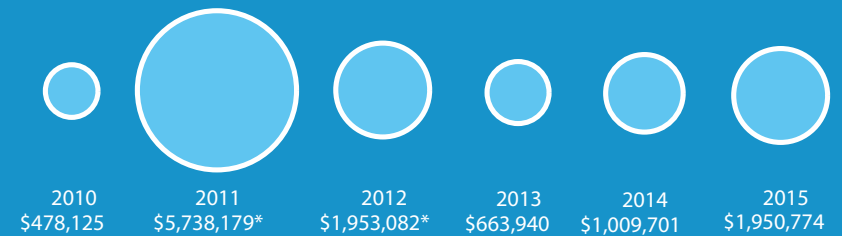
ORION Network Backbone Utilization in Mbps

NETWORK

INVESTMENTS

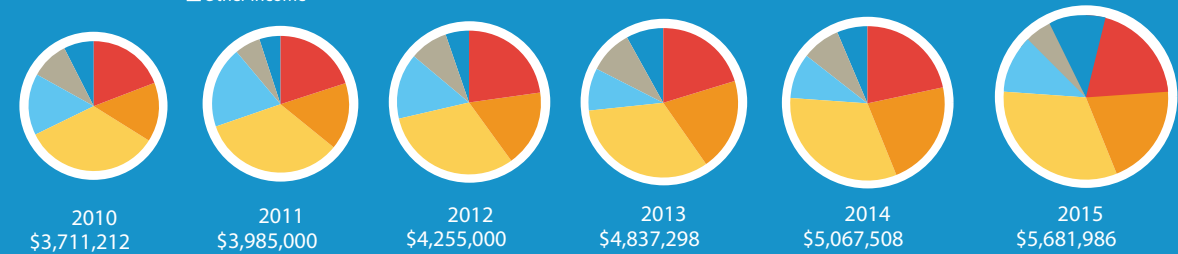
NETWORK INFRASTRUCTURE INVESTMENTS

ORION is continuously upgrading its network infrastructure with support from federal funding sources.



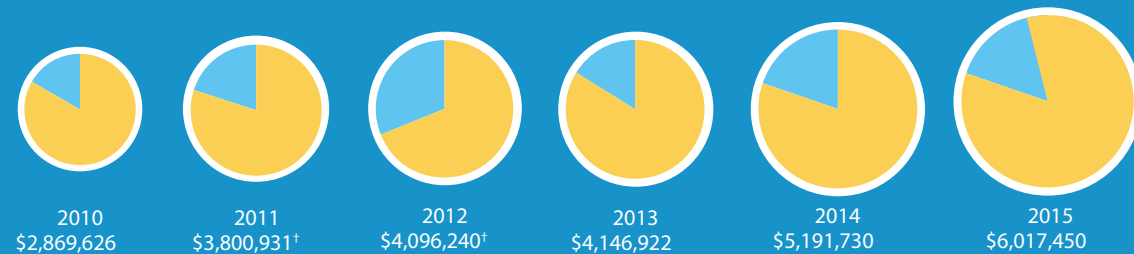
REVENUE

- Colleges
- School Boards
- Universities
- Research/Cultural
- Teaching Hospitals
- Other Income



EXPENSES

- Operating Expenditures
- Capital Expenditures



* Part of the 100Gig upgrade, including CANARIE support
 † Not including 100Gig upgrade

WHERE ORION JOURNEYS NEXT

ORION's journey is part of a collective evolution. During 2015, ORION finished the first step of our strategic planning voyage with the completion of the Nexus Project, our year-long initiative engaging our stakeholders for their ideas. By working closely with our community, we have navigated a path forward and even taken our first steps. Together, we can help our users transform themselves and create a better future for Ontario.

IDEA

INNOVATION

When ORION talks about “digital infrastructure” we are focusing on how connectivity, computing, data and services can be combined in a coordinated and strategic way to better serve our RE&I community. One of the ways we're helping to shape an effective digital infrastructure for RE&I is through government awareness and policy development. Drawing from the input of our stakeholders, ORION, like our sister provinces and CANARIE, submitted ideas to Industry Canada's Science, Technology and Innovation Strategy consultation. Similarly, we are working closely with several Ontario ministries to help them create useful digital infrastructure funding and implementation programs.

DIGITAL FOUNDATIONS

COMPUTING PARTNERSHIPS

IMPLEMENT

ORION is partnering with Compute Ontario to deliver more. This relationship goes beyond ORION connecting the major high-performance computing (HPC) centres and researchers, to understanding how we can work more closely together to be more efficient in sharing resources and delivering joint initiatives. We're starting by linking our user conferences for 2016 at diTHINK. In partnership we can address the challenges of massive amounts of data generated by user-centric technologies.

IMPACT GROWTH

ORION connects over two million users in 21 communities. In this year's impact study, the Conference Board of Canada discovered that the work relying on our network influences Ontario's GDP by billions of dollars a year. We're working with the Ontario government to help ensure that the network continues to provide world-class service for decades to come. We're already working with some new commercial partners to enhance our ORION Nebula security offerings for our users. ORION also needs to grow our network outward to reach further into local communities to help shorten the expensive “first mile” links to the nearest ORION Point-of-Presence (PoP). In this way, we can expand our impact, connecting more rural and northern communities, including offering greater opportunities to our First Nations peoples.

The rise of “Intelligent Communities,” as happening all over the world, is where ORION sees the power of collaboration at a local level. By using digital infrastructure with connectivity as the core, municipalities are being empowered with new tools to tackle their challenges. ORION hopes to support municipalities, libraries, hospitals and the local government on their quest to implement smarter, data-driven solutions to traffic congestion, health care for their communities, citizen scientists, education, poverty and improved lifestyle. These help make better and more intelligent communities.

COLLABORATIVE COMMUNITIES

GET CONNECTED

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