



Rural Ontario Foresight Papers

2017

Broadband
Infrastructure for
the Future

Broadband Infrastructure for the Future: Connecting Rural Ontario to the Digital Economy

Dr. Catherine Middleton

Introduction

Recognizing that broadband networks are now essential infrastructure, this paper discusses the current availability of broadband in rural and remote Ontario and makes the case that immediate action is needed to improve and extend connectivity across the province. Recommendations for developing future-proof broadband are offered, calling for a variety of approaches to attract investment from private and public partners, and to enable local communities to develop solutions that meet their needs.

The paper focuses on fixed broadband services, but both fixed and mobile broadband should be considered as policy makers develop a comprehensive approach to improving broadband infrastructure in Ontario. The paper does not address issues of broadband affordability, focusing instead on actions to extend availability. To realize the full benefits of investment in broadband infrastructure, people must have the skills and literacy to use it to their advantage. Encouraging digital literacy, improving affordability and ensuring the development of mobile broadband networks are all issues that are crucial to realizing a thriving digital economy in Ontario but these issues are beyond the scope of this paper.¹

Ontario is going digital

According to the province's Digital Government website, "Ontario is becoming the most modern and digital government in Canada by accelerating how citizens engage and interact with government through the power of digital technology."² The Premier has instructed Ontario's Minister responsible for Digital Government to work with the province's first Chief Digital Officer (hired in 2017) and other colleagues to "drive digital transformation across government and modernize public service delivery."³ At the federal level, Canada's Minister of Innovation, Science and Economic Development is developing an agenda to advance innovation in a world where "technology is digitizing and automating every aspect of our lives — and it's happening much faster than anyone ever imagined."⁴

While the full promise of widespread, rapid digital transformation is yet to be realized, there is little doubt that information and communication technologies (ICTs) are now central to everyday life. Economic and social activities are increasingly enabled by ICTs, with the effect that, as declared by OECD ministers in June 2016, "the world economy is becoming ever more digital" and "growing use of and investment in digital technologies and knowledge-based capital is profoundly transforming our societies."⁵

The terminology of the "digital" economy is relatively recent but the underlying acknowledgment that society and the economy are being transformed by ICTs is not new. As a 1992 discussion paper prepared by the Ontario Ministry of Culture and Communications noted, "Telecommunications has the potential to allow everyone in Ontario to have immediate access to emergency and health services, education and training resources, government information, library resources, a world of information and databases, cultural resources and programs, and a range of newly developing services provided both publicly and privately."⁶ Substitute "digital technology" for "telecommunications" and this statement would not look out of place if published in 2017, 25 years later.

There is extensive evidence documenting the ways in which ICTs improve quality of life, increase economic productivity, support greenhouse gas reduction, and enable social inclusion and engagement in society.^{7,8} But the digitization of the economy is both uneven and incomplete.⁹ Declaring that "the digital economy is the economy,"¹⁰ as the federal Minister of Innovation, Science and Economic Development did recently, does not necessarily make it so. Likewise, Premier Wynne's claim that Ontario is "at the cutting edge of the digital economy"¹¹ is aspirational rather than reflective of reality for many

residents of, and businesses operating in, Ontario. Nevertheless, digital technologies are embedded in, and essential to, the everyday lives of Ontarians. This paper examines the need for better telecommunications services across the province to enable the digital economy.

Broadband availability in Ontario today

Among the factors slowing Ontario's transition to a fully digital economy is the lack of universal access to affordable and high-quality telecommunications services. Telecommunications infrastructure is an essential enabler of the digital economy. As early as 1992, a vision for telecommunications infrastructure to enable Ontario's economic growth called for:

- "a ubiquitous, transparently mobile, digital, high capacity network infrastructure provid[ing] integrated voice, data, image and video services to meet the diverse requirements of businesses, governments, institutions and consumers alike.
- Ontario businesses [to] have available affordable, innovative telecommunications services equal to anywhere in the world which support their competitiveness and enable ongoing productivity gains.
- Advanced telecommunications services [to be] available in all areas of the province, including rural and remote areas."¹²

Since 1992, the province has invested hundreds of millions of dollars in telecommunications infrastructure, funding the extension of broadband (i.e., very fast internet access) to rural and remote areas, and connecting citizens, businesses, educational institutions and local governments to each other and to the world.¹³ Provincial investments were often matched with federal funding¹⁴ and/or funds from local governments (as with EORN, the Eastern Ontario Regional Network), further extending the reach of broadband networks across the province. Additionally, private telecommunications companies, small and large, have collectively invested billions of dollars in fixed and mobile telecommunications infrastructure in the province.

Much progress has been made. In urban Ontario, individuals and businesses have access to broadband services from a number of providers, supporting internet use for communications, education, entertainment and access to government services. Infrastructure is in place or available to support sensor networks and to enable the "Internet of Things," making the development of "smart" communities and autonomous vehicles possible.¹⁵ Mobile services support ubiquitous use of smart phones, facilitating always-on communications and providing access to services as people move around cities and travel on major roads across the province. These services are more expensive in Canada than in many other OECD countries,¹⁶ but it is reasonable to assume that in urban Ontario individuals and businesses who want to use digital technologies to engage in society and to generate economic activities have the necessary infrastructure to do so. Unfortunately, for many individuals and businesses located in rural and remote parts of the province, this assumption does not hold. The 1992 vision for universal access to telecommunications infrastructure in Ontario has yet to be fully realized.

In 2011, the CRTC (Canada's telecommunications regulator) set a target for broadband speeds in Canada, calling for all Canadians to have access to broadband connections providing a minimum of 5 Mbps (megabits per second)¹⁷ download speed and 1 Mbps upload speed by the end of 2015.¹⁸ These speeds were recognized as sufficient to allow multiple people in a household to simultaneously use the internet for browsing (viewing text and low-quality video files), email and voice applications. Videoconferencing, for instance to support online learning or health consultations, or access to higher-definition video streams, could also be provided at these speeds but only for a single user at a time.

In urban Canada, these speeds have been available since the late 1990s, over cable or telephone (DSL) networks. CRTC data indicate that by 2015, 96 percent of Canadian households could access a broadband service that met the download speed target of 5 Mbps.¹⁹ But the 4 percent of households not able to get broadband service at 5 Mbps were disproportionately rural. All households in communities with more than 1,000 residents had access at the target speed, compared to just 81 percent of

households in rural areas.²⁰

The CRTC reports that 85 percent of Ontario households subscribed to a broadband service in 2015,²¹ but does not indicate whether the subscription rates are different in urban and non-urban parts of the province. Statistics Canada data from 2012 indicated that 84 percent of Toronto households had a broadband connection, compared to just 64 percent of households in rural Canada.²² Rural broadband adoption has always lagged adoption in Canada's urban centres,²³ and it is likely that this pattern persists.²⁴ There is, however, strong demand for higher-quality, more affordable²⁵ broadband in rural Ontario. The quotes below are from submissions to the CRTC's 2015–2016 consultation to define the characteristics of basic telecommunications services needed to "participate meaningfully in the digital economy."²⁶

"I feel like the service we are receiving is actually declining instead of improving. ... In today's wireless society it is very difficult not being able to access services that everyone else takes for granted (e.g., online banking, streaming video, online radio, renting movies, work, shopping, school assignments, research....)" (Georgian Bay area)

"I live within 5 km of a major city, 2 km of a smaller town and less than 1 km from another town. I am limited to three types of internet, dial-up which is not broadband access, cellular internet or satellite/line of site. The latter two are extremely expensive compared to other plans within the city. For something practical and realistic for me I cannot even get close to your [the CRTC's] goals of broadband at 5 Mbps." (Southwestern Ontario)

"Due to the traffic management policy of [the internet service provider] between the hours of 8 am and 1 am speeds are reduced to that of dial up. I cannot watch videos, use Skype, I have had to discontinue my education online at Durham college as I cannot participate in some class chats or video conferences. Our internet services are constantly going down or experiencing technical issues, more and more often I am relying on my cell phone data to access the internet. Our service is expensive, unreliable and extremely disappointing. It's 2015, the internet is no longer a luxury it's a necessity." (Eastern Ontario)

"Download speed from 0100 hours to 0800 hours is 9 mbps, upload is 0.6 mbps. Between 0800 and 1530 hours, the speed drops to 4 mbps down and 0.4 mbps up. Between the hours of 1531 and 0100, the speed drops to 1 mbps down and 0.2 mbps up. This is not sufficient to do any type of video streaming. I do not have any other options. I am retired so I can do my internet research etc. prior to the speed dropping. My grandchildren live close by and are stuck with the same inadequate service. High speed internet is not a luxury for them rather, it is a necessity. They are in school and are at a disadvantage to all of their classmates who enjoy wired high speed internet service." (50 km north of Toronto)

"[P]eople in Rural areas should have the same access as anyone else. We have the same interests in the way we use the internet and we change our viewing habits like anyone else. We are driven by the same social/economic pressures and the same need to keep up with everyone else." (Georgian Bay area)

"Living in a remote Northern Ontario town does not make it OK for our residents and business owners to suffer daily with extremely slow internet speeds. High speed internet is the way of the future and everyone in Ontario and Canada should benefit from reliable speeds. Our education system is also suffering, where kids at local schools can't even do proper research on the internet, as the capacity is not there and the high speed can't keep up. Something needs to be done very soon, to rectify this grave problem that affects the entire community and region." (North of Wawa)

These quotes express the frustration of rural and remote Ontario residents who have poor-quality, expensive broadband and are unable to access the information and services required to support their daily activities. There is less data available from rural and remote businesses but there is every reason to believe that they experience the same frustrations. So, while the CRTC reports that in 2015, 96 percent of Canadians did have access to broadband service that met its 2011 target (a target that supports very basic uses of the internet), many rural Canadians told the CRTC that the 2011 target was insufficient for their needs and that action was needed to bring high-quality, affordable broadband services to rural and remote parts of the country.

Broadband for the future

Rural Ontario needs better broadband connectivity. But what are the future requirements for rural broadband? The simplest answer to this question is that the future requirements for rural broadband are exactly the same as the future requirements for urban broadband. If the Ontario government is to succeed in its “digital by default” approach to providing services (in which the preferred delivery mechanism is digital), and if all Ontario residents and businesses are to be able to realize the benefits of widespread adoption of digital technologies, the province needs ubiquitous, uniform and future-proof broadband connectivity.

High-quality broadband connectivity is essential for all, but the consequences of not having good broadband are more serious outside urban areas.²⁷ Among the specific benefits better broadband provides to rural areas are: online access to health and education services that are not currently available in rural communities, and the capacity to buy physical goods and obtain services that are not available locally.²⁸ The deployment of broadband in rural communities promotes employment and wage growth,²⁹ and makes advanced manufacturing and high-end video production and editing possible. Broadband enables the establishment of local healthcare and advanced education facilities and supports law-enforcement agencies. Broadband also supports access to audio and video content, not just for entertainment but also for education, as illustrated by reaction to a recent TVO proposal. In early 2017, TVO, the province’s educational television station, announced that it intended to shut off eight over-the-air television transmitters. It stated that less than one percent of Ontario households would be impacted³⁰ because households could access TVO through cable or satellite TV providers, as well as online using a broadband connection. The reaction from Ontarians whose internet connections did not allow them to access TVO content was swift and furious, and within a couple of weeks TVO decided to keep the over-the-air transmitters in service.³¹ TVO assumed that broadband capacity was sufficient to allow viewing of their video content across the province. This was not the case, and they faced the ire of viewers whose access to educational television would be severely constrained due to their lack of broadband connectivity.

Economic benefit also comes from the rapidly evolving practices of “smart farming” and “precision agriculture” (enabled by the “agricultural Internet of Things”).³² In areas where broadband infrastructure provides sufficient bandwidth (often through mobile or wireless connections, with support for uploading large volumes of data as well as downloading), farmers and agribusinesses are deploying a wide array of new technologies to increase the productivity and sustainability of their operations.³³ A 2016 report on advancing competitiveness in the US agricultural sector is clear that “The future of agriculture depends on the adoption of new field technologies that facilitate the gathering of data.” Such data include soil sampling and crop yield information, satellite imagery and GPS data, which can be combined with data from other sources on prices, productivity and other factors and analyzed using big data techniques.³⁴

Other papers included in these *Foresight Papers* also offer insights on demand for broadband services in rural Ontario. Chamberlain discusses the growth of the local food movement, which uses the internet to connect producers to consumers, and notes the development of online resources for immigrants to identify business opportunities in rural Ontario. The availability of good-quality broadband in rural communities will assist in attracting and retaining younger residents, and will support the development of social enterprises by facilitating information sharing and community building. Rural business

succession will not happen without the availability of broadband infrastructure to allow these businesses to join and thrive in the digital economy.

Fenn identifies trends that are expected to impact life in Ontario in the coming decades. With universal connectivity every rural community and every farm can have easy, affordable access to global resources, providing expertise in health care, education and training, and agricultural enterprise. Ubiquitous broadband will enable the advent of driverless and shared vehicles, 3D printing, nano-technologies and robotics. He also describes the possibilities of using sensor and monitoring technologies to assist in maintaining physical infrastructure like roads and bridges, and broader applications of the “Internet of Things.”³⁵

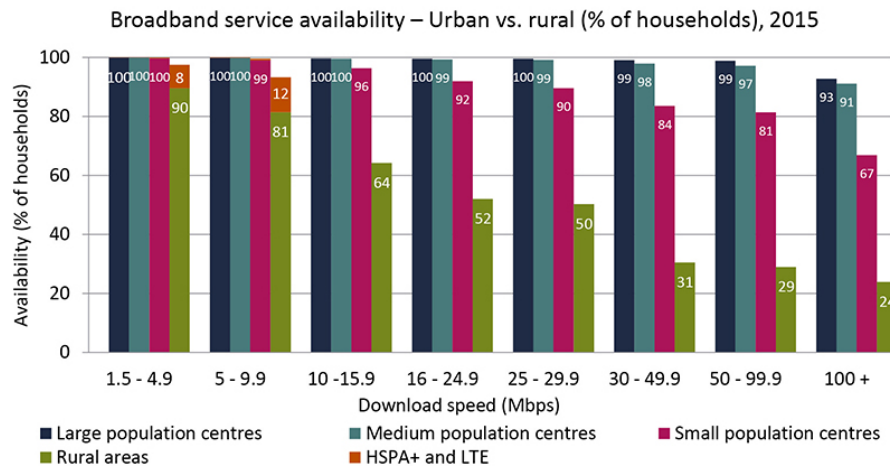
These possibilities are real, but a recent American report warns of the perils for those unable to access the Internet of Things (IoT). Once IoT devices become central to the delivery of health care and other services, if “the public sector does not implement policies to encourage equitable deployment, the Internet of Things could exacerbate existing inequalities by providing the benefits of data-driven decision making only to some, and placing already underserved communities at an even greater disadvantage.”³⁶ The danger of exacerbating existing inequalities extends beyond the Internet of Things to internet access in general.

The issues of providing service to underserved communities, and of removing inequality of access to the digital economy, were central to the CRTC’s 2015–2016 consultation on basic telecommunications services.³⁷ In its December 2016 decision, Telecom Regulatory Policy CRTC 2016-496: *Modern Telecommunications Services – The Path Forward for Canada’s Digital Economy*,³⁸ the CRTC determined that “broadband internet access services are vital to Canada’s economic, social, democratic, and cultural fabric,”³⁹ and called for all Canadian households and businesses to have access to fixed (i.e., wired) broadband internet services offering download speeds of a minimum 50 Mbps and upload speeds of at least 10 Mbps. The decision also establishes that “the latest generally deployed mobile wireless technology should be available not only in Canadian homes and businesses, but on as many major transportation roads as possible in Canada.” The inclusion of mobile services will be of particular benefit to those in rural Canada, as current mobile phone coverage is often poor or even non-existent outside towns and cities.

The CRTC decision is generally recognized as a positive step forward for Canada’s digital economy and is designed to bring real benefits to parts of the country where high-quality broadband is not currently available. Broadband services offering 50 Mbps download speeds and 10 Mbps upload (50/10) speeds at specified service-quality levels⁴⁰ and deployed ubiquitously will support the uses described above. But the history of the internet has demonstrated that connections that were adequate at one point in time very quickly become inadequate as applications become more bandwidth-intensive and new services are adopted. Given this reality, it is possible that by the time broadband services meeting the minimum universal service objective criteria are rolled out in rural and remote Canada, they will already be straining to deliver adequate access to the latest applications and services in use at that time.

Indeed, in announcing this decision, the Commission noted that more than 80 percent of Canadians already have access to fixed broadband services at 50/10 speeds.⁴¹ Most rural Canadians cannot currently subscribe to a broadband service offering speeds anywhere near the new target, yet in urban Canada services faster than the target speeds are already widely available (see Figure 1). As telephone companies replace their copper telephone lines with fibre-optical networks, urban Canadians will have a choice of service providers offering speeds in excess of 50/10. The real challenge for rural Canada then is not achieving the CRTC’s 50/10 universal service target for fixed broadband services, but developing a strategy to ensure more future-proof broadband services are, or will be, available even in small population centres across the country in the next few years. This challenge is examined in the following section.

Figure 1: Broadband service availability – Urban vs. rural (% of households), 2015 (Sources: Innovation, Science and Economic Development Canada (ISED) and CRTC data collection)⁴²



Meeting Ontario’s future broadband needs

Despite extensive investments in broadband infrastructure by governments and the private sector, many individuals and businesses in rural and remote parts of the country still do not have the broadband they need. This section identifies actions already underway to improve broadband availability in rural and remote Ontario, and outlines further actions needed to ensure universal access for all. It calls for the development of a provincial broadband strategy and offers examples of how new broadband investments can be funded, recognizing that improvements to broadband infrastructure can be initiated by individuals and communities, not just through provincial and federal government actions.

Current programs

The CRTC’s recent decision establishes a fund to extend broadband infrastructure to locations where the new target speeds are not available. The fund will distribute a maximum of \$750 million in its first five years, with funding to be awarded on a competitive basis. Applicants must invest in the project themselves and secure “non-nominal” contributions from a government entity.⁴³ Given the lead time needed to establish the program (initial funding decisions are not anticipated until 2019 or 2020),⁴⁴ and then the time needed to extend broadband connectivity, the CRTC does not anticipate that its target of 50 Mbps download and 10 Mbps upload speeds available to all premises will be met for another ten to fifteen years.⁴⁵

The CRTC has indicated a desire to align its fund with existing funding programs.⁴⁶ For example, the federal government has pledged to invest \$500 million for broadband infrastructure by 2021, through the Connect to Innovate (CTI) program.⁴⁷ CTI funds are awarded on a competitive basis, with a focus on investments in backbone infrastructure (backbone networks are analogous to main roads, and bring high-capacity connectivity into communities, linking smaller locations to the internet at local “points of presence”). CTI will also invest in last-mile connectivity, which is more analogous to local roads, connecting individual homes and businesses to the internet “main road” at a local point of presence. As is common with broadband funding programs, CTI will not fund 100 percent of any project, requiring applicants to get contributions from other federal government programs or agencies, or from other sources (including provincial and municipal agencies). Applications for CTI funding are currently being adjudicated, and it is likely that demand will exceed the available supply of funds.

An urgent need for leadership and action

In its submission to the federal government's 2016 Innovation Agenda consultation, the CRTC was very clear about what is needed to ensure broadband access for all, stating:

"Meeting the nation's broadband challenges will require billions of dollars over many years to come. Closing all of the gaps will require coordinated and collaborative action on the part of multiple stakeholders, including the private sector, community and non-profit organizations, the CRTC, and governments at all levels. The record of the proceeding [the CRTC's consultation on basic telecommunication services] supports the federal government's leadership of this approach."⁴⁸

The need for large-scale investment in broadband, led by the federal government, has been recognized for more than 15 years, yet there is still no national strategy in place to ensure broadband for all. For instance, the 2001 National Broadband Task Force (NBTF, appointed by the federal government) was clear that "The priority of the broadband deployment strategy should be to link all First Nations, Inuit, rural and remote communities to national broadband networks using appropriate technology."⁴⁹ The NBTF called for broadband for all by 2004. Some investments were made to improve broadband availability following the NBTF but they were insufficient to provide connectivity to everyone. Recognizing the continued need for investment, the 2006 Telecommunications Policy Review Panel recommended a targeted subsidy program to achieve universal access.⁵⁰ This recommendation was not acted upon. The 2010 federal consultation on a digital economy strategy for Canada yet again recognized the need for better broadband, stating "Given the huge importance of access to high speed networks, governments will likely have an ongoing role to ensure that Canadians in rural areas are not left behind. In doing so, Canada must ensure that citizens and communities have more than just basic broadband, but the speeds and capacity needed for economic growth."⁵¹ No digital economy strategy resulted from this consultation, but in 2014 the federal government did make additional funds available for investment in rural broadband networks (these funds are being allocated through the CTI program).⁵²

In 2017, the Ontario government has embraced the use of digital technologies to deliver services to Ontarians. Broadband has been declared an essential service, but access to the broadband infrastructure that allows digital service delivery remains a challenge for many. Researchers have noted the paradox of poor broadband access, observing that those who could benefit the most from digital delivery of services (using digital technologies to bridge distances and improve quality of health care, educational access and facilitate economic participation) are least likely to have access to the infrastructure needed to make digital delivery possible.⁵³ The problem of poor broadband access is real, and has increasingly serious consequences. Despite repeated recommendations for federal action to address the problem, there is still no unified national strategy in place to ensure broadband for all. In order for Ontario to advance its aspirations to be at the cutting edge of the digital economy, it must act now to develop a plan to ensure that all Ontarians will have access to future-proof broadband and mobile technologies as soon as possible, to allow their full participation in the digital economy.

Developing a broadband strategy for Ontario

In 2016, the Premier of Ontario appointed the province's first Minister Responsible for Digital Government, with a mandate "to make government work better for citizens by delivering simple and straightforward digital services and products."⁵⁴ The Minister is to work with other government ministries on "high-impact signature digital projects" and make "it easier for citizens to participate in government." The Minister's mandate also includes the development of a digital literacy strategy and appointment of a Chief Digital Officer for the province,⁵⁵ but makes no explicit mention of ensuring that all Ontarians have access to the infrastructure needed to engage in digital society. While the work of the Minister for Digital Government and the Chief Digital Officer appears to be focused on the development of digital government services, these services will not be accessible to all without universal broadband access. Responsibility for advancing the rollout of broadband infrastructure in Ontario appears to rest with four

other ministers.⁵⁶ The Minister of Infrastructure and the Minister of Economic Development and Growth are instructed to work together “on expanding broadband infrastructure and improving connectivity in communities across the province.” The Minister of Northern Development and Mines is to seek federal support and work with Indigenous partners and other ministers, including the Minister of Intergovernmental Affairs, to provide a “modern broadband network across Northern Ontario.” The Minister of Infrastructure is required to deliver an infrastructure plan by the end of 2017, and the Minister of Digital Government is to develop a Digital Government Action Plan.

Access to broadband is fundamental to supporting education, health care, culture,⁵⁷ commerce and social engagement. Broadband is essential infrastructure, and the competitive approach to funding broadband, in which limited funds are awarded to communities deemed to have the best proposals, and other communities receive no funding, must change. Broadband can no longer be developed through a patchwork approach that has rewarded those local communities who do have the capacity to argue why they are deserving of support to build this essential infrastructure, while excluding their neighbours who do not have this capacity. At present, however, the provincial government’s approach to ensuring that Ontario residents and businesses have access to broadband infrastructure is fragmented and incomplete. The province does not appear to have committed to high-quality broadband for all, instead calling for “improving” connectivity.⁵⁸ At a time when action is urgently needed, a single ministry should develop a strategy to ensure that the province’s stated objectives to use digital technologies to transform service delivery and improve the quality of life for Ontarians are realized. The province alone cannot solve the problem of poor access, but it must take a leadership role in making broadband available to all.

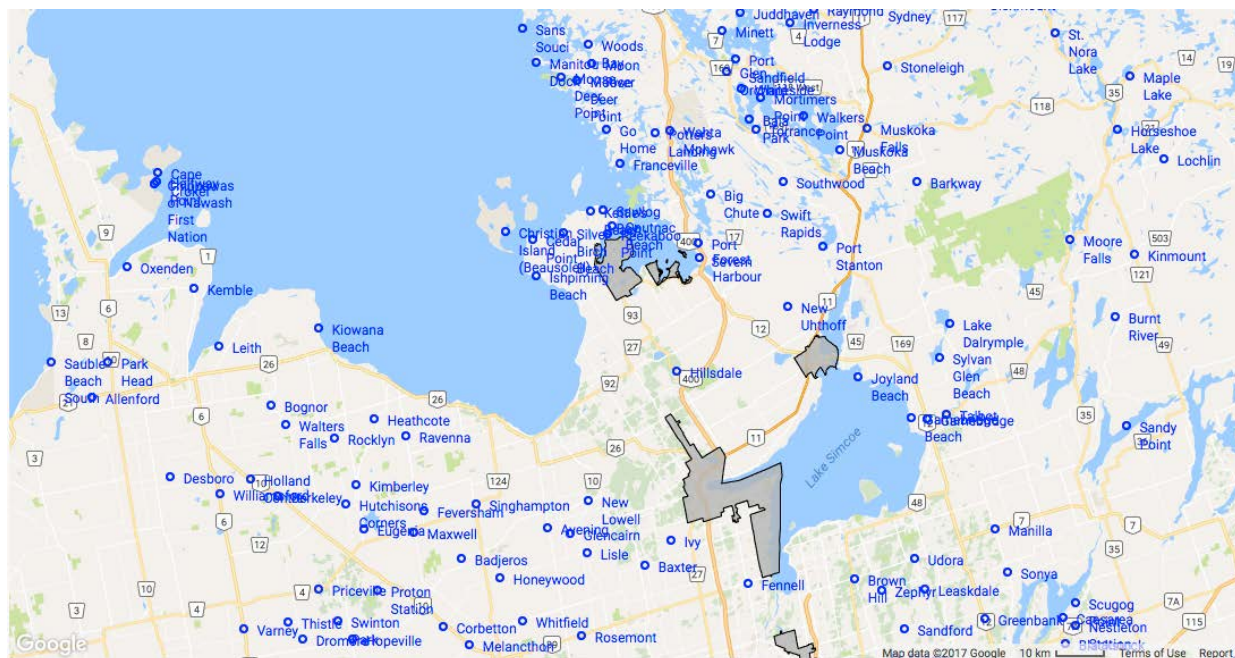
As a starting point, the strategy should explicitly acknowledge the need for all Ontario communities to have affordable access⁵⁹ to fixed and mobile broadband at the CRTC’s target speeds as soon as possible. To ensure longer-term competitiveness, a provincial broadband strategy should go beyond the CRTC’s targets with a plan to develop future-proof broadband infrastructure for rural and remote Ontario. It is beyond the scope of this paper to offer a detailed discussion of the technologies used to provide broadband access,⁶⁰ and it is difficult to anticipate future demand. There are uncertainties about the potential future capacity of existing technologies, and ongoing debates as to whether wireless technologies will advance sufficiently to become a true substitute for wired connections. These debates will continue, but current consensus is that the most future-proof broadband available today is provided through fibre-optical networks.⁶¹

Fibre broadband is available in urban Canada, typically offering speeds of 1 gigabit per second (1 Gbps, which equals 1000 Mbps). Fibre networks can offer symmetrical services, meaning that upload and download speeds are the same (facilitating data storage in the cloud and making it easier for individuals and businesses to send large files as well as to receive them). Gigabit connectivity means download speeds twenty times faster the CRTC’s 50 Mbps target, and upload speeds one hundred times faster than the 10 Mbps target. Additionally, once a fibre network is installed, data transfer speeds can be increased by changing the equipment used to run the network. So as demand for speeds increase, a gigabit network can be upgraded to offer 10 Gbps or 100 Gbps or more over the existing fibre. To future-proof broadband access in Ontario, and to ensure that all Ontarians have the capability to participate fully in the digital economy, it is necessary to extend fibre networks as deeply as possible into rural and remote parts of the province.

A broadband strategy for Ontario should develop approaches to extend gigabit connectivity into the 687 Ontario communities⁶² eligible to receive new backbone funding from the federal government’s Connect to Innovate program⁶³ (recognizing that many of these communities will not receive support from the CTI program). These communities, located across the province, are at least two kilometres away from a gigabit point of presence. As an example, Figure 2 identifies eligible communities in areas northwest and northeast of Toronto, illustrating the need for better broadband in this part of rural Ontario. In addition to these communities that are eligible for new backbone funding, hundreds more are eligible for funding to upgrade the existing backbone connection or increase network resiliency. Investment in fibre across the

province will also support the rollout of next generation (5G) mobile networks, anticipated to offer much faster and more reliable connectivity.

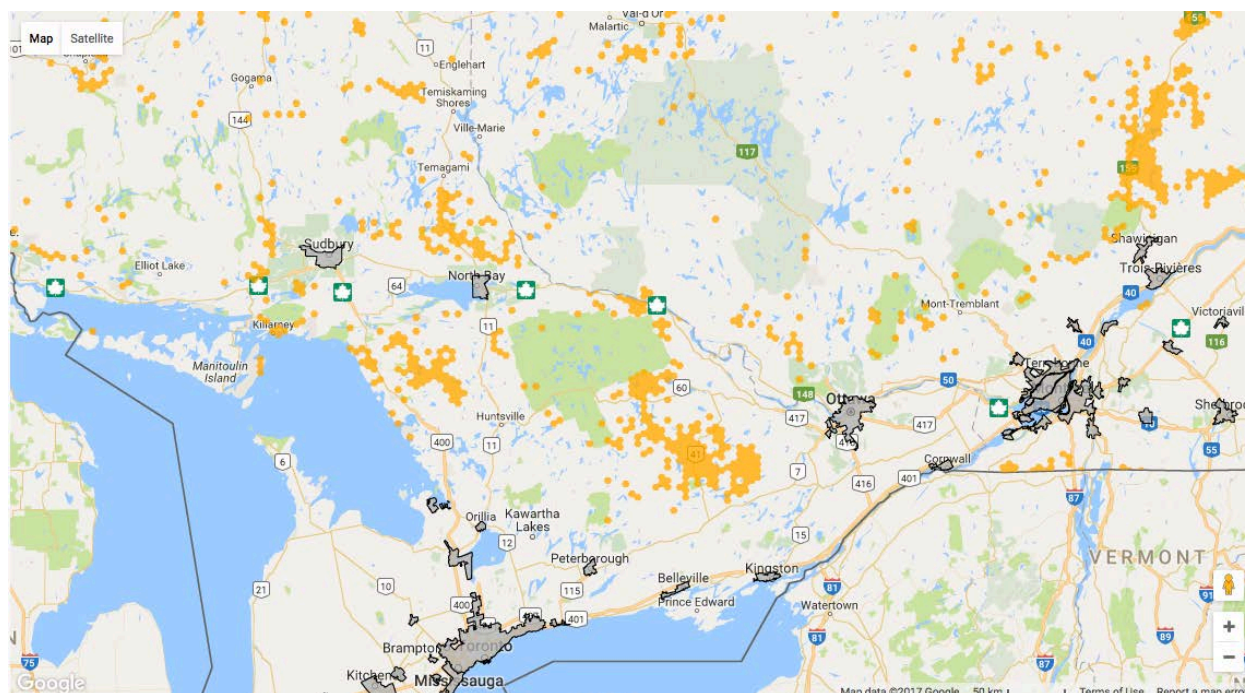
Figure 2: Areas eligible for new backbone funding to enhance broadband access through the Connect to Innovate program (Source: Innovation, Science and Economic Development Canada: <http://www.ic.gc.ca/app/sitt/ibw/hm.html?lang=eng>)



A provincial broadband strategy also needs to address last-mile access (i.e., the connection from a point of presence to an individual premise).⁶⁴ The orange hexagons on the map in Figure 3 show communities eligible for last-mile funding from CTI. This map only identifies locations where there is no last-mile connectivity at all, excluding communities where some premises do have service (for example, in southwestern Ontario). Note that according to the parameters of the CTI program, communities are considered to be connected if they can access a 5 Mbps broadband service. Applying the CRTC's 50/10 target would likely identify almost all the non-urban parts of the province as unserved. (There are exceptions where local internet service providers have deployed fibre to the home networks in rural Ontario, but as noted in Figure 1, less than a third of rural residents had access to broadband at speeds greater than 50 Mbps in 2015.) Wherever possible, broadband networks should be built using fibre directly to the premise (often referred to as fibre to the home, FTTH, or fibre to the premise, FTTP). In some parts of the province FTTH will not be economically viable so last-mile connectivity will need to be provided by satellite or fixed wireless⁶⁵ technologies.

It is beyond the scope of this paper to discuss approaches to encourage the rollout of mobile broadband networks and to ensure that the fixed and mobile networks serving rural and remote Ontario offer affordable services. These issues do need to be addressed in the provincial broadband strategy in an integrated manner (recognizing that both fixed and mobile services are essential), along with a plan to advance digital literacy for all.

Figure 3: Areas eligible for last-mile funding to enhance broadband access through the Connect to Innovate program (Source: Innovation, Science and Economic Development Canada: <http://www.ic.gc.ca/app/sitt/ibw/hm.html?lang=eng>)



Funding models and examples

Broadband can be funded by the private sector, by the public sector or through public-private partnerships (PPP).⁶⁶ Financing options include revenue-based models, private capital and financial markets, government-backed bank loans and bonds, public funds and bottom-up community financing.⁶⁷ To extend broadband to everyone in the province a mix of business models, funders and service providers will be required.

Although it is often argued that there is no business case to extend broadband to areas with low-population densities, private capital is funding fibre-backbone networks in the remotest parts of North America. For instance, the Quintillion project⁶⁸ brings fibre to communities on Alaska's northern coast, operating a 1,200 mile submarine fibre-optic cable through the Arctic Ocean, and demonstrating that there is a business case for private investment in areas not served by existing internet service providers. In developing a strategy to extend broadband to everyone in Ontario, the government should actively seek out private sector investors who might invest in backbone infrastructure because they value steady, sustainable long-term returns.

Large internet service providers have not extended their highest speed networks into much of rural Canada. In Ontario, however, there are a number of independent internet service providers that have built fibre-to-the-home networks in rural communities, demonstrating that it is possible to do so. Examples include the co-ops Quadro Communications⁶⁹ and Hay Communications,⁷⁰ providing fibre to small communities outside Stratford and London, and WTC Communications⁷¹ offering fibre in several locations north of Kingston.

Public ownership of broadband networks is fairly uncommon in Canada. One Ontario example of a public broadband provider is Lakeland Networks, a division of a municipally owned energy company. Lakeland offers fibre to the home in rural areas outside Huntsville and Bracebridge,⁷² with partial project funding provided by the Small Communities Fund.⁷³ Many communities in the United States have adopted a

public ownership model, often led by municipal utilities. Smaller towns like Sandy, Oregon⁷⁴ and Ammon, Idaho⁷⁵ have demonstrated that it is feasible to provide FTTH to residents and businesses at an affordable price.⁷⁶ This approach could be used more widely in Ontario to improve broadband quality in smaller towns.

In Olds, Alberta (a town of less than 10,000 people), local community members planned and built Canada's first community-owned FTTH network, which offers gigabit speed service to every residence and business in town.⁷⁷ In northern England, rural residents decided to address their lack of reliable broadband service by building their own FTTH network. Community members learned how to install fibre, digging their own trenches across fields to connect farms and villages. Broadband for the Rural North, or B4RN, now provides more than 2,300 customers with gigabit broadband, funded by the community.⁷⁸ In Sweden, the widespread availability of publicly owned open-access fibre networks has enabled a similar "fibre to the farm" approach, in which neighbours work together to connect themselves to the internet.⁷⁹

The Eastern Ontario Regional Network (EORN) and the Southwest Integrated Fibre Technology (SWIFT) Network are public-private partnerships developed to improve broadband access in rural Ontario. The EORN network was completed in 2014, and offers access to broadband at speeds of 10 Mbps or higher to more than 1 million residents of Eastern Ontario.⁸⁰ The SWIFT network, currently in the design phase, will initially provide fibre-backbone connectivity into 350 communities in southwestern Ontario, and will work with partners to extend last-mile access across the region.⁸¹ The SWIFT network will support locally owned last-mile networks (like the do-it-yourself approaches described above, as well as initiatives making use of wireless technologies), making FTTH connectivity more feasible in small communities.

The Quintillion, EORN and SWIFT networks are all examples of open-access networks, in which the network owner sells capacity on the network to other operators, allowing multiple providers to use the same infrastructure.⁸² All projects funded by CTI must be open access, and this model is often mandated for publicly funded and PPP-funded networks. Open-access models enable competition among service providers, and generate returns for the network owner/operator by increasing the use of their infrastructure. Some experts argue that open-access models are particularly well-suited to advance the rollout of rural fibre networks, as they can reduce investment risk.⁸³ It is recommended that any project funded with public dollars be operated on an open-access basis.

Recommendations: What can the province do now?

In developing a broadband strategy, the province should draw on the extensive work done in other jurisdictions. There is a wealth of information available in national and regional broadband plans,⁸⁴ reports from the OECD and the ITU, and from not-for-profit organizations that champion community and municipal broadband networks (see Appendix 1 for some examples).⁸⁵ While the province works to develop a complete strategy, there are actions that can be initiated immediately to advance the objective of universal broadband across Ontario. Four of these are noted below, and may build on initiatives already underway in the province.

Assess the current state of broadband in Ontario

The province should catalogue the availability of broadband across the province to identify areas that are unable to get fixed (i.e., wired) service at the CRTC's new target speed (50/10),⁸⁶ and to identify existing resources⁸⁷ that might be leveraged to extend connectivity. It is assumed that much of this information will already be available,⁸⁸ and Cybera's *State of Alberta Digital Infrastructure Report*⁸⁹ provides a model for this exercise. Based on this assessment, which must be done rapidly, a rough classification can be made of the types of remedies that are most likely to address connectivity problems across Ontario. It is necessary to understand where investment in backbone networks is required, where last-mile connectivity is the challenge, and where both backbone and last-mile connectivity is required. Developing an estimate of where it could be feasible to extend fibre (with a

variety of funding approaches) and where satellite or fixed wireless last-mile solutions are needed will help define the range of policies needed to ensure broadband is available to all. As part of this exercise, it will be useful to estimate the support that Ontario projects could receive through the CRTC's new broadband fund and the federal Connect to Innovate program, and to understand the possibilities afforded by leveraging the SWIFT and EORN networks.

Identify approaches to finance investments in broadband networks

To realize the digital transformations envisaged by politicians and the government's own vision, the province must invest in the extension of future-proof broadband to all homes and businesses, and encourage other parties to invest as well. The cataloguing exercise described above will provide a foundation for estimating the investment required to bring broadband to all (including contributions to CTI and CRTC broadband fund projects), by identifying the mix of public and public-private projects needed to extend access to locations that will not be served by private-sector providers. Investment approaches may include direct investment in network infrastructure (for publicly owned networks or for PPPs), outsourcing provision to the private sector, and providing subsidies to existing providers to extend or improve their services.⁹⁰ The province can begin to investigate ways to finance these investments in parallel with the development of a broadband strategy, considering options beyond existing programs like the Ontario Community Infrastructure Fund and the federal Small Communities Fund.⁹¹ Approaches to help finance broadband network construction could include providing guarantees for loans or creating infrastructure bonds, approaches that could assist local communities in funding their own network builds. Cost-benefit analyses across provincial ministries can identify instances where direct provincial investment in broadband infrastructure may be warranted due to reduced costs of delivering services over broadband networks, or reductions in carbon emissions, and provide a means for prioritizing investments. The costs of investing in broadband must be assessed in the context of the implications of not investing, in terms of lost productivity and social and economic disadvantage for those without adequate broadband.⁹²

Develop policies and practices to facilitate access to passive infrastructure

Construction costs make up a major component of the cost of rolling out fibre networks. The province should investigate its options to encourage more access to, and reuse of passive infrastructure owned by public and private entities.⁹³ The cost of fibre rollouts can be reduced by making it easier for providers to use existing rights of way and to reuse physical infrastructure already in place (e.g., ducts and utility poles).⁹⁴ It is also sensible to coordinate civil works and to develop a "dig once" approach to construction projects (e.g., laying conduit for fibre when roads are built, even if it will not be used immediately). Provincially funded construction projects should routinely be assessed to determine how they might be leveraged to extend broadband connectivity. For instance, while the proposed high-speed rail project will provide passenger service only to major cities, as part of the project it would be possible to develop a fibre network running parallel to the tracks to provide "branch line" broadband connectivity to the many smaller towns and villages along the route.

Support capacity building in rural and remote Ontario

The province should establish a staffed resource centre to provide information and guidance for communities and municipalities considering investment in broadband infrastructure, leveraging expertise in the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), the Ministry of Infrastructure and elsewhere in the provincial civil service. As noted throughout this paper, there are many resources to assist those seeking to improve broadband connectivity, and much expertise in communities and municipalities in Canada and beyond. What is needed though is development of specific expertise to support the differing requirements across the province (as identified in the assessment exercise), to allow for targeted approaches to capacity building in rural and remote Ontario. In particular, support should be available for all interested parties (including the private sector, local government and citizen groups) in rural and remote Ontario to develop viable plans to fund and rollout broadband infrastructure investment in their areas.

Conclusion

The importance of high-quality, reliable telecommunications infrastructure in supporting social and economic objectives has been understood for decades. But despite repeated calls for investments to ensure telecommunications infrastructure is available to rural and remote areas of the province, Ontario still lacks universal broadband access. The challenges of bringing broadband to all are real and must be addressed with coordinated actions across multiple levels of government, and in consultation with citizens and business owners who will use this infrastructure. In the apparent absence of efforts to develop a coordinated national strategy, this paper offers recommendations that can be implemented by the province of Ontario, now, to improve access to this essential infrastructure within Ontario. There are many good resources available to support the province in developing and implementing a provincial broadband strategy. These resources outline various possible approaches and will support the development of business cases to attract investment from the private sector, the public sector and by public-private partnerships to extend broadband to rural and remote Ontario. The residents and businesses of rural and remote Ontario need better broadband today, but it will take years to achieve the goal of a completely connected province. Action is needed immediately to advance the rollout of future-proof broadband across the province so that the 1992 vision of telecommunications infrastructure enabling economic growth and social inclusion for everyone in Ontario will finally be realized.

Endnotes

¹ For discussion of these issues see Middleton, C. (2016). *There's an App for That. Unless There Isn't – The Challenges of Digital Inclusion in Canada in 2016*. Big Thinking Lecture, Royal Society of Canada Annual Meeting. Kingston. <http://www.ryerson.ca/~cmiddlet/ourresearch/Middleton-Digital-Inclusion-Canada-2016.pdf>

² <https://www.ontario.ca/page/digital-government>

³ Wynne, K. (2016). September 2016 Mandate Letter: Digital Government.

<https://www.ontario.ca/page/september-2016-mandate-letter-digital-government>

⁴ Innovation Science and Economic Development Canada. (2016). *Innovation for a Better Canada*. [http://www.ic.gc.ca/eic/site/062.nsf/vwapj/Innovation-for-a-better-Canada.pdf/\\$file/Innovation-for-a-better-Canada.pdf](http://www.ic.gc.ca/eic/site/062.nsf/vwapj/Innovation-for-a-better-Canada.pdf/$file/Innovation-for-a-better-Canada.pdf)

⁵ OECD. (2016). *The Cancún Ministerial Declaration on the Digital Economy*.

<http://www.oecd.org/internet/Digital-Economy-Ministerial-Declaration-2016.pdf>

⁶ Ministry of Culture and Communication. (1992). *A Telecommunications Strategy for Ontario: Framework for Discussion*.

⁷ For recent examples see Mölleryd, B. G. (2015). *Development of High-Speed Networks and the Role of Municipal Networks*. *OECD Science, Technology and Industry Policy Papers*, No. 26. Paris:

<http://dx.doi.org/10.1787/5jrql7rvns3-en>; OECD. (2015). *OECD Digital Economy Outlook 2015*. Paris:

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http://www.oecd.org/sti/ieconomy/Cancun_ChartBooklet.pdf; and OECD. (2016). Innovation and the Digital Economy, in *OECD Science, Technology and Innovation Outlook 2016*. Paris: OECD Publishing.

⁸ Broadband Commission for Digital Development. (2016). Open Statement from the Broadband Commission for Sustainable Development to the Marrakech Climate Change Conference (COP-22) – broadband for Implementing the Paris Agreement. http://broadbandcommission.org/Documents/BBCommission_Open_Statement_COP22_11Nov2016.pdf

⁹ Salemink, K., Strijker, D., & Bosworth, G. (in press). Rural Development in the Digital Age: A Systematic Literature Review on Unequal ICT Availability, Adoption, and Use in Rural Areas. *Journal of Rural Studies*. <https://doi.org/10.1016/j.jrurstud.2015.09.001>

¹⁰ Bains, N. (2016). International Institute of Communications Canada Conference – Speaking Points. <http://news.gc.ca/web/article-en.do?nid=1155469>

¹¹ Office of the Premier. (2017). Creating the Jobs of Tomorrow, Today. Ontario Investing \$650 Million in the Business Growth Initiative. <https://news.ontario.ca/opo/en/2017/05/creating-the-jobs-of-tomorrow-today.html>

¹² Advisory Committee on a Telecommunications Strategy for the Province of Ontario. (1992). *Telecommunications: Enabling Ontario's Future: The Report of the Advisory Committee on a Telecommunications Strategy for the Province of Ontario to the Minister of Culture and Communications*. Toronto: Ministry of Culture and Communications., p. 52

¹³ Provincial initiatives included ONIP (Ontario Network Infrastructure Program), Connect Ontario Broadband Regional Access (COBRA), and Rural Connections, as well as partial funding for the Eastern Ontario Regional Network (EORN). For more details on these programs see McNally, M. B., Rath, D., Evaniew, J., & Gareau-Brennan, C. (2015). Intervention in Response to Canadian Radio-Television and Telecommunications Commission Telecom Notice of Consultation CRTC 2015-134.

<https://services.crtc.gc.ca/pub/ListeInterventionList/Documents.aspx?ID=223980&en=2015-134&dt=i&lang=e&S=C&PA=t&PT=nc&PST=a>

¹⁴ See McNally et al., cited above.

¹⁵ See the paper in this collection by Michael Fenn for discussion of some of technology trends anticipated to improve quality of life in the future.

¹⁶ Nordicity. (2016). *2016 Price Comparison Study of Telecommunications Services in Canada and Select Foreign Jurisdictions*. Prepared for the CRTC.

<http://www.crtc.gc.ca/eng/publications/reports/compar/compar2016.htm>, Organisation for Economic Co-operation and Development. (2015). *OECD Digital Economy Outlook 2015*. Paris: OECD Publishing.

¹⁷ Mbps = megabits per second and is a measure of data transfer speeds. The top speed for dial up internet access is 56 kbps (k=kilo), or about 10 times slower than the 5 Mbps target speed. Gigabit broadband is now available in parts of Ontario, with a 1 Gbps connection providing data transfer at 200 times the speed of a 5 Mbps connection.

¹⁸ Telecom Regulatory Policy CRTC 2011-291: Obligation to Serve and Other Matters.

<http://www.crtc.gc.ca/eng/archive/2011/2011-291.htm>

¹⁹ Canadian Radio-television and Telecommunications Commission. (2016). *Communications Monitoring Report*. Ottawa: <http://www.crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2016/cmr.htm>, p. 247. This figure excludes mobile and satellite internet services, which are more expensive and offer lower download limits than broadband services provided over telephone or cable networks, or by fixed wireless. Given the limitations of mobile and satellite internet services, they would not allow for affordable access to high definition video streaming and as such would not deliver the functionality envisaged in the 2011 CRTC target.

²⁰ Defined as areas with populations below 1000, or with a population density below 400 per square kilometre. CRTC. (2016). *Communications Monitoring Report*, p. 270.

²¹ CRTC. (2016). *Communications Monitoring Report*, p. 266.

²² Statistics Canada. (2014). *Canadian Internet Use Survey, 2012 [Canada]: Household File*.

²³ See Landry, K. M., & Lacroix, A. (2014). *The Evolution of the Digital Divides in Canada*. Paper presented at the Telecommunications Policy Research Conference, Arlington, VA. <http://ssrn.com/abstract=2418462> and McKeown, L., Noce, A., & Czerny, P. (2007). Factors Associated with Internet Use: Does Rurality Matter? *Rural and Small Town Canada Analysis Bulletin*, 7(3), 1-15.

²⁴ Recent data shows rural Americans have lower technology adoption rates than urban Americans, and it seems reasonable to assume that a similar pattern would exist in Canada. Perrin, A. (2017). Digital Gap between Rural and Nonrural America Persists. Fact Tank. Pew Research Center.

<http://www.pewresearch.org/fact-tank/2017/05/19/digital-gap-between-rural-and-nonrural-america-persists/>

²⁵ The average minimum price for broadband in rural Canada is about \$52 per month. Monthly prices in rural Ontario range from \$30 - \$93, compared to \$53 in urban Ontario. See CRTC. (2016). *Communications Monitoring Report*, p. 52 and p. 256.

²⁶ Telecom Notice of Consultation CRTC 2015-134: Review of Basic Telecommunications Services.

<http://crtc.gc.ca/eng/archive/2015/2015-134.htm>. The quotes are from public interventions submitted in the first phase of the consultation, available online at

<https://services.crtc.gc.ca/pub/ListeInterventionList/Default-Default.aspx?en=2015-134&dt=i&lang=e&S=C&PA=t&PT=nc&PST=a>

²⁷ Saleminck, K., Strijker, D., & Bosworth, G. (in press). Rural Development in the Digital Age: A Systematic Literature Review on Unequal ICT Availability, Adoption, and Use in Rural Areas. *Journal of Rural Studies*. <http://doi.org/10.1016/j.jrurstud.2015.09.001>

²⁸ See for example Australian Medical Association. (2017). AMA Position Statement: Better Access to High Speed Broadband for Rural and Remote Health Care - 2016. <https://ama.com.au/position-statement/better-access-high-speed-broadband-rural-and-remote-health-care-2016>; Skerratt, S., Farrington, J., & Heesen, F. (2012). Section 5: Next Generation Broadband in Rural Scotland: Mobilising, Meeting and Anticipating Demand. *Rural Scotland in Focus 2012*. (pp. 70-85). Edinburgh: Rural Policy Centre, Scottish Agricultural College.; and Stenberg, P., Morehart, M., Vogel, S., Cromartie, J., Breneman, V., & Brown, D. (2009). *Broadband Internet's Value for Rural America: Economic Research Report Number 78*. Washington, DC: https://www.ers.usda.gov/webdocs/publications/err78/9335_err78_1.pdf

²⁹ Ivus, O., & Boland, M. (2015). The Employment and Wage Impact of Broadband Deployment in Canada. *Canadian Journal of Economics*, 48(5), 1803-1830.

³⁰ <http://tvo.org/article/about/tvo-decommissions-8-over-the-air-transmitters>

³¹ <http://tvo.org/article/about/tvos-8-over-the-air-transmitters-will-continue-to-send-signals>

³² <https://www.ibm.com/blogs/internet-of-things/iot-agricultural-applications/>

³³ Griffith, C., Heydon, G., Lamb, D., Lefort, L., Taylor, K., Trotter, M., & Wark, T. (2013). *Smart Farming: Leveraging the Impact of Broadband and the Digital Economy*. <http://24green.com/wp->

[content/uploads/2013/08/Smart-Farming-leveraging-the-impact-of-broadband-and-the-digital-economy.pdf](#); Mark, T. B., Griffin, T. W., & Whitacre, B. E. (2016). The Role of Wireless Broadband Connectivity on 'Big Data' and the Agricultural Industry in the United States and Australia. *International Food and Agribusiness Management Review*, 19(A), 43-56.

³⁴ Coble, K., Griffin, T., Ahearn, M., Ferrell, S., McFadden, J., Sonka, S., & Fulton, J. (2016). *Advancing US Agricultural Competitiveness with Big Data and Agricultural Economic Market Information, Analysis, and Research*. http://www.cfare.org/UserFiles/file/10-7-2016BigData_v1.pdf

³⁵ See Department of Commerce Internet Task Force & Digital Economy Leadership Team. (2017). *Green Paper: Fostering the Advancement of the Internet of Things*. Washington, DC:

<https://www.ntia.doc.gov/other-publication/2017/green-paper-fostering-advancement-internet-things>;

McKinsey & Company. (2015). *The Internet of Things: Mapping the Value Beyond the Hype*.

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(2016). *The Internet of Things: Seizing the Benefits and Addressing the Challenges – Background Report for Ministerial Panel 2.2*. Paris:

[http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/CISP\(2015\)3/FINAL&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/CISP(2015)3/FINAL&docLanguage=En). The 2009-2015 Rural Digital Economy Research Hub project, led by researchers at

the University of Aberdeen, offers links to projects on rural applications of the Internet of Things at <http://www.dotrural.ac.uk/iot/>.

³⁶ Department of Commerce Internet Task Force, & Digital Economy Leadership Team. (2017). *Green Paper: Fostering the Advancement of the Internet of Things*. Washington, DC:

<https://www.ntia.doc.gov/other-publication/2017/green-paper-fostering-advancement-internet-things>,

p. 20. Note that this quote comes from comments submitted by the Center for Data Innovation, see the Center's full comments at <https://www.ntia.doc.gov/files/ntia/publications/cdi-2016-ntia-internet-of-things.pdf>.

³⁷ Telecom Notice of Consultation CRTC 2015-134: Review of Basic Telecommunications Services.

³⁸ Telecom Regulatory Policy CRTC 2016-496. <http://www.crtc.gc.ca/eng/archive/2016/2016-496.htm>

³⁹ Telecom Regulatory Policy CRTC 2016-496. Paragraph 21.

⁴⁰ The CRTC's Interconnection Steering Committee is to make recommendations on quality of service metrics to "reflect the objective that broadband Internet access services in rural and remote areas be of similar high-quality as those in urban areas." Telecom Regulatory Policy CRTC 2016-496. Paragraph 110.

⁴¹ Telecom Regulatory Policy CRTC 2016-496. Paragraph 79.

⁴² CRTC (2016), p. 270.

⁴³ Canadian Radio-television and Telecommunications Commission. (2016). Backgrounder: New Funding Mechanism. <http://news.gc.ca/web/article-en.do?nid=1172419>

⁴⁴ Canadian Radio-television and Telecommunications Commission. (2017). CRTC Three-Year Plan 2017-2020. <http://crtc.gc.ca/eng/backgrnd/plan2017/plan2017.htm>

⁴⁵ Telecom Regulatory Policy CRTC 2016-496

⁴⁶ Telecom Regulatory Policy CRTC 2016-496

Canadian Radio-television and Telecommunications Commission. (2016). Backgrounder: New Funding Mechanism. <http://news.gc.ca/web/article-en.do?nid=1172419>

⁴⁷ Innovation Science and Economic Development Canada. (2016). Connect to Innovate Application Guide. https://www.canada.ca/content/dam/ised-ised/documents/pdf/programs/computer-internet-access/connect-to-innovate/CTI_Application_Guide.pdf

⁴⁸ *CRTC Submission to the Government of Canada's Innovation Agenda*. Ottawa:

<http://www.crtc.gc.ca/eng/publications/reports/rp161221/rp161221.htm>

⁴⁹ National Broadband Task Force. (2001). *The New National Dream: Networking the Nation for Broadband Access*. Ottawa: <http://publications.gc.ca/collections/Collection/C2-574-2001E.pdf>, pp. 10-11.

⁵⁰ Telecommunications Policy Review Panel. (2006). *Telecommunications Policy Review Panel - Final Report 2006*. Ottawa: <http://dsp-psd.pwgsc.gc.ca/Collection/lu4-77-2005E.pdf>

⁵¹ Government of Canada. (2010). *Improving Canada's Digital Advantage. Strategies for Sustainable Prosperity – Consultation Paper on a Digital Economy Strategy for Canada*. Ottawa: http://publications.gc.ca/collections/collection_2010/ic/lu4-144-2010-eng.pdf

⁵² Government of Canada. (2014). *Digital Canada 150*. Ottawa: [https://www.ic.gc.ca/eic/site/028.nsf/vwapj/DC150-EN.pdf/\\$FILE/DC150-EN.pdf](https://www.ic.gc.ca/eic/site/028.nsf/vwapj/DC150-EN.pdf/$FILE/DC150-EN.pdf)

⁵³ Saleminck, K., Strijker, D., & Bosworth, G. (in press). Rural Development in the Digital Age: A Systematic Literature Review on Unequal ICT Availability, Adoption, and Use in Rural Areas. *Journal of Rural Studies*. <http://doi.org/10.1016/j.jrurstud.2015.09.001>

⁵⁴ The 2016 mandate letters of all Ontario government ministers are online at <https://www.ontario.ca/page/mandate-letters-2016>. The quotations in this paragraph are from these mandate letters.

⁵⁵ Hillary Hartley took up this position in April 2017. <https://news.ontario.ca/maesd/en/2017/03/ontario-names-first-chief-digital-officer.html>

⁵⁶ See the mandate letters, at <https://www.ontario.ca/page/mandate-letters-2016>

⁵⁷ The importance of digital technologies in cultural production and consumption is highlighted in the province's 2016 culture strategy. Ontario. (2016). *The Ontario Culture Strategy – Telling Our Stories, Growing Our Economy*. Toronto: <http://www.ontla.on.ca/library/repository/mon/30007/335811.pdf>

⁵⁸ Wynne, K. (2016). September 2016 Mandate Letter: Infrastructure.

<https://www.ontario.ca/page/september-2016-mandate-letter-infrastructure>

⁵⁹ A discussion of affordability is beyond the scope of this paper. For a detailed consideration of affordability of telecommunications services see Rajabiun, R., Ellis, D., & Middleton, C. (2016). *Literature Review: Affordability of Communications Services. Report for the Canadian Radio-Television and Telecommunications Commission*. <http://www.ryerson.ca/~cmiddlet/ourresearch/lit-review-for-crtc-2016-affordability-rajabiun-ellis-middleton.pdf>

⁶⁰ See <https://www.fcc.gov/general/types-broadband-connections> for a simple description of the types of broadband connections. For a more technical explanation of the differences in networking technologies, see pp. 14-25 in OECD Directorate for Science Technology and Industry. (2008). *Developments in Fibre Technologies and Investment*. Paris. <http://www.oecd.org/sti/broadband/40390735.pdf>

⁶¹ European Commission. (2016). Commission Staff Working Document Accompanying the Document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society. http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=17182; WIK Consult, Deloitte, & IDATE. (2016). *Regulatory, in Particular Access, Regimes for Network Investment Models in Europe*. Luxembourg. <http://www.wik.org/index.php?id=838&L=1>

⁶² These communities are listed in Template 5 of the Connect to Innovate application guide, accessible at [http://www.ic.gc.ca/eic/site/028.nsf/vwapj/Template5_NewBackbone_CC_WholeSalePricing.zip/\\$FILE/Template5_NewBackbone_CC_WholeSalePricing.zip](http://www.ic.gc.ca/eic/site/028.nsf/vwapj/Template5_NewBackbone_CC_WholeSalePricing.zip/$FILE/Template5_NewBackbone_CC_WholeSalePricing.zip)

⁶³ Innovation Science and Economic Development Canada. (2016). Connect to Innovate Application Guide. https://www.canada.ca/content/dam/ised-isde/documents/pdf/programs/computer-internet-access/connect-to-innovate/CTI_Application_Guide.pdf

⁶⁴ The “last mile” terminology reflects a provider-centric perspective, in that it refers to the last mile of connectivity from the core network to the consumer. Community-centric providers often refer to this connection as the “first mile” as it is the first link from an individual to the internet. This perspective is widely adopted by First Nations communities, as documented by the First Mile Connectivity Consortium at firstmile.ca.

⁶⁵ Fixed wireless broadband provides a wireless connection to fixed location on a building. It is not the same as mobile broadband which provides connectivity to a device (smartphone or portable Wi-Fi hotspot) that can be moved. A fixed wireless signal can be distributed within a building using Wi-Fi.

⁶⁶ These options are discussed in detail in a recent report on improving broadband access in the Arctic. Telecommunications Infrastructure Working Group. (2016). *Arctic Broadband – Recommendations for an*

Interconnected Arctic. https://arcticeconomiccouncil.com/wp-content/uploads/2017/02/AEC-Report_Final-LR-1.pdf

⁶⁷ <https://ec.europa.eu/digital-single-market/en/main-financing-tools>

⁶⁸ <http://qexpressnet.com/system/>

⁶⁹ <http://www.quadro.net/internet/fibre>

⁷⁰ <http://www.hay.net/page/internet>

⁷¹ <https://www.wtcccommunications.ca/residential/internet/fibre>

⁷² <http://www.lakelandnetworks.com/get-gig-lakeland-networks-1-gigabit-fibre/>

⁷³ <http://www.infrastructure.gc.ca/plan/sc-cp-eng.html>

⁷⁴ <http://www.ci.sandy.or.us/sandynet/>

⁷⁵ <http://b.ci.ammon.id.us/fiber-optic/>

⁷⁶ A recent report by University of Pennsylvania researchers

(<https://www.law.upenn.edu/live/news/7099-new-penn-research-assesses-financial-viability-of>)

concluded that the business case for publicly funded networks was weak. This conclusion was quickly refuted by organizations that support the development of public and community-funded broadband networks, who argued that the benefits to communities are extensive and not easily assessed by models that focus primarily on financial returns on investment (<https://muninetworks.org/content/addressing-upenn-report-dud-data-unsuitable-approach>).

⁷⁷ <http://o-net.ca/>; <https://www.oldsinstitute.com/choose-olds/gigabit-broadband-in-olds/>

⁷⁸ <https://b4rn.org.uk/about-us/>. For a description of community-led broadband projects see Ashmore, F. H., Farrington, J. H., & Skerratt, S. (in press). Community-Led Broadband in Rural Digital Infrastructure Development: Implications for Resilience. *Journal of Rural Studies*.

<http://doi.org/10.1016/j.jrurstud.2016.09.004>

⁷⁹ European Commission. (2014). *Guide to High-Speed Broadband Investment, Release 1.1*.

<https://ec.europa.eu/digital-agenda/en/guide-high-speed-broadband-investment>; Swedish Local Fibre Alliance. The Swedish Local Fiber Networks. https://www.ssnf.org/globalassets/in-english/facts-and-statistics/ssnf_thestory_hres.pdf

⁸⁰ <https://www.eorn.ca/en/About-EORN.asp>;

https://icreate5.esolutionsgroup.ca/230002_iCreate_NewsModule//Management/Attachment/Download/52f27b20-7d37-4e28-b8f3-fc14db9e71ce

⁸¹ <http://swiftnetwork.ca/>

⁸² <https://ec.europa.eu/digital-single-market/en/broadband-business-models>

⁸³ Felten, B., & Langer, T. (2016). *Structurally Independent Broadband Infrastructure Can Solve Perceived FTTH Coverage Issues*. SSRN. <https://ssrn.com/abstract=2794850>

⁸⁴ For a list of national broadband policies see Annex 1 in Broadband Commission for Digital Development. (2016). *The State of Broadband 2016: Broadband Catalyzing Sustainable Development*. Geneva. http://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.17-2016-PDF-E.pdf

⁸⁵ There is also extensive information in the academic literature, but this tends to be written for an expert audience and is less accessible to those looking for practical advice on broadband network financing and deployment approaches.

⁸⁶ This exercise could also document the availability of mobile service.

⁸⁷ Ontario's ORION network, supporting research, education and innovation across the province, is one such possibility. <http://www.orion.on.ca/about-us/>

⁸⁸ e.g. as noted in the Northern Perspectives commentary for this paper, Blue Sky Net's *Broadband and Associated Infrastructure Mapping Analysis Project* documents broadband availability in Northern Ontario. <http://www.connectednorth.ca/learn>. The federal Connect to Innovate program also offers extensive mapping of broadband availability, see <http://www.ic.gc.ca/app/sitt/ibw/hm.html?lang=eng>

⁸⁹ Cybera. (2016). *State of Alberta Digital Infrastructure Report*. Calgary. http://www.cybera.ca/wp-content/uploads/2016/09/2016_Digital_Infrastructure_Report.pdf

⁹⁰ Examples of how these approaches have been used in Canadian provinces are found in Rajabiun, R., & Middleton, C. (2013). Rural Broadband Development in Canada's Provinces: An Overview of Policy Approaches. *Journal of Rural and Community Development*, 8(2), 7-22. See also the European Commission.

(2014). *Guide to High-Speed Broadband Investment, Release 1.1*. <https://ec.europa.eu/digital-agenda/en/guide-high-speed-broadband-investment>

⁹¹ <http://www.omafr.gov.on.ca/english/rural/infrastructure-broadband/>

⁹² The record of the CRTC's 2015-134 consultation on basic telecommunications services offers extensive and compelling evidence of the social and economic costs of poor broadband connectivity borne by those in rural and remote Canada.

⁹³ Guidance can be found a European Commission directive on reducing the costs of deploying broadband networks, <https://ec.europa.eu/digital-single-market/news/directive-201461eu-european-parliament-and-council>

⁹⁴ Access to utility poles is regulated by the Ontario Energy Board and is currently under review.

Appendix 1: Resources to Advance Broadband Infrastructure Development

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NORTHERN PERSPECTIVES

Broadband Infrastructure for the Future: Connecting Rural Ontario to the Digital Economy

Charles Cirtwill & Emma Helfand-Green³

Ontario may be “going digital”, but the north is being left behind. Infrastructure investments for internet and cell technology that provide reliable, quality services are still lacking in many areas in northern Ontario, especially rural areas in the remote north (Fig. 1 & 2). The consequences of this lack of infrastructure are real and significant. It acts as yet another barrier to northerners participating fully in a changing economy, accessing advanced education and training and benefitting from public services that are increasingly being delivered online. As Middleton states, “Digital technologies surround us” yet, for many northerners, access remains a barrier. The inequity with regards to access to the broadband infrastructure necessary to engage in these technologies will result in northern Ontario lagging behind and missing out on new and emerging opportunities that are necessary for the future of the region.

Due to the geographic realities of the north, which spans almost 90 percent of Ontario’s geography while representing less than 10 percent of the population, online service delivery in the northern part of the province has real potential. Indeed, healthcare services and educational services delivered online can be an important means for providing and improving access for communities — especially First Nations — located in remote areas (Cloutier, Hoffman Morin & Dabous, 2016, p.6). Although virtual care “cannot replace in-person visits” with health professionals in all cases (Al-Hamand & O’Gorman, 2015, p.8), there are real opportunities to improve conditions for rural and remote populations through internet-based provision. This is especially true as the population of northern Ontario ages, which may result in older adults facing more physical barriers to accessing services in larger, urban centres.

Similarly, “geographical distance and possible isolation of northern Ontario can be considerably reduced through online education (Carter and Graham, 2012, p.1)” which can provide residents with opportunities to gain skills in a changing economy. However, without the appropriate broadband infrastructure, the benefits of this form of service provision cannot be realized.

Economic opportunities in rural and remote northern Ontario are also hindered by a lack of sufficient broadband infrastructure. As Mandy Masse (2016) writes, “By arming communities with opportunities that are unfettered by eternal download speeds and sprawling geography which place knowledge and opportunity out of reach, high speed broadband services can function as a springboard of opportunity for small, northern communities to expand their horizons, and markets.”

Furthermore, the importance of sufficient broadband infrastructure to enable cell and wireless communications are relevant for transportation and tourism in northern Ontario. In fact, a discussion paper released as part of the *Northern Ontario Multimodal Transportation Strategy*, highlights the importance of wireless connectivity for “enabling safer transportation” and argues that enhanced ICT infrastructure could improve the “ability to arrange carpooling, organize shopping assistance among people with limited access to personal vehicles and utilize smartphone apps aimed at improving mobility” (NOMTS, 2016, p.12). All of the above arguments demonstrate the far-reaching consequences to northern Ontario as a result of not being fully connected to the broadband system.

In her paper Middleton highlights the fact that many argue that there is “no business case to extend broadband to areas with low-population densities” (p.16). The Quintillion project described in Middleton’s paper, an initiative to bring fibre-optic cables to Alaska’s Northern coast, demonstrates that there is a business case to be made, with the right information.

³ The authors gratefully acknowledge the contributions to this piece made by James Barsby.

The Broadband & Associated Infrastructure Mapping Analysis Project, completed by Blue Sky Net and funded by FedNor, was a mapping exercise conducted to identify areas in northern Ontario that are underserved in terms of access to broadband. The project identified gaps in existing service areas, the bandwidths available in serviced areas and clusters of demand for the service in under and un-served areas (Connected North, 2017). Through this work, Blue Sky Net hopes to provide necessary information to help provide a better understanding of the demand for service in the north to help businesses develop a business case to improve access to the internet.

A discussion about costs of internet access, although beyond the scope of Middleton’s paper, is critical when thinking about northern Ontario’s unique barriers to online connection. In 2016, it was found that a basic internet plan, providing 5 Mbps internet service, cost between \$25–\$58 per month in urban Ontario, compared to \$30–\$93 per month in rural Ontario. However, 2014 Taxfiler data also shows that average family incomes in northern Ontario are lower than southern Ontario (\$71,532 as compared to \$80,698 respectively), meaning that those with lower incomes are required to pay more for access (Statistics Canada, 2016). Furthermore, First Nations individuals, often living in rural and remote communities, had a province-wide median income of \$22,546 compared to \$36,971 for the non-Indigenous population in 2010 (Leary 2016). The lowest median incomes for First Nations peoples were found in Manitoulin (\$17,249) and Kenora (\$17,404), both districts with significant rural populations (Leary, 2016). Thus, the conversation about access to internet services in northern Ontario must consider price, as many individuals, especially First Nations in rural and remote areas, are required to pay more, even though they earn less.

The development of a province-wide strategy to improve access to quality broadband infrastructure will only become more important in the future. As noted in Middleton’s report, while a number of government initiatives have been announced and are currently in place to address the discrepancy in access, challenges remain. Without collaboration between the various federal, provincial and private and non-profit partners, the ‘digital divide’ between rural and urban, and north and south, will continue, acting as an additional barrier for communities and individuals.

Figure 1: Map of households underserved by 5Mbps Broadband connections Northwestern Ontario in 2015. (Source: <http://www.connectednorth.ca/wp-content/uploads/2015/09/dwellings-underserved-northwest-new.jpg>)

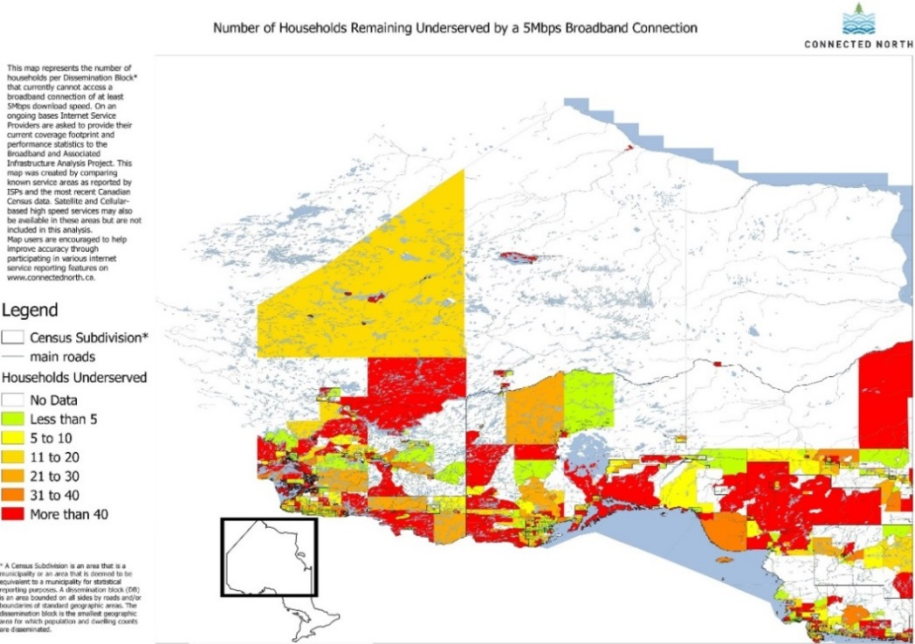
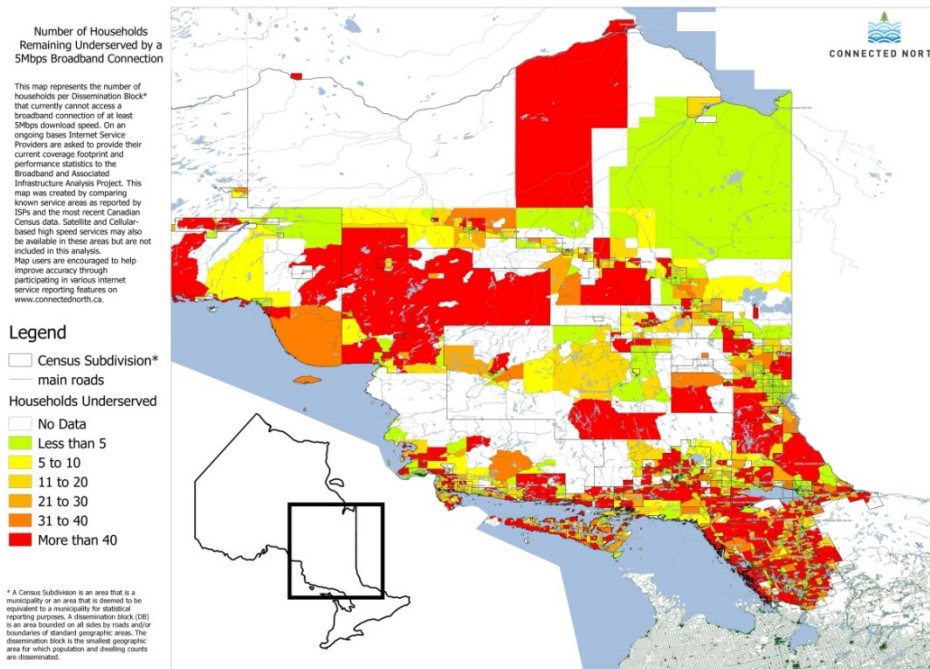


Figure 2: Map of households underserved by 5Mbps Broadband connections Northeastern Ontario in 2015.
 (Source: <http://www.connectednorth.ca/wp-content/uploads/2015/09/dwellings-underserved-northeast-new.jpg>)



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