



**THE CORPORATION OF THE MUNICIPALITY OF TEMAGAMI
SPECIAL COUNCIL MEETING
AGENDA**

Monday, November 4, 2019, 6:30 P.M.

Main Level Chambers

An audio recording of the Open Session of this meeting is being made and will be available through the Municipal Website as a public service to further enhance access to municipal government services and to continue to promote open and transparent government. As a visitor, your presence may be recorded and your name and address may be revealed during certain parts of the Council meeting.

Pages

1. PURPOSE OF THIS SPECIAL MEETING

A Special Meeting of Council to be held on November 4, 2019 at 6:30 in the Council Chambers presenting the Corporation of the Municipality of Temagami and Temagami First Nation Broadband Assessment phase one report.

2. CALL TO ORDER AND ROLL CALL

3. DECLARATION OF CONFLICT OR PECUNIARY INTEREST AND GENERAL NATURE THEREOF

4. DELEGATIONS/ PRESENTATIONS

4.1 Phase One Report - The Corporation of the Municipality of Temagami and Temagami First Nation Broadband Assessment phase one report.

1

Draft Motion:

BE IT RESOLVED THAT Council receive the presentation from Amedeo Bernardi Consulting Inc regarding The Corporation of the Municipality of Temagami and Temagami First Nation Broadband Assessment phase one report.

5. ADJOURNMENT

Draft Motion:

BE IT RESOLVED THAT this meeting adjourn at p.m.

PHASE ONE REPORT

The Corporation of the Municipality of Temagami and Temagami First Nation Broadband Assessment

FINAL VERSION



OCTOBER 1, 2019

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1.0 Introduction

The Municipality of Temagami and Temagami First Nation (“Temagami”) seek to establish an affordable, ubiquitous, and scalable broadband network to enhance connectivity within the region and improve access to a wider global network. As part of this goal, Temagami commissioned this study as a first step to researching, defining and implementing a solution that will improve the availability of services to the communities and industries in the area so to tangibly increase economic diversity in the region.

The key to the success of this project is that it brings together several communities within Temagami that individually might not influence the significant investment required in their region. However, as a collective they have a critical mass that will drive creative solutions, economies of scale and return on investment that potential funders and vendors will take note of. A company might not be able to address a community of 40 homes but combining 400 may enable a sustainable model. However, refer to the section entitled “Recommendations” for additional commentary and suggested direction.

A study was recently published by the University of Tennessee at Chattanooga and Oklahoma State University that underscores the essence of the importance of broadband in rural areas. The researchers stated:

“We find that high speed broadband has significant effects on county-level unemployment rates... We also find measurable benefits to early adoption of high speed broadband. Compared to urban areas, the benefits of better quality broadband are disproportionately greater in rural areas.”¹

The study references the results of other research that suggest high-speed broadband:

- facilitates efficiency, heightens productivity and, likely, fosters innovation;
- positively impacts productivity, growth, employment and poverty levels;

¹ Broadband Speed and Unemployment Rates: Data and Measurement Issues, April 22, 2019

- where not available or is restricted, cuts off many families from e-commerce, banking, health care and other services;
- has impacts in applications to medicine, banking, education, and in the evolution of an entrepreneurial ecosystem; and
- has positive effects on disaster recovery services for businesses and benefits stemming from intelligent traffic systems (ie: smart grid technology).

The researchers take care to delineate broadband and speed, as the terms are now often used interchangeably. It is not enough to say a particular area has access to broadband internet – the speed and quality of that service is paramount. Please refer to the section entitled “High-Speed” that expands on this.

This report encapsulates the results of a desktop and a “ground truthing” (visual site inspection) analysis of the visible broadband infrastructure connecting the communities and the network within each. There is no question that a large broadband gap exists as highlighted in red in the chart².

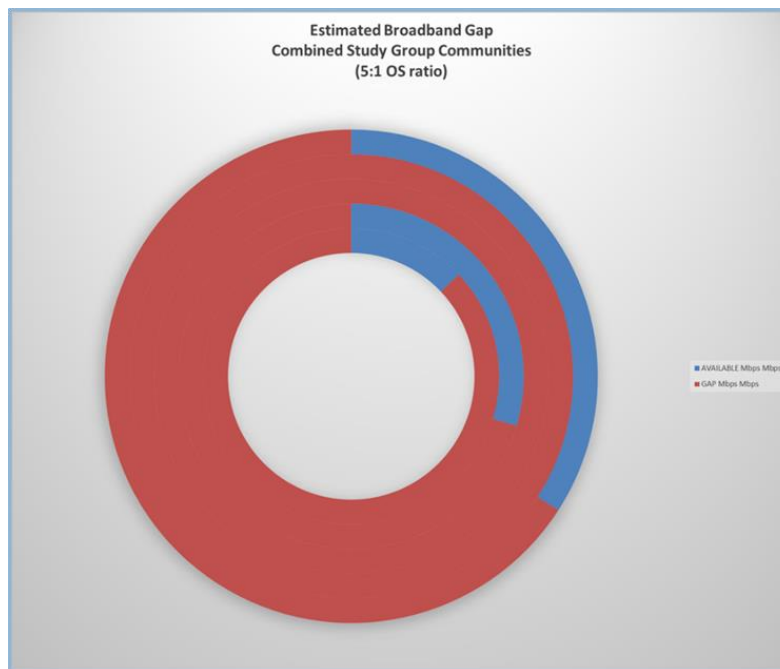


Figure 1: Estimated broadband gap (combined)

² Refer to Section 7.3 for details and assumptions contained in the chart.

To help areas such the Temagami region, the CRTC announced the “Closing the Broadband Gap” policy that sets out the target for all Canadians to have Internet access with speeds of at least 50 Mbps download, 10 Mbps upload and the option of unlimited data. The plan is to invest up to \$750 million over five years to build or upgrade access and transport infrastructure in underserved areas. This report is the first step in aligning Temagami towards meeting the requirements of the funding whose parameters are expected to be announced imminently.

Ontera (owned by Bell Canada) dominates both the regional fibre transport system and the community last mile networks. With Bell having re-absorbed its regionally focused Bell Aliant subsidiary and with the purchase of Ontera, the region has become challenged to attract any of Bell’s national near-term capital investment funding. Therefore, it is critical for Temagami to seek whatever possible funding available so that broadband infrastructure partnerships can be forged with other service providers in the region. One of the Temagami communities might also consider becoming its own regional ISP to ensure ongoing focus and participation in the keystone of the global economy – broadband Internet.

This report is organized into three general areas: the first provides a background on broadband Internet itself, the related Canadian regulatory environment and the basic infrastructure that underlies its delivery. The second area focuses on the regional and local infrastructure, the relative gaps and community recommendations. The last area summarizes the regional risks and respective recommendations, followed by various supporting exhibits.

2.0 Approach to the Study

The Project Lead, Amedeo Bernardi Consulting Inc. was responsible for the following deliverables, and to engage stakeholders as required in order to accomplish the deliverables ss per the Scope of Work document provided to Temagami:

2.1 Phase 1

Research and document the current broadband infrastructure in the region.

Determine the state of terrestrial infrastructure, community needs and engage regional service providers.

Phase 1 – Deliverables:

- Perform a “desktop” gap and needs analysis using publicly available resources and data.
- Conduct site visits to identify visible telecommunications infrastructure in the communities (ground truthing). The study will focus on terrestrial-based services such as existing copper, coax and fibre plant. Buried services will be identified and/or assumed dependent on service markers and/or weather conditions. Mobile and fixed wireless services will be noted where feasible and to the extent service providers will supply information.
- To the extent feasible, engage regional telecommunications service providers as a source of information.
- Prepare, conduct and analyze community-based surveys with the assistance of the Prime Communities.
- Acquire data sets including Speed Test Data* and other statistical information as might be feasible with the assistance of the Prime Communities.
- Provide an overview of relevant regulatory matters that might have an impact on the project (ie: open access policy, basic service determination and potential access to new funding).
- Prepare a consolidated report outlining the current status of regional connectivity, needs, infrastructure gaps, risk matrix and recommendations.
- Prepare a high-level project budget based on the recommended methodologies.
- Provide status updates to the Prime Communities’ project liaison.

***Note: While speed test data was collected as part of the project, the data was unusable due to inconsistencies including cellphone tests and testing from areas outside of Temagami (ie: USA). However, lack of this data has not impacted the exercise as the current network cannot support the CRTC’s 50/10 aspirational goal.**

3.0 Participating Communities

This phase of the project included the Municipality of Temagami (including Temagami Core, Temagami North, Marten River, Lake Temagami) and Temagami First Nation's community of Bear Island (a portion of n'Daki-Menan³).

The Municipality of Temagami has been sub-divided to allow for a more granular review of the state of the broadband network and related gaps. Data for each area or "community" is further detailed in Section 7.4.

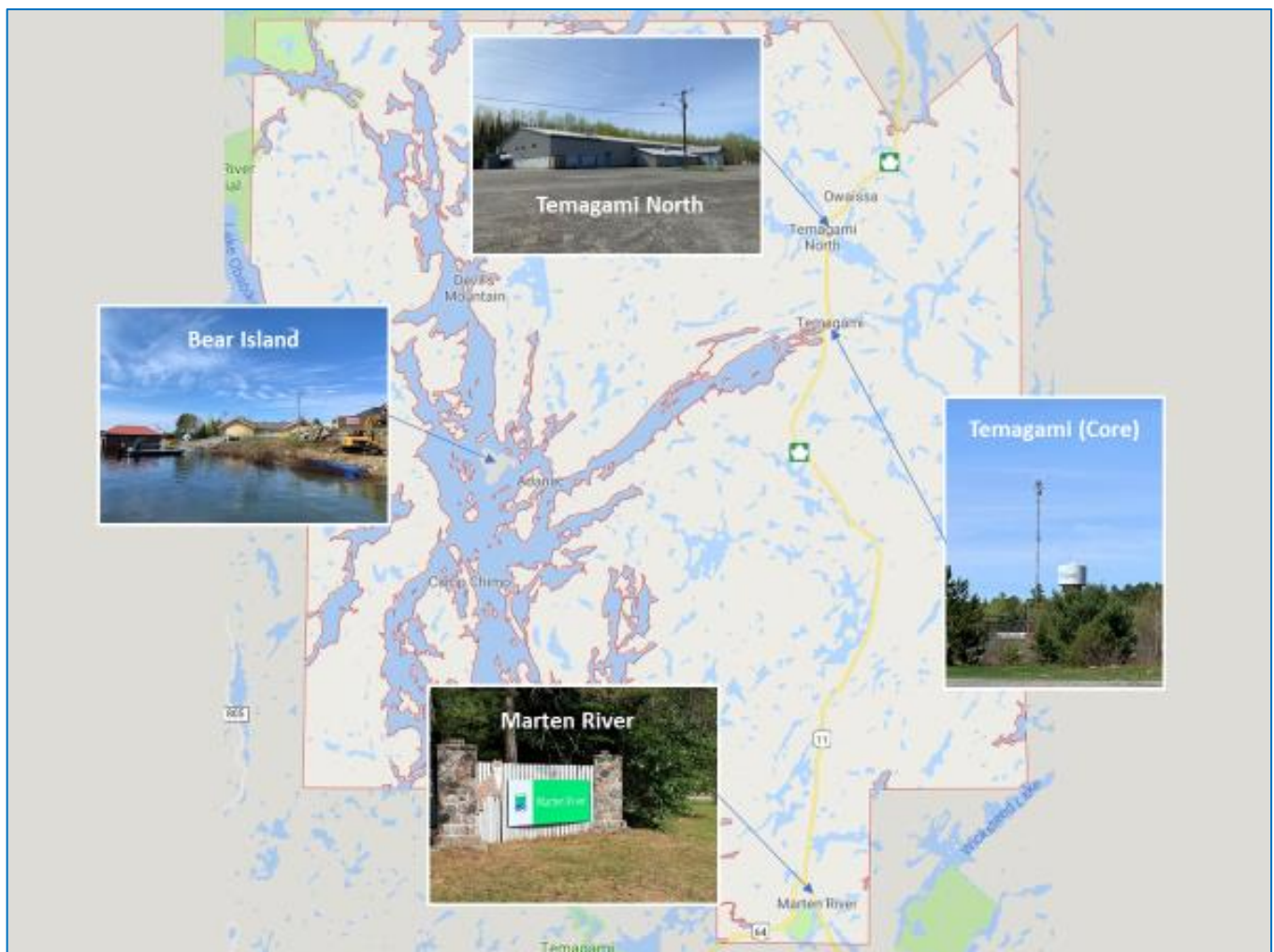


Figure 2: Study areas

³ <https://www.temagamifirstnation.ca/about-us/>

4.0 Broadband Primer

Prior to reviewing the regional and community-specific broadband data, a review of what broadband itself is will be discussed. This section will step through the definition of “broadband” including relevant statistics. The global and Canadian backbones that enable the movement of data will be highlighted to provide insight on the highway system our information travels upon.

4.1 What is broadband?

The CRTC’s 2017 Communications Monitoring Report defines broadband Internet as “high-speed Internet, with access of at least 1.5 Mbps”. In 2016 the CRTC set the well-publicized goals of 50 Mbps download and 10 Mbps upload for broadband Internet by 2021⁴. While it might be possible that a large part of connected Canada can achieve these speeds - as many already do, there will be those areas that continue to languish as they do today. As such, the goal is to reduce from 18 per cent to 10 per cent, the number of homes in Canada that don't have access to those speeds or data by 2021, then down to zero over the subsequent 10 to 15 years.⁵

The Federal Communications Commission (FCC) in the United States changed their current definition of broadband to mean download speeds of at least 25 Mbps and upload speeds of at least 3 Mbps⁶. This has spurred its own debates and issues within the US with regards to funding mechanisms and an overall reset of expectations. It will be interesting to follow this topic and any potential spillover into the Canadian regulatory arena. Thankfully, Canada has not followed in the American regulator’s footsteps with regards to Net Neutrality which will be further discussed in the Regulatory Matters section.

⁴ The State of Broadband Connectivity in Canada’s Rural and Remote Regions 2018 Internet Society isoc@isoc.org

⁵ <https://www.cbc.ca/news/canada/thunder-bay/tbaytel-waiting-crtc-decision-1.4564590>

⁶ The Verge

Broadband Internet can be delivered across a variety of mediums including fibre optics, coaxial cable, copper, fixed wireless, mobile wireless and satellite. Before diving into the details of each, it will help to review the following chart that provides a current snapshot as to the carriers active in the study region and the types of broadband technologies they use in the area. This graphic will be referenced again later in the report and the acronyms will be defined.

	FTTH	FTTN	DSL	Dial-up	HFC	Coax	4G/LTE	2G/3G	Fixed wireless	satellite
Ontera		X	X	X						
Xplornet									X	X
Galaxy Broadband										X
Bell Mobility							X	X		
Rogers							X	X		
Does not include cellular flanker brands (ie: Virgin, Koodo), satellite TV (ie: ExpressVu), telecom resellers (ie: Distributel)										

Figure 3: Study area broadband sources

This list does not represent all the services the companies provide in their telecommunications portfolio, only those specific to broadband in the study footprint. Also, there may be Internet Service Providers (ISPs) and Competitive Local Exchange Carriers (CLECs) in the footprint that are not reflected in the chart above. For the most part, these service providers use Ontera (Bell) or other wholesale services to provide their products in the study area; therefore, they have not been listed above.

Broadband Service Layers

Broadband Internet is delivered to the end-user through three main service layers: passive infrastructure, active network and service delivery. While there are many more detailed and technological models within these, the layers as presented are essentially universal.

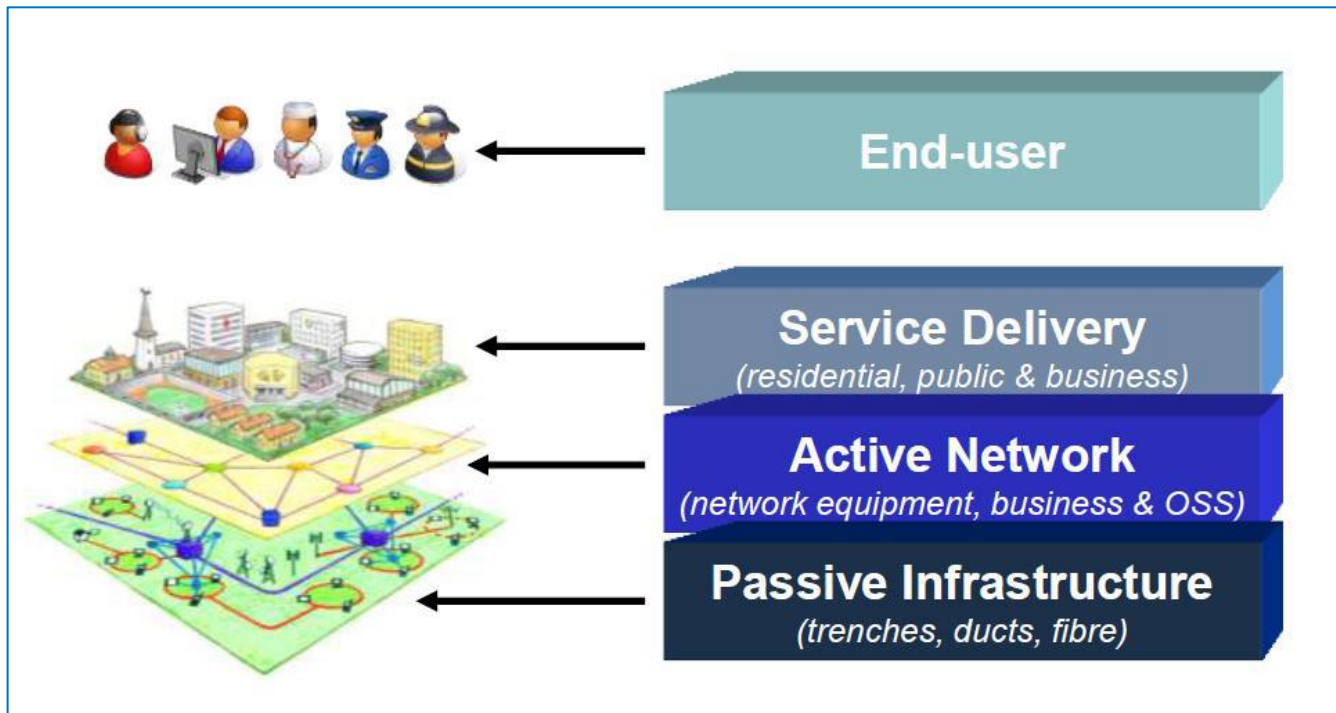


Figure 4: FTTH Handbook, D&O Committee, FTTH Council Europe 2014

The passive infrastructure layer comprises the physical items that are needed to construct the broadband network. Both visible and hidden elements include utility poles, underground ducts, fibre, cable, microwave dishes, towers, equipment racks and so forth.

The active network is made up of the electronics needed to “light up” the passive layer. There are also back office systems such as the operational and billing platforms included in this layer to enable the service provider to commercialize their services.

Finally, the retail services layer comes into play when the other two layers are set. Here the products and services such as Internet and Internet Protocol Television (IPTV)

are packaged and marketed to the consumer. Sales, marketing, and customer service are all part of this layer.

For illustrative purposes, a regional example of these layers could look like the following:

- Passive infrastructure regionally: Ontera's fibre attached to its own telephone poles entering and exiting its own equipment shelters along Highway 11 entering Temagami North.
- Active infrastructure: Ontera electronics housed within the roadside Ontera equipment shelters that repeat and boost the laser-produced light carrying data across the fibre to its Central Office (CO) in Temagami North. Within the CO, Ontera has additional electronics that parse the data into its respective service types for delivery on its copper plant outside of the CO to Ontera's customer base.
- Retail services: Ontera packages, markets and supports its telephone and Internet products for sale to consumers and businesses.

The above model can get somewhat confusing when another service provider either connects to Ontera within its CO to access services directly for distribution in a community on its own passive and active network layers OR if a reseller (usually an ISP) uses the entire Ontera network right to the customer premises and only provides its own retail services. These wholesale and reseller scenarios are typically invisible to the consumer as they receive a bill and service from the retail company.

4.2 High-Speed

While most people might be familiar with the terminology of “download” and “upload”, it is helpful to understand what “high-speed” really means with relation to the Internet. Speed is a combination of bandwidth and latency. For the purpose of illustration, bandwidth is how wide or narrow a pipe is and latency is how fast the material flows within the pipe.

Satellite internet subscribers will be familiar with latency. This is the time it takes for data to travel between points. For satellite services, it can take an appreciable amount of time for data to travel up to the satellite and then get bounced down to the recipient. Excessive latency levels can negatively impact any services that must have precision – ie: telerobotic surgery or even gamers at home.

Bandwidth is the rate at which data flows over the network. This is a measure of throughput (amount per second) rather than speed (distance traveled per second). The following chart illustrates how common network technologies compare in performance to one another.

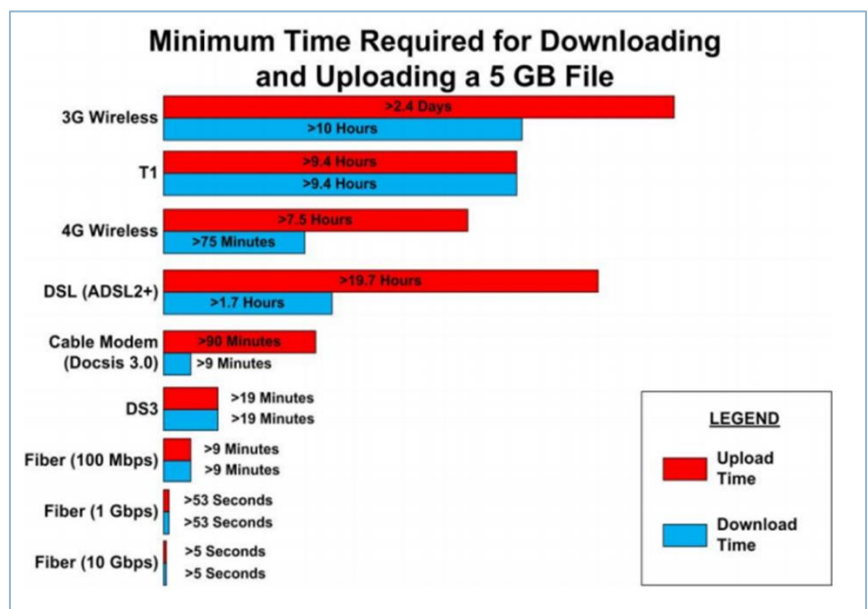


Figure 5: Minimum time required for downloading and uploading a 5GB file

Oversubscription

This is an underlying item that may also affect a customer's Internet performance and a critical component in analyzing system needs and gaps. Oversubscription is similar to the airlines' practice of over-selling seats on particular flight routes. Historical data and customer habits provide the companies with the ability to forecast how many passengers will show up for a flight. As airlines prefer full airplanes, they tend to sell more seats than are actually available in the aircraft. If everyone shows up, then there are issues. It is similar to what Internet Service Providers (ISPs) have to do when forecasting for data usage.

Service providers must employ various calculations when determining how much capacity they need to provide for a particular community or customer situation. As electronics and bandwidth are costly, service providers will typically build to a base forecast and allow for network growth as they monitor actual usage. Simply put, they logically assume that not everyone will be accessing a service at the exact same time and at the maximum capacity. The calculations to determine the needs and gaps in this study use the same logic (see Section 7.3).

4.3 Broadband Statistics

The Canadian Internet Registration Authority (CIRA) publishes an annual report on the state of Canada's Internet. Packed with good information and statistics, it provides a snapshot on several key metrics relevant to this regional study.

More than half of Canadians have at least 5 Internet-connected devices in their homes. As discussed in the preceding section, this not only drives the demand for greater Internet speeds, but also places challenges on the quality of the service due to those aforementioned factors.

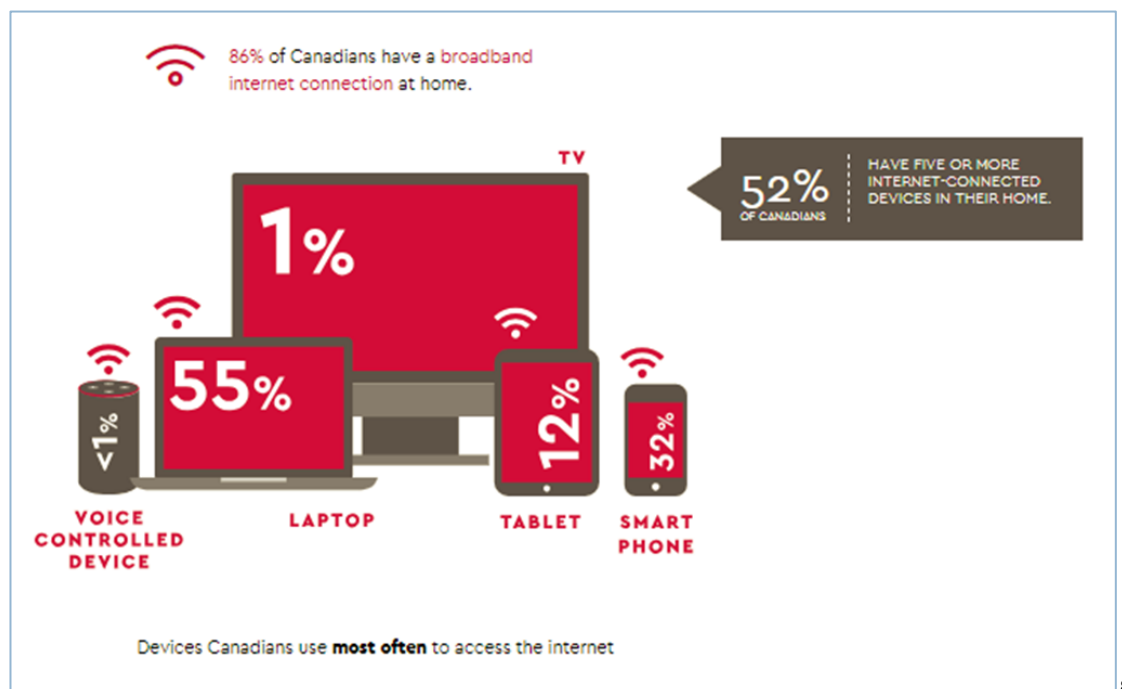


Figure 6: Devices Canadians use most often to access the internet

Service providers constantly monitor their overall network quality and capacity. Key to them is that historically the aggregate cross-industry Internet growth has been consistent at 50% Compound Annual Growth Rate (CAGR). This means the total Internet transit traffic towards a network (or subscriber) from the Internet increases by 50% (ie: 1.5x) every year. This has been the trend since the mid-1990s for most high-

⁸ CIRA - Canada's Internet Factbook 2018

speed Internet providers. Emphasis has been placed on traffic towards the network since the popularity of online video from the likes of YouTube and Netflix accounts for more than 50% of the network traffic as shown on the following chart⁹.

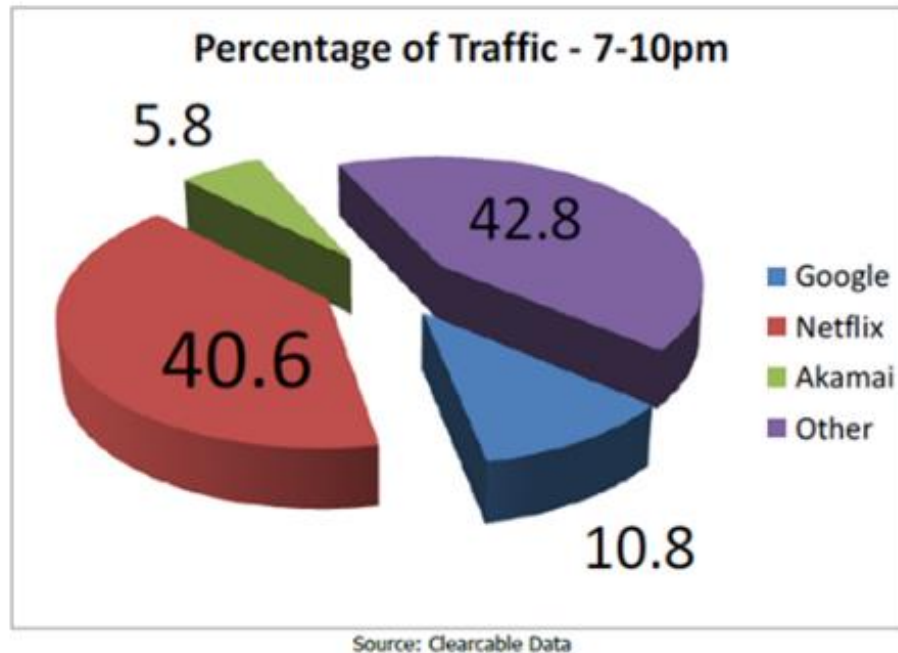


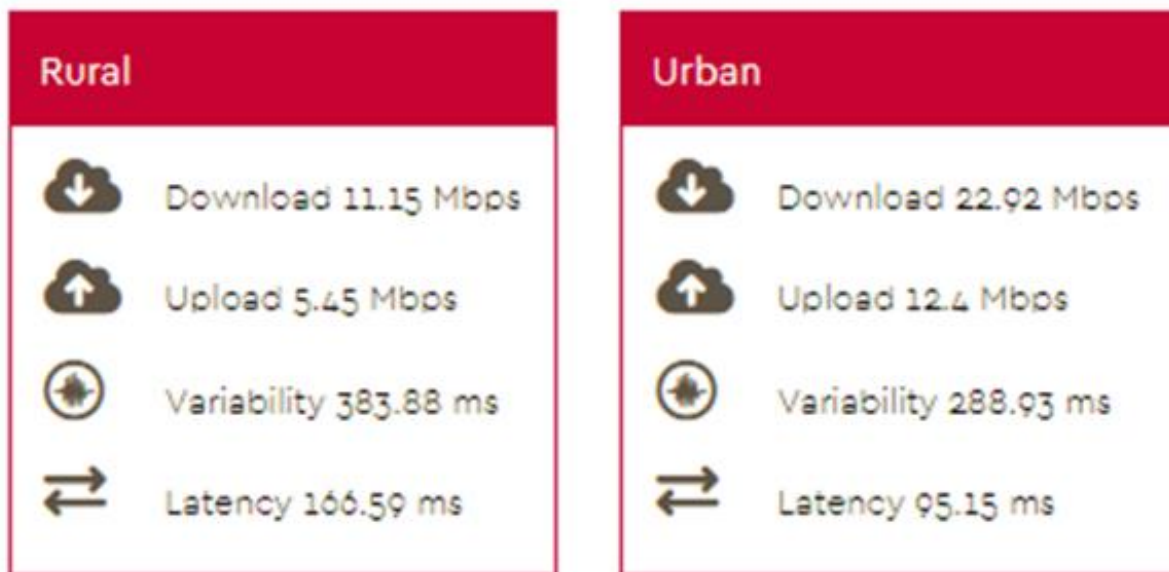
Figure 7: Percentage of network traffic – 7-10pm

Of note, the graphic is a sample snapshot of Internet traffic in the evening between 7pm and 10pm. With the onslaught of Netflix, Internet demand has shifted from predominantly daytime business usage to evening home demand. Add to this Google apps, including YouTube, and the consumer demand is creating inordinate pressure on data requirements for the carriers (the “active network”). Service providers also have to continuously forecast their network data traffic capacities to try to best meet the demands on the system at various times of day. Further, they must calculate the total usage at peak periods to meet the needs of their customers. Based on formulas, historical statistics and the cost of the bandwidth, the carriers will typically over-subscribe the network as discussed in the previous section. If there are 100 homes in a neighbourhood, and everyone purchased a 25Mbps Internet package, it is highly unlikely that every home will be using the maximum at the exact same time; therefore, they plan on a smaller percentage of usage at any one time.

⁹ Clearcable Networks

From a community perspective, carriers need to forecast what they believe the total capacity requirement will be for all their current and potential customers. Homes will have one metric and larger enterprise customers that are contracted for high data requirements will have a different metric. Each carrier calculates their needs differently due to technologies and historical models. In some cases, an ISP might use a ratio of 10:1 or less. In another, a company might assess residential DSL customers at 100:1 and businesses at 50:1 ratio. For example, an ISP that has 1,000 subscribers with 10 Mbps service might contract for a 100 Mbps connection rather than the maximum 10,000 Mbps Internet connection its users might require.¹⁰ As noted above, this is important in trying to determine a particular community's needs versus its apparent service gap. Invariably, the service provider will employ a more conservative model to control costs.

Not surprisingly, CIRA's analysis of Internet performance data concludes that rural Internet users generally experience lesser quality Internet service as noted in the graphic below.



11

Figure 8: Rural vs urban internet quality of service

¹⁰ CTC Technology and Energy

¹¹ CIRA - Canada's Internet Factbook 2018

4.4 Global Network

Taking a few large steps back, it is helpful to understand the high-level interactions that illustrate how data traverses our planet and connects the North to the global ecosystem. The World Wide Web is an intricate and complex mesh of computing and storage devices interwoven across the world. It is also a somewhat recent phenomenon when compared to the lifecycle of plain old telephone service of the past century. This new evolution of communications has given rise to the infamous “Cloud” and “Internet-of-Things” (IoT) that many of us interact with while accessing online music or setting our new thermostats.

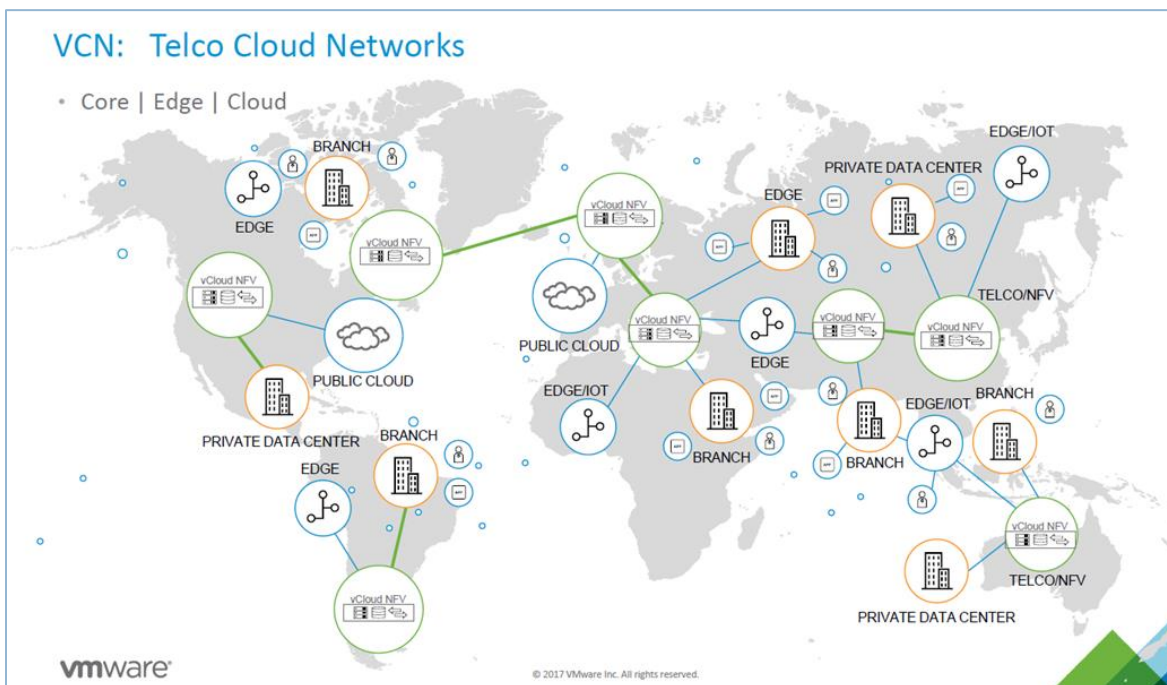


Figure 9: VmWare Inc. cloud networks

Not too long ago, the long-distance telephone network depended primarily on satellites to bounce voice signals across the globe. On the ground, large microwave installations relayed these signals between communities.

Today however, there is an impressive network of undersea fibre optic cables crisscrossing the ocean allowing data to travel at the speed of light from continent to continent. Gone (mostly) are the days of echoes on calls and that perceptible delay (latency) as you waited for your friend to reply to you. It will not be too long before the maps on the following page show the completed undersea fibre network across

Canada's Arctic Ocean – a huge boost for the Far North communities that get connected.

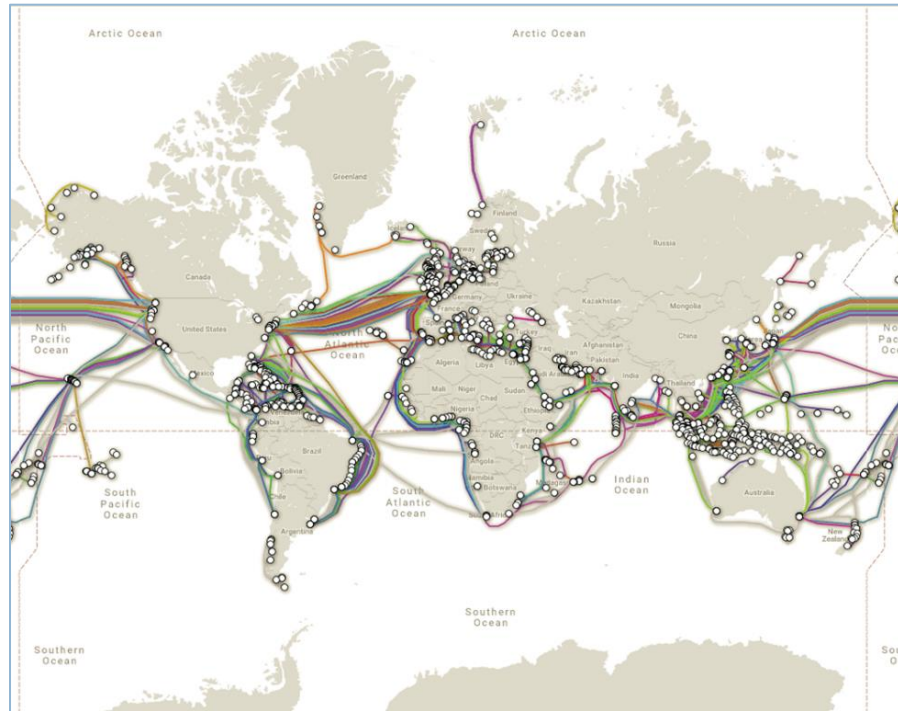


Figure 10: Fibre optics global undersea routes (Huawei Marine)

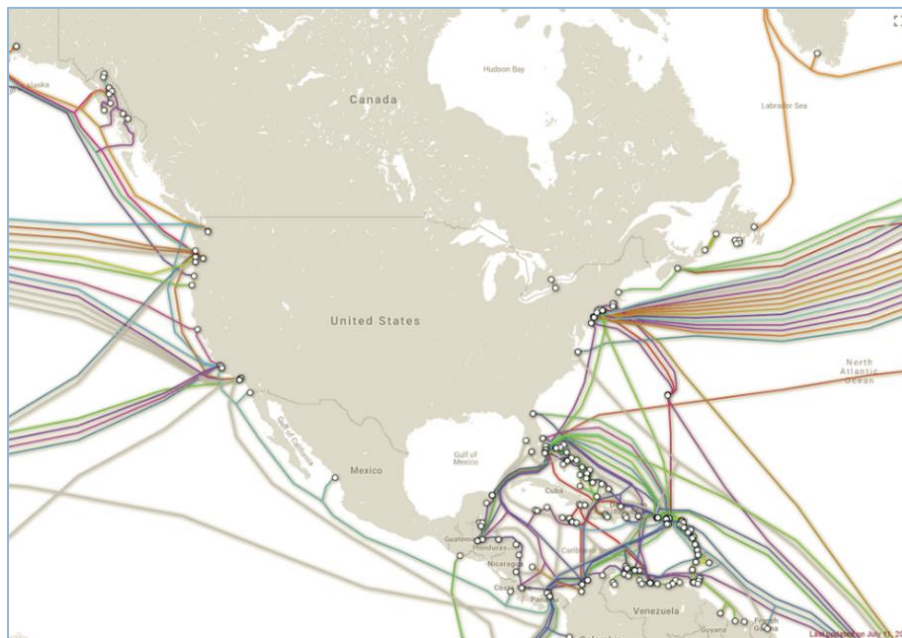


Figure 11: Fibre optics North American landing points (Huawei Marine)

These undersea cables make landfall at strategic locations along the shorelines of their destination countries. From there, ground-based fibre optic transmission routes bring the data in to central data centres, such as carrier hotels.

Canadian Network

All the major communication service providers meet at these data hubs and interconnect with each other so to facilitate the flow of data across their networks and across the country. Given the symbiotic nature of this data exchange, many of the smaller service providers also strive to interconnect at some of these centres to pick-up their traffic at greatly reduced costs and increased efficiencies. However, before discussing data centres, it is important to understand how data traffic gets to these centres and between each other across Canada.

The following map published by Shaw Business is a great example of the predominantly railway based fibre optic transport network across Canada and into key US locations. It also shows the major carrier hotels (indicated by the yellow stars) where Shaw is located so that their potential customers can interconnect with them to buy services. Further to the global fibre maps above, this map shows some of the key international peering locations in New York (to Europe), Seattle (to Asia) and San Jose (to Asia).

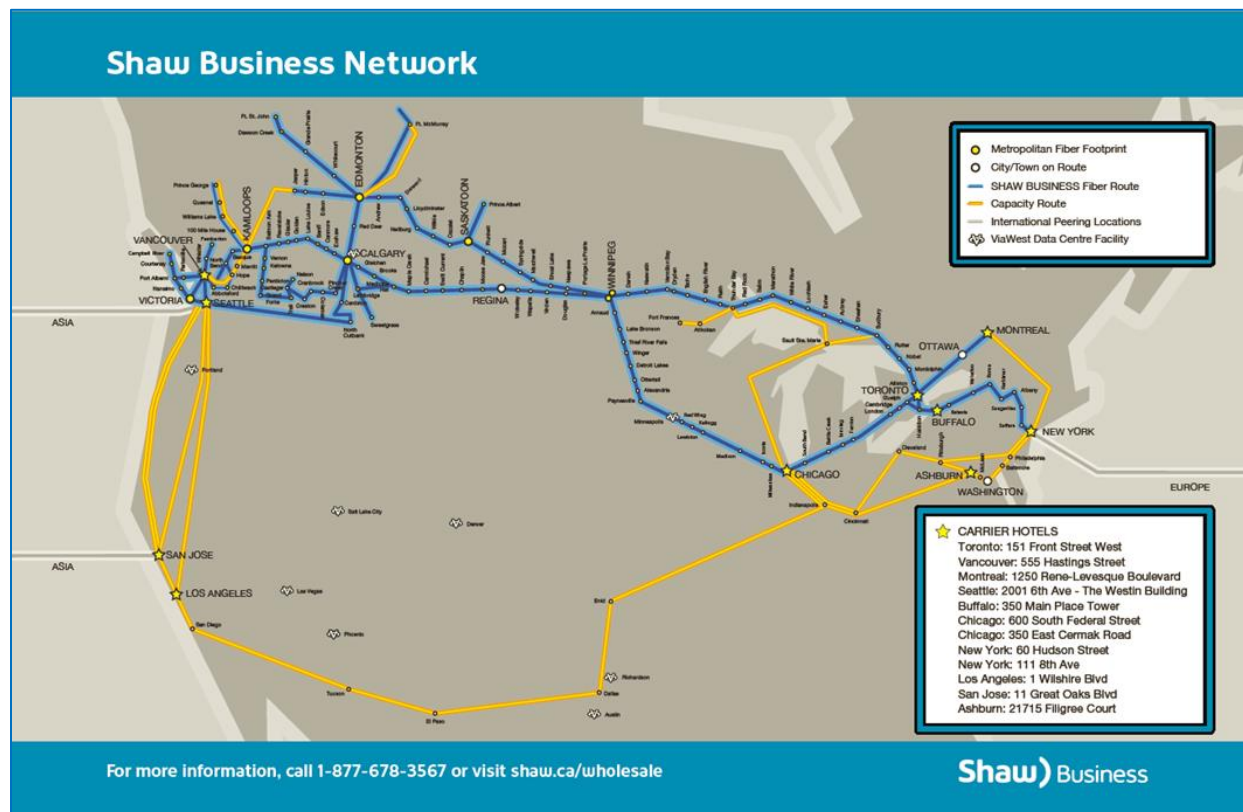


Figure 12: Shaw Business North American fibre routes

The routes shown in the map correspond (mostly) to rail routes. The rail network provides a natural pathway for fibre optic cable to traverse the country. Rail companies own significant Right of Ways (ROW) on either side of their track system and enjoy certain regulatory privileges as was set out in the Railway Act. In most places, rail tracks have priority access across all land (“Dominant Tenement”) which simplifies matters for the carriers and why telecommunications companies negotiated directly with the railways to bury fibre within the rail ROW. It reduced the requirement for other complicated approvals, reduced the need to deal with a plethora of landowners and increased the speed by which they could roll out a cross country network.

While it would seem logical to simply access the national fibre that in many cases intersects a community within the rail ROW, it is typically unfeasible. Fibre equipment shelter spacing was based on the electronics of the time and on rail access. There is limited fibre within the older ROWs as dozens of strands may have been placed years ago which are now at full capacity versus the hundreds (sometimes thousands) that are typically installed now. Upgrades to the electronics to create additional capacity and/or gain access to the fibre are significant.

Data Centres

One of Canada’s most important “carrier hotels” is located at 151 Front Street West in downtown Toronto. Situated alongside Canada’s major railway corridor and in the shadow of the CN Tower, this facility has grown into a secure, hardened technology centre where a majority of Canada’s service providers have either direct access to or connect to those that do.



Figure 13: 151 Front Street West, Toronto

Data centres are incredibly secure and they must have fully redundant systems. Only those with security clearance can access these facilities. The buildings will have at least two diverse fibre entry points, multiple generators and advanced fire suppression systems. Due to the volume of electronic equipment in the facility, cooling is a costly factor to deal with; therefore, electricity rates are a challenge for the operators.

The following graphic shows a typical floor in a centre such as 151 Front Street. On a much smaller scale, the Ontera or Bell central offices in communities have similar configurations as do the equipment shelters at the base of towers or alongside fibre facilities.

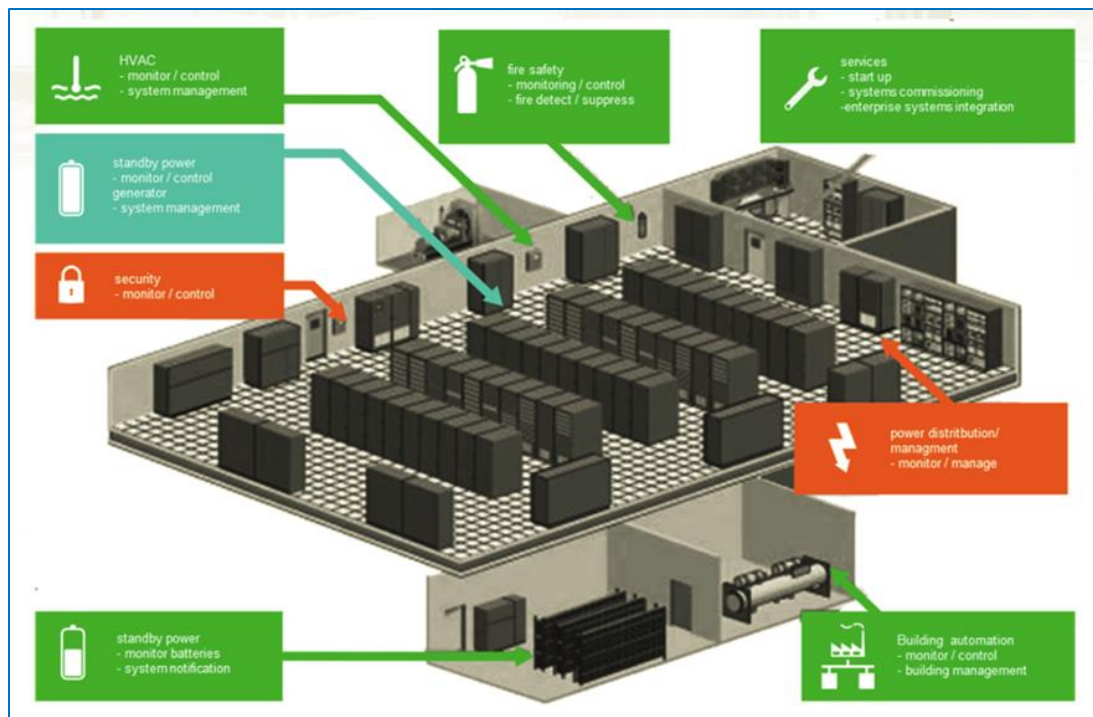


Figure 14: Rebel Networks data centre

The photo shows the rows of equipment cabinets that house the various electronics. Overhead there are cable trays that keep all the wiring organized and safe. Usually cooling is provided underneath the flooring if there are raised floors or ducted throughout the room.



Figure 15: Rebel Networks data centre

Neighbour to 151 Front Street and straddling the other side of the rail corridor, the CN Tower itself is a major communications hub as it was built first and foremost as a large antenna tower. In the bubble beneath the rotating restaurant, there are several levels of massive microwave dishes broadcasting and receiving TV, radio and other data streams across the landscape.



Figure 16: CN Tower, Toronto, ON



Figure 17: CN Tower, Toronto, ON

Internet Exchange Points (IXPs)

IXPs are data centres specific to the exchange of Internet traffic. CIRA points out that one of the benefits to such facilities is that while it brings key Internet suppliers together, it also serves as a way to keep Canadian data within Canada's borders. There are certain classes of data that cannot (or should not) cross into international territory especially due to privacy concerns.¹²

The primary purpose of an IXP is to allow networks to interconnect directly, via the exchange, rather than through one or more third-party networks. The primary advantages of direct interconnection are cost, latency, and bandwidth. It is much cheaper and quicker to exchange traffic directly with each other than to have to send data across distances through multiple carriers. Each step adds time (latency) and consequently costs.

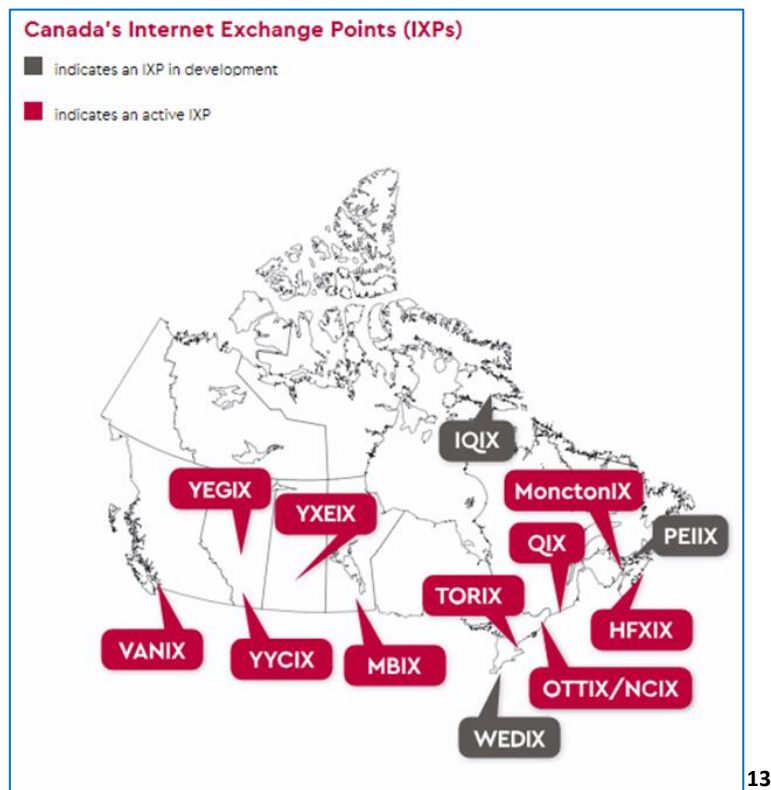


Figure 18: Canada's Internet Exchange Points (IXPs)

¹² CIRA.ca

¹³ CIRA.ca

5.0 Regulatory Overview

The Canadian telecom market is constantly transitioning – as are all technology-based sectors – from a once legacy era to new technologies able to deliver telephony services along with a plethora of other cutting-edge applications. Many of Canada’s telecom service providers “TSPs” have existed for over a century established at the same time railways were being built and telegraph lines installed alongside them. However, while technology has been evolving rapidly, changes to Canada’s telecommunications regulatory regime have been slow and deliberate. There are those that argue it has been far too slow and even question its relevance in a free market; however, there is no question as to its importance in trying to bring digital equity to the underserved areas of Canada.

The telecommunications industry in Canada is governed by the federal Telecommunications Act. As such, any service provider in Canada must abide by the rules and regulations that are administered through the Canadian Radio-television and Telecommunications Commission (CRTC).

The Department of Innovation, Science and Economic Development Canada (ISED) plays a key role in the promotion of broadband in Canada and works closely with the CRTC to promote and drive the Federal Innovation Agenda. It has become increasingly apparent that both the CRTC and ISED are intrinsically linked in bringing about Canada’s broadband growth. The CRTC recently announced “Connected – Closing the Broadband Gap”, a \$750 Million fund to be distributed over five years. Meanwhile, ISED rolled out the \$500 Million “Connect to Innovate” fund.

With the advent of high-speed broadband and big data pipes, everything from voice services through to a wide array of media can stream across the Net. In the past it was easier to delineate between the infrastructure and technologies that delivered broadcast services such as television and radio versus that of telephone services. Now the Internet has brought about a ubiquitous pipe that is seemingly limitless in terms of the content and services it can serve up globally. More often than not, the telecommunications and broadcasting silos are being knocked down as carriers have

diversified their products and services. Both Bell and Telus have become two of Canada's largest television broadcasting companies with their IPTV deployments. Similarly, Shaw has expanded into telephony, including mobility with the recent purchase of Freedom Wireless.

Setting policies and rules to oversee these continuously interweaving areas and administering them continues to be a challenge. This section will focus on the CRTC and ISED, and some of the more important decisions and policies that they have introduced in relation to broadband. The section will close with an overview of the industry's telecommunications service provider framework.

5.1 Canadian Radio-television and Telecommunications Commission (CRTC)

The CRTC is an administrative tribunal within the Government of Canada that is responsible for regulating and supervising Canada's communication system in the public interest. The CRTC operates under a number of legislative authorities and Acts of Parliament. These include the following: the CRTC Act, the Bell Canada Act, the Broadcasting Act, the Telecommunications Act, Canada's Anti-Spam Legislation (CASL) and the Canada Elections Act, which includes provisions that established the Voter Contact Registry (VCR).¹⁴

The Commission, as it is otherwise referred to, reports to the Minister of Canadian Heritage. It is comprised of the Chairperson, Vice-Chairperson of Broadcasting and Vice-Chairperson of Telecommunications. There can be up to 13 Commissioners, all federal Cabinet appointees.¹⁵ While the Commission is politically appointed, it acts at an arm's length from the government in more of a judicial-like manner whereby it tends to make decisions much in the same way a court would based on evidence and consultations.

¹⁴ CRTC THREE YEAR PLAN 2017-2020

¹⁵ <https://crtc.gc.ca/eng/acrtc/organ.htm>

The Telecommunications Act sets out what elements and services are to be regulated. Over the years, the CRTC has rendered many decisions and policies that have guided Canada's broadband industry. However, under certain conditions, the CRTC is able to "forbear" or "refrain" from regulating all or part of a service. This is the case with Internet services, allowing the industry to operate in a more market-based manner. It has refrained from the direct regulation of rates, enforcing quality of service issues, or overseeing the business practices of Internet service providers (ISPs) unlike its regulation of certain telephone voice services.

In 2006, the Government of Canada directed the CRTC to rely on market forces as much as possible. In some markets, several consumer choices are available, resulting in natural competition that brings better prices for consumers. In these cases, the CRTC limits regulations and allows competition to drive the market; in other markets, CRTC regulation is necessary.¹⁶

5.2 Innovation, Science and Economic Development

The Department of Innovation, Science and Economic Development (ISED) was previously known as Industry Canada. It is comprised of 17 federal departments and agencies, including the Federal Economic Development Initiative for Northern Ontario (FedNor). There are four Ministers that form the senior leadership of this portfolio. The Minister of Innovation, Science and Economic Development has purview over broadband technology matters and spectrum management.

The Minister of Innovation, Science and Economic Development, through the Department of Industry Act, the Radiocommunication Act and the Radiocommunication Regulations, with due regard to the objectives of the Telecommunications Act, is responsible for spectrum management in Canada. As such, the Minister is responsible for developing national goals and policies for spectrum utilization and for ensuring effective management of the radio frequency spectrum resource.¹⁷

¹⁶ <https://www.thecanadianencyclopedia.ca/en/article/canadian-radio-television-and-telecommunications-commission/>

¹⁷ https://www.ic.gc.ca/eic/site/icgc.nsf/eng/h_00022.html

While the CRTC “regulates and supervises” according to the Acts; ISED is responsible for the legislation of the Acts themselves, most relevant to this report being the Telecommunications Act. The ISED is also the driver behind the federal government’s Innovation Agenda to bolster Canada’s economic development and global competitiveness. It has introduced six areas for action of which the fifth, “Compete in a Digital World” links directly to broadband:

“Canada must also do more to give rural communities and low-income Canadians affordable access to high-speed Internet so that they can participate fully in a digital and global economy for a better quality of life.”¹⁸

The Connect to Innovate (CTI) initiative was a direct output of this action area.

5.3 Regulatory Matters

There have been an innumerable amount of policy directives and decisions rendered by the Federal government with regards to the telecommunications industry over the years. The larger telecommunications companies have sizeable regulatory staffs and outsourced legal firms to try and keep up with the requirements as set forth by the government. Add in an ever-expanding service portfolio by the companies, and the task becomes more complex to ensure compliance in the eyes of the CRTC. There is also quarterly, semi-annual, and annual reporting that most carriers must comply with, except for the very smallest of them.

This section will highlight some of the more recent and relevant decisions and policy directives as they relate to broadband especially within the study region.

Open Access (Net Neutrality)

Unlike the ongoing battle in the US over Net Neutrality, Canada has not had the same level of concern in maintaining open access. Within the Telecommunications Act... “internet service providers are treated like utilities, and there are rules around how they can act. There are two key rules in particular: service providers can't give ‘undue

¹⁸ Positioning Canada to Lead: An Inclusive Innovation Agenda

or unreasonable preference’ — say, to one application or online service over another — nor can they influence the content being transmitted over their networks. Those rules were put in place in 1993, and they pretty much form the bedrock for net neutrality in Canada today.”¹⁹

The Federal Communications Commission (FCC) in the United States is a much more politically charged organization as was recently witnessed by the appointment of the Republican’s choice for Commissioner. The CRTC Commissioners are also government appointees, but the Commission does operate more as a court as discussed above. There are several States that are trying to have the American Net Neutrality decision reversed and undoubtedly that fight will continue to wage on. The Canadian public and all of the lower tier telecommunications service providers continue to be very active and extremely vocal ensuring that open access remains as an infeasible right — not to say there won’t continue to be pressure by those that would like to see some relaxation of the policies in the future.

Broadband Internet Decision

Telecom Regulatory Policy CRTC 2016-496²⁰

This Decision also is known as “Closing the Gap” or the “Faster Internet” decision. In it, the CRTC made several landmark announcements.

The Commission has recognized and declared that both (i) fixed and mobile wireless broadband Internet access services, and (ii) fixed and mobile wireless voice services are now considered basic telecommunications services. This marks a change from the long-held regulatory focus on wireline services, such as landline telephone, along with the subsidy mechanisms that supported those services.

With a focus on broadband Internet, the CRTC has now provided the industry the regulatory mandate to invest efforts in ensuring all Canadians, regardless of location, receive what it considers this revised universal service objective.

¹⁹ “Why Canada's net neutrality fight hasn't been as fierce as the one in the U.S.”

²⁰ Telecom Regulatory Policy CRTC 2016-496

As such, the CRTC Decision sets out the following objectives:

- Canadians in urban, rural, and remote areas can access affordable, high-quality telecommunications services;
- telecommunications companies continue to invest in, and various levels of government continue to fund robust infrastructure that can be upgraded in the future and that is capable of providing high-quality telecommunications services to Canadians across the country;
- Canadians can access innovative service offerings that enhance social and economic development; and
- Canadians can make informed decisions about their telecommunications services.²¹

To meet these objectives, the CRTC has set forth the target for all Canadians to have Internet access with speeds of at least 50 Mbps download, 10 Mbps upload and the option of unlimited data.

The Commission has announced that it will alter the way it will start to calculate and collect subsidies from the telecommunications service providers so to create a new funding mechanism. The plan is to invest up to \$750 million over five years to build or upgrade access and transport infrastructure in underserved areas. For the first year of the fund, no more than \$100 million will be distributed. This amount will increase by \$25 million annually over the following four years to reach an annual cap of \$200 million.

This initiative is meant to be in addition to other government programs and funding. Specifically, the CRTC points out that... “this decision complements the Government of Canada’s Innovation Agenda, notably the action area of competing in a digital world.” This in reference for example, to ISED’s Connect to Innovate fund (CTI).

The CRTC held public consultations on this Decision in 2017 and provided a skeleton outline of certain mechanisms it believes should be included as documented in Telecom Notice of Consultation CRTC 2017-112, which should bode well for the region.

²¹ Telecom Regulatory Policy CRTC 2016-496

The Commission has just released in application process for Northern Canada including satellite dependent communities and will open applications for the remainder of Canada by Fall 2019.

Fibre Access Decision

Telecom Decision CRTC 2016-379 (Follow-up to Telecom Regulatory Policy 2015-326) Implementation of a disaggregated wholesale high-speed access service, including over fibre-to-the premises access facilities

Directly related to Telecom Regulatory Policy CRTC 2015-326, this Decision was rendered to set out and clarify the myriad of technical details and costing required for the large incumbent carriers to adhere to. This applies to both telecom and cable incumbents.

The intent is not to provide an analysis of the various architecture and interconnection details, but rather highlight that both this decision and the related Policy will enable competitive service providers in the region access to higher performing network elements and services of the incumbents. This can then translate into a greater choice of providers and competitive pricing once fully implemented.

5G and the 3500 MHz Band

Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band

The next generation of wireless technology is expected to offer faster speeds with less lag time and support many more connected devices. To build networks that offer broad coverage and also the high-speed transfers of large amounts of data, telecom providers will need to use a mix of different types of airwaves, known as spectrum. Lower-frequency airwaves can travel farther while high-band spectrum carries more data.²²

The ISED had started a consultation process regarding revisions to the wireless spectrum 3500MHz and related bands. This consultation has driven increased media

²² "Ottawa reveals plans for upcoming auctions for wireless spectrum" Christine Dobby, Globe and Mail, June 5, 2019

attention since it is linked to the eventual roll out of 5G and its possible negative impacts fixed wireless spectrum used in rural and remote settings.

ISED acknowledges that 5G is still a distance away from full commercialization, but it has to proactively study the 3500 MHz band to make sure Canada stays in step with the global market – especially that which will set the manufacturing standards for 5G enabled technology such as smartphones. It is also keenly aware of the importance of 3500 MHz in rural coverage.

“For example, given Canada's geography and widely dispersed population, it can be difficult to make a business case for the deployment of new innovative services in some rural and remote areas of the country. Consequently, some rural areas may continue to rely on fixed wireless access in the 3500 MHz band over a longer period of time than urban areas. As such, and in accordance with one of the objectives of the Telecommunications Act—to promote the availability of reliable and affordable services to all regions of Canada—ISED continues to consider options for promoting access in rural areas within the context of managing this spectrum resource, and within a broader policy context, noting that challenges may vary based on geography, population density and the state of the marketplace.”²³

The ISED's policy objectives for the 3500 MHz band are to:

- foster innovation, investment and the evolution of wireless networks by enabling the development and adoption of 5G technologies;
- support sustained competition, so that consumers and businesses benefit from greater choice; and
- facilitate the deployment and timely availability of services across the country, including rural areas.

As such, the ISED announced that it will initiate a claw back of a portion of 3500 MHz spectrum held by several service providers in preparation for a spectrum auction in 2020. Currently, spectrum in the 3,500-MHz band is designated only for “fixed-wireless” use, which means telecom operators use the airwaves to deliver internet

²³ <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11298.html>

service using communications towers and wireless signals. However, in next year's auction they will be deemed as "flexible use", suitable for either fixed wireless or mobile service, key for larger service providers seeking to cover dense urban cellular footprints.

Xplornet, a national carrier that primarily serves customers just outside urban centres and remote areas through a combination of wireless, satellite and fibre optics, said earlier this year it planned to spend \$500 million over five years to provide 5G wireless and faster internet in rural parts of Canada.²⁴ It is one of the companies, along with Bell and Rogers that will be impacted by the claw back. Refer to the section entitled "5G" for additional details.

Tower Sharing

CPC-2-0-17 — Conditions of Licence for Mandatory Roaming and Antenna Tower and Site Sharing and to Prohibit Exclusive Site Arrangements

The Canadian cellular industry has gone through several infrastructure build phases over the years as technologies have changed and coverage has increased. The wireless carriers have always considered their towers as strategic assets and have been hesitant to allow colocation, unless they could get a strategic location from the other carrier. There have been many attempts by cellular entrants to deploy their own network services. Increased tower requests were being made at municipalities and the residents began to push back with NIMBY – Not In My Back Yard. All levels of government were demanding that cellular companies cooperate to allow colocation and therefore reduce the number of towers appearing next to each other.

Finally ISED released revised conditions of licencing for wireless carriers stating that... "the Licensee must facilitate sharing of antenna towers and sites, including rooftops, supporting structures and access to ancillary equipment and services ("Sites") and not cause or contribute to the exclusion of other telecommunications common carriers from gaining access to Sites."²⁵

²⁴ "Ottawa looking to balance tensions between telecom carriers, consumers" David Paddon, The Canadian Press, June 5, 2019

²⁵ <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09081.html>

Unfortunately, even with this condition, there are still enough exclusions that colocation requests are often prevented or greatly impeded. The lack of willing colocation can impact the region as wireless ISPs (WISPs) or other cellular companies look to cover communities and/or existing transportation corridors as effectively as possible.

Pole Attachment Fees Increase

The OEB's New Wireline Pole Attachment Framework: Updated Single Provincial Pole Attachment Charge

The Ontario Energy Board is the provincial body that regulates, amongst other things, electricity rates and utility pole access fees. Their recent decision to almost double the per pole rental fee from \$22.35 to \$43.63 has sparked an uproar amongst all the companies that have to attach to utility poles to carry their facilities.

In the view of the OEB... "Elements of the underlying methodology as well as certain costs were updated in favour of electricity ratepayers, while other elements were updated in favour of carriers. In the OEB's view, the increase in the charge is reasonable given the benefit that carriers have received over the last 13 years. Unlike the majority of electricity distribution customers, carriers enjoyed the benefit of what was essentially a rate freeze."²⁶

The Ontario Broadband Coalition was formed by a large cross-section of service providers and special interest groups. It points out that the new rates make Ontario's pole fees the most expensive on the continent and almost double that of the rest of Canada.²⁷

Rock is prevalent in Northern Ontario which makes burying fibre optic cable untenable for any business case. For smaller providers, installing their own poles can also negatively impact any decision to bring new service to a community. The increased fee also jeopardizes those providers that currently use these poles and will in turn affect customers as prices may have to rise.

²⁶ EB-2015-0304 Report of the Ontario Energy Board Wireline Pole Attachment Charges March 22, 2018

²⁷ <http://ontariobroadbandcoalition.ca/>

Recently, the Doug Ford government committed to reviewing these fees, among other policy items, in a bid to encourage additional broadband deployment.

Final rates for aggregated wholesale high-speed access services

Telecom Order CRTC 2019-288

On August 15, 2019, the CRTC issued Telecom Order CRTC 2019-288 that set off a media barrage by the large incumbents, blasting the Commission for setting low wholesale rates for access to their networks by other service providers. Bell Canada led the offensive declaring that they would stop investing in the roll-out of their Fixed Wireless broadband internet network. They stated that they would no longer deploy the last 200,000 households in their rural internet expansion program and will reassess all of their other broadband projects. Many of the other larger telecom and cableco's also stated they would adjust their broadband projects, particularly impacting rural and remote regions across Canada.

As stated in a release by the CRTC:

*"To foster competition at the wholesale level, the CRTC requires that large companies sell access to their networks under specific terms and conditions. Service providers use this access, with their own networks, to offer Internet and other services to their own retail customers. In other words, independent service providers are wholesale customers of large cable and telephone companies. The CRTC sets the rates at which telephone and cable companies may charge their wholesale clients. The rates are based on the costs that the large cable and telephone companies incur to provide the wholesale service, and include a reasonable markup."*²⁸

While this is a significant decision by the CRTC, it does not necessarily impact the Study Region as Ontera is the registered service provider. Even though it is part of Bell, Ontera operates within its own tariffs thus the effects will need to be analyzed further. However, in larger centres where companies such as TekSavvy make heavy use of the underlying Bell network to access its clients, this outcome will provide a marked cost

²⁸ <https://crtc.gc.ca/eng/internet/facbill.htm>

savings to their operations that, one assumes, will provide the capacity for increased competition in pricing.

At time of writing, the large cable companies have filed a notice of motion with the Federal Court of Appeal to appeal the CRTC's ruling on wholesale internet rates.

M-208, Rural Digital Infrastructure

Rural Wireless Digital Infrastructure: A Critical Role

*"On 8 May 2019, the House of Commons unanimously adopted Private Member's Motion M-208, calling on the House of Commons Standing Committee on Industry, Science and Technology (the Committee) to study approaches to encourage wireless infrastructure deployment in rural Canada, given that this infrastructure is critical, particularly during a crisis. The Committee acknowledges that considerable effort has been made in recent years to improve connectivity in Canada, particularly in rural and remote areas. However, it is worth conducting a more in-depth study of how these initiatives can further wireless infrastructure deployment in rural and remote areas, as well as a more in-depth review of available, reliable, and authoritative data and analysis on connectivity in these areas. This infrastructure is critical for rural Canadians, not only during emergencies or natural disaster, but also in their daily lives. The Committee expresses concerns regarding the appropriateness of the CRTC's stewardship of the deployment of wireless infrastructure in rural and remote areas, and the amount of time it is taking to provide solutions."*²⁹

The Committee has made the following recommendations:

- Consider prospective solutions to address gaps in wireless infrastructure deployment in rural Canada.
- Study ways to improve wireless infrastructure availability and reliability to ensure optimal performance in all circumstances and particularly, in an emergency.
- Ensure that when allocating spectrum licenses, the interests of rural areas are considered.

²⁹ <https://www.ourcommons.ca/DocumentViewer/en/42-1/INDU/report-18/page-ToC>

- Support and encourage the development of innovative ways to provide digital wireless services in rural areas to improve connectivity in areas where deploying wireless and/or wired infrastructure is physically and economically challenging.
- Treat mobile services as essential to both the safety of the public and participation in the modern economy, particularly in rural areas that are currently unserved or underserved.

Connect to Innovate (CTI)

The Connect to Innovate program was the outcome of the ISED's Innovation Agenda action area "Compete in a Digital World". CTI was introduced as part of federal Budget 2016 as a five-year initiative committing \$500 million to extend and improve broadband service in rural and remote communities. The intake for applications closed in 2017; however, this summary was included as the CTI process might serve as a window to the CRTC "Closing the Broadband Gap" fund.

The ISED stated that there is... "a focus on supporting new backbone infrastructure projects that connect public institutions like schools, hospitals and First Nation band offices. A portion of funding is also available for backbone infrastructure upgrades and last-mile projects connecting underserved households and businesses currently lacking service at speeds of 5 Megabits per second (Mbps).³⁰

The most recent Federal Budget allotted additional funds to the CTI program to surpass the original \$500M. At the time of writing, there has been \$517.6M awarded with additional projects being announced.

³⁰ <https://www.canada.ca/en/innovation-science-economic-development/programs/computer-internet-access/connect-to-innovate/announced-projects.html>

5.4 Telecom Service Provider Categories

The CRTC defines a Telecommunications Service as “any service involving the use of telecommunications in whole or in part and which is provided by any person, organization, unit, or legal entity to any other private person, organization, unit, or legal entity. Telecommunications services include both regulated and unregulated services, such as the provision of Internet access”.³¹ It further defines telecommunications as “any emission, transmission, or reception of intelligence by any wire, cable, radio, optical, or other electromagnetic systems.”³²

A Telecommunications Service Provider (TSP), otherwise referred to as a “service provider” or “carrier” in this report, must register with the CRTC – regardless of size. This includes Voice over IP (VoIP) services, wireless services and Internet services to name a few. It does not mean that the CRTC directly regulates the actual business operation, but it must be registered, nonetheless.

The CRTC subdivides the different types of TSPs into two major categories, namely “facilities-based” or “non-facilities-based”. As the terms imply, the first group provides services over transmission facilities that they either own or operate, the second essentially re-sell services over another provider’s network facilities.

Facilities-Based-Providers

These types of telecommunications entities own or operate transmission facilities as defined in the Telecommunications Act, such as:

- Incumbent Local Exchange Carriers (ILECs) - facilities-based incumbent provider of local voice services. These are the large telephone companies, such as Bell and Telus. There is also a sub-classification known as Small Incumbent Local Exchange Carriers (SILECS). These include companies like Cochrane Telecom (and formerly Ontera) that have operated in their communities for over 100 years in most cases.

³¹ <https://crtc.gc.ca/eng/dcs/glossaryt.htm#w>

³² <https://crtc.gc.ca/eng/dcs/glossaryt.htm#t>

- Competitive Local Exchange Carriers (CLECs) - a telecommunications entities that own and/or operate transmission facilities, as per the Telecommunications Act, and is in competition with the ILECs. Companies such as Vianet (Exatel) operate as CLECs in some of the region. Many of the ILECs and SILECs also compete in each other's territories.
- Wireless Carriers – in this case, those wireless carriers that own and/or operate transmission facilities. Examples would include Bell Mobility, Rogers Wireless and Telus Mobility. Many of these companies also have flanker brands, such as Koodo, Fido and Virgin Mobile.
- Other Carriers – somewhat of a catch basin for carriers such as Xplornet and Galaxy Broadband that have their own facilities but provide satellite and fixed wireless.

Non-Facilities-Based Providers

These are telecommunications entities that do not own or operate transmission facilities. These companies purchase all their services from a facilities-based company such as those noted above, to resell to retail customers. In the case of broadband Internet services, companies might fall into one of these two categories:

- Resellers of High Speed Retail Internet Service (RHSRIS) - entities engaged in the resale of Internet services to retail customers. Examples in the region might include Teksavvy and Distributel.
- Digital Subscriber Line (DSL) Providers - This type of provider provides DSL service. They do not provide the telephone line over which the service is delivered. Digital subscriber line (DSL) service provides high-speed access to digital networks via the same copper telephone lines that are used for common voice telephone services.

An Internet service provider (ISP) is an organization that provides services for accessing, using, or participating in the Internet. Internet service providers may be

organized in various forms, such as commercial, community-owned, non-profit, or otherwise privately owned.³³

An ISP can be a provider within any of the above defined categories (ILEC, CLEC, Resellers). In other words, an ISP can provide Internet services using its own network, parts of another provider's network or completely wholesale other network providers' systems.

A wireless Internet service provider (WISP) is an Internet service provider with a network based on wireless networking. Technology may include commonplace Wi-Fi wireless mesh networking, or proprietary equipment designed to operate over open 900 MHz, 2.4 GHz, 4.9, 5.2, 5.4, 5.7, and 5.8 GHz bands or licensed frequencies such as 2.5 GHz (EBS/BRS), 3.65 GHz (NN) and in the UHF band (including the MMDS frequency band) and LMDS.

A WISP is distinct from other wireless services we currently use. Most cell-phone service providers offer wireless Internet service—with 4G LTE being the fastest current technology—but that doesn't make them WISPs.³⁴

³³ https://en.wikipedia.org/wiki/Internet_service_provider

³⁴ <https://www.pcworld.com/article/2067283/meet-wisp-the-wireless-future-of-internet-service.html>

6.0 Local Access Distribution Network

There are many delivery methodologies for broadband Internet services depending on the location and availability of service providers. This section will highlight the most popular types and provide a description of the technology, including:

Terrestrial:

- Fibre-to-the-Home (FTTH). This is also referred to as Fibre-to-the Premised (FTTP) to include businesses and other non-residential premises.
- Fibre-to-the-Node (FTTN)
- Digital Subscriber Line (DSL)
- Coax Cable
- Hybrid Fibre Coax (HFC)

Wireless:

- Fixed Wireless
- Mobile Wireless (not typically considered a broadband access technology; however, in the region there are many that use data hubs and turbo sticks from carriers such as Bell Mobility and Rogers so it will be referenced herein.)
- Satellite

The graphic that follows does a very good job at illustrating the relative performance metrics between wireless and wireline technologies. Essentially, FTTP is a far better architecture than DSL and older cable technologies. 5G has been announced as the next evolution of high capacity wireless technology, but its full implementation is several years away, at least in the study region. It is not shown on the graphic below but certainly would rank higher in the matrix than the other noted wireless technologies once it becomes commercialized and depending on which version of 5G is referenced. See the section entitled “5G” for additional information.

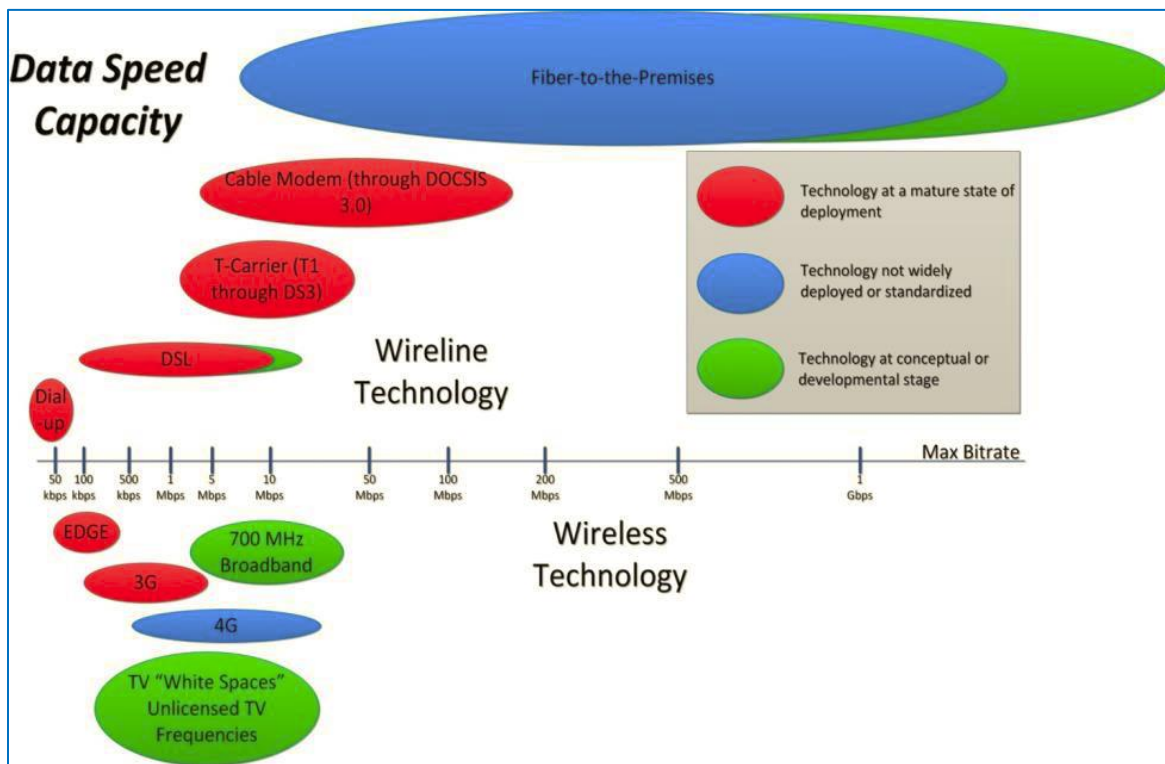


Figure 19: Data speed capacity (CTC Technology and Energy)

As previously noted, the following chart highlights the local service providers and a cross-section of their access technologies in use within the study area. Resellers that may be using wholesale access from carriers such as Ontera, are not shown on this chart.

	FTTH	FTTN	DSL	Dial-up	HFC	Coax	4G/LTE	2G/3G	Fixed wireless	satellite
Ontera		X	X	X						
Xplornet									X	X
Galaxy Broadband										X
Bell Mobility							X	X		
Rogers							X	X		
Does not include cellular flanker brands (ie: Virgin, Koodo), satellite TV (ie: ExpressVu), telecom resellers (ie: Distributel)										

Figure 20: Study area broadband sources

Of course, several of these service providers are capable of carrying more than Internet services. With the expansion of competitive telephone companies (CLECs) and quickly evolving technology, providers can deliver Internet, telephone and television; however, to what effectiveness depends on location factors as noted throughout this report.

6.1 Terrestrial

Overview

In all instances, data is delivered to each community to a service provider's point of presence (POP). There are several examples of POPs depending on the location being served and the service provider. The traditional telephone companies, Ontera in this case, have Central Offices (CO). These are buildings that house all the telecommunications equipment required to operate and deliver the services in the community. They are either backed up by generators and/or large battery banks (refer to the section entitled “

Data Centres” for additional information). The size of COs used to be predominantly dictated by the quantity of copper wires that needed to be connected into the community. These copper plants and related switching gear took up a lot of space and in many of the study communities, this is still the case. However, with the advent of fibre networks, these facilities are beginning to shrink in size.

While there are no cable TV operators in the study, it is useful to understand the concept. Cable TV providers also have a similar infrastructure as noted above but as they dealt with television broadcasting exclusively until more recent times, these buildings are known as Head Ends. Prior to fibre optic transport, most TV channels were delivered over satellite to very large satellite dishes next to the building. This is still the case in a majority of locations, including large urban centres such as Toronto. However, companies such as Cogeco or Eastlink can now aggregate most of their channel delivery at key facilities and then distribute their line up across other means, preferably across their fibre backbone networks to their local distribution hubs. Most local content is still received via regional and local satellite dishes.

These companies along with smaller providers do not always need COs or Head Ends in communities and can place equipment in much smaller environmentally secure shelters or cabinets. These are still considered POPs for the purposes of this report. A POP houses the relevant type of equipment specifically suited to the service that needs to be delivered. Each technology has a different set of equipment, but for the purposes of this report the focus will be on the access and distribution methods from the POP to the premises, not on the electronics themselves.

The following graphic illustrates a POP in relation to a fibre-based local network.

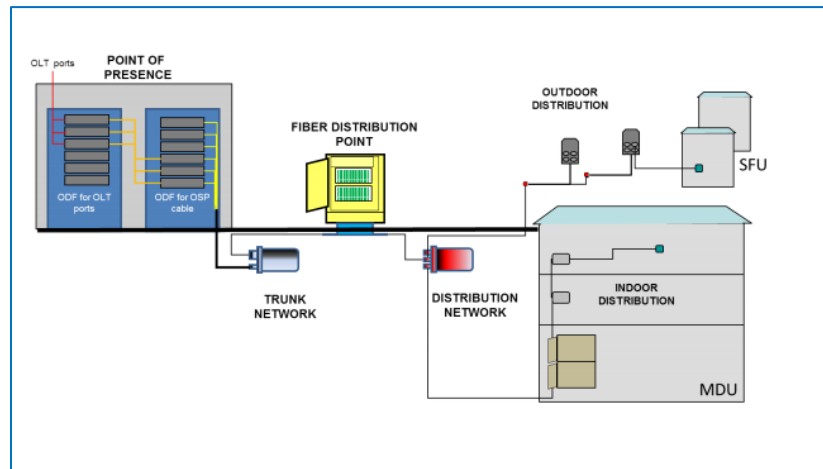


Figure 21: SFU=Single Family Unit, MDU=Multi Dwelling Unit

The following graphic shows the various iterations of fibre towards the home or premises (FTTP). In the following sections both Fibre-to-the-Home (FTTH) and Fibre-to-the-Node (FTTN) will be highlighted. Fibre-to-the-Curb (FTTC) is closely related to FTTN; similarly, Fibre-to-the-Building (FTTB) is interchangeable with FTTP in this case.

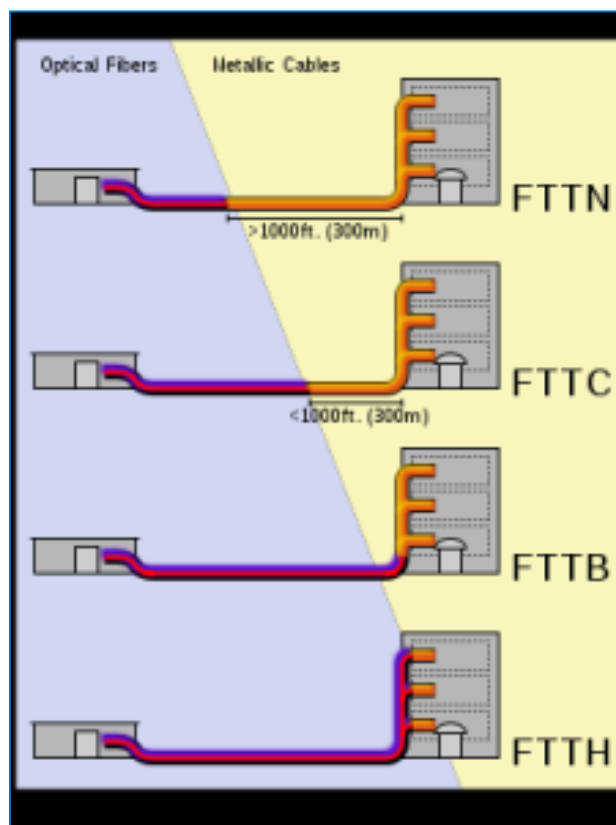


Figure 22: Types of Fibre-to-the-X (Attinternet-service.com)

Fibre-to-the-Home (FTTH)

FTTH is a fibre optic communications path that connects the service providers electronics directly to the customers premises. Also called Fibre-to-the-Premises (FTTP).³⁵

There are two prevalent forms of FTTH topology – point to multi-point (P2MP) and point to point (P2P).

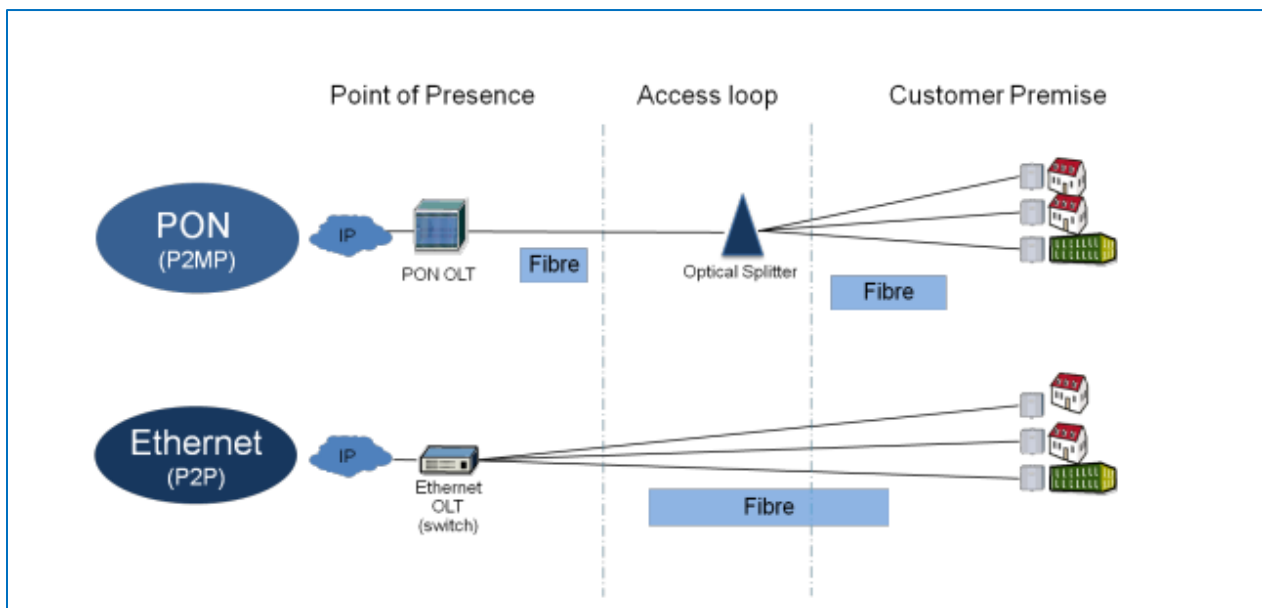


Figure 23: Types of FTTH topology (FTTH Council Europe)

As illustrated above, P2MP begins with one fibre that is then split to multiple fibres closer to the target neighbourhood. The technology that combines with this distribution is known as passive optical network (PON); whereby, the light waves travelling through the fibres are split into channels to carry data to and from the customer. This is quickly becoming the favoured deployment strategy of carriers as it can take advantage of existing and potentially constrained fibre assets already in the market to extend direct fibre links to customer premises.

³⁵ What Fiber Broadband Can Do For Your Community, BROADBAND COMMUNITIES, www.bbcmag.com, FALL 2016

The second topology is P2P which means a dedicated fibre link directly between the service provider's POP and the end user. This topology uses an ethernet transmission technology, also known as Active E. The advantages include a dedicated connection and a more future-proof ability to transmit greater amounts of data over the fibre since the waves are not split towards the user. However, one can argue that the pace of electronics development and its ability to carry greater amounts of data through the spectrum of light waves, is increasing rapidly. This is likely to reduce the risk of bandwidth constraint with PON architecture, especially on residential applications.



Figure 24: Ontera fibre (orange/red tags)

Fibre-to-the-Node (FTTN)

In a FTTN network, fibre is extended to a street cabinet or an on-pole cabinet an average of 1,000 to 5,000 feet from users. From there, copper connects users, typically through a variant of digital subscriber lines (DSL). Cable companies, such as Cogeco also use the FTTN topology in their hybrid fibre coax (HFC) local networks as will be described below. In this case, coaxial cable extends from the node to the premises.

The following example shows FTTN deployed in a telephone company network. The node houses the digital subscriber line access multiplexer (DSLAM), a network device that aggregates the data from individual DSL delivered to end users.

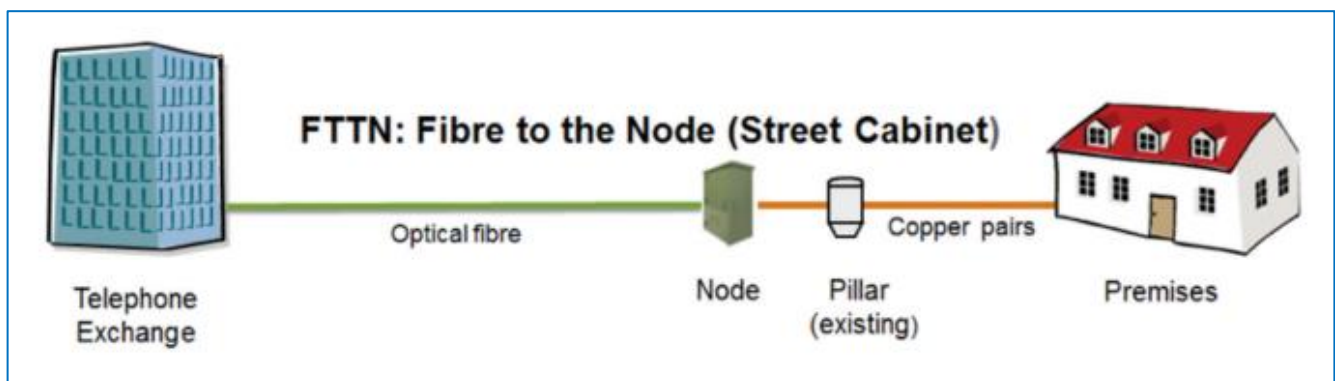


Figure 25: FTTN example (www.nbnco.com.au/.../fttn-construction-fact-sheet.pdf)

FTTN is a preferred way for service providers with existing local copper and coax distribution to increase the amount of data capacity it can bring to neighbourhoods without having to replace all the copper to each premises. Distance greatly affects the amount of data copper can carry between the service provider's POP and a customer's location as shown in the graph below. By using fibre to between the POP and neighbourhood node, the service provider can eliminate extremely long copper runs and increase capacity. As noted in a previous section, the elimination of the copper entering the Central Office also has its benefits for the carriers.

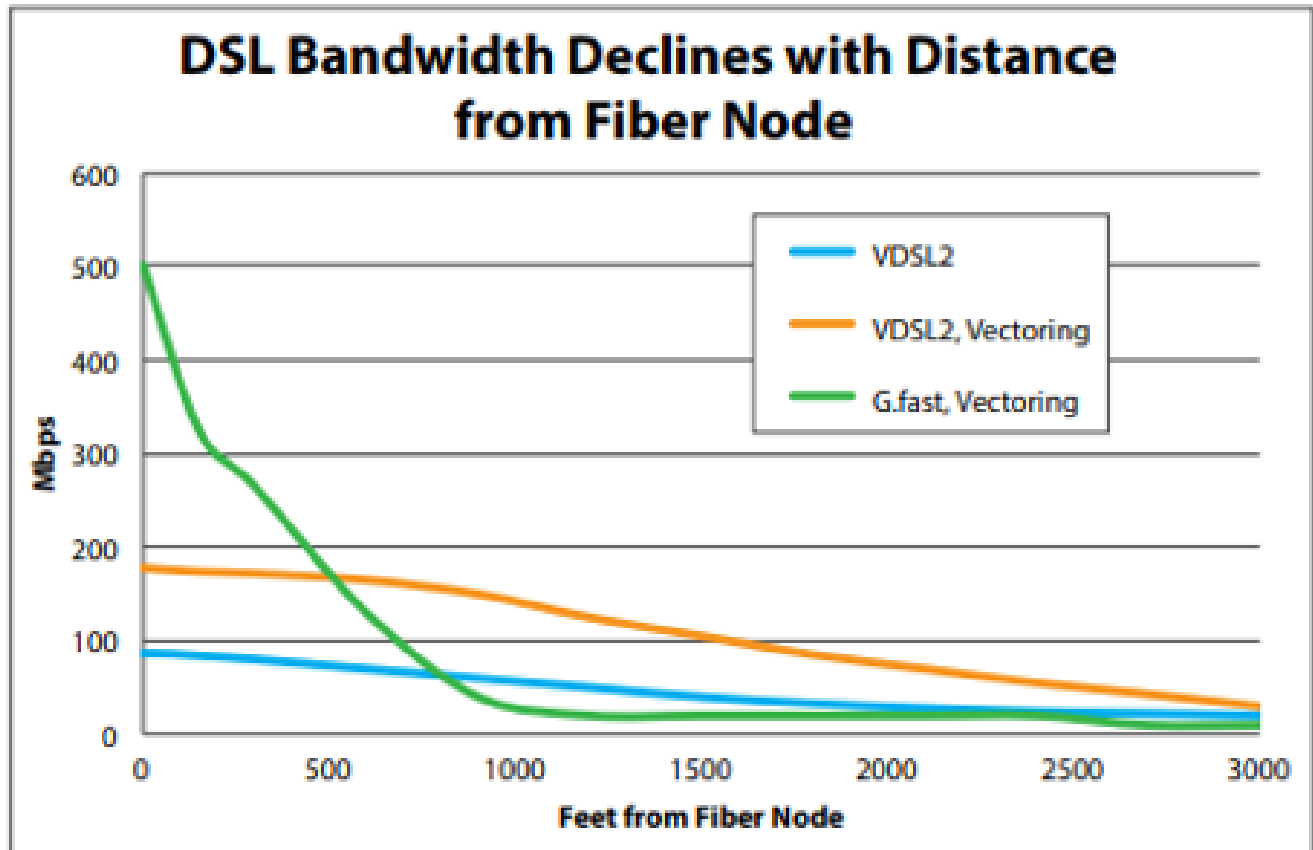


Figure 26: Broadband Communities - What Fiber Broadband Can Do For Your Community

Digital Subscriber Line (DSL)

DSL is a technology for Internet access over voice lines. There are various types of DSL, including asymmetric DSL (ADSL – used in the study area), high-bit-rate DSL (HDSL), symmetric DSL (SDSL) and very-high-bit-rate DSL (VDSL). The whole group is sometimes referred to as “xDSL.”³⁶ VDSL is super-fast DSL service. This type of DSL Internet is the fastest: providing speeds of up to 50 Mbps in certain areas.³⁷ The study area only has the slower, older ADSL technology.

The following chart provides an overview of various DSL technology speeds versus FTTH. (Only ADSL is present in the region).

³⁶ <https://www.gartner.com/it-glossary>

³⁷ The Internet ExpertsSM Blog

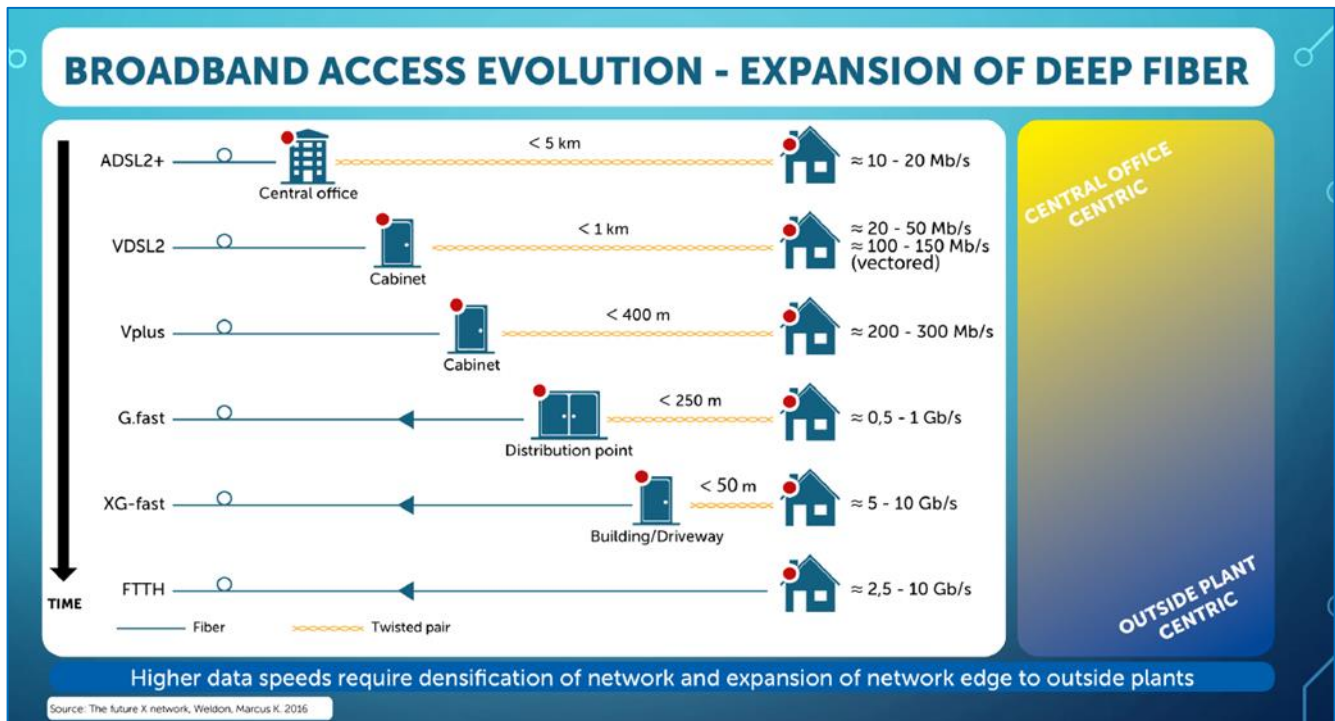


Figure 27: Fibre-based network options (The Future X Network)

Traditional telephone service and dial-up Internet only use a very small portion of the available frequency ranges which could pass over a copper telephone wire. DSL uses a portion of the remaining frequency ranges. This allows DSL to attain high speeds over the same wires without interfering with the phone service.

As noted in the FTTN section above, the quality of a DSL line depends on the distance from the CO (or remote cabinet) that a customer is connected to. As the data travels along the telephone line, increased interference and electrical resistance causes the signals to degrade. This degradation directly affects the advertised Internet speeds an end user might be expecting. In some communities, the distance is so great between the telephone company's equipment that the Internet speeds are terribly low.

Coax Cable

Cable Internet uses the same infrastructure as a cable television. It provides an Internet signal over the coaxial cable lines which run to a customer's premises. Similar to DSL, cable Internet makes use of unused channels (predefined frequency ranges) to pass data without interfering with television programming.

Cable is a shared connection. The line that runs to a house is a branch of a larger trunk which also feeds the neighbours' homes. This means that if that trunk is not wide enough to feed the neighbourhood it may become congested causing decreased speeds. On the plus side, cable uses coaxial cables which are very heavily shielded. This means that unlike DSL, distance is of very little concern to a cable connection.³⁸

Hybrid Fibre Coax (HFC)

This architecture is used by cable television companies. In a typical HFC system, fibre runs to an optical node in each neighborhood, and coaxial cable running from the node serves between 100 and 500 users as shown below.

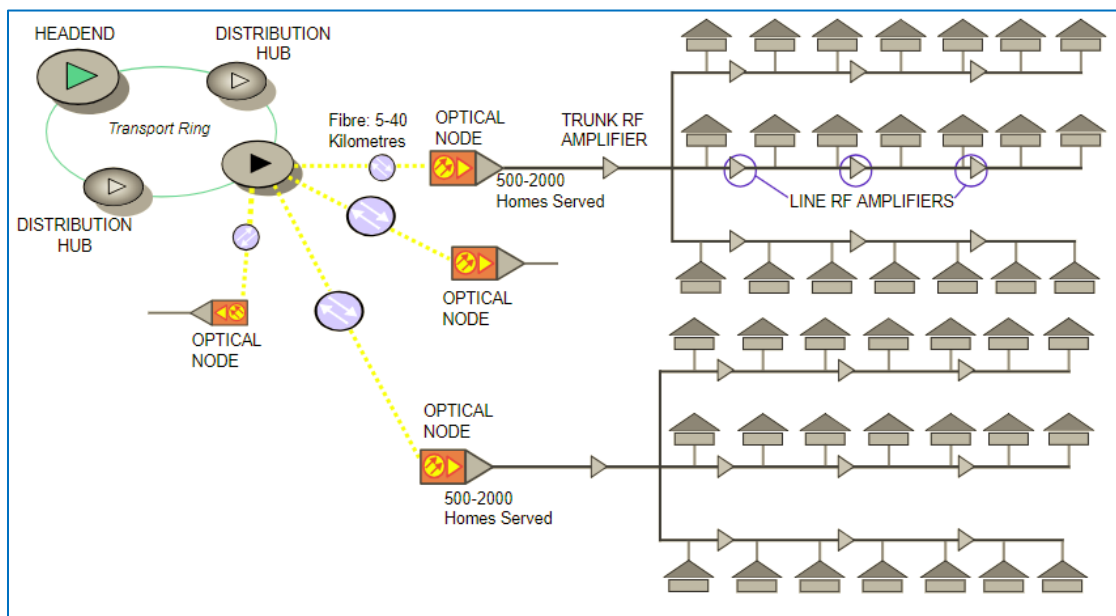


Figure 28: Wikipedia Hybrid Fibre-Coaxial

³⁸ TekSavvy Solutions Inc.

6.2 Wireless

Overview

As noted in the section entitled “5G and the 3500 MHz Band”, 5G has drawn enormous attention based on what it is anticipated to provide once fully deployed, but there are proven alternatives with suitable characteristics, equipment availability and a long evolution path, such as LTE (refer to “LTE” below for additional details).

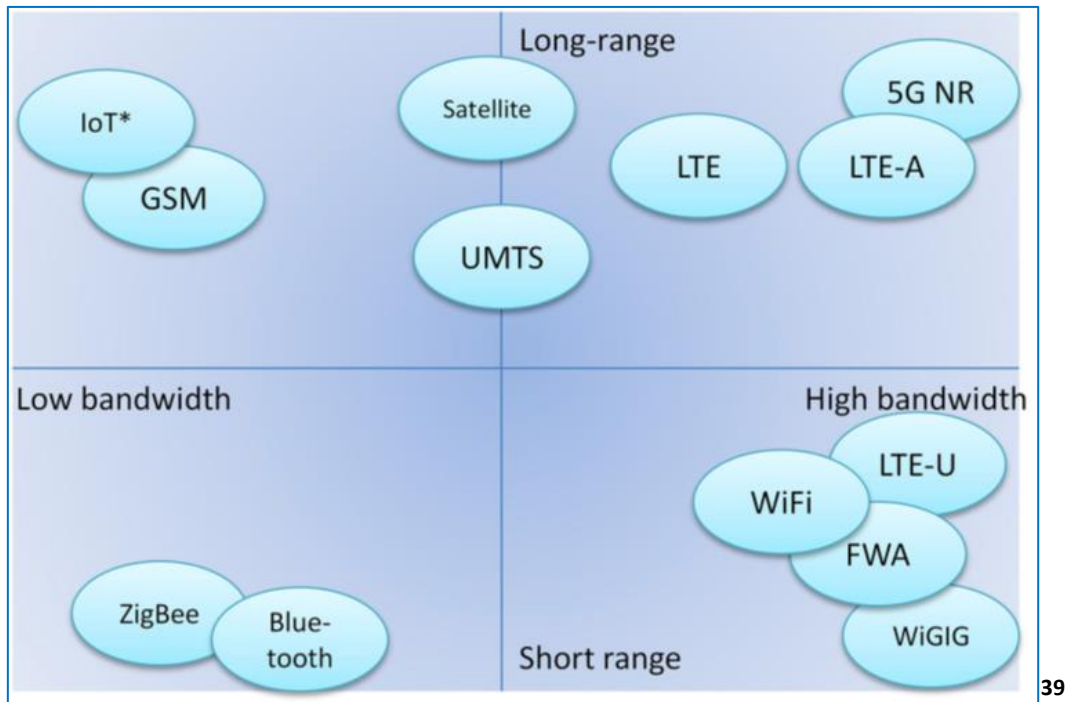


Figure 29: Wireless technologies and their characteristics

While there are many wireless technologies deployed throughout the world, this study will predominantly focus on those in the long-range, high bandwidth quadrant given the challenges of local terrain. There are both licensed and unlicensed wireless technologies that can be deployed in a variety of situations. In general, the technologies in the upper quadrants are licensed (except IoT) and those in the lower quadrants are unlicensed (except fixed wireless access “FWA”).

³⁹ Connected Train and Customer Communications: Rail and Digital Industry Roadmap

The graphic below provides a good representation of the coverage range characteristics of the levels of wireless signals. Particularly, the difference between satellite (GEO, LEO) technologies and earthbound towers.

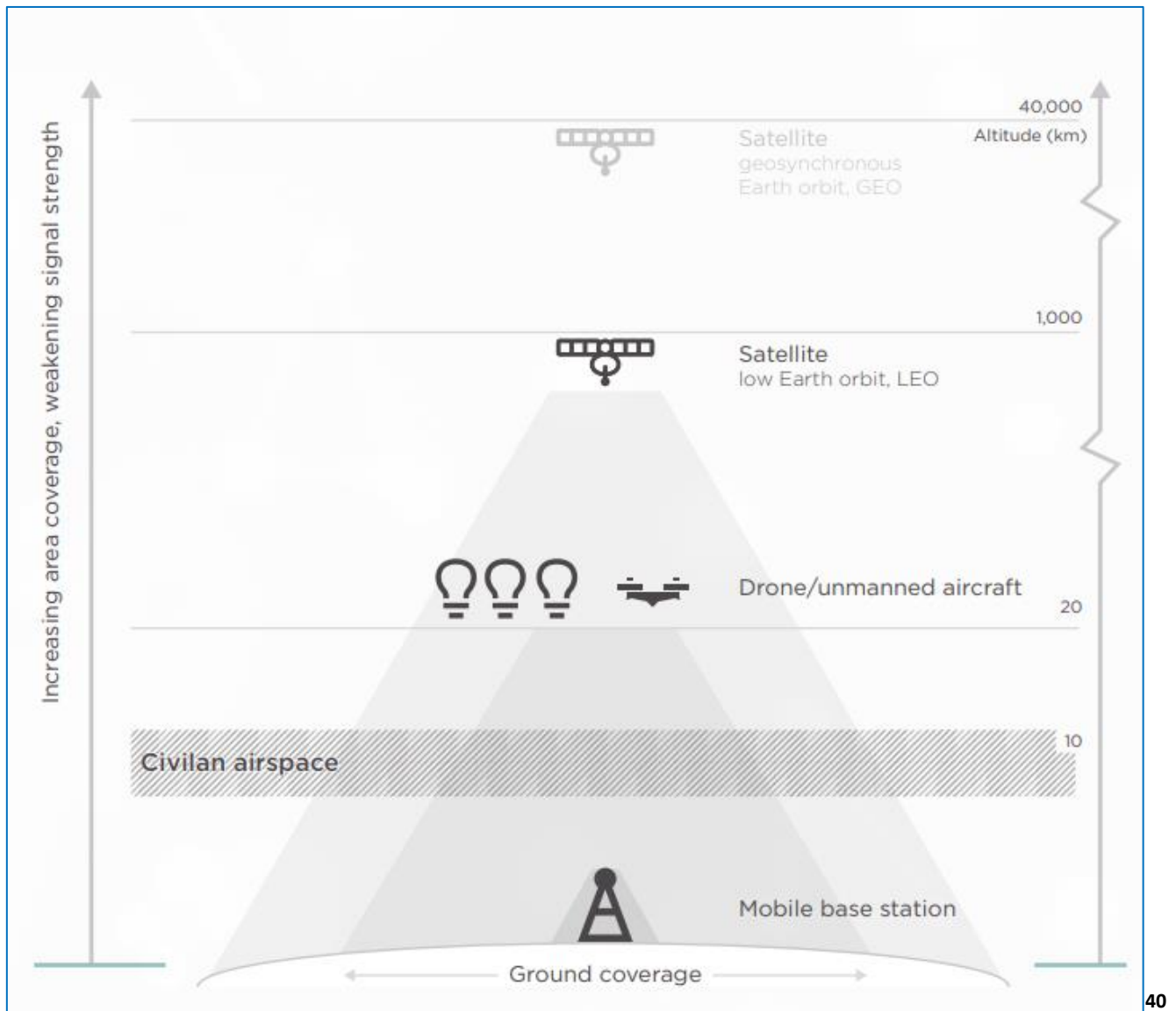


Figure 31: Types of wireless technologies and related coverage ranges

⁴⁰ GSMA Intelligence, Global Mobile Trends 2017

Fixed Wireless

Fixed wireless allows for broadband connectivity to a premises that may not have access to reliable wireline services or has poor dial-up speeds. This technology requires the installation of a small panel antenna at the premises which is aimed towards a nearby tower as shown in the graphic below. Depending on the technology deployed by the service provider, users can experience in the range of 1.5Mbps up to 25Mbps as advertised by Xplornet.

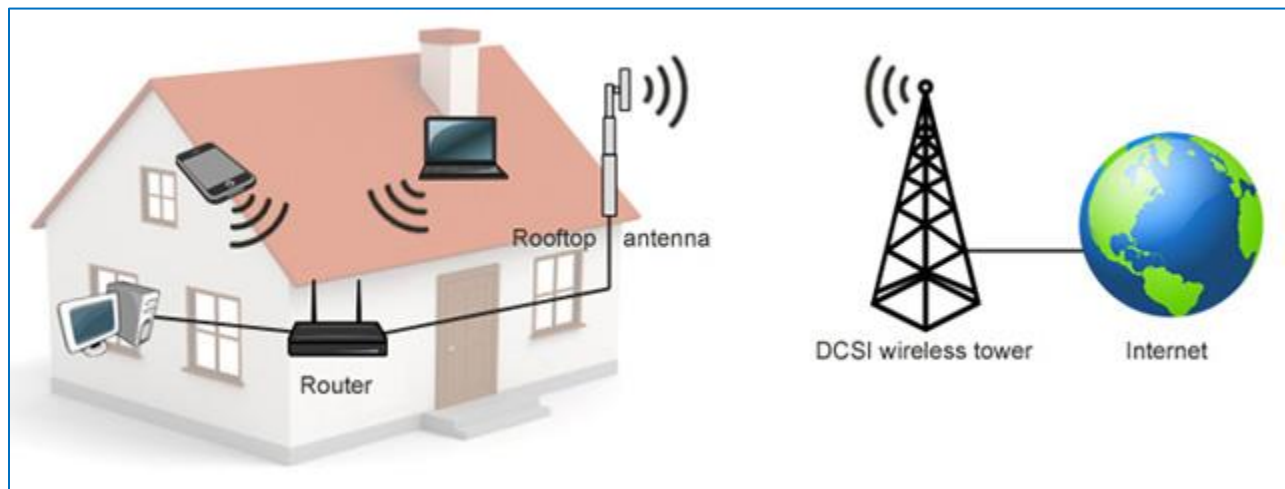


Figure 32: Typical FWA network (www.androidauthority.com/what-is-fixed-wireless-internet)

There are a few challenges with receiving quality fixed wireless service, namely weather and location. Similar to satellite, there can be signal degradation due to weather conditions. However, location proves to be a bigger challenge in that the system needs to have line of site between the user's panel and the tower's antennas for the best experience. Trees and elevation are factors if there's either blockage or perhaps the premises is located at a lower elevation along a river bank or shore of a lake.

Fixed wireless can be a more cost-effective way for service providers to cover a rural area over the cost of bringing fibre to a community. A service provider might be able to use existing structures such as microwave towers and water towers to create a microwave (wireless) backbone connecting its facilities to the target area. Service providers might also build new towers along the path to fill in missing areas. As with

cellular mobile wireless, tower locating can be challenging due to the lack of accessible power, suitable ground conditions and distances.

Another consideration is what kind of bandwidth or data capacity can be delivered to the transmission site at the community. In rare cases there might be a fibre feed to the tower which greatly increases the amount of capacity the site can deliver. However, in rural settings fibre is not usually an option and the service provider is restricted by the carrying capacity of its backbone microwave system, at least for part of the route, to deliver services. Also, given the shared nature of the bandwidth at the transmission site, there is the chance the users will experience variable speeds depending on the number of concurrent users connected to the site.

Ultimately, fixed wireless technology continues to improve as the global service providers are committing more resources to the sector as a viable rural broadband solution.

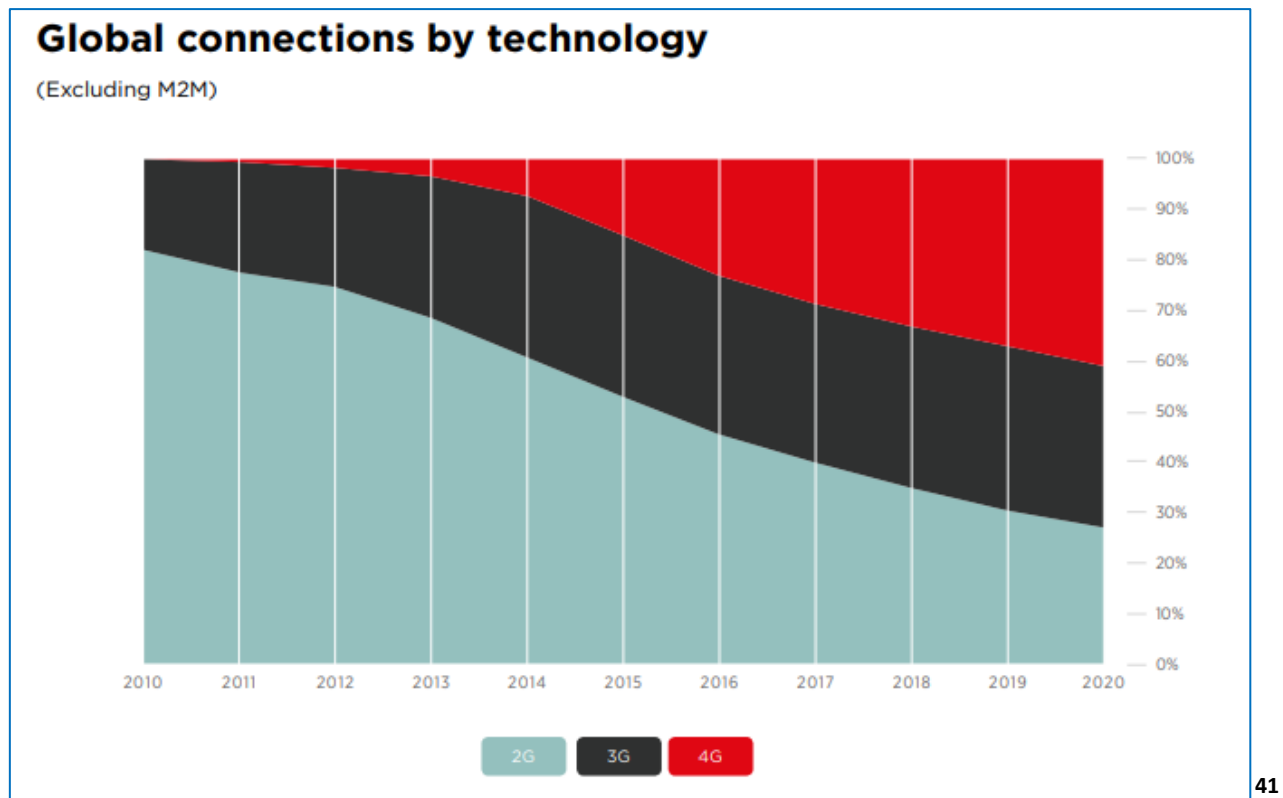
LTE

Most people in Canada are well acquainted with cellular service given the penetration of the technology across the country. Over the years there have been many terms used such as GSM, CDMA, HSPA+, 2G, 3G and the more recent 4G/LTE.

Second generation (2G) technology was rolled out globally as GSM (Global System for Mobile Communications) ie: Rogers. CDMA (Code-division multiple access) was a 2G technology more prevalent in North America ie: Bell and Telus, but also used in other countries. Most 2G networks handled phone calls, basic text messaging, and small amounts of data.

Third generation (3G) technology was an upgrade on 2G over both GSM and CDMA technologies. 3G allows for larger data formats, including standard HTML pages, videos, and music. UMTS (Universal Mobile Telecommunications System) in Figure 29 refers generally to the GSM evolution to HSPA+ (Evolved High Speed Packet Access). CDMA also evolved to W-CDMA ("wideband" CDMA). Canadian cellular companies still have 3G technology deployed in their networks but are steadily phasing it out in favour of 4G/LTE.

The following chart (Figure 33) shows the global proportion of these technologies as 4G/LTE continues to grow.



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Figure 33: Global wireless (mobile) connections by technology

LTE (Long-Term Evolution) is synonymous with 4G networks, albeit there is a substantial underlying level of detail that will not be covered here – and some marketing spin. Essentially LTE is the path towards achieving the 4G standard. The goal of LTE was to increase the capacity and speed of wireless data networks. A further goal was the redesign and simplification of the network architecture to an IP-based system with significantly reduced transfer latency compared to the 3G architecture. The LTE wireless interface is incompatible with 2G and 3G networks, so that it must be operated on a separate radio spectrum.⁴²

⁴¹ GSMA Intelligence, Global Mobile Trends 2017

⁴² [https://en.wikipedia.org/wiki/LTE_\(telecommunication\)](https://en.wikipedia.org/wiki/LTE_(telecommunication))

LTE-A (Long-term Evolution Advanced) is a further upgrade to LTE and closer to the 4G standard. Bell Mobility's Moosonee cell site is advertised as LTE-A.

Some advantages of LTE technology as it pertains to broadband:

- Peak download rates up to 300Mbps and upload rates up to 75Mbps
- Low data transfer latencies
- Improved support for mobility, performing at up to 350 km/h or 500 km/h (depending on the frequency band)
- Increased spectrum flexibility
- Support for cell sizes from tens of metres radius (femto and picocells) up to 100 km radius macrocells. In the lower frequency bands to be used in rural areas, 5 km is the optimal cell size, 30 km having reasonable performance, and up to 100 km cell sizes supported with acceptable performance.⁴³

600MHz

As part of LTE, 600MHz was the most recently auctioned spectrum in Canada. In March 2019, ISED held a spectrum auction of the 600MHz band. According to ISED, "the low-frequency 600 MHz spectrum carries signals well over long distances and penetrates structures better than higher frequency bands. This makes it well suited to deliver next-generation wireless services in both urban and rural settings."⁴⁴ The higher the frequency of the radio signal, the less distance it can travel through the air. Conversely, the lower the frequency, the further it goes. This also applies to buildings, windows, and trees - lower frequency signals go through more stuff.⁴⁵

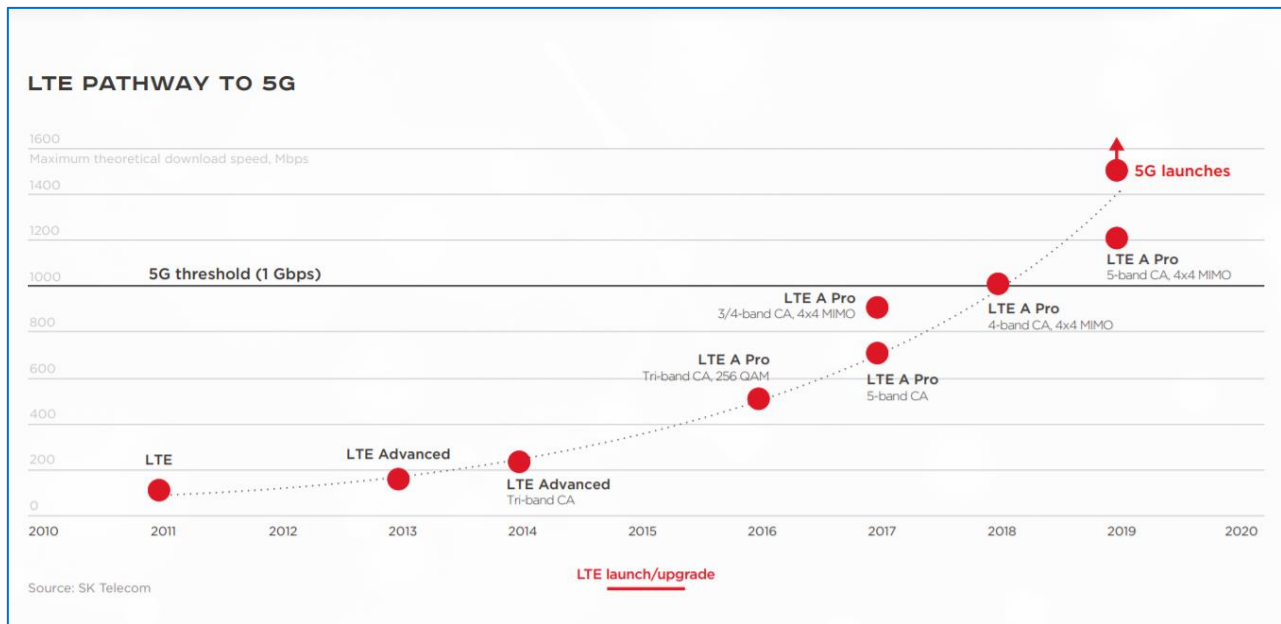
This makes the 600Mhz band important to potential rural broadband deployments. Some of the bidders in the 600 MHz auction included Bragg Communications, the private owner of Eastlink, TBayTel of Thunder Bay, Ont., the Saskatchewan government's SaskTel, and Xplornet Communications Inc.⁴⁶

⁴³ [https://en.wikipedia.org/wiki/LTE_\(telecommunication\)#Features](https://en.wikipedia.org/wiki/LTE_(telecommunication)#Features)

⁴⁴ <https://www.canada.ca/en/innovation-science-economic-development/news/2019/04/600-mhz-spectrum-auction--process-and-results.html>

⁴⁵ "Analyst Angle: What 600 MHz spectrum will be good for ... and what it will not." Iain Gillott, April 6, 2016

⁴⁶ "Ottawa looking to balance tensions between telecom carriers, consumers" David Paddon, The Canadian Press, June 5, 2019



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Figure 34: LTE pathway to 5G

5G

5G technology is based on a New Radio (NR) platform and is subdivided into two frequency bands, FR1 (below 6GHz) and FR2 (mmWave). The most common frequency band for FR1 is 3500Mhz and for FR2 is greater than 24Ghz.

It is important to note some of the differences between the 5G bands and their applications. One should not confuse the performance of millimeter wave 5G deployments in fixed wireless networks to that of 5G at the 3500MHz level. In the lower frequency band, 5G and LTE can perform similarly depending on the type of LTE, spectrum allotment and number of antennas (see Figure 34). However, speeds in the FR2 range will be much greater, but cell sites much closer together. In this case, 5G base stations may be only 100 metres apart but capable of connecting 1000 more devices than 4G/LTE.

The following is an excellent overview of the advantages of 5G taken from “Eight Reasons Why 5G Is Better Than 4G”, March 16, 2018 by Shatrughan Singh:

⁴⁷ GSMA Intelligence, Global Mobile Trends 2017

- Peak data rate. Reaching up to 1 gigabit per second (Gbps), 4G's peak data rate is satisfactory for most of today's apps. But 4G won't be sufficient to support the growing number of wireless devices being introduced into wireless networks every day—thanks in large part to the growth of Internet of Things (IoT)—and the number of applications requiring real-time high-throughput data. With a peak data rate of up to 20 Gbps, 5G will be able to handle these new apps without breaking a sweat.
- User-experienced data rate. The data rate that the end user experiences in 4G can be up to 10 Megabits per second (Mbps), which is sufficient for most of today's applications. But as IoT and mobile devices advance, users will require faster throughput. With speeds of up to 100 Mbps, 5G will give them the boost they need.
- Spectrum efficiency. If you want to optimize a system, you need to utilize its available resources as efficiently as possible. Keeping that in mind, 5G cells will be able to utilize the available spectrum three times more efficiently than 4G cells.
- Mobility. Today, 4G can support mobility of up to 350 kilometres per hour (kph). As the technology advances and magnetic levitation high-speed trains become more common, 5G will break through this speed barrier by supporting mobile devices traveling up to 500 kph.
- Latency. Autonomous vehicles and vehicle-to-vehicle (V2V) communication in a vehicular ad hoc network (VANET) are still a few years from commercialization, despite many of the foundational technologies being well developed and tested. One major part of it is data latency. The latency for VANET needs to be less than 100 milliseconds. Today, latency in 4G cells is up to 100 milliseconds for the control plane and 10 milliseconds for the data plane. Combined, this is too slow to support VANET as any small delay in V2V communication could cause a traffic incident or worse. 5G solves the latency issue by decreasing control-plane latency by 50% and data-plane latency by 90%, which is 50 milliseconds and 1 millisecond, respectively.
- Connection density. As the IoT market accelerates, many more devices will be connected to cells. 5G allows up to 900,000 more devices to be connected per square kilometre than 4G, which supports the connection of at most 100,000 devices per square kilometre.

- Network energy efficiency. The 5G network will be 100 times more energy efficient than 4G. So even as the number of wireless devices increases, the energy required to power them will decline. This means the carbon footprint of wireless communication networks globally will also decline or at least not increase proportionate to the number of devices increases.
- Area traffic capacity. As the number of networked devices increases, 5G will have the capacity to manage the increase in network throughput. That's because the expected area traffic capacity—defined as the end user data rate measured in megabits per second per square meter—of 5G networks will be 100 times higher than existing 4G networks.

5G still has a long path ahead of it – especially in the study region. It is widely debated as to how effective 5G will be in a rural setting given its limited propagation characteristics, regardless of the frequency range. At best, 5G in the FR1 band might be utilized, notwithstanding deployments in higher density locations (ie: along the main street). The following chart (Figure 35) highlights some of the key milestones vis-à-vis world events and in relation to other wireless technologies.

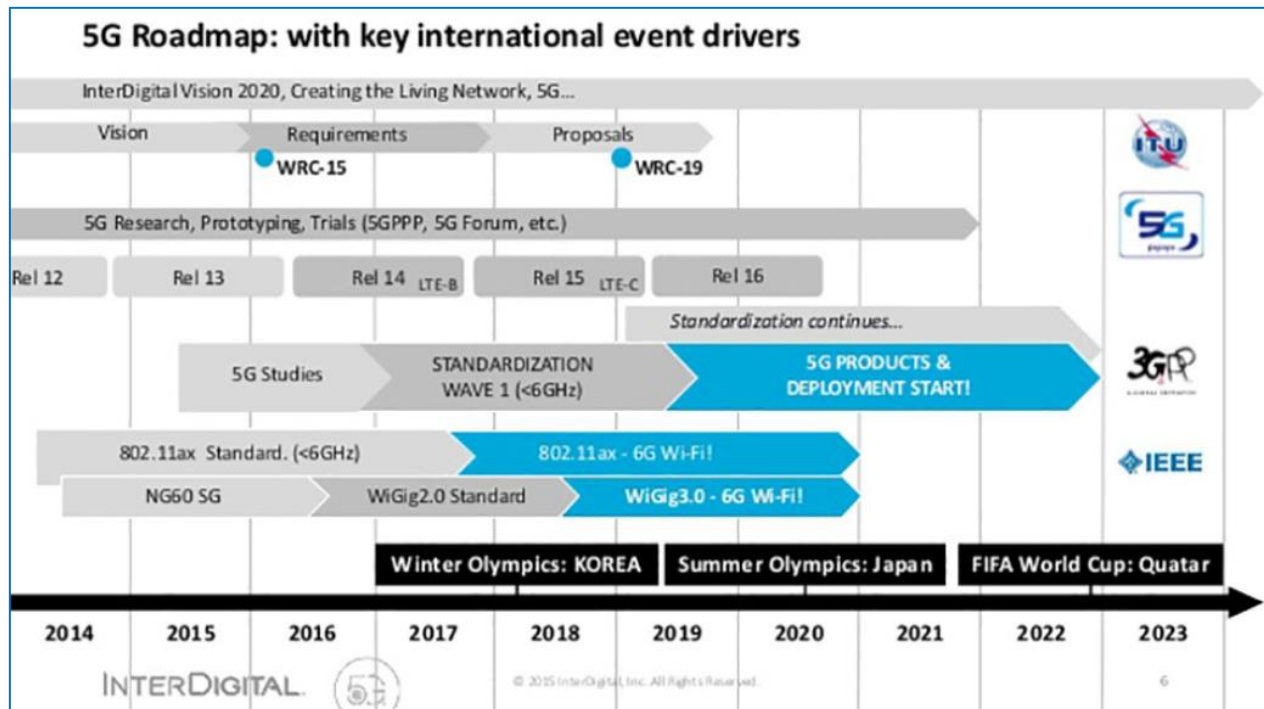


Figure 35: 5G roadmap with key international drivers

Satellite

Satellite Internet has been a viable, if not sole option for many rural customers. It does not require access to land-based telephone or cable TV lines as the link is between the satellite and the dish located at the premises. Current systems perform well beyond dial-up telephone capabilities.



Figure 36: How satellite works (www.reivew.org/interent-service/best-satellite-internet-providers)

In the study region, Xplornet and Galaxy Broadband are the prime satellite providers for consumer broadband communications. Shaw Direct advertises that it is bundling Xplornet's Internet service with its TV product. These satellites use a geostationary orbit, often referred to as a geosynchronous equatorial orbit (GEO); whereby, the satellite orbits the earth at a very high altitude above the equator and follows the earth's orbit. To an earthbound observer, the satellite appears fixed in the sky and therefore the dish at the premises can stay aimed in the same southerly position.

Satellite broadband has advanced over the past years with new, high capacity equipment employing the latest technology. However, satellite communications are affected by heavy rain or snow (rain fade). They also are affected by a signal delay (latency) because of the distance data must travel from the user to the satellite back

down to an earth station and then along the path again to the user. This latency is a factor in services that cannot tolerate perceptible delays, such as tele-robotic medicine.

However, satellite broadband has advanced over the past few years with new, high capacity equipment employing the latest technology. The industry has been getting a lot of mainstream attention recently with the well-publicized race by many companies such as SpaceX and OneWeb to develop and launch low earth orbit (LEO) systems. These constellations of satellites will number in the thousands with the promise of lower latency and higher throughput. While not usually publicized, satellite networks also require a substantial terrestrial network that provides the linkages to the equipment and the global network. Eventually, the technology can be a major benefit to rural coverage as networks are completed and pricing drops.

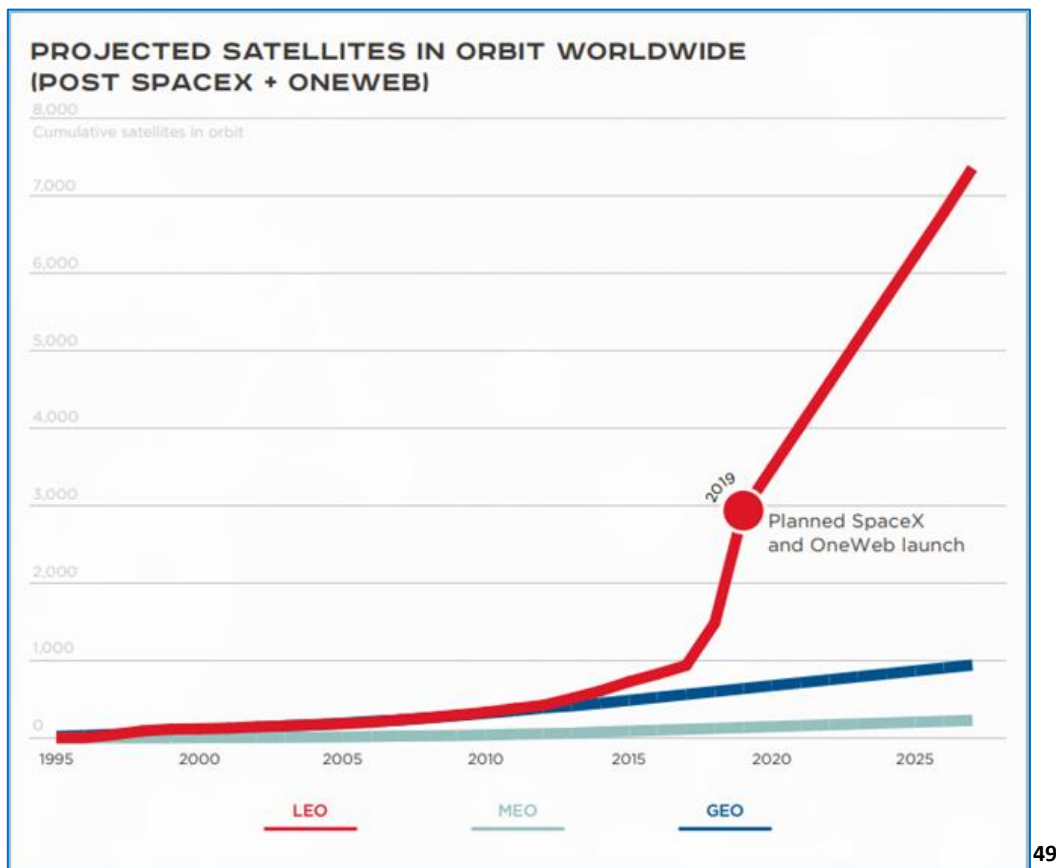


Figure 37: Projected satellites in orbit worldwide (post SpaceX + OneWeb)

⁴⁹ GSMA Intelligence, Global Mobile Trends 2017

Canada's Kepler Communications has already launched its first bread loaf sized satellite, initially for commercial use in the resources sector. Telesat has outlined its coverage plans as illustrated in the graphic below (Figure 38).

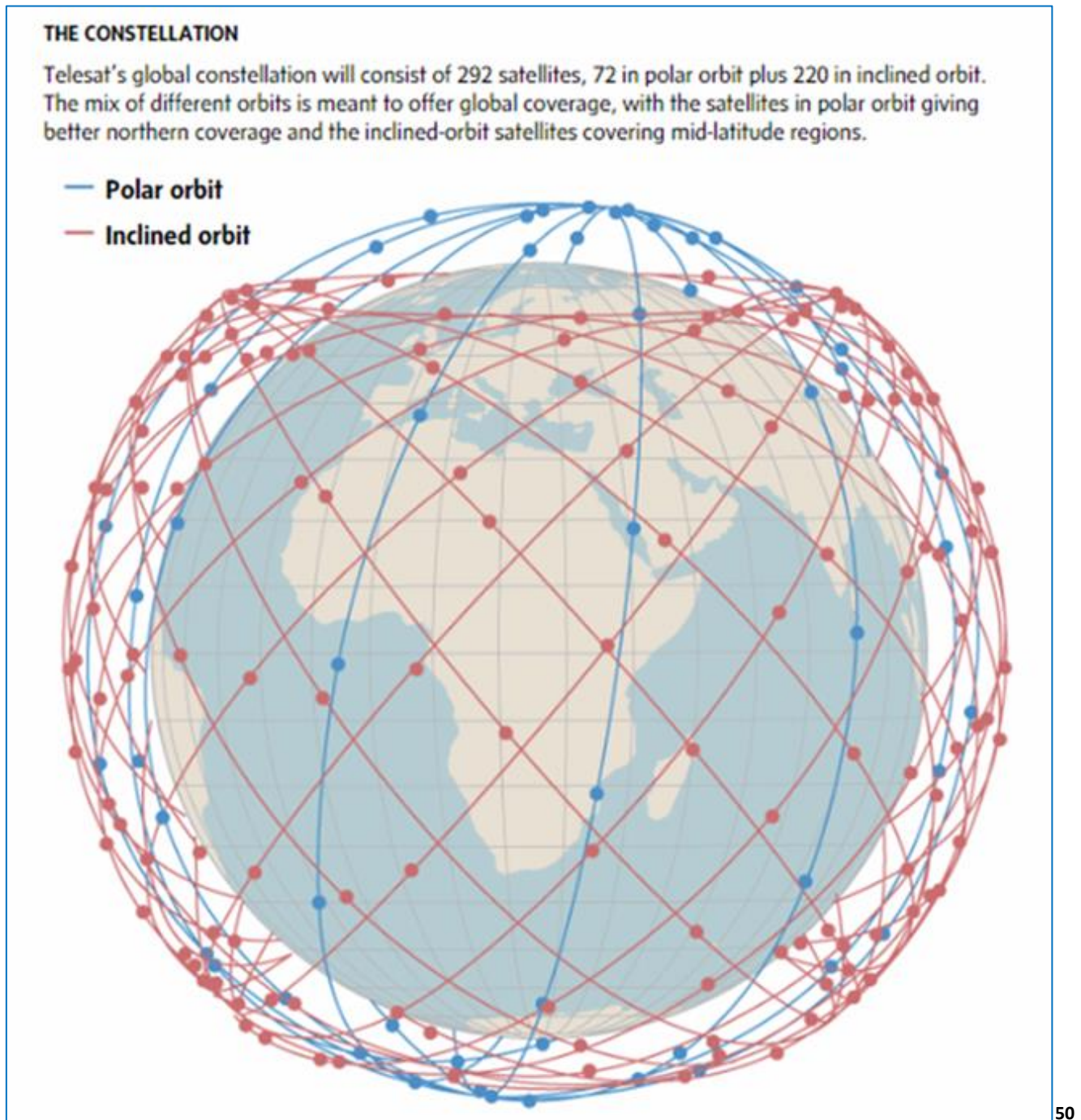


Figure 38: Telesat future global satellite constellation

⁵⁰ "Canada's Telesat takes on U.S. giants in 'low-Earth orbit' internet space race" Globe and Mail, January 31, 2019

Mobile Wireless

Mobility (cellular) was not in scope for this study; however, with the advent of 4G/LTE technology as deployed by the wireless service providers, broadband access across large swaths of Canada's cellular corridors has increased.

As a function of the increase in mobile data, cellular companies are moving rapidly to try and bring direct fibre connectivity to their cell sites. Where that isn't possible, they bring fibre to a key site which then reduces the number of wireless/microwave hops to other sites.

Given the amount of regional fibre Bell and Ontera have in the study area, a number of their cellular towers have been directly connected to their fibre network. Adjacent tower sites without fibre are more easily reached due to shorter microwave hops and can therefore access additional bandwidth. Bell Mobility customers in the core of downtown Temagami should experience very good cellular data speeds from the tower at the community.



Figure 39: Bell Mobility cellular tower Temagami

7.0 Study Area Analysis

Site visits were conducted during May 27th and August 2nd, 2019. The site visits were limited to visual, non-destructive investigation of facilities-based telecommunications infrastructure, specifically the visible “passive network”. This included copper telephone routes, coaxial cable (none were noted) and fibre optic systems. While outside the scope of this study, cellular sites were noted to the extent possible, particularly as they could serve as potential fixed wireless sites for any future projects. The field visit information was further enhanced by a desktop analysis of publicly available network information.

Several meetings were held with Ontera representatives so to attempt confirmation of visual networking as noted above. Typically, these carriers consider their network information as confidential as they protect against competitive strategies. However, they were co-operative in confirming visual items.

7.1 Regional Transport Network

The transport network is the connectivity provided between communities or other long distances on a point to point basis. Last mile that will be discussed next, are those connections from a service provider’s CO or Head End (if cable) to the end-user. Within the study region footprint, the broadband passive transport layer is predominantly Ontera-owned pole mounted fibre optics.

There are several fibre optic routes that travel through the area. Ontera has fibre buried within the Ontario Northland Rail’s right-of-way (ROW). There is a Bell Canada national fibre route located within the TransCanada pipeline.

Visual confirmation of a particular carrier’s fibre cable is possible via recognizable markers on the cable. In the case of aerial (pole mounted) cable, Ontera uses small rectangular orange tags that indicate the fibre optics, ownership and contact information. Similarly, (in other markets) Shaw uses a light blue tag and ribbon; whereas, Vianet uses a yellow tag. This is common practice with all companies as routes can be congested with various suppliers, whether fibre, traditional copper

telephone lines or cable especially when cables need to be repaired. These aerial facilities are always located well below any power lines for safety reasons (telecom space vs power space). Buried cable also carries warnings as shown in the figures below.



Figure 40: Ontera aerial fibre tag



Figure 41: Ontera buried fibre marker

The following map traces Ontera's visible regional aerial fibre route crossing through the footprint on Highway 11 and towards Bear Island. Other than certain road, rail and water crossings, most of the regional fibre is aerial along the highways due to the prevalence of rock that makes burial very expensive.

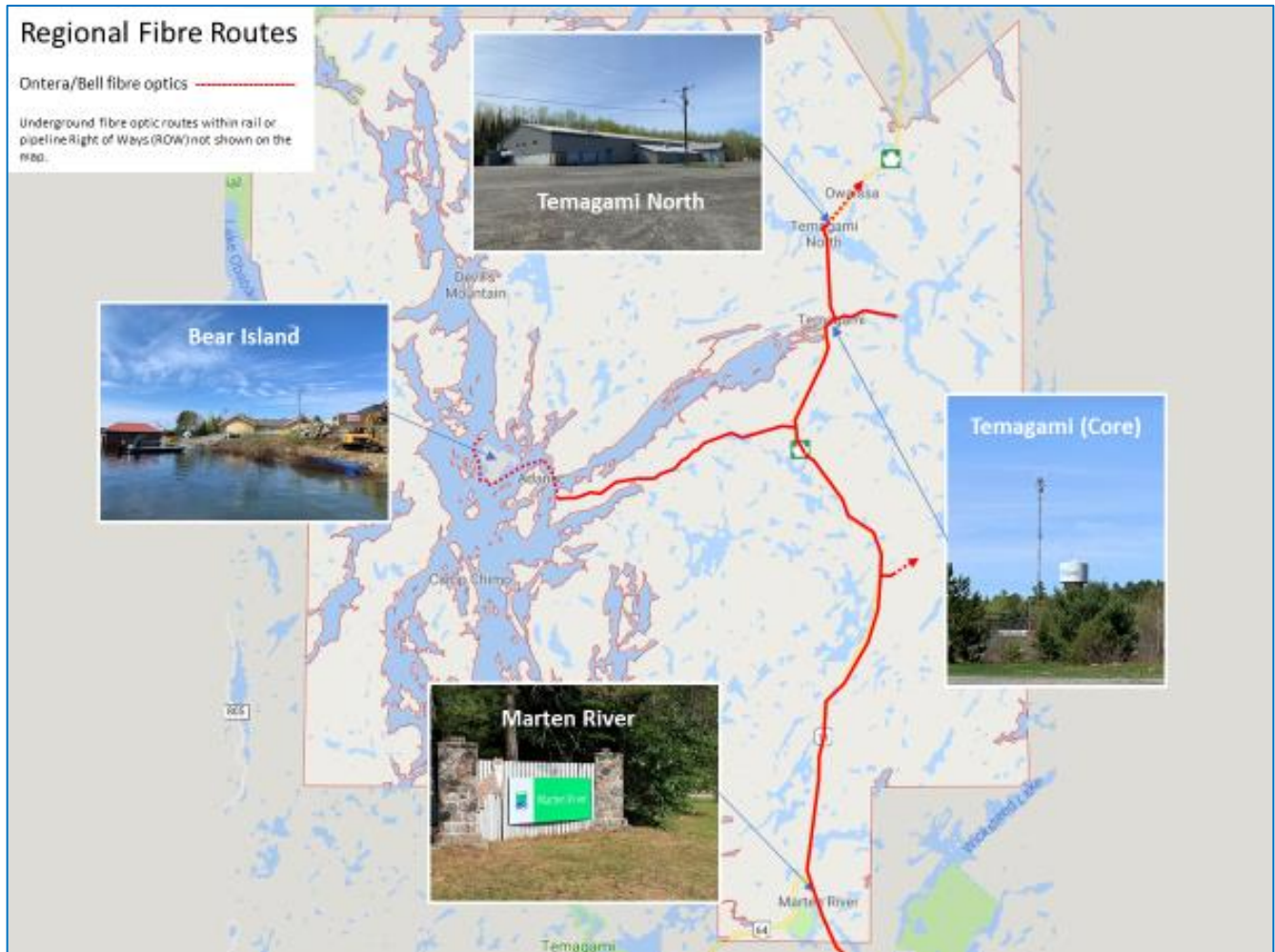


Figure 42: Regional fibre routes

Ontera Fibre and Equipment POP

One Ontera's points of presence (POPs) is located in downtown Temagami adjacent to the ONR tracks. The next photo shows a close up of Ontera's buried fibre orange warning post. Fibre enters and exits the POP from underground in this location.



Figure 43: Ontera equipment shelter (POP)



Figure 44: Ontera buried fibre marker

However, it does not always work out that accessible fibre equipment repeater shelters are located within community boundaries. National shelter spacing was based on the electronics of the time and on rail access. There are many such shelters that can only be accessed by rail equipment. Therefore, it can be prohibitively expensive for the telephone companies to access these locations to bring fibre to adjacent communities. Also, there is limited fibre within the older ROWs as dozens of strands may have been placed years ago versus the hundreds that are typically installed now.

Bell Canada Fibre Access Point

As noted previously, there is a Bell Canada fibre access point located at the TransCanada pipeline compressor facility on Tonomo Lake Road. Similar to national fibre routes within rail ROWs, Bell also had constructed a route along the pipeline.



Figure 45: Bell Canada fibre equipment shelter



Figure 46: TransCanada compressor station



Figure 47: Bell buried fibre marker

7.2 Community Last Mile Networks

Last mile is a term given to the local connectivity between a service provider's POP and the customer premises. It can also be known as the distribution layer. The term can technically apply in fixed wireless applications – the wireless “shot” from the tower to the customer's panel antenna.

Within the communities, Ontera is the only facilities based, terrestrial last mile carrier based on its copper distribution. Ontera's equipment provides ADSL level electronics that supplies internet to premises. There is very limited point to point fibre last mile from Ontera to locations such as the school and medical centre. Xplornet does provide fixed wireless last mile connectivity in the area; however, the extent of coverage and their customer base was not determined.

Several survey respondents noted that they have a variety of Internet service providers, but all except Ontera are non-facilities based, meaning they access customers over Ontera's network.

Cellular data was provided as a reference point; however, it was not a part of the scope of the study. Cellular data has been sourced from publicly available information as noted on the maps and whose accuracy could not be verified, linked to the ISED database.

7.3 Needs and Gap Overview

An oversubscription ratio was used in this study to calculate a reasonable expectation for a community's particular broadband requirements. For the study, a 5:1 oversubscription ratio has been used to determine a reasonable initial local POP size. Ratios and capacity calculations will vary depending on the actual service provider based on their business metrics and network capacity.

The "available" broadband capacity was based on information derived from the service providers where available and network assumptions based on local visible infrastructure. Wireless broadband capacity was not included unless otherwise noted.

Each community's broadband "need" was calculated based on the following metrics:

Premises Type	Mbps
Dwellings	25
Businesses	100
Hospitals/Clinics	100
Schools	100
Student	1

Figure 48: Broadband metrics

The full "need" would be the result of the above-noted metrics multiplied by each of the community's data sets (# of dwellings + # of students, etc.). The "adjusted need" was calculated by applying the ratio of 5:1 to the total community need (total divided by 5).

The "gap" was determined by subtracting the "available" broadband capacity from the "adjusted need". The table below details the data sets used to estimate the gaps per location.

Community Broadband Gap Analysis	STATISTICS						DATA (Mbps)					NEED	OS ratio 5:1	AVAILABLE Mbps	GAP Mbps
	POP	Dwellings	Businesses	Hospital/ Clinics	Schools	Students	Dwellings	Businesses	Hospital/ Clinics	Schools	Students				
							25	100	100	100	1	Mbps		Mbps	Mbps
Temagami (core)	520	220	20	1	1	24	5500	2000	100	100	24	7724	1545	200	1344.8
Temagami North	242	115	5	0	0	0	2875	500	0	0	0	3375	675	200	475.0
Lake Temagami	2100	908	5	0	0	0	22700	500	0	0	0	23200	4640	0	4640.0
Marten River	40	20	5	0	0	0	500	500	0	0	0	1000	200	0	200.0
Bear Island	244	110	14	1	1	44	2750	1400	100	100	44	4394	879	300	578.8

Figure 49: Community broadband gap analysis calculations

The breakdown of data for the Municipality of Temagami “communities” is based on estimates of premises contained within the general boundaries of each location using Stats Can 2016 Census information and a variety of Temagami related information sources that will be detailed further in the report in Section 7.4.

The following map illustrates the relative gap (red) versus the estimated available broadband (blue) per study group community⁵¹.

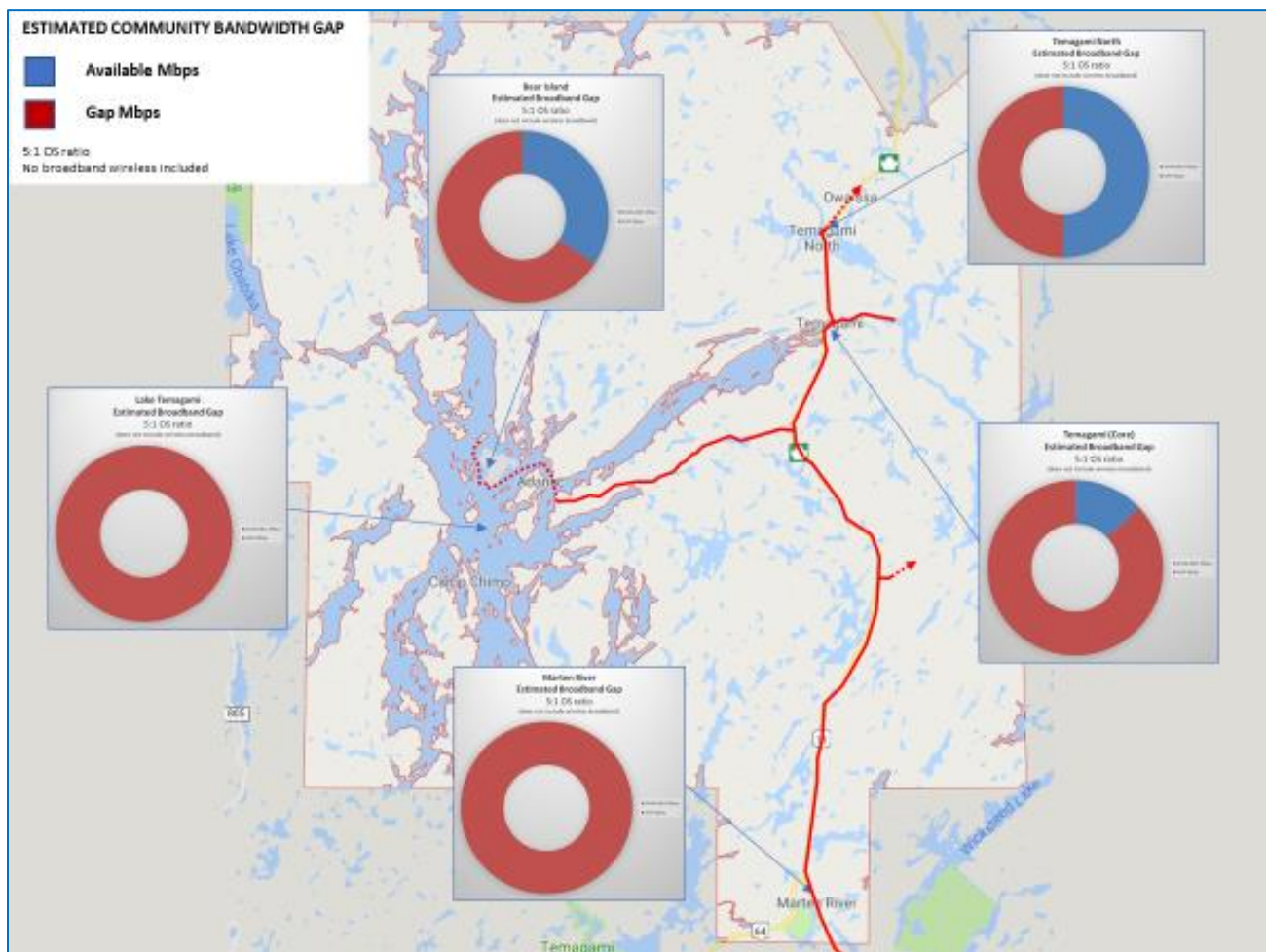


Figure 50: Study area gap analysis

There is a visibly definitive broadband gap in the study group communities. These will be discussed in greater detail in each respective section below.

⁵¹Calculations based on facilities-based fixed (non-wireless/mobile) data available

The community aggregated analysis, the gap (red) comprises a significant portion of the chart below versus the estimated available capacity (blue).

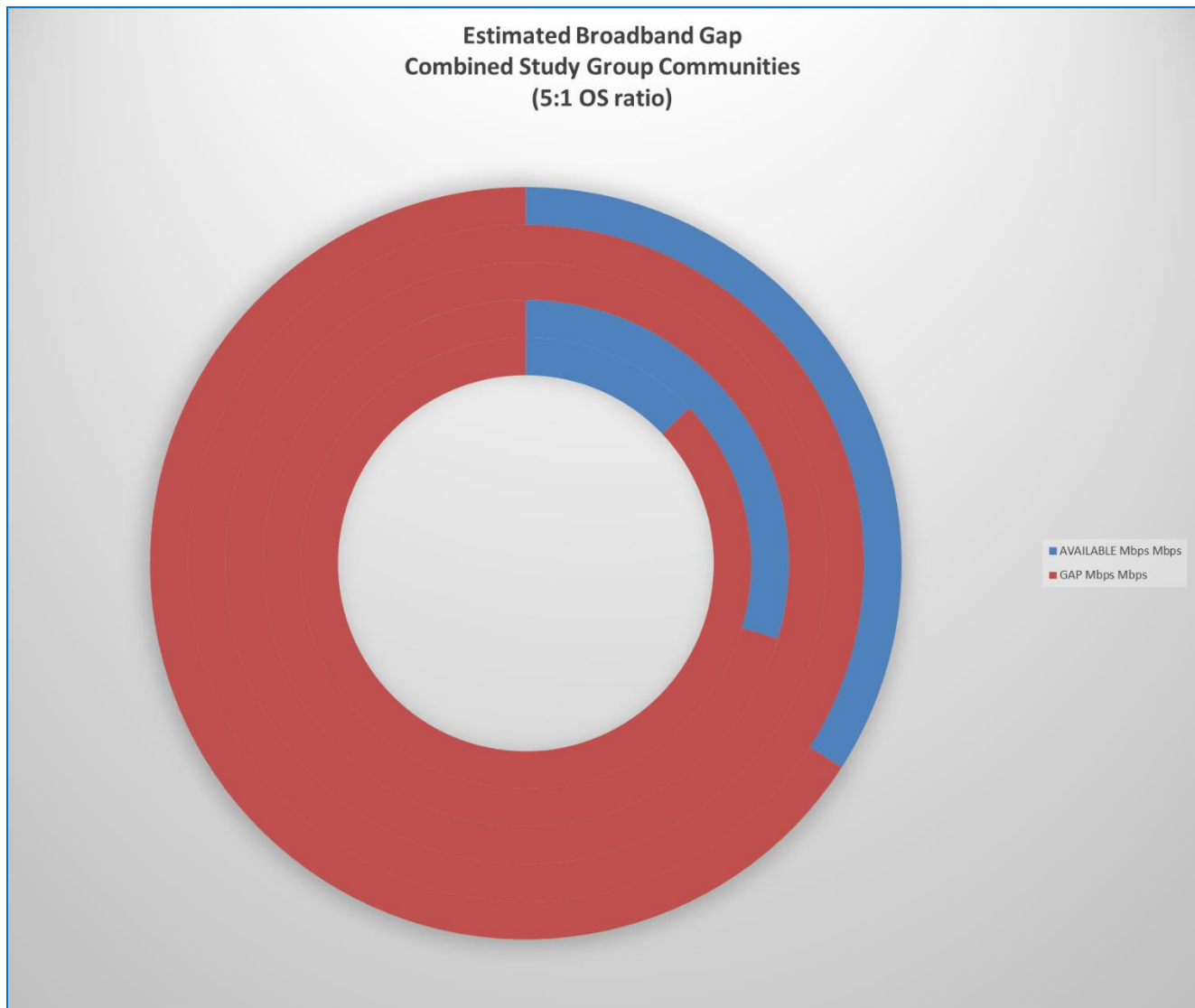


Figure 51: Combined study area gap analysis

7.4 Community Analysis Introduction

This section is divided into 5 parts, one for each general area within the Municipality of Temagami plus Temagami First Nation. Specifically, the Municipality of Temagami has been broken down into the following four “communities”:

- Temagami Core
- Temagami North
- Lake Temagami
- Marten River

The breakdown allows for a more granular analysis of each location versus lumping all the area into one general catchment. It is meant to align with the ground-truthing exercise that attempted to document all the visible fibre optic networking upon which a more fruitful estimation of budgetary costs and targeted broadband gaps could be ascertained for future planning.

The population, dwelling and business data contained in the following sections are estimates based on an analysis of StatsCan 2016 census data, local economic development documents and a visual estimation of structures derived from Google Earth data. In discussion with municipal representatives, the breakdowns provided herein are a fair representation of the disbursement of locations. However, when combined, the data for Temagami Core, Temagami North, Marten River and Lake Temagami reflects StatsCan information.

For each of the communities, local statistics and observations are provided. Market overview maps indicate visible aerial fibre optic broadband. In the case of Ontera’s underwater fibre at Bear Island, local knowledge of the network was relied on. Ontera copper telephone infrastructure was not mapped given its ubiquitous coverage and the inability to ascertain underwater routing to the various islands on Lake Temagami. As there is no terrestrial cable TV provider, there were no coax cable facilities to document. As previously noted, cellular towers are indicated where visible and with corresponding publicly available transmission data. Xplornet is collocated on the tower in downtown Temagami (Temagami Core) near the school. Xplornet’s fixed wireless capacity is not included in the gap calculations as noted below or in Exhibit B – Gap Analysis.



7.5 Temagami (Core)

Quick View

Site Visit: May 27th and August 2nd, 2019

Population: 520

of homes: 220

of businesses: 20

of students: 24

of schools: 1

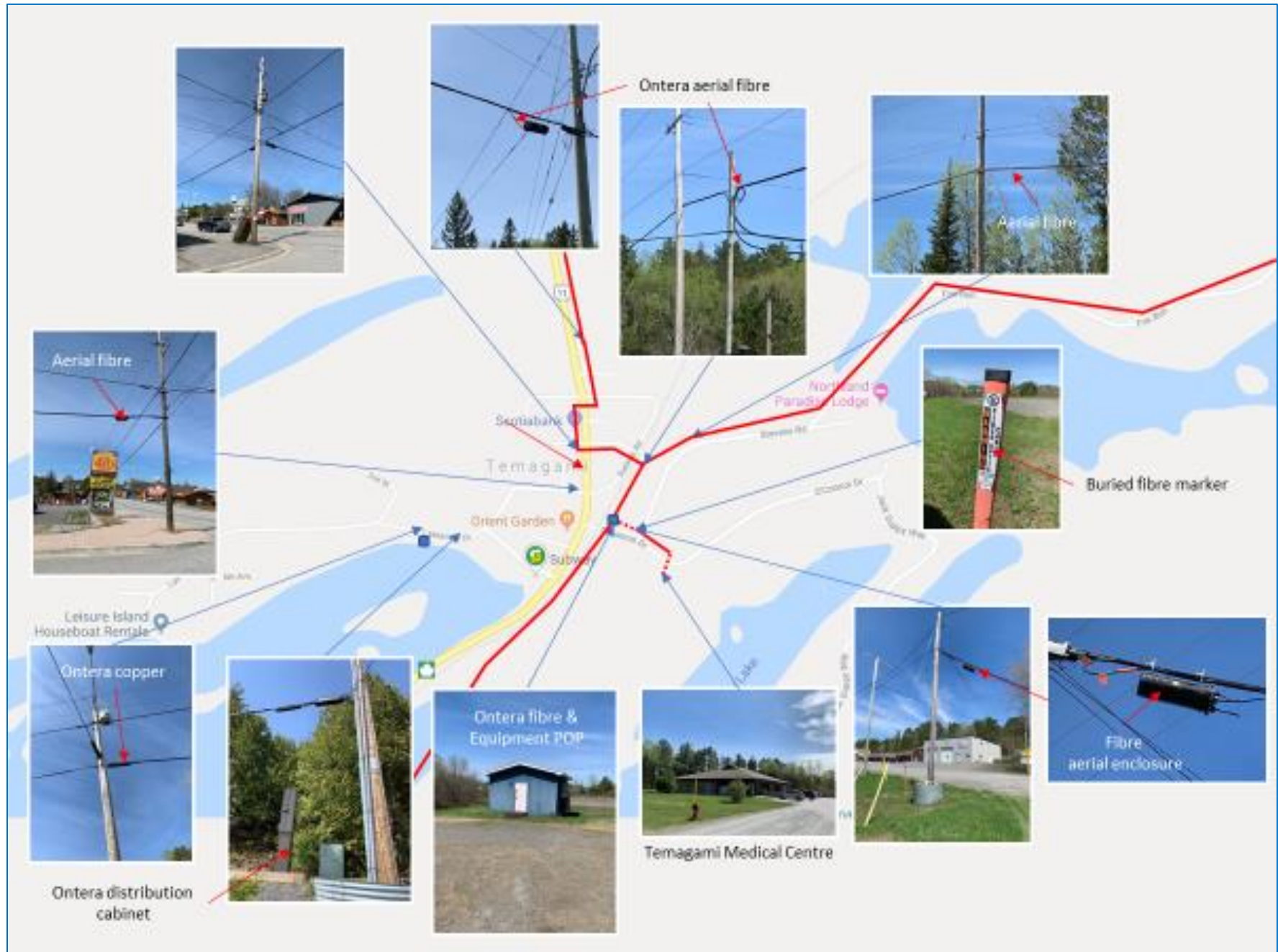
of hospitals/clinics: 1

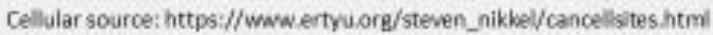
Telecommunications Observations

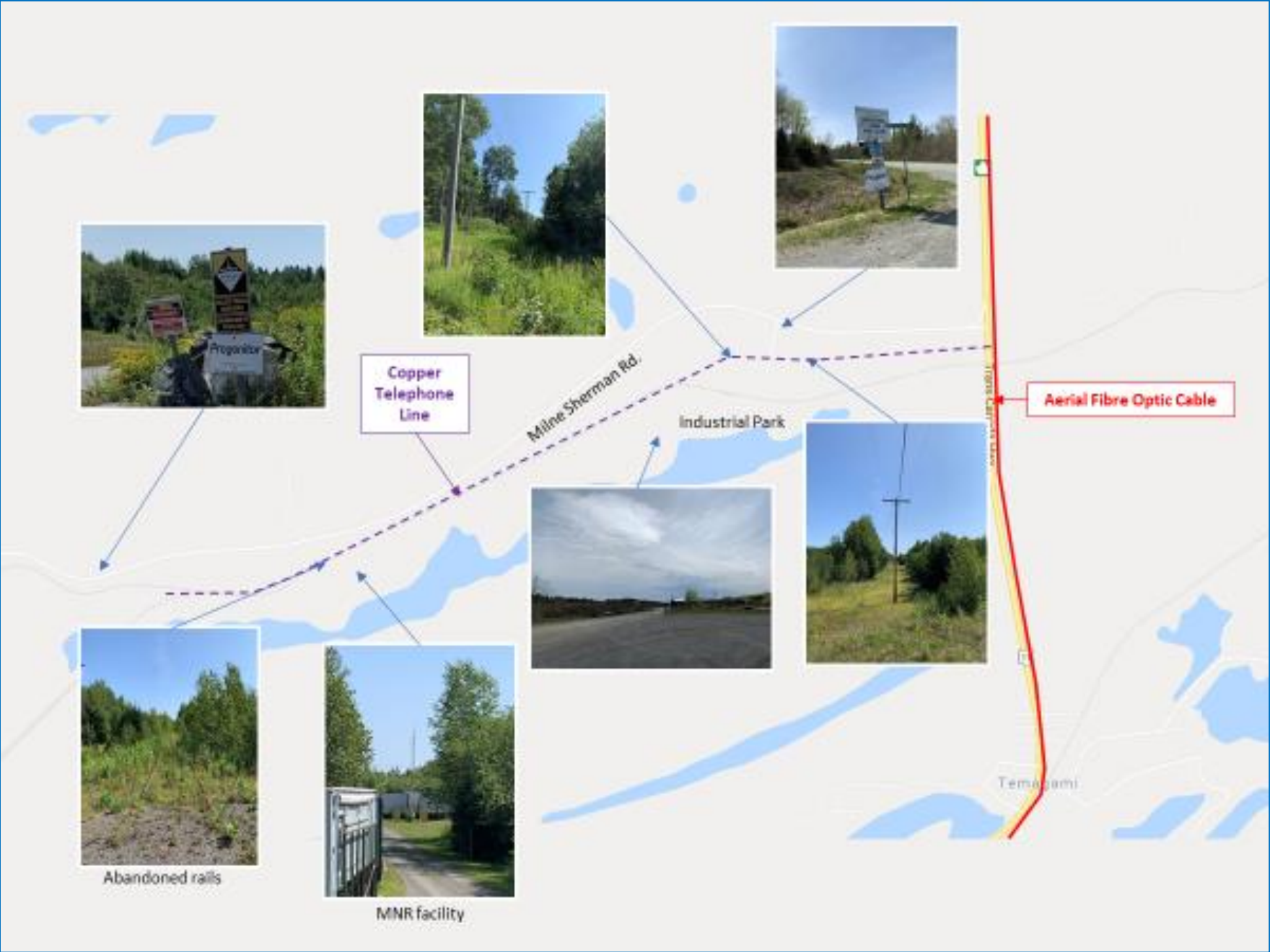
The core of Temagami is serviced by Ontera's copper ADSL plant, which is older technology with limited capacity.

As shown on the diagrams that follow, Ontera does have aerial fibre optic assets that pass through the footprint with a breakout to the clinic and school, likely due to previous service contracts. However, additional point to point fibre connections could not be determined visually. Ontera also has an equipment POP near the railway lines as their fibre also is located within the ONR right-of-way. Ontera does service some of its distribution nodes with fibre so to extend their reach, such as Fox Road as shown below. There is an Ontera pole line that delivers copper-based services down Milne Sherman Rd. to the industrial park area and beyond.

There is also a Bell Mobility 4G/LTE tower site near the school with both Rogers and Xplornet collocate on the same structure. Xplornet recently collocated on the tower located; however, their operating capacity is not known nor their market penetration. Both Xplornet and Galaxy Broadband are reported to provide satellite data services; however, few premises mounted dishes were visible. Television satellite dishes were not covered in this scope (ie: ExpressVu).



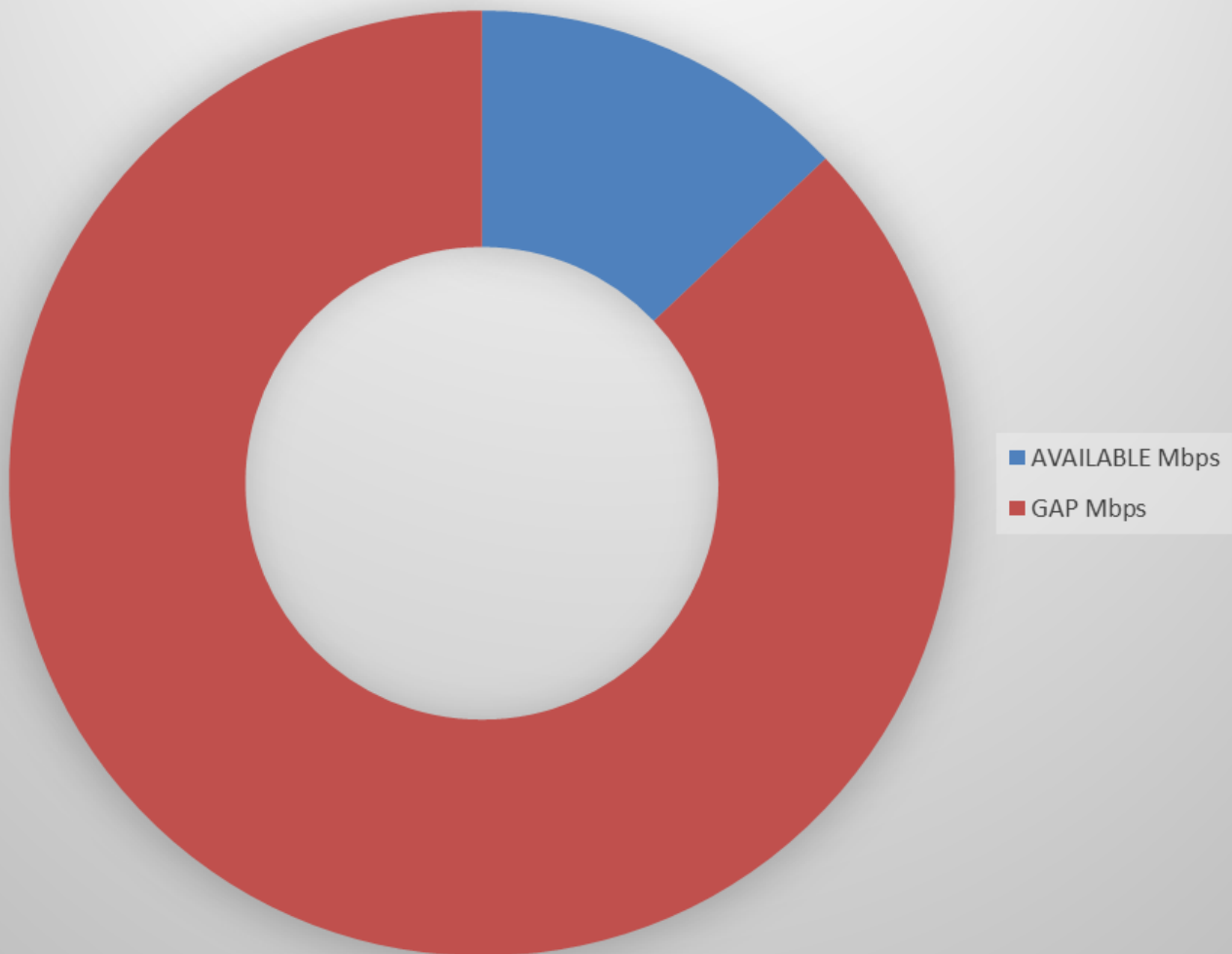




The core of Temagami has a sizeable broadband gap as illustrated below in red. However, there is the potential to increase capacity as recommended herein.

Community Broadband Gap Analysis	STATISTICS						DATA (Mbps)					NEED	OS ratio 5:1	AVAILABLE Mbps	GAP Mbps
	POP	Dwellings	Businesses	Hospital/ Clinics	Schools	Students	Dwellings	Businesses	Hospital/ Clinics	Schools	Students				
							25	100	100	100	1	Mbps		Mbps	Mbps
Temagami (core)	520	220	20	1	1	24	5500	2000	100	100	24	7724	1545	200	1344.8

Temagami (Core) Estimated Broadband Gap 5:1 OS ratio (does not include wireless broadband)



Recommendations

- Given the level of fibre connectivity through Temagami's core, Ontera should be contacted to discuss the potential to upgrade the community's local access and distribution. For instance, discuss whether Ontera will install a FTTN/DSLAM within the community and deploy VDSL. While that would not meet the CRTC's aspirational goals of 50/10, it would at least improve user experience in the interim.
- Ontera will also need to confirm the transport capacity of its current fibre into the community should it require additional equipment to be sized properly for local distribution.
- The presence of fibre does provide the opportunity for an alternate service provider to access Ontera wholesale services and deploy either as a WISP and/or a FTTP deployment, depending on a sustainable business case.

Estimated Capital Ranges

[refer to Exhibit A – Estimated Capital Ranges for full project view]

		MARKET PROJECTION		CONNECTED PREMS		
Communities	Premis Passed	Target Market Penetration	Target Prem Project Total	Year One Connected Premis	Year Two Connected Premis	Year Three Connected Premis
Temagami (Core)	240	80%	192	77	58	58

TRANSPORT	DISTRIBUTION	DROPS	YEAR TWO & THREE		TOTAL FTTP COSTS		
Transport + electronics	Distribution + Electronics	FTTP Drop + Prem Total Cost	Year Two PREM Capital	Year Three PREM Capital	Total Project Cost	Total Cost Per Prem PASSED	Total Cost Per CONNECTED Prem
\$ 111,948	\$ 560,000	\$ 89,088	\$ 66,816	\$ 66,816	\$ 894,668	\$ 3,500	\$ 4,660

Premis Passed = # of premises that distribution cabling passes along a street, but not connecting to the premises (drop)

Target Market Penetration = estimate of how many customers would use the new service

Transport + Electronics = cost of construction backbone fibre to community + electronics, or electronics if transport fibre in place

Distribution + Electronics = cost of constructing last mile distribution fibre + electronics within the community

VDSL Per Connected Prem = cost of installing the node divided by the number of total subscribers

LOW (VDSL) = estimated lower end of providing a degree of broadband in the community

HIGH (FTTP) = estimated upper end of providing a degree of broadband in the community

Overall Assumptions:

pole make ready costs not included

% of premis connected varies, max 80% where no competitor to Ontera/Bell, max 60% where a facilities based competitor exists

VDSL will not require distribution copper upgrades

all values are estimates, additional accuracy requires market design and pricing exercise

WIRELESS AND FIXED WIRELESS SOLUTIONS NOT INCLUDED EXCEPT FOR LAKE TEMAGAMI

7.6 Temagami North

Quick View

Site Visit: May 27th and August 2nd, 2019

Population: 242

of homes: 115

of businesses: 5

of students: 0

of schools: 0

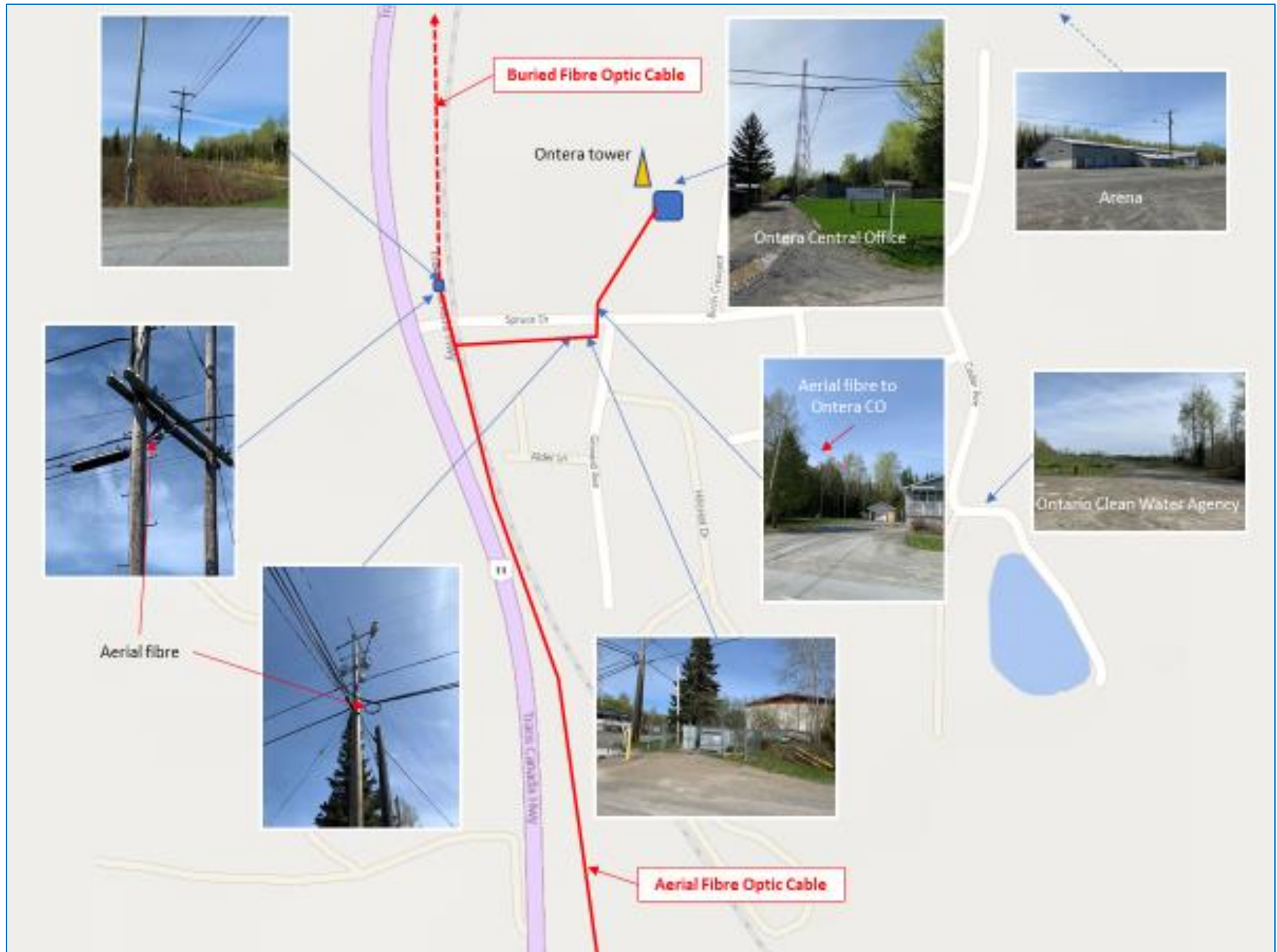
of hospitals/clinics: 1

Telecommunications Observations

Ontera's central office (CO) is located in Temagami North. As such, Ontera has aerial fibre assets that come into the community from the highway and rail systems. There is a now abandoned microwave tower at Ontera's property.

However, the community itself is serviced by aged ADSL technology with limited capacity, which greatly drops the further a dwelling is located from the CO. Ontera's plant is aerial copper throughout the community. There is likely some Xplornet service available as a small Xplornet panel antenna was noted on a dwelling pointed southward towards Temagami Core. However, the total capacity of the facility is unknown.

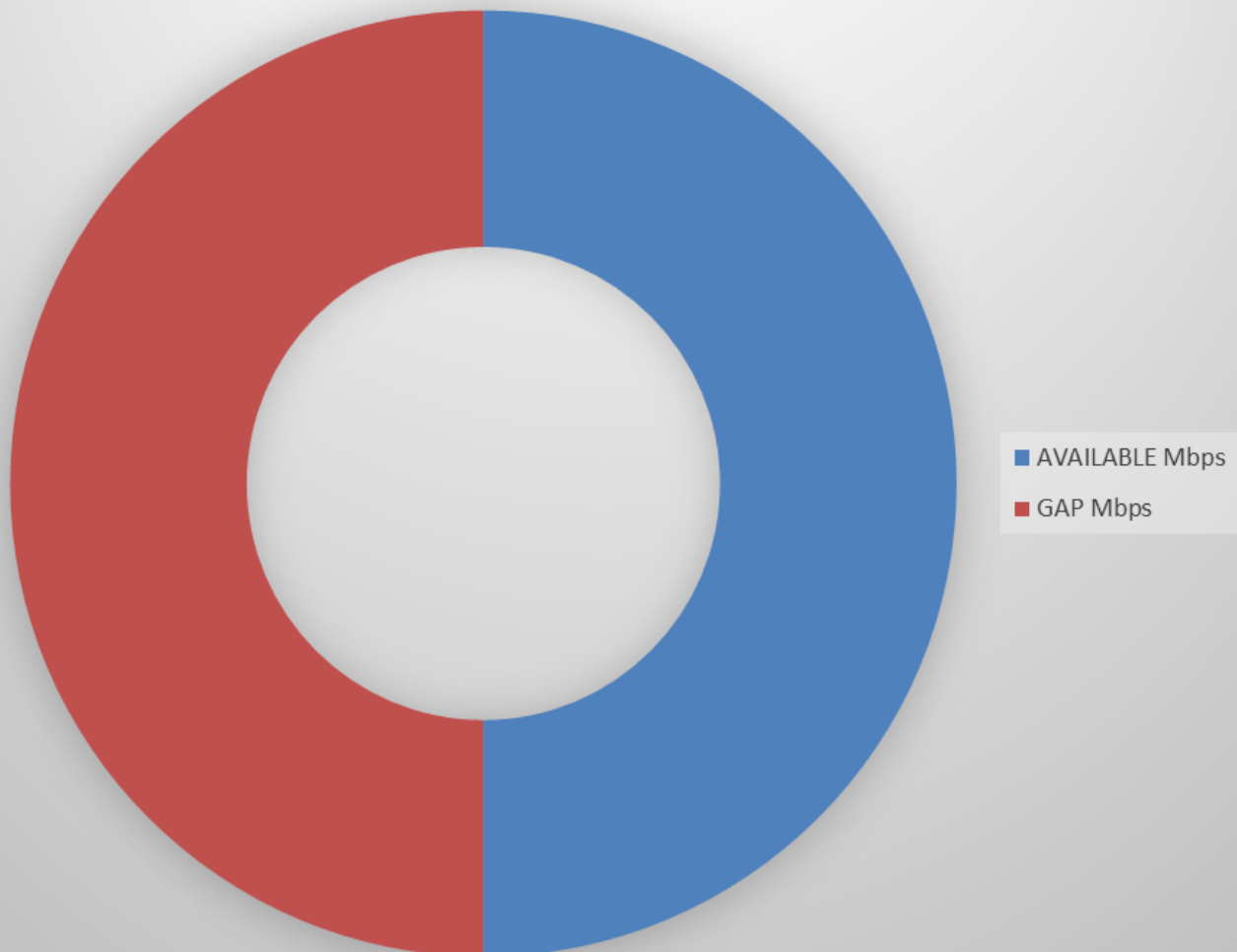
Mobility coverage appears to come from the cellular tower site near the school in Temagami. Both Xplornet and Galaxy Broadband are reported to provide satellite data services; however, no premises mounted dishes were visible. Television satellite dishes were not covered in this scope (ie: ExpressVu).



Temagami North does have a relatively sizeable gap as noted below in red. However, there is the potential to increase capacity as recommended herein.

Community Broadband Gap Analysis	STATISTICS						DATA (Mbps)					NEED	OS ratio 5:1	AVAILABLE Mbps	GAP Mbps
	POP	Dwellings	Businesses	Hospital/ Clinics	Schools	Students	Dwellings	Businesses	Hospital/ Clinics	Schools	Students				
							25	100	100	100	1	Mbps		Mbps	Mbps
Temagami North	242	115	5	0	0	0	2875	500	0	0	0	3375	675	200	475.0

Temagami North Estimated Broadband Gap 5:1 OS ratio (does not include wireless broadband)



Recommendations

- Given the level of fibre connectivity into Temagami North given Ontera's central office location, they should be contacted to discuss the potential to upgrade the community's local access and distribution. For instance, discuss whether Ontera will install an upgraded DSLAM within their CO and deploy VDSL. While that would not meet the CRTC's aspirational goals of 50/10, it would at least improve user experience in the interim.
- Ontera will also need to confirm the transport capacity of its current fibre into the community should it require additional equipment to be sized properly for local distribution.
- The presence of fibre does provide the opportunity for an alternate service provider to access Ontera wholesale services and deploy either as a WISP and/or a FTTP deployment, depending on a sustainable business case.

Estimated Capital Ranges

[refer to Exhibit A – Estimated Capital Ranges for full project view]

		MARKET PROJECTION		CONNECTED PREMS		
Communities	Premis Passed	Target Market Penetration	Target Prem Project Total	Year One Connected Premis	Year Two Connected Premis	Year Three Connected Premis
Temagami North	120	80%	96	38	29	29

TRANSPORT	DISTRIBUTION	DROPS	YEAR TWO & THREE		TOTAL FTTP COSTS		
Transport + electronics	Distribution + Electronics	FTTP Drop + Prem Total Cost	Year Two PREM Capital	Year Three PREM Capital	Total Project Cost	Total Cost Per Prem PASSED	Total Cost Per CONNECTED Prem
\$ 111,948	\$ 280,000	\$ 44,544	\$ 33,408	\$ 33,408	\$ 503,308	\$ 4,083	\$ 5,243

Premis Passed = # of premises that distribution cabling passes along a street, but not connecting to the premises (drop)

Target Market Penetration = estimate of how many customers would use the new service

Transport + Electronics = cost of construction backbone fibre to community + electronics, or electronics if transport fibre in place

Distribution + Electronics = cost of constructing last mile distribution fibre + electronics within the community

VDSL Per Connected Prem = cost of installing the node divided by the number of total subscribers

LOW (VDSL) = estimated lower end of providing a degree of broadband in the community

HIGH (FTTP) = estimated upper end of providing a degree of broadband in the community

Overall Assumptions:

pole make ready costs not included

% of premis connected varies, max 80% where no competitor to Ontera/Bell, max 60% where a facilities based competitor exists

VDSL will not require distribution copper upgrades

all values are estimates, additional accuracy requires market design and pricing exercise

WIRELESS AND FIXED WIRELESS SOLUTIONS NOT INCLUDED EXCEPT FOR LAKE TEMAGAMI

7.7 Marten River

Quick View

Site Visit: August 2nd, 2019

Population: 40

of homes: 20

of businesses: 5

of students: 0

of schools: 0

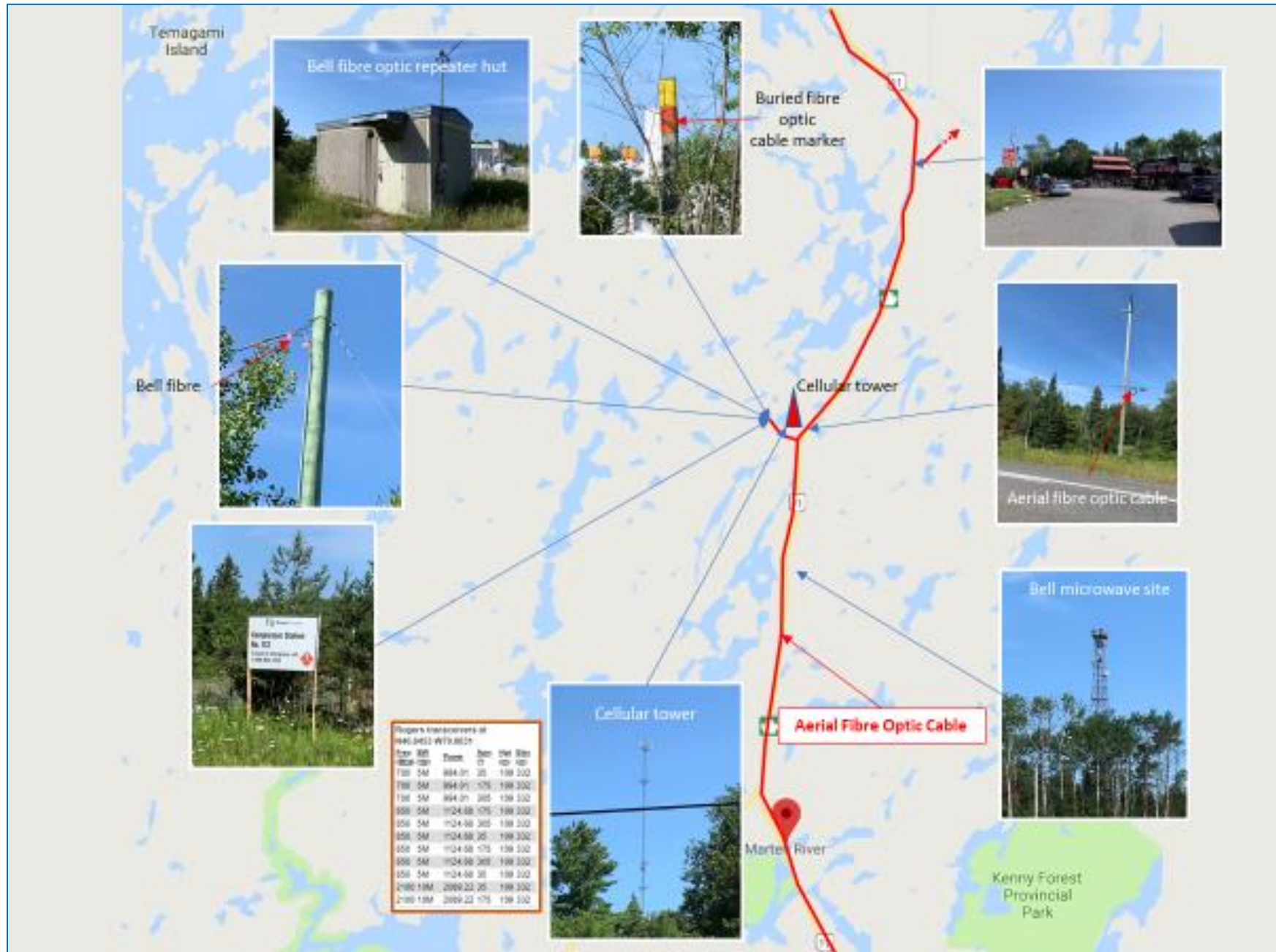
of hospitals/clinics: 0

Telecommunications Observations

The community has aerial Ontera fibre facility that passes through along Highway 11. There is only aerial copper plant installed along Highway 64. Local distribution is limited to copper with aged ADSL technology at low speeds.

Mobility coverage comes from towers in the vicinity as noted in the mapping below. Both Xplornet and Galaxy Broadband are reported to provide satellite data services; however, no premises mounted dishes were visible. Television satellite dishes were not covered in this scope (ie: ExpressVu).





Marten River has a complete broadband gap as illustrated below in red. However, there is the potential to increase capacity as recommended herein.

Community Broadband Gap Analysis	STATISTICS						DATA (Mbps)					NEED	OS ratio 5:1	AVAILABLE Mbps	GAP Mbps
	POP	Dwellings	Businesses	Hospital/ Clinics	Schools	Students	Dwellings	Businesses	Hospital/ Clinics	Schools	Students				
							25	100	100	100	1	Mbps		Mbps	Mbps
Marten River	40	20	5	0	0	0	500	500	0	0	0	1000	200	0	200.0

Marten River Estimated Broadband Gap 5:1 OS ratio (does not include wireless broadband)



■ AVAILABLE Mbps
■ GAP Mbps

Recommendations

- Given the level of fibre connectivity passing through a portion of Marten River along Highway 11, Ontera should be contacted to discuss the potential to upgrade the community's local access and distribution. For instance, discuss whether Ontera will install a FTTN/DSLAM within the community and deploy VDSL. While that would not meet the CRTC's aspirational goals of 50/10, it would at least improve user experience in the interim.
- Ontera will also need to confirm the transport capacity of its current fibre into the community should it require additional equipment to be sized properly for local distribution.
- The presence of fibre does provide the opportunity for an alternate service provider to access Ontera wholesale services and deploy either as a WISP and/or a FTTP deployment, depending on a sustainable business case.

Estimated Capital Ranges

[refer to Exhibit A – Estimated Capital Ranges for full project view]

		MARKET PROJECTION		CONNECTED PREMS		
Communities	Premis Passed	Target Market Penetration	Target Prem Project Total	Year One Connected Premis	Year Two Connected Premis	Year Three Connected Premis
Marten River	25	80%	20	8	6	6

TRANSPORT	DISTRIBUTION	DROPS	YEAR TWO & THREE		TOTAL FTTP COSTS		
Transport + electronics	Distribution + Electronics	FTTP Drop + Prem Total Cost	Year Two PREM Capital	Year Three PREM Capital	Total Project Cost	Total Cost Per Prem PASSED	Total Cost Per CONNECTED Prem
\$ 559,741	\$ 237,500	\$ 9,280	\$ 6,960	\$ 6,960	\$ 820,441	\$ 39,862	\$ 41,022

Premis Passed = # of premises that distribution cabling passes along a street, but not connecting to the premises (drop)

Target Market Penetration = estimate of how many customers would use the new service

Transport + Electronics = cost of construction backbone fibre to community + electronics, or electronics if transport fibre in place

Distribution + Electronics = cost of constructing last mile distribution fibre + electronics within the community

VDSL Per Connected Prem = cost of installing the node divided by the number of total subscribers

LOW (VDSL) = estimated lower end of providing a degree of broadband in the community

HIGH (FTTP) = estimated upper end of providing a degree of broadband in the community

Overall Assumptions:

pole make ready costs not included

% of premis connected varies, max 80% where no competitor to Ontera/Bell, max 60% where a facilities based competitor exists

VDSL will not require distribution copper upgrades

all values are estimates, additional accuracy requires market design and pricing exercise

WIRELESS AND FIXED WIRELESS SOLUTIONS NOT INCLUDED EXCEPT FOR LAKE TEMAGAMI

7.8 Bear Island

Quick View

Site Visit: May 27th, 2019

Population: 244

of homes: 110

of businesses: 14

of students: 44

of schools: 1

of hospitals/clinics: 1

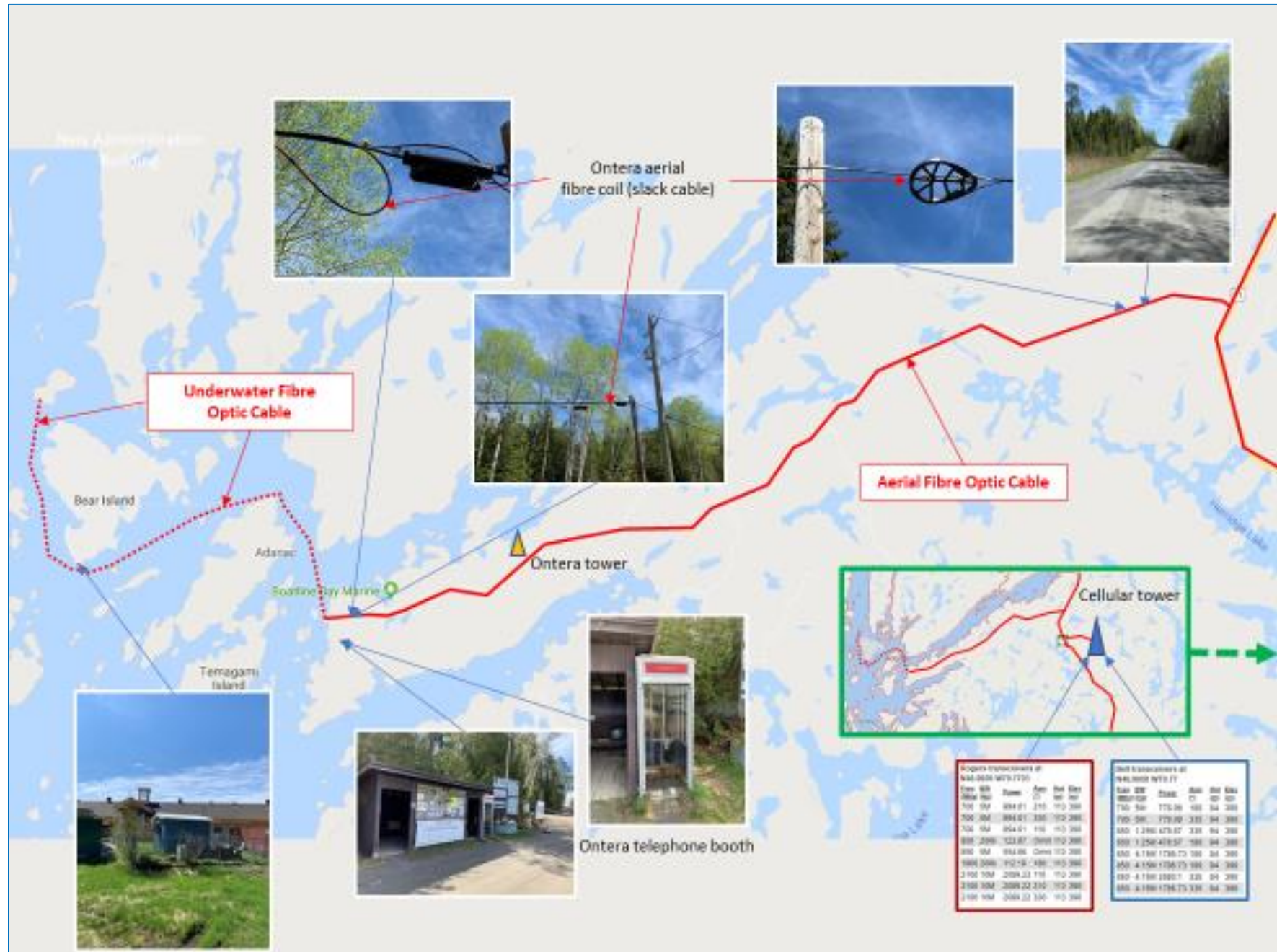
Telecommunications Observations

Bear Island is served by Ontera's fibre optic cable that comes ashore and into their POP as shown below. The community itself has an Ontera aerial copper distribution network. Some of the copper plant has been upgrade in the past few years; however, it is still an aged ADSL system with limited capacity. There is a single point to point fibre from the Ontera POP to the Doreen Potts Health Centre that was likely installed as part of KNET's service contract with eHealth (Provincial program to connect medical facilities). It was observed that attempts have been made to access the bandwidth to create wireless connections to points in the community. Inherently, such a system would not be optimal as the original circuit was not intended to support the additional traffic, nor was it a carrier-grade installation.

There are a few locations that are served by Xplornet satellite services, especially at the construction trailer site. That particular installation is temporary.

Cellular coverage is spotty at best to non-existent given the topography of Bear Island and that of the surrounding territory.

Television satellite dishes were not covered in this scope (ie: ExpressVu).



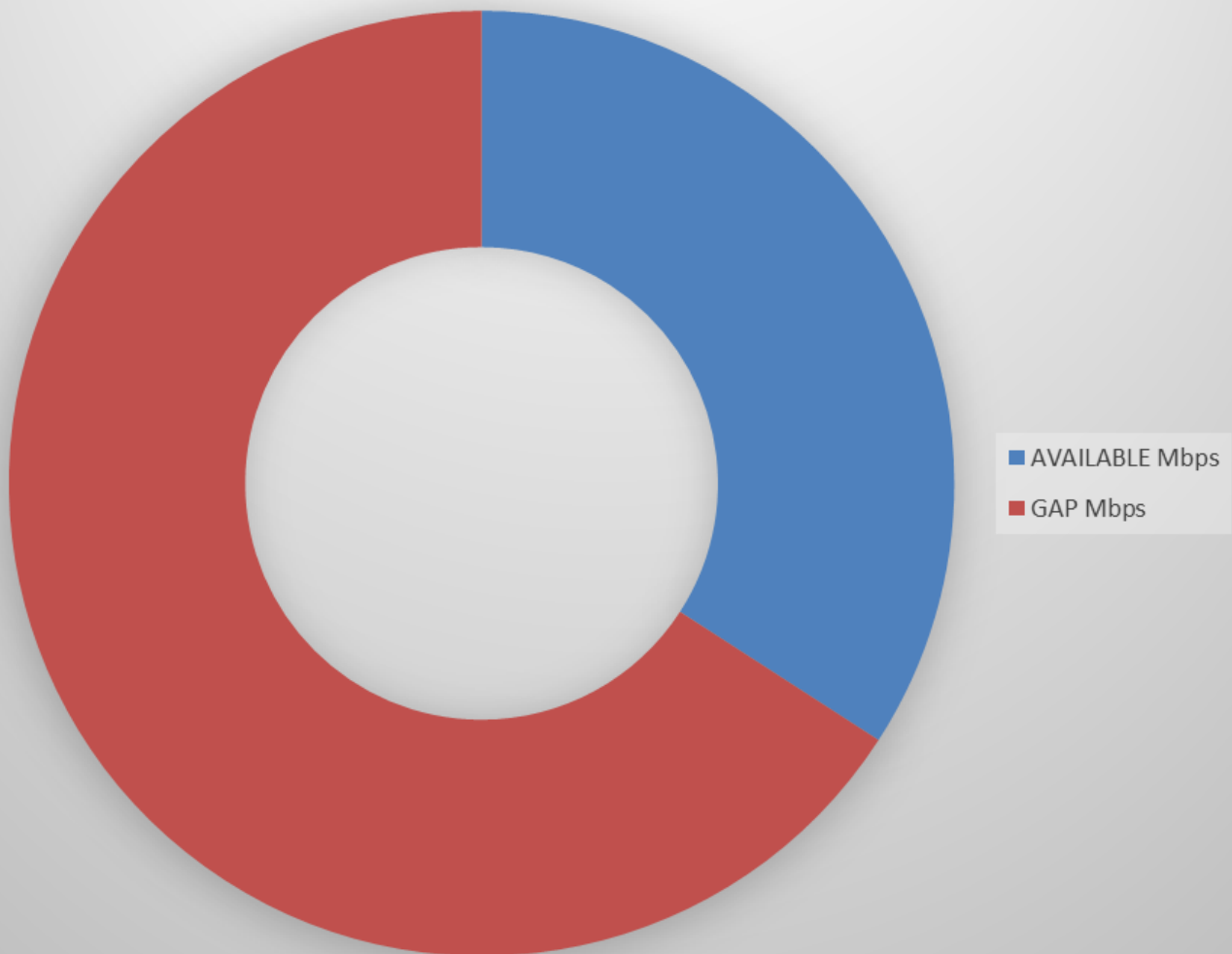




Bear Island does have a relatively sizeable gap as noted below in red. However, there is the potential to increase capacity as recommended herein.

Community Broadband Gap Analysis	STATISTICS						DATA (Mbps)					NEED	OS ratio 5:1	AVAILABLE Mbps	GAP Mbps
	POP	Dwellings	Businesses	Hospital/ Clinics	Schools	Students	Dwellings	Businesses	Hospital/ Clinics	Schools	Students				
							25	100	100	100	1	Mbps		Mbps	Mbps
Bear Island	244	110	14	1	1	44	2750	1400	100	100	44	4394	879	300	578.8
STUDY AREA TOTALS	3146	1373	49	2	2	68	34325	4900	200	200	68	39693	7938.6	700	7238.6

Bear Island
Estimated Broadband Gap
5:1 OS ratio
 (does not include wireless broadband)



Recommendations

- Given the level of fibre connectivity onto Bear Island, Temagami First Nation has contracted Amedeo Bernardi Consulting Inc. to investigate if additional capacity can be provisioned for Bear Island. Ontera is currently assessing its network and determining whether its equipment is sized properly for the increased request.
- A consideration in the interim is to have Ontera upgrade the community's local copper access and distribution. Ontera has upgraded much of its copper plant in the main section of the Island. At a minimum, Ontera could install an upgraded DSLAM within the community and deploy VDSL. While that would not meet the CRTC's aspirational goals of 50/10, it would at least improve user experience in the interim. However, until Ontera confirms its overall network capacity on to Bear Island, the discussion is premature.
- The presence of fibre does provide the eventual opportunity for an alternate service provider to access Ontera wholesale services and deploy either as a WISP and/or a FTTP deployment, depending on a sustainable business case.

Estimated Capital Ranges

[refer to Exhibit A – Estimated Capital Ranges for full project view]

		MARKET PROJECTION		CONNECTED PREMS		
Communities	Prem Passed	Target Market Penetration	Target Prem Project Total	Year One Connected Prem	Year Two Connected Prem	Year Three Connecte d Prem
Bear Island	125	90%	113	45	34	34

TRANSPORT	DISTRIBUTION	DROPS	YEAR TWO & THREE		TOTAL FTTP COSTS		
Transport + electronics	Distribution + Electronics	FTTP Drop + Prem Total Cost	Year Two PREM Capital	Year Three PREM Capital	Total Project Cost	Total Cost Per Prem PASSED	Total Cost Per CONNECTED Prem
\$ 55,974	\$ 287,500	\$ 52,200	\$ 39,150	\$ 39,150	\$ 473,974	\$ 3,053	\$ 4,213

Prem Passed = # of premises that distribution cabling passes along a street, but not connecting to the premises (drop)

Target Market Penetration = estimate of how many customers would use the new service

Transport + Electronics = cost of construction backbone fibre to community + electronics, or electronics if transport fibre in place

Distribution + Electronics = cost of constructing last mile distribution fibre + electronics within the community

VDSL Per Connected Prem = cost of installing the node divided by the number of total subscribers

LOW (VDSL) = estimated lower end of providing a degree of broadband in the community

HIGH (FTTP) = estimated upper end of providing a degree of broadband in the community

Overall Assumptions:

pole make ready costs not included

% of prems connected varies, max 80% where no competitor to Ontera/Bell, max 60% where a facilities based competitor exists

VDSL will not require distribution copper upgrades

all values are estimates, additional accuracy requires market design and pricing exercise

WIRELESS AND FIXED WIRELESS SOLUTIONS NOT INCLUDED EXCEPT FOR LAKE TEMAGAMI

7.9 Temagami (Lake)

Quick View

Site Visit: May 27th, 2019

Population: 2100 (predominantly seasonal)

of homes: 908

of businesses: 5

of students: 0

of schools: 0

of hospitals/clinics: 0

Telecommunications Observations

The dwellings on Lake Temagami are predominantly seasonal, recreational cottages that peak during the summer months. Given the extensive shoreline and number of islands on the Lake, wired connectivity has always been a challenge. Most locations are serviced by Ontera's network of underwater copper plant. Distribution points are fed by fibre (ie: from Bear Island and Wabun/Garden Island), copper and microwave (ie: from Ontera tower on Lake Temagami Access Rd to other lake towers).

Based on survey responses, it was observed that some seasonal residents rely on cellular based data services, where there is coverage. However, cellular coverage is spotty at best to non-existent given the topography of the surrounding territory.

Both Xplornet and Galaxy Broadband are reported to provide satellite data services. Television satellite dishes were not covered in this scope (ie: ExpressVu).

Lake Temagami has a complete broadband gap as illustrated below in red. However, there is the potential to increase capacity as recommended herein.

Community Broadband Gap Analysis	STATISTICS						DATA (Mbps)					NEED	OS ratio 5:1	AVAILABLE Mbps	GAP Mbps
	POP	Dwellings	Businesses	Hospital/ Clinics	Schools	Students	Dwellings	Businesses	Hospital/ Clinics	Schools	Students				
							25	100	100	100	1	Mbps		Mbps	Mbps
Lake Temagami	2100	908	5	0	0	0	22700	500	0	0	0	23200	4640	0	4640.0

Lake Temagami Estimated Broadband Gap 5:1 OS ratio (does not include wireless broadband)



■ AVAILABLE Mbps
■ GAP Mbps

Recommendations

- It would be cost prohibitive to replace the existing Ontera underwater copper network based on the low density and seasonal population. Over time, Ontera might replace key segments with fibre based on costing, but that does not ensure that the underlying network capacity would be increased in step.
- This report is not intended to review or analyze wireless-based coverage; nor make any related recommendations. However, so to provide a potential scope of the potential effort to provide additional capacity to portions of Lake Temagami, some high-level suggestions follow. Note that a radio-frequency engineering analysis was not commissioned, and this is merely based on observations.
- As noted in the report, LEO (low earth orbit) satellite network constellations are starting to be launched. Should one or more of the providers commercialize their offerings successfully, the potential for coverage in the region is greatly increased.
- A potential option to consider is the installation of at least one tower on Bear Island at the height of land. A second tower could be considered on another sector of the lake (or more).
- A Bear Island tower of 100' – 200' in height may provide a sizeable coverage footprint for fixed wireless services to adjacent locations. Capacity is predicated on accessing sufficient services from the Ontera network (see Bear Island section).
- A proxy of the possible costs to implement one to two towers is estimated in the table below.
- A benefit to a tower on Bear Island is that cellular companies such as Bell Mobility and Rogers might be attracted to collocate on the facility (for a recurring fee). One or more of the companies should be approached to even consider partially funding the structure, as long as there is a business case for the tower owners.
- The diagrams that follow are included for illustration purposes only and are not meant to represent an actual design.

Estimated Capital Ranges

[refer to Exhibit A – Estimated Capital Ranges for full project view]

		MARKET PROJECTION		CONNECTED PREMS			
Communities	Prem Passed	Target Market Penetration	Target Prem Project Total		Year One Connected Prem	Year Two Connected Prem	Year Three Connecte d Prem
Lake Temagami	913	30%	274		110	82	82
TRANSPORT	DISTRIBUTION	DROPS	YEAR TWO & THREE		TOTAL FTTP COSTS		
Transport + electronics	Distribution + Electronics	FTTP Drop + Prem Total Cost	Year Two PREM Capital	Year Three PREM Capital	Total Project Cost	Total Cost Per Prem PASSED	Total Cost Per CONNECTED Prem
\$ 559,741	\$ 1,569,500	\$ 127,090	\$ 95,317	\$ 95,317	\$ 2,446,965	\$ 7,774	\$ 8,934

NOTE: The values as presented are only a proxy for the estimated costs of two towers, do not reference fibre-related terminology.

Prem Passed = # of premises that distribution cabling passes along a street, but not connecting to the premises (drop)

Target Market Penetration = estimate of how many customers would use the new service

Transport + Electronics = cost of construction backbone fibre to community + electronics, or electronics if transport fibre in place

Distribution + Electronics = cost of constructing last mile distribution fibre + electronics within the community

VDSL Per Connected Prem = cost of installing the node divided by the number of total subscribers

LOW (VDSL) = estimated lower end of providing a degree of broadband in the community

HIGH (FTTP) = estimated upper end of providing a degree of broadband in the community

Overall Assumptions:

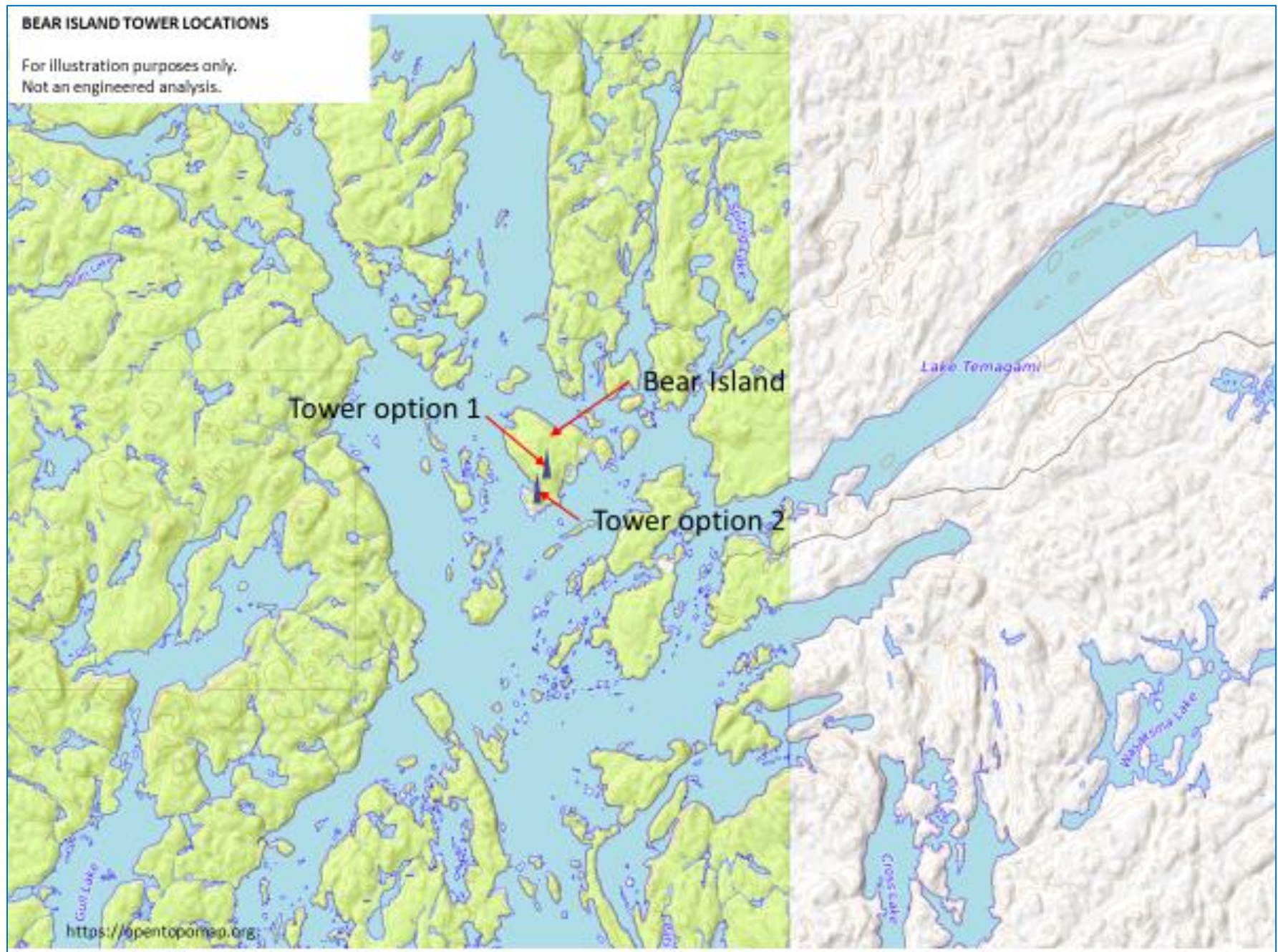
pole make ready costs not included

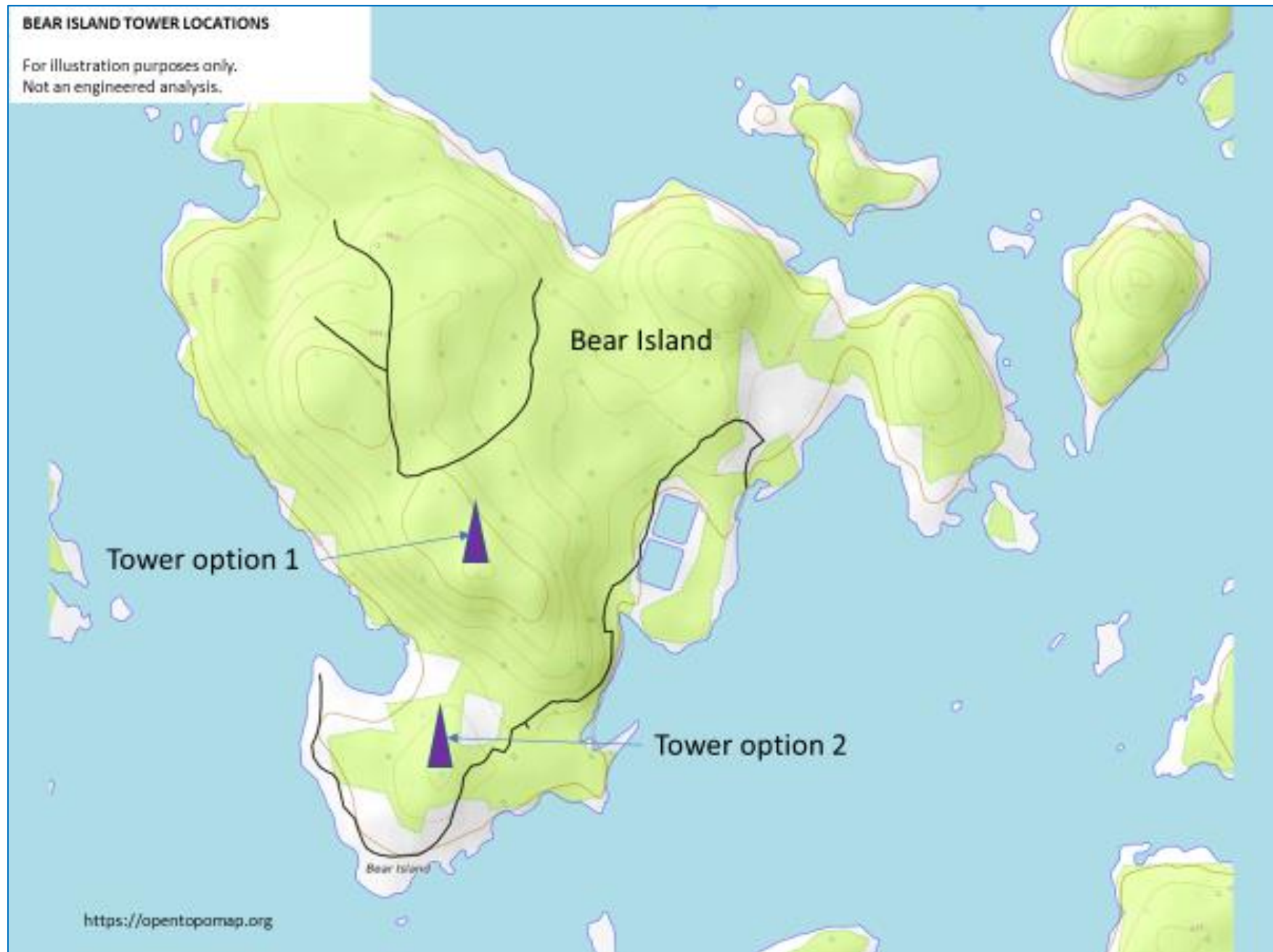
% of prem connected varies, max 80% where no competitor to Ontera/Bell, max 60% where a facilities based competitor exists

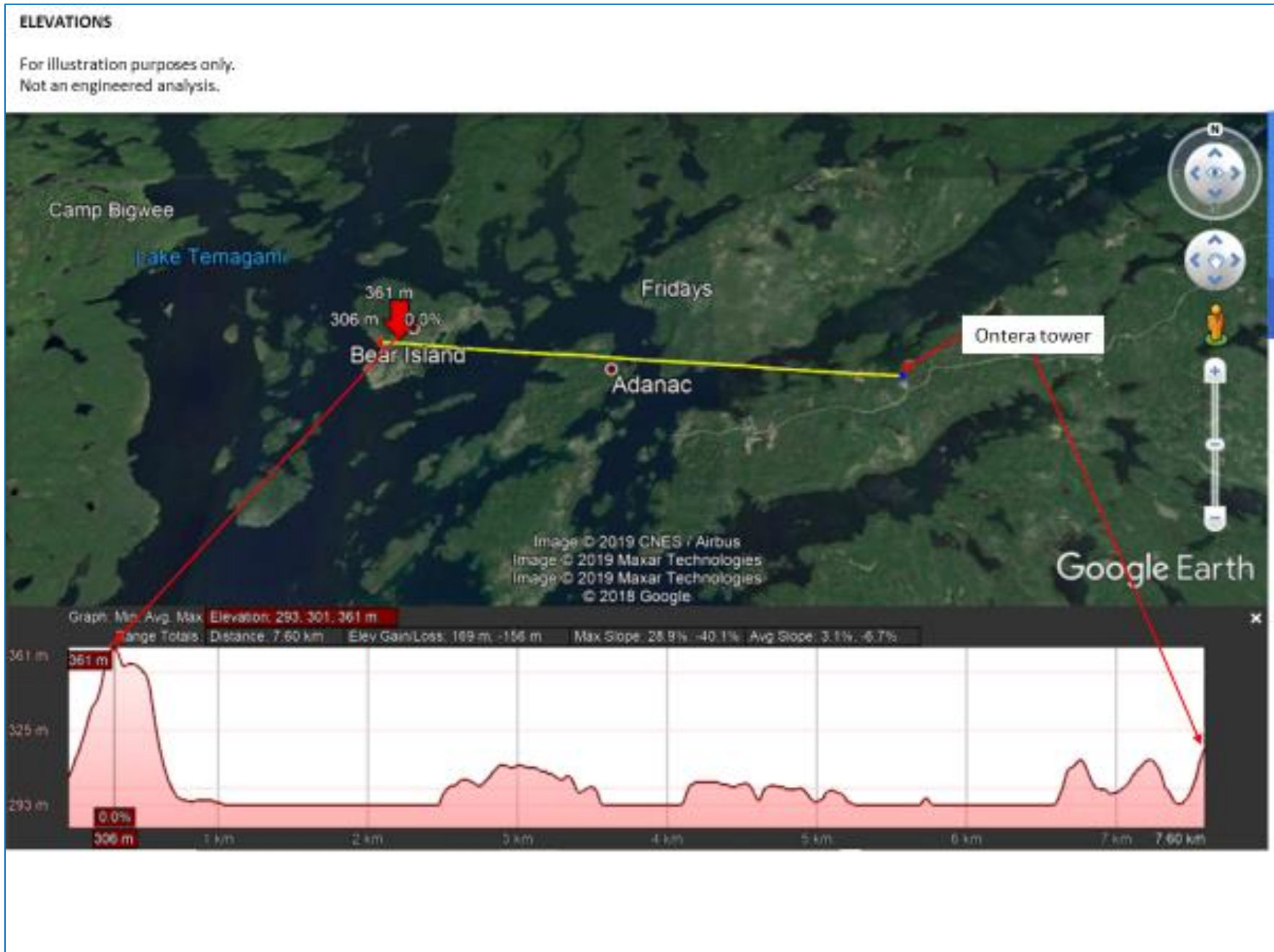
VDSL will not require distribution copper upgrades

all values are estimates, additional accuracy requires market design and pricing exercise

WIRELESS AND FIXED WIRELESS SOLUTIONS NOT INCLUDED EXCEPT FOR LAKE TEMAGAMI

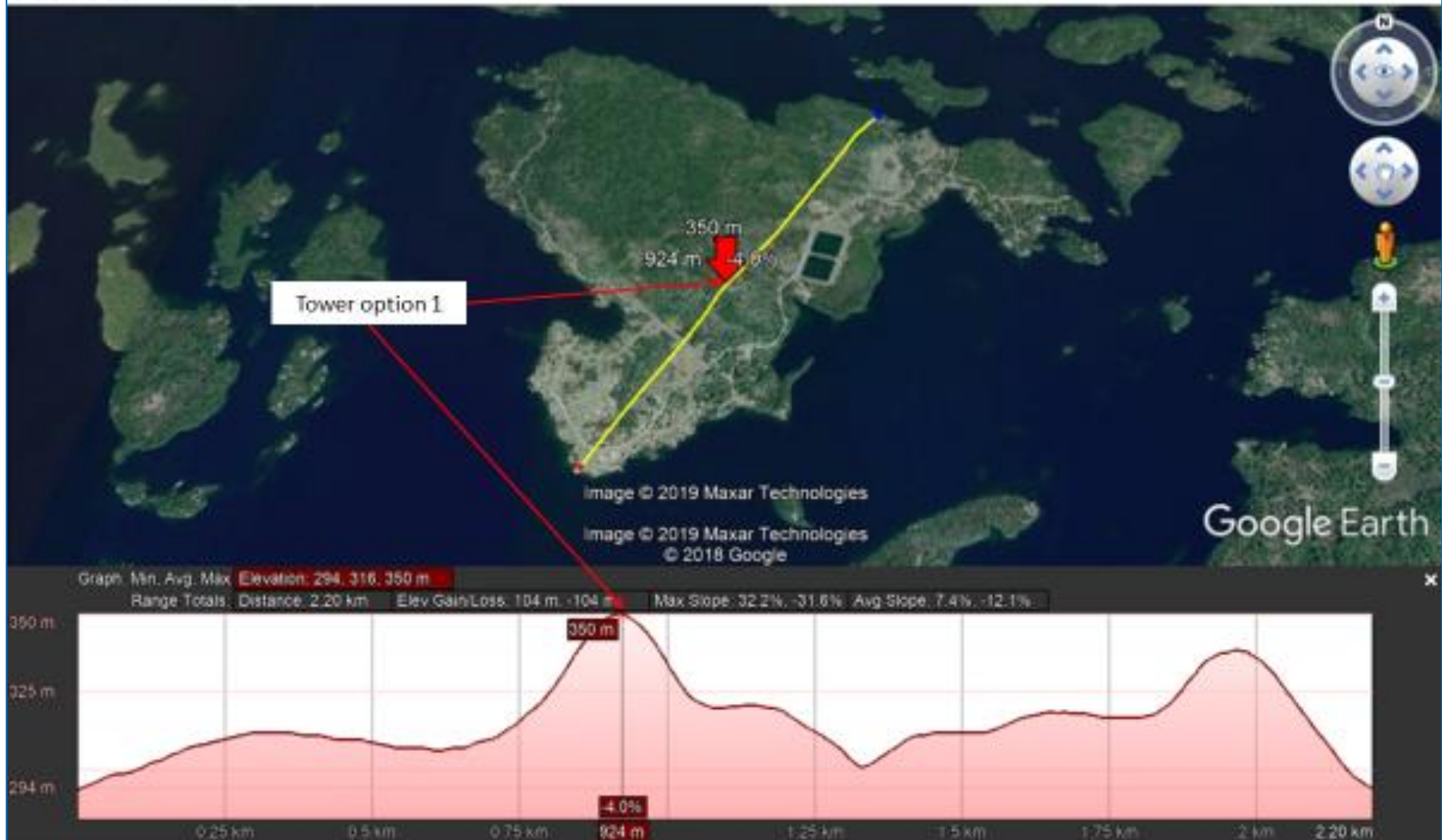






ELEVATIONS

For illustration purposes only.
Not an engineered analysis.



8.0 Survey

8.1 Overview

The survey was administered from July 29th to August 16th, 2019. It was provided in both online and paper formats. Representatives of the participating communities employed a variety of communications methods to drive participation in the survey.

The following table is a summary of the survey engagement.

Surveys Completed	385
Total Dwellings*	1408
Percentage Completed	27%
*Total Dwellings based on 2016 Stats Can census, TFN Community Profile Feb 2019 (110), Connected North parcel 2019 information (1298)	

The survey was premises-based versus individual responses so to reduce multiple results from the same home or business. There was an overall 27% participation rate across the communities with 37% representing residences and 55% seasonal respondents. This aligns closely with the data that follows the table below.

Participation by Premises Type	#	%
Home or primary residence	144	37%
Seasonal residence/cottage	213	55%
Business (not including tourist camp)	10	3%
Tourist camp/resort	11	3%
Other	7	2%
Total	385	100%

Responses were tabulated relative to their communities as noted in the table below with 58% of input received from Lake Temagami.

Participation by Community (Cumulative)	#	%
Bear Island	49	13%
Temagami North	35	9%
Temagami	63	16%
Lake Temagami	223	58%
Marten River	15	4%
Total	385	100%

Grouping the areas by their census areas, the results indicate that Bear Island had a 45% participation rate and Municipality of Temagami a rate of 26% based on respondents versus total number of dwellings and parcels.

Participation by Community	#	%
Bear Island	49	45%
Municipality of Temagami	336	26%

8.2 Survey Details

The following information was derived from the survey and has been arranged into three general categories: i) current broadband status, ii) desired connectivity and iii) cellular. The full survey results can be referenced in the Exhibits section.

Current Broadband Status

- 92% of the respondents were residential/seasonal.

Home or primary residence	144
Seasonal residence/cottage	213
Business (not including tourist...)	10
Tourist camp/resort (owner, n...	11
Other	7



- 69% of all respondents have Internet access from their location.

Yes	267
No	118



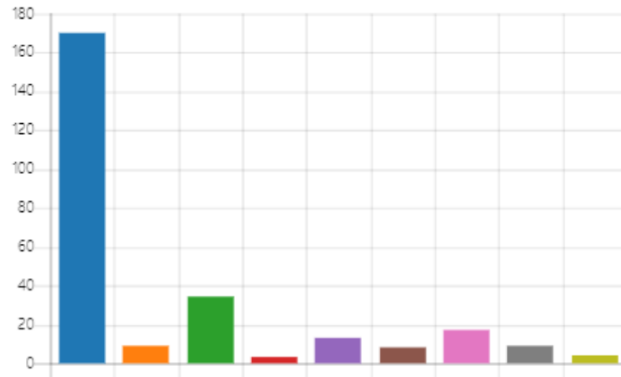
- Of those that do not, 50% said it was due to lack of service.

There is no Internet service av...	64
It is too expensive to install Int...	29
I do not want to have Internet ...	12
Other	23



- The predominant connection type is DSL (44%) followed by satellite (9%)

DSL (Digital Subscriber Line o...	170
Fixed Wireless (ie: Xplornet - n...	9
Satellite Service	34
Fibre Optic (directly to your pr...	3
Cellular Data (ie: Rocket Stick, ...	13
Cable Modem	8
Dial-Up Connection (over Tele...	17
I don't know	9
Other	4



- 72% of respondents are dissatisfied with their current services.

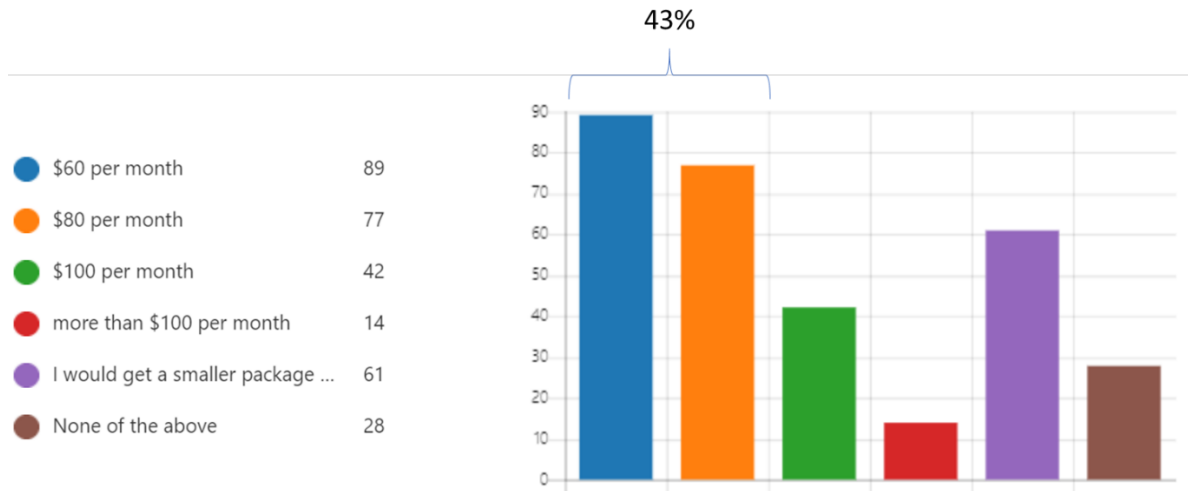
Yes	74
No	193



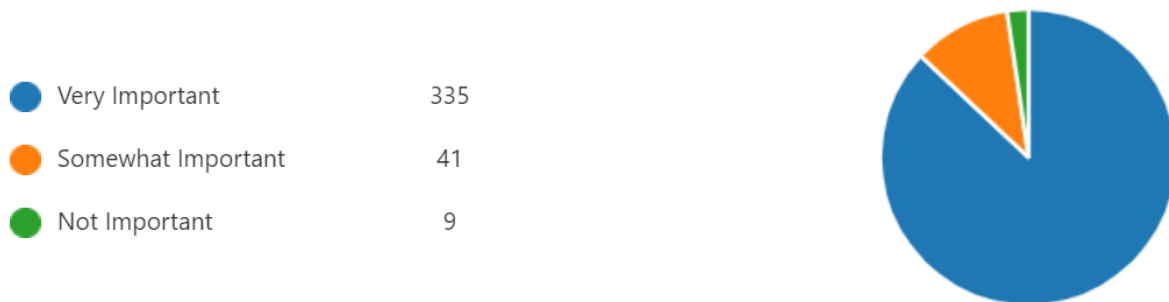
The responses in this category align with the findings of this report. Ontera does have the most widespread broadband network in the region with 77% of the respondents subscribed to Ontera.

Desired Connectivity

- 43% of respondents would subscribe to packages that cost \$60-\$80 per month to achieve the Federal goal of 50/10. That increases to 54% for those willing to spend between \$60-\$100 per month.



- 87% of respondents believe that advanced communications are very important for the community, inhabitants and businesses.



There is a strong demand of improved speeds in the region with the willingness to subscribe to fair priced packages if they were available. This suggests that there is a definite opportunity for service providers willing to invest and communities seeking partners in developing broadband for their residents and businesses.

Cellular

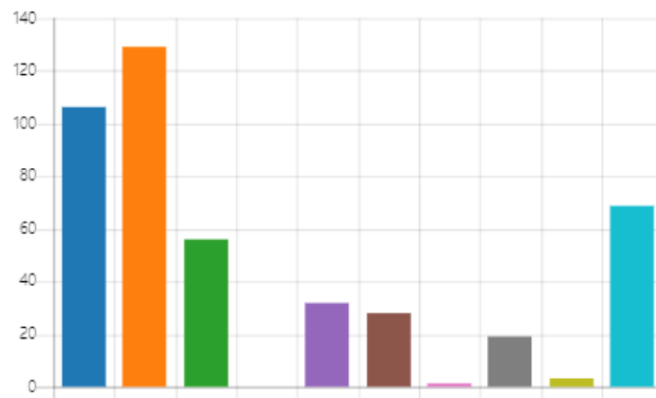
- 95% of households own at least one cellphone.

Yes	365
No	20

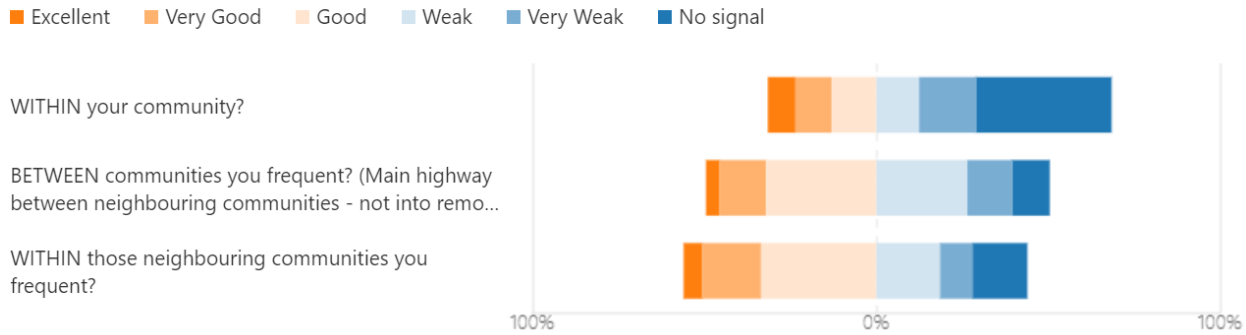


- While most respondents have Rogers as their provider (30%), when the respective flanker brands and roaming partners (ie; Bell and Telus) are accounted for, Rogers et al account for 34% of cellular users and Bell/Telus total 51%.

Bell Mobility	106
Rogers	129
TELUS Mobility	56
Tbaytel Mobility	0
Koodo Mobile	32
Virgin Mobile	28
Chartr Mobile	1
Fido Mobile	19
NorthernTel Mobility	3
Other	69



- Approximately one-third of respondents rate cellular coverage within their community as good to excellent. Almost 60% consider coverage within neighbouring communities to be good to excellent. However, approximately 50% indicate that the coverage between communities is weak to no coverage at all.



Cellphones have become an indispensable tool, not only for communications but assisting with many everyday tasks. Given the topology of the region combined with severe winter weather patterns, deficiencies in cellular coverage present challenges in emergency planning and safety concerns for residents. This issue was outside of the original scope of this study, but it is recommended that it be investigated further.

9.0 Risk Matrix

The potential regional risks that could influence the impact of broadband Internet improvement plans are captured over the coming pages. The assessed likelihood coupled with the estimated impact results in a rating of the potential risk using the scales in the two charts below.

LIKELIHOOD = Probability of the risk event actually occurring.	
Score:	Description:
1	Improbable; Rare
2	Unlikely
3	Possible
4	Likely
5	Certain

IMPACT = Degree of severity of the consequence.	
Score:	Description:
1	Insignificant - negligible effects.
2	Minor - normal administrative difficulties;
3	Significant - delay in accomplishing program or project objectives;
4	Major - program or project re-design, re-approval and re-do
5	Catastrophic - project or program irrevocably finished; objective will not be met.

The risks are grouped for ease of reference: Economy, Environment, Political, Regulatory, Safety, Strategic, and Technology. Suggested mitigation strategies that accompany each risk will also serve to inform of overall recommendations for the communities to consider.

CATEGORY	RISK	LIKELIHOOD (1-5 low-high)	IMPACT (1-5 low-high)	SCORE TOTAL	RANK	BACKGROUND	MITIGATION
Economy	Regional economy impacts - expansion or contraction of projects (natural resources valuations ie gold, forestry, etc)	1	4	4	LOW	Expansion or contraction of existing industries, effects of national and international trade, and financial stability of those operating in the Region can impact demand on Broadband.	Industry can be a major partner in furthering the communities' Broadband goals, whether as investors and/or their own lobbying efforts. They also benefit highly with a solid Broadband underpinning in the web-based and global economy. Continuous efforts to monitor their progress and solicit their help is key.
Environment	Natural disasters such as forest fires, ice rain, landslides, flooding, windstorms and lightning have impaired telecommunications network connectivity.	3	4	12	HIGH	The region is susceptible to many types of natural disasters, especially forest fires. With a predominantly aerial fibre and copper infrastructure, communities can risk isolation.	Communities must continue their vigilance and press their service providers on network redundancy strategies.
Political	Upcoming Federal elections (October 21, 2019) potential to change governing party and/or remove majority. Can result in discontinuation of funding priorities such as rural broadband and wireless expansion, delay budgetary approvals, and/or contribute to increased regulation (Internet traffic management).	3	5	15	HIGH	The success of the region's Broadband development is intrinsically linked to Federal policies and directions given the low population densities and challenging terrains.	Contact and dialogue with Federal politicians and bureaucrats must be maintained. Regional and local needs must continue to be addressed and impacts highlighted.
Political	New provincial government. Still unclear on broadband direction and funding priorities as MOI plans are scheduled for Spring 2020.	3	4	12	HIGH	The success of the region's Broadband development is intrinsically linked to Provincial policies and directions given the low population densities and challenging terrains.	Contact and dialogue with Provincial politicians and bureaucrats must be maintained. Regional and local needs must continue to be addressed and impacts highlighted.
Political	Closing the Broadband Gap - what will be the Federal government's funding priorities in the coming year(s).	2	4	8	MEDIUM	The new fund will be a key funding mechanism to enable the Region's and communities' Broadband objectives. Where and when the fund become available could be significant for the area.	Contact and dialogue with Federal politicians and bureaucrats must be maintained. Regional and local needs must continue to be addressed and impacts highlighted. Importantly, the communities should participate as jointly as possible in applications and support for local initiatives. While being the lead applicant, partnerships with service providers and private enterprises can increase likelihood of funding. Parallel applications to other funds, especially Provincial, are crucial.
Political	Indigenous Funders	3	4	12	HIGH	Based on the possible participation of stakeholders such as Temagami First Nation, the contribution of the various federal Indigenous funding programs is essential.	The communities should seek ways to work together as soon as possible. Bear Island can serve as a key network location (tower, fibre access) to the mutual benefit of the area.

Political	FedNor - what will funding priority role be in upcoming year(s)	2	4	8	MEDIUM	FedNor is an important support vehicle for the Region's needs. Their prominence and influence of government policies will remain key to the Region's Broadband initiatives.	Contact and dialogue with Federal politicians and bureaucrats must be maintained. Regional and local needs must continue to be addressed and impacts highlighted. Importantly, the Region should participate as jointly as possible in applications and support for local initiatives. While being the lead applicant, partnerships with service providers and private enterprises can increase likelihood of funding. Parallel applications to other funds, especially Provincial, are crucial.
Political	MENDM - what will funding priority role be in upcoming year(s)	2	4	8	MEDIUM	MENDM is an important support vehicle for the Region's needs. Their prominence and influence of government policies will remain key to the Region's Broadband initiatives.	Contact and dialogue with Provincial politicians and bureaucrats must be maintained. Regional and local needs must continue to be addressed and impacts highlighted. Importantly, the Region should participate as jointly as possible in applications and support for local initiatives. While being the lead applicant, partnerships with service providers and private enterprises can increase likelihood of funding. Parallel applications to other funds are crucial.
Political	NOHFC - what will funding priority role be in upcoming year(s)	2	4	8	MEDIUM	NOHFC is an important support vehicle for the Region's needs. Their prominence and influence of government policies will remain key to the Region's Broadband initiatives.	Contact and dialogue with Provincial politicians and bureaucrats must be maintained. Regional and local needs must continue to be addressed and impacts highlighted. Importantly, the Region should participate as jointly as possible in applications and support for local initiatives. While being the lead applicant, partnerships with service providers and private enterprises can increase likelihood of funding. Parallel applications to other funds are crucial.
Regulatory	CRTC - Open Access (Net Neutrality)	1	5	5	LOW	Should Canada decide to abandon its Open Access platform, smaller operators will be unable to consider competing and servicing customers in remote/rural areas.	Participate as a regional group to actively monitor and contribute to Regulatory proceedings. Consider participation in existing industry groups with similar causes and concerns as required. Maintain active contact with local Federal MPs.
Regulatory	CRTC - Faster Internet and Basic Service Offering, \$750M broadband fund - how will the fund be administered?	4	5	20	EXTREME	The CRTC's direction on the establishment of its broadband objectives and funding mechanisms will have a significant bearing on the overall improvements to Broadband in the region.	Participate as a regional group to actively monitor and contribute to Regulatory proceedings. Consider participation in existing industry groups with similar causes and concerns as required. Maintain active contact with local Federal MPs.

Regulatory	CRTC - Implementation of a disaggregated wholesale high-speed access service	2	2	4	LOW	The CRTC's implementation of high-speed access will begin to have appreciable impacts only once Ontera has a FTTP network within participating communities.	Participate as a regional group to actively monitor and contribute to Regulatory proceedings. Consider participation in existing industry groups with similar causes and concerns as required. Maintain active contact with local Federal MPs.
Regulatory	ISED - Revisions to the 3500 MHz Band	2	4	8	MEDIUM	The ISED's direction on the upcoming auction must be monitored as it can have impacts on those regional providers that rely on licenced spectrum to deliver fixed wireless broadband or other WISPs.	Participate as a regional group to actively monitor and contribute to Regulatory proceedings. Consider participation in existing industry groups with similar causes and concerns as required. Maintain active contact with local Federal MPs.
Regulatory	ISED - Antenna Tower and Site Sharing	3	3	9	MEDIUM	Cellular coverage is an important for regional safety and commerce. Enforcing tower sharing will enable service providers to extend and enhance their wireless networks to a greater extent if they can colocate on existing towers, putting capital towards added transmission equipment versus tower construction.	Participate as a regional group to actively monitor and contribute to Regulatory proceedings. Consider participation in existing industry groups with similar causes and concerns as required. Maintain active contact with local Federal MPs.
Regulatory	Ontario Energy Board's New Wireline Pole Attachment Framework	4	4	16	HIGH	The region is located on the Canadian Shield; therefore, the majority of fibre optic network expansion, at least between communities, will likely be pole mounted. The historical rates per pole have doubled with increases contemplated thus jeopardizing sustainable business cases for service providers. The potential of increased retail pricing is a consideration impacting consumers.	Participate as a regional group to actively monitor and contribute to OEB/Provincial proceedings. Consider participation in existing industry groups with similar causes and concerns as required. Maintain active contact with local Provincial MPPs.
Safety	Cellular corridor coverage between the communities.	4	5	20	EXTREME	Deficiencies in cellular coverage present challenges in emergency planning and safety concerns for residents living in rural and remote areas. This issue was outside of the original scope of this study, but it is recommended that it be investigated further.	The Province has indicated that a study was commissioned earlier this year and is awaiting review post-election. Community members should continue to liaise with the Provincial representatives to ensure the matter remains at the forefront of government policy. Additionally, consider expanding the scope of future phases to include cellular wireless in as much as it may qualify for the CRTC fund for the data component to assist communities that may not get access to upgrades for FTTH or DSL.

Strategic	Stakeholders - clear definition of requirements and delineation of responsibilities	2	4	8	MEDIUM	Stakeholders include the Community and Band administration, Economic Development representatives, local politicians, residents, businesses and the service providers. Each has a different role, set of responsibilities and degrees of accountability.	Each Stakeholder must be listed with clearly delineated roles, responsibilities, and accountabilities. A communications plan must be tailored to address these elements. Care must be taken to ensure controls and management of efforts.
Strategic	Ontera - what investment directions will it have beginning in 2020? Where will it focus its broadband?	3	4	12	HIGH	Ontera is the major regional service provider in the Study Area. Its corporate fiscal goals can have direct impact on the region's connectivity and participating community's level of upgrades.	Establish contacts within Ontera and maintain dialogue underscoring importance of improvements and positive impact to both the communities and the service provider.
Strategic	Xplornet - what investment directions will it have beginning in 2020? Where will it focus its broadband?	3	4	12	HIGH	Xplornet is the major fixed wireless regional service provider in the Study Area. Its corporate fiscal goals can have direct impact on the region's connectivity and participating community's level of upgrades.	Establish contacts within Xplornet and maintain dialogue underscoring importance of improvements and positive impact to both the communities and the service provider.
Technology	Developments in 5G deployments and funding impacts	1	1	1	LOW	5G is garnering significant technology media coverage with the promise of facilitating data communications. Also concerns with access to 3500Mhz spectrum and the negative impact to rural fixed wireless.	5G should not play a significant role in the early stages of the project given the rural and low density parameters.
Technology	Sparse mobile cellular coverage on Lake Temagami	2	5	10	MEDIUM	Deficiencies in cellular coverage on the lake present challenges in emergency planning and safety concerns for residents.	Consider expanding the scope of future phases to include cellular wireless in as much as it may qualify for the CRTC fund for the data component to assist communities that may not get access to upgrades for FTTH or DSL.
Technology	Developments in LEO deployments and funding impacts	2	5	10	MEDIUM	Low earth orbit (LEO) satellite systems are starting to be deployed around the globe with the promise of high capacity, ubiquitous broadband coverage.	The proliferation of LEO systems is a positive "risk" for the sustainability of a future project as it could be the answer to coverage gaps along the PBX route. However, trends in costing and coverage will need to be monitored.
Technology	Propagation assumptions	4	4	16	HIGH	Project network coverage was based on a single RFI respondent's estimations.	A Radio Frequency (RF) study should be commissioned as an initial step in any future project to assess optimal design.

Technology	600MHz licenced spectrum	4	3	12	HIGH	Similar to the propagation estimates, access to cost effective 600MHz spectrum can be a factor in the future project.	A Radio Frequency (RF) study should be commissioned as an initial step in any future project to assess optimal design. Furthermore, initiating discussions with spectrum licencees early in the future project will be beneficial. However, there are alternate frequency ranges available.
Technology	Fibre optic availability and pricing	3	3	9	MEDIUM	The global demand for fibre optics continues to grow and timely availability is always tenuous.	It is key to identify projects as soon as possible, especially if significant fibre optic lengths are required. Communities must be mindful of the lead times for contractors to source such critical materials when approving timelines.

10.0 Recommendations

In anticipation of the upcoming CRTC's "Closing the Broadband Gap" funding that will total \$750 Million over the first five years and potential Provincial programs by the Ministry of Infrastructure (MOI), the communities have taken the first step in preparing for their imminent release by undertaking this report. The communities are underserved for the most part based on the findings of this study. Community-specific infrastructure recommendations were summarized at the end of each respective community section. The following serves to provide items to consider for the communities as a whole.

The recommendations are not presented in any particular order of importance or rank as they may not all apply to the individual communities to the same extent, with the exception of the first two bullets:

- The communities should seek to add adjacent communities to this effort, especially if the intent is to seek future funding. Current indications of funding programs underscore the importance of multiple communities (multi-region) and First Nation partnerships. The Northeast Superior Regional Broadband Network currently totals ten communities (5 First Nation and 5 municipal members) that have grown organically into a regional body seeking future funding. Other examples include SWIFT and EORN.
- The communities should undertake a feasibility study to assess the benefits of creating a regional ISP tailored to meet the needs of the participating communities and general area. The individual communities themselves might consider investing in their own ISP as other locations have been doing successfully in recent years such as: Stratford, Ontario; Olds, Alberta; and Hearst, Ontario. However, a joint effort would provide greater benefits to the region given a larger base to leverage, economies of scale, and reduction in overhead – both from a systems perspective and management oversight.
- As a joint entity, the communities should take the lead in the upcoming Federal "Closing the Broadband Gap" funding application and bring the service providers

on board as partners as opposed to the service providers leading the applications. This will allow the communities to create the mandate, drive the project(s), and maintain priority. The carriers must balance between other areas in the province (or Canada) where they might get funding which jeopardizes the focus the region requires. Future broadband projects can be further advanced through the tangible cooperation of private partners. These can be anchor industries within the community and smaller service providers that are seeking a new market or foothold in an area.

- Consider supporting the efforts of the Ontario Broadband Coalition in actively monitoring and contributing to Ontario Energy Board (OEB) pole attachment proceedings. Consider participation in existing industry groups with similar causes and concerns as required. Maintain active contact with local MPPs on this provincial matter.
- Secure the expertise of a Regulatory resource that can monitor and advise on current and upcoming proceedings that could have an impact on the region and the communities with regards to broadband Internet. It will become increasingly important to have a unified voice and to actively contribute to government actions. Join available industry groups to stay informed and prepared.
- Appoint a resource to liaise directly with the regional service providers including Ontera and Xplornet. It will be crucial to stay informed of their network planning as it relates to the area and to offer input and support where applicable.
- Undertake a review of the Smart Cities and Intelligent Communities movements. These global initiatives are not just about the quality of broadband Internet but can underpin the efforts of the communities to improve their overall prosperity and quality of life. Smart City projects make cities work better; whereas, Intelligent Communities seek to make better cities.⁵²

⁵² https://www.intelligentcommunity.org/from_smart_cities_to_intelligent_communities

11.0 Funding Options

Broadband Internet funding options have become limited as there is now a waiting period between ISED announcing the last of the CTI funding, the CRTC unveiling how and when they will open access to the anticipated \$750 Million Closing the Broadband Gap fund, and any provincial programs.

The table on the following page is a summary of the current and traditionally available funding sources that could apply to broadband infrastructure or a derivative of broadband services.

Table 1: Potential funding programs

Funding Program	Owner	Funding	Description
Closing the Broadband Gap	Canadian Radio-television and Telecommunications (CRTC)	\$750M fund over 5 years	To build or upgrade access and transport infrastructure in underserved areas. https://crtc.gc.ca/eng/internet/internet.htm
Strategic Economic Infrastructure Program	Northern Ontario Heritage Fund Corporation (NOHFC)	The lesser of 50% or \$1 million	Municipalities, municipal organizations, First Nations, Community Based Networks or ICT community champions (non-profit economic development / innovation centres) in Northern Ontario. https://nohfc.ca/en/pages/programs/strategic-economic-infrastructure-program
Rural Economic Development Program (RED)	Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)	Up to 50% of the project costs or a maximum \$100,000	Funding . Activities that grow the local economy and remove barriers to economic development. www.ontario.ca/page/rural-economic-development-program
Indigenous Economic Development Fund (IEDF)	Ontario Ministry of Indigenous Affairs (OMIA)	\$70 million over the next seven years to extend the fund, originally launched in 2014, for a total combined investment of \$95 million over 10 years.	The IEDF has 3 funding programs: The Business and Community Fund Program, Economic Diversification Grants Program, Regional Partnership Grants Program. www.grants.gov.on.ca/GrantsPortal/en/OntarioGrants/GrantOpportunities/PRDR012765
First Nation Infrastructure Fund	Indigenous Services Canada (ISC)	The amount of money planned under FNIIP varies from year-to-year because of time-limited, targeted funding programs.	The FNIF was created as a complementary source of funding to the Capital Facilities and Maintenance Program and includes eight categories of eligible infrastructure projects including connectivity. www.sac-isc.gc.ca/eng/1100100010656/1533645154710
Community Investment Program	Canadian Internet Registration Authority (CIRA)	To date CIRA has contributed \$6.7 million in Community Investment Program grants.	CIRA funds innovative community projects to build a stronger, safer and more accessible internet for all Canadians - improving digital literacy, internet infrastructure, access and online services. www.cengn.ca/ontario-broadband-program
Next Generation Network Program (NGNP)	Centre of Excellence in Next Generation Networks (CENG)	This intake has already passed; however CENG noted that there will be future applications. In this previous intake, CENG contributed 50 percent of eligible project costs for an approved project to a maximum contribution of \$500,000 per project.	Their mission is to accelerate the growth of the Canadian Information and Communications Technology (ICT) sector, enabling economic strength and prosperity, as well as innovation and competitiveness. www.cengn.ca/ontario-broadband-program
Rural and Northern Communities Infrastructure	Infrastructure Canada	The Government will invest \$2 billion over the next decade to support a broad range of infrastructure projects.	Investments in rural and northern infrastructure will help grow local economies, build stronger, more inclusive communities, and help safeguard the environment and the health of Canadians. Because rural and northern communities have unique infrastructure needs that require a more targeted approach. www.infrastructure.gc.ca/plan/rmc-crn-eng.html

Exhibit A – Estimated Capital Ranges

Temagami Community Capital Projections

Communities	Premises Passed	MARKET PROJECTION		CONNECTED PREMS			TRANSPORT	DISTRIBUTION	DROPS	YEAR TWO & THREE		TOTAL FTTP COSTS			Notes
		Target Market Penetration	Target Prem Project Total	Year One Connected Prems	Year Two Connected Prems	Year Three Connected Prems	Transport + electronics	Distribution + Electronics	FTTP Drop + Prem Total Cost	Year Two PREM Capital	Year Three PREM Capital	Total Project Cost	Total Cost Per Prem PASSED	Total Cost Per CONNECTED Prem	
Temagami (Core)	240	80%	192	77	58	58	\$ 111,948	\$ 560,000	\$ 89,088	\$ 66,816	\$ 66,816	\$ 894,668	\$ 3,500	\$ 4,660	access at Ontera POP c/w upgrades
Temagami North	120	80%	96	38	29	29	\$ 111,948	\$ 280,000	\$ 44,544	\$ 33,408	\$ 33,408	\$ 503,308	\$ 4,083	\$ 5,243	access at Ontera CO c/w upgrades
Lake Temagami	913	30%	274	110	82	82	\$ 559,741	\$ 1,569,500	\$ 127,090	\$ 95,317	\$ 95,317	\$ 2,446,965	\$ 7,774	\$ 8,934	proxy for two towers on Lake (Bear Island + TBD)
Marten River	25	80%	20	8	6	6	\$ 559,741	\$ 237,500	\$ 9,280	\$ 6,960	\$ 6,960	\$ 820,441	\$ 39,862	\$ 41,022	POP undetermined, distances estimated
Bear Island	125	90%	113	45	34	34	\$ 55,974	\$ 287,500	\$ 52,200	\$ 39,150	\$ 39,150	\$ 473,974	\$ 3,053	\$ 4,213	fibre available (nodes and transport)
Total Prems	1423		694	278	208	208	\$ 1,399,353	\$ 2,934,500	\$ 322,202	\$ 241,651	\$ 241,651	\$ 5,139,357			

\$ 3,740,004 includes Years 1-3 (if applicable)

AVG	AVG
\$ 11,654	\$ 12,814

Premises Passed = # of premises that distribution cabling passes along a street, but not connecting to the premises (drop)

Target Market Penetration = estimate of how many customers would use the new service

Transport + Electronics = cost of construction backbone fibre to community + electronics, or electronics if transport fibre in place

Distribution + Electronics = cost of constructing last mile distribution fibre + electronics within the community

VDSL Per Connected Prem = cost of installing the node divided by the number of total subscribers

LOW (VDSL) = estimated lower end of providing a degree of broadband in the community

HIGH (FTTP) = estimated upper end of providing a degree of broadband in the community

Overall Assumptions:

pole make ready costs not included

% of prems connected varies, max 80% where no competitor to Ontera/Bell, max 60% where a facilities based competitor exists

VDSL will not require distribution copper upgrades

all values are estimates, additional accuracy requires market design and pricing exercise

WIRELESS AND FIXED WIRELESS SOLUTIONS NOT INCLUDED EXCEPT FOR LAKE TEMAGAMI

Temagami Community Capital Projections - Estimated High - Low Ranges

	Transport		Distribution		Total Deployment	
	Low	High (+30%)	Low	High	Low	High
Temagami (Core)	\$ 111,948	\$ 145,533	\$ 351,948	\$ 894,668	\$ 463,896	\$ 1,040,201
Temagami North	\$ 111,948	\$ 145,533	\$ 351,948	\$ 503,308	\$ 463,896	\$ 648,841
Lake Temagami	\$ 559,741	\$ 727,663	\$ 799,741	\$ 2,446,965	\$ 1,359,482	\$ 3,174,628
Marten River	\$ 559,741	\$ 727,663	\$ 799,741	\$ 820,441	\$ 1,359,482	\$ 1,548,104
Bear Island	\$ 55,974	\$ 72,766	\$ 295,974	\$ 473,974	\$ 351,948	\$ 546,740
Community Totals	\$ 1,399,353	\$ 1,819,158	\$ 2,599,353	\$ 5,139,357	\$ 3,998,705	\$ 6,958,515

Deployment "Low" includes only 1 DSLAM c/w cabinet, power, installation allowance

Deployment "High" includes full FTTP system and fibre transport (where needed)

These estimated ranges are provided solely for planning and require detailed analysis if used for other uses.

Exhibit B – Gap Analysis

TEMAGAMI MASTER DATA - NEEDS ANALYSIS

Community Broadband Gap Analysis	STATISTICS						DATA (Mbps)					NEED	OS ratio 5:1	AVAILABLE Mbps	GAP Mbps
	POP	Dwellings	Businesses	Hospital/ Clinics	Schools	Students	Dwellings	Businesses	Hospital/ Clinics	Schools	Students				
							25	100	100	100	1	Mbps		Mbps	Mbps
Temagami (core)	520	220	20	1	1	24	5500	2000	100	100	24	7724	1545	200	1344.8
Temagami North	242	115	5	0	0	0	2875	500	0	0	0	3375	675	200	475.0
Lake Temagami	2100	908	5	0	0	0	22700	500	0	0	0	23200	4640	0	4640.0
Marten River	40	20	5	0	0	0	500	500	0	0	0	1000	200	0	200.0
Bear Island	244	110	14	1	1	44	2750	1400	100	100	44	4394	879	300	578.8
STUDY AREA TOTALS	3146	1373	49	2	2	68	34325	4900	200	200	68	39693	7938.6	700	7238.6
	0	0													

Assumptions

Temagami (core) base population of 802 taken from 2016 stats can census, then adjusted by approx 2 people per dwelling
 Temagami North counted visible dwellings on Google Map - subtracted this from the Tem total and adjusted Temagami core (along with MR estimate)
 Lake Temagami population taken from statement in Temagami 2011 EcDev document
 Marten River counted visible dwellings on Google Map - subtracted this from the Tem total and adjusted Temagami core (along with MR estimate)
 Bear Island taken from 2019 ecdev document
 Business counts are estimates

**Estimated Broadband Gap
Combined Study Group Communities
(5:1 OS ratio)**

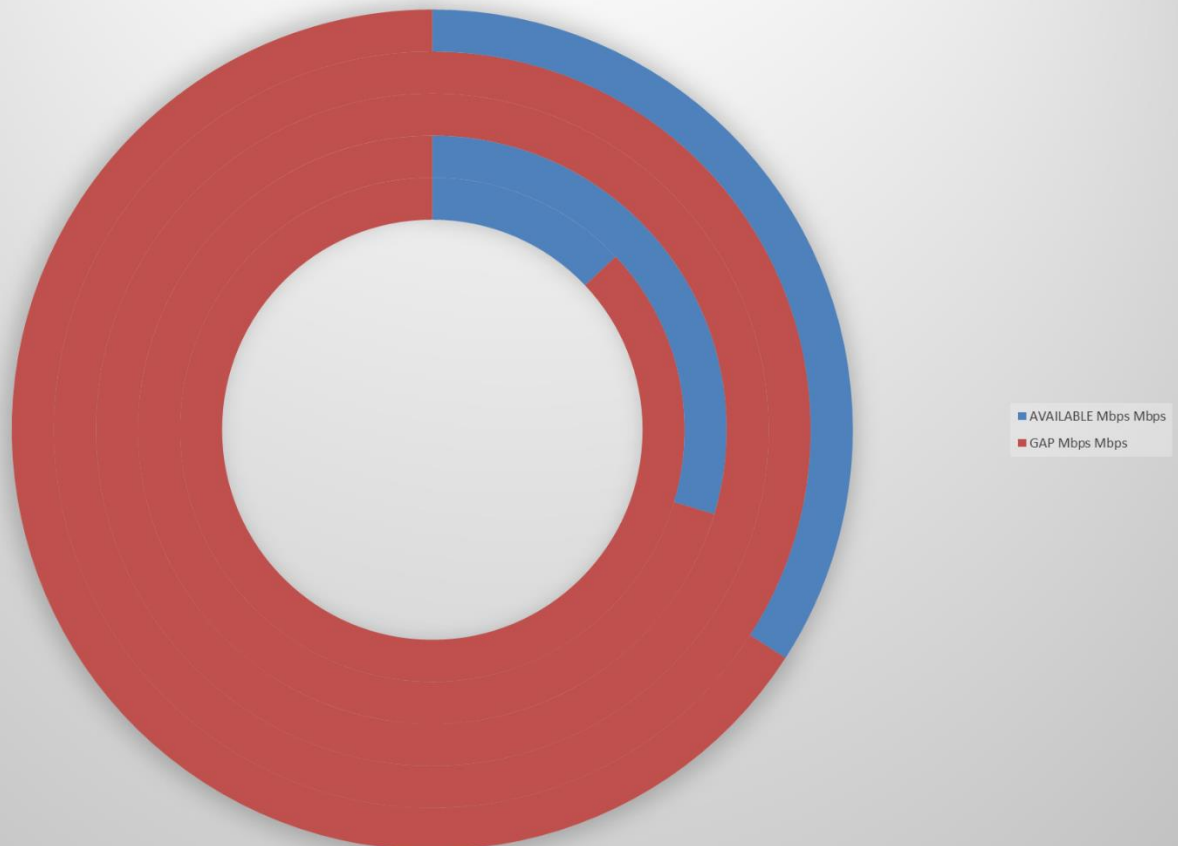


Exhibit C – Survey Results

385

Responses

13:55






Average time to complete

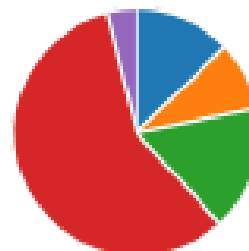
Closed

Status






Ideas

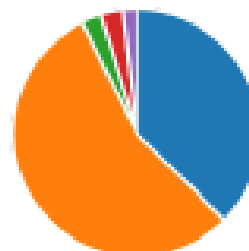
1. Which of the participating communities do you reside in?

 Bear Island	49
 Temagami North	35
 Temagami	63
 Lake Temagami	223
 Marten River	15



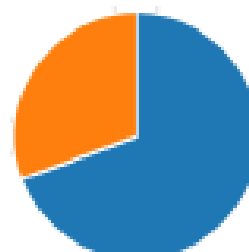
2. Describe your premises (home, cottage, business) within one of the participating communities noted above. If you have more than one premises within the community (ie: a home and a separate business location), please complete a separate survey for EACH location and corresponding speed test.

 Home or primary residence	144
 Seasonal residence/cottage	213
 Business (not including tourist...	10
 Tourist camp/resort (owner, n...	11
 Other	7



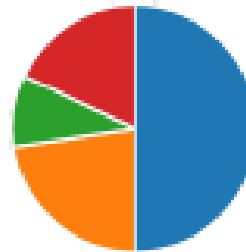
3. Do you have Internet service at this premises?

 Yes	267
 No	118



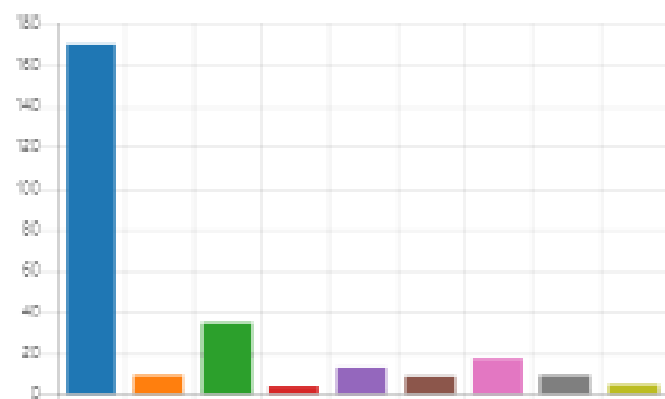
4. If "NO", why do you not have Internet service at this premises?

There is no Internet service av--	64
It is too expensive to install Int...	29
I do not want to have Internet ...	12
Other	23



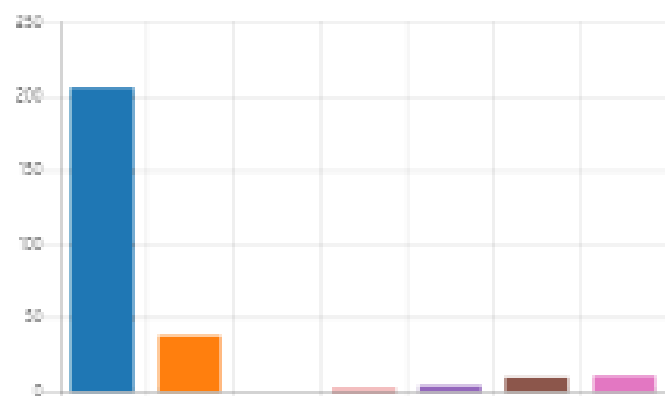
5. If you do have Internet service, what type of connection do you have at your premises?

DSL (Digital Subscriber Line o...	170
Fixed Wireless (ie: Xplornet - n...	9
Satellite Service	34
Fibre Optic (directly to your pr...	3
Cellular Data (ie: Rocket Stick, ...	13
Cable Modem	8
Dial-Up Connection (over Tele...	17
I don't know	9
Other	4

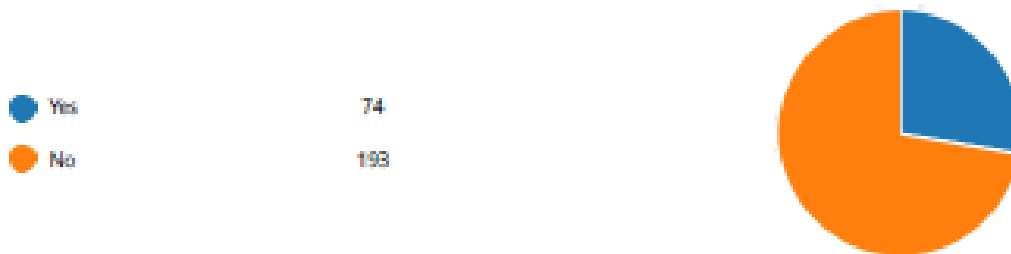


6. Who do you purchase your Internet services from?

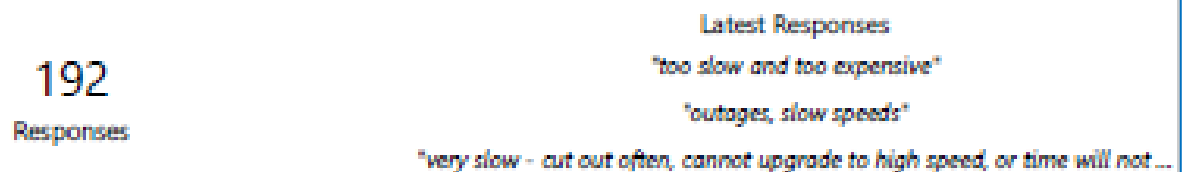
Ontario	206
Xplornet	38
KNET	0
NorthernTel	1
Bell Mobility hub or "stick" (no...	3
Rogers Mobility hub or "stick" ...	9
Other	10



7. If you have Internet services at your premises, are you satisfied with the level of service?



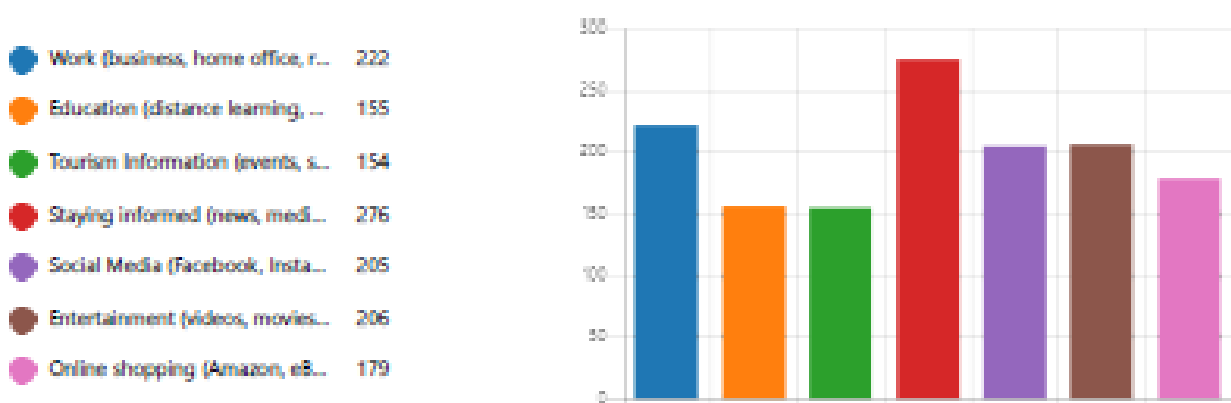
8. If you are NOT satisfied with the level of Internet services, please describe your reason:



9. If you do have Internet, what kind of package do you have and how much does it cost per month? (Do not include other charges if you purchase bundled services ie: phone, tv, internet, cellular)

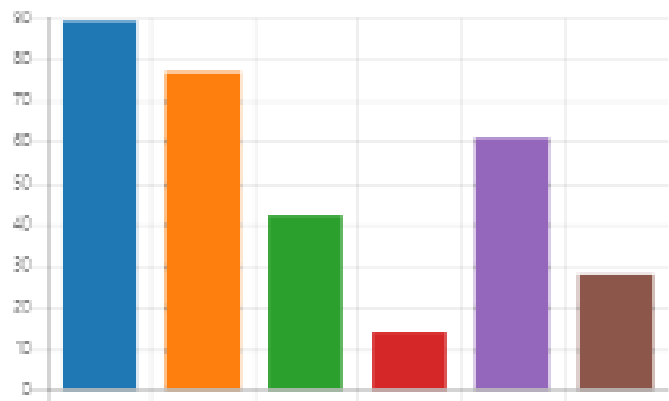


10. Whether or not you have Internet access, what would you use the internet for? (Select all that are applicable to you.)



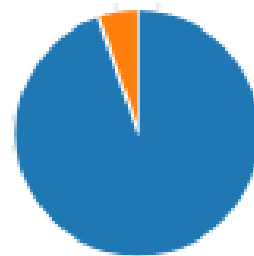
11. If you were able to subscribe to the Federal and Provincial goal of 50Mbps download and 10Mbps upload speeds with no data caps, how much would you be willing to spend each month?

● \$60 per month	89
● \$80 per month	77
● \$100 per month	42
● more than \$100 per month	14
● I would get a smaller package ...	61
● None of the above	28



12. Do you or someone at your premises own a cellphone?

● Yes	365
● No	20



13. If YES, how many cellphones do you own? (This may vary on the number of users you have or are billed for.)

365
Responses

Latest Responses

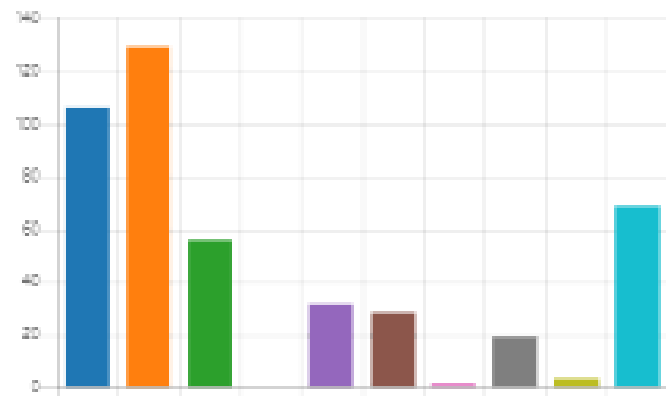
"2"

"3"

"2"

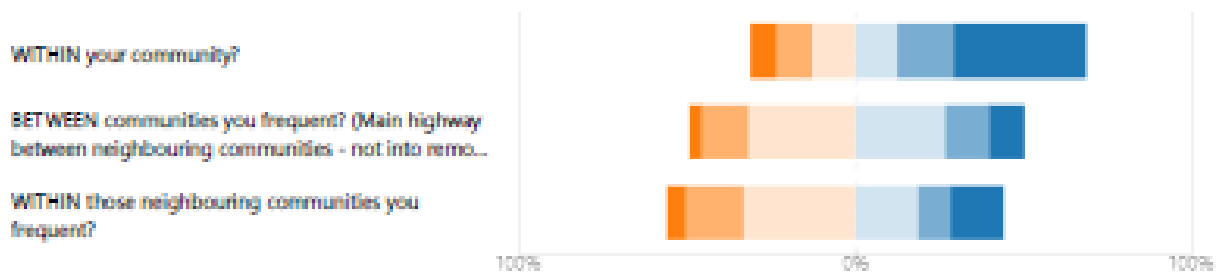
14. If YES, who is your cellular provider? (Check all that apply if you receive multiple bills)

Bell Mobility	106
Rogers	129
TELUS Mobility	56
Tbaytel Mobility	0
Koodo Mobile	32
Virgin Mobile	28
Chartr Mobile	1
Fido Mobile	19
NorthernTel Mobility	3
Other	69



15. If YES, how would you rate the quality of your cellphone service?

Excellent Very Good Good Weak Very Weak No signal



16. Do you believe advanced communications services to be important for the community, residents and businesses?

Very Important	335
Somewhat Important	41
Not Important	9

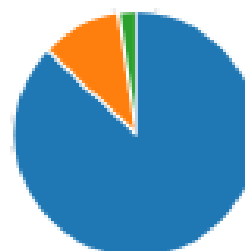


Exhibit D - Coverage Analytics

As per the CRTC's recent "Broadband Fund Application Guide for the 3 June 2019 Call for Applications", the definition of the eligible hexagon areas is noted below (highlighting added for emphasis):

*6.1.3(d) Access project eligibility criteria – Geographic eligibility (1-G2)
Access project proposals must involve building or upgrading infrastructure in an eligible geographic area, defined as a 25 km² hexagon where there is at least one household (as defined in Appendix 1), as per Statistics Canada's latest census data, but where no household has access to broadband Internet access service at universal service objective-level download and upload speeds (i.e. 50/10 Mbps). The maps displaying potentially eligible geographic areas based on 2017 information have been made available. As described above, applicants should conduct their own due diligence to ensure that their projects meet the geographic eligibility criterion. The CRTC has provided information on geographic eligibility based on the information that was available as of the launch date of this call for applications. It may also rely on more up-to-date information, whether public or confidential, as it is received and verified. Updated information on geographic eligibility may therefore be made available during the period following the launch date of this call for applications until the submission deadline.⁵³*

The map below illustrates the community areas that are currently noted as eligible (green hexagons) should the upcoming Federal funding process follow the same eligibility criteria as noted above. Specifically, these hexagons do not have services capable of delivering 50/10 broadband speeds.

⁵³ <https://crtc.gc.ca/eng/internet/guid.htm>

Fixed Internet Access and Transport Maps

● Communities without high-capacity transport

■ Areas without 50/10 Mbps fixed broadband access

Population centres

13 km
Map Scale: 1:400,000

9/2/2019

The Municipality of Temagami requested broadband data from Blue Sky Net on behalf of this study. The information contained in the mapping that follows illustrates the minimum broadband speeds in the communities as pulled from data supplied by service providers (ie: Ontera, Xplornet). This is a good tool to assess those areas tabulated in their Connected North database.

As supplied by Blue Sky Net:

- *Analysis compares spatial broadband coverage files submitted by ISPs and the best possible base map available. In most cases this is the MPAC Digital Parcel. Failing that, Census Dissemination Blocks.*
- *The performance classification for fixed broadband is separated into three classes= 1) Better than 5Mbps-describes high speed services that constantly deliver 5 Mbps down and 1 Mbps up. These networks likely deliver better service and different packages/rates. These networks are shown in green shading. 2) Less than 5Mbps-These networks deliver high speed, but cannot consistently deliver 5Mbps down and 1 up. These networks are depicted in red shading. 3) Finally areas left unshaded do not have fixed broadband coverage and would likely have to rely on mobile data (depicted on separate map) or satellite internet services.*
- *Parcel Property classifications are based on MPAC property codes and are grouped into the categories of: Commercial, Government Owned, Industrial, Institutional, Residential, Seasonal, Special Purpose and Vacant.*
- *Accuracy of the analysis is dependent on the accuracy of the ISP submitted coverage files and the accuracy of the MPAC base map.*

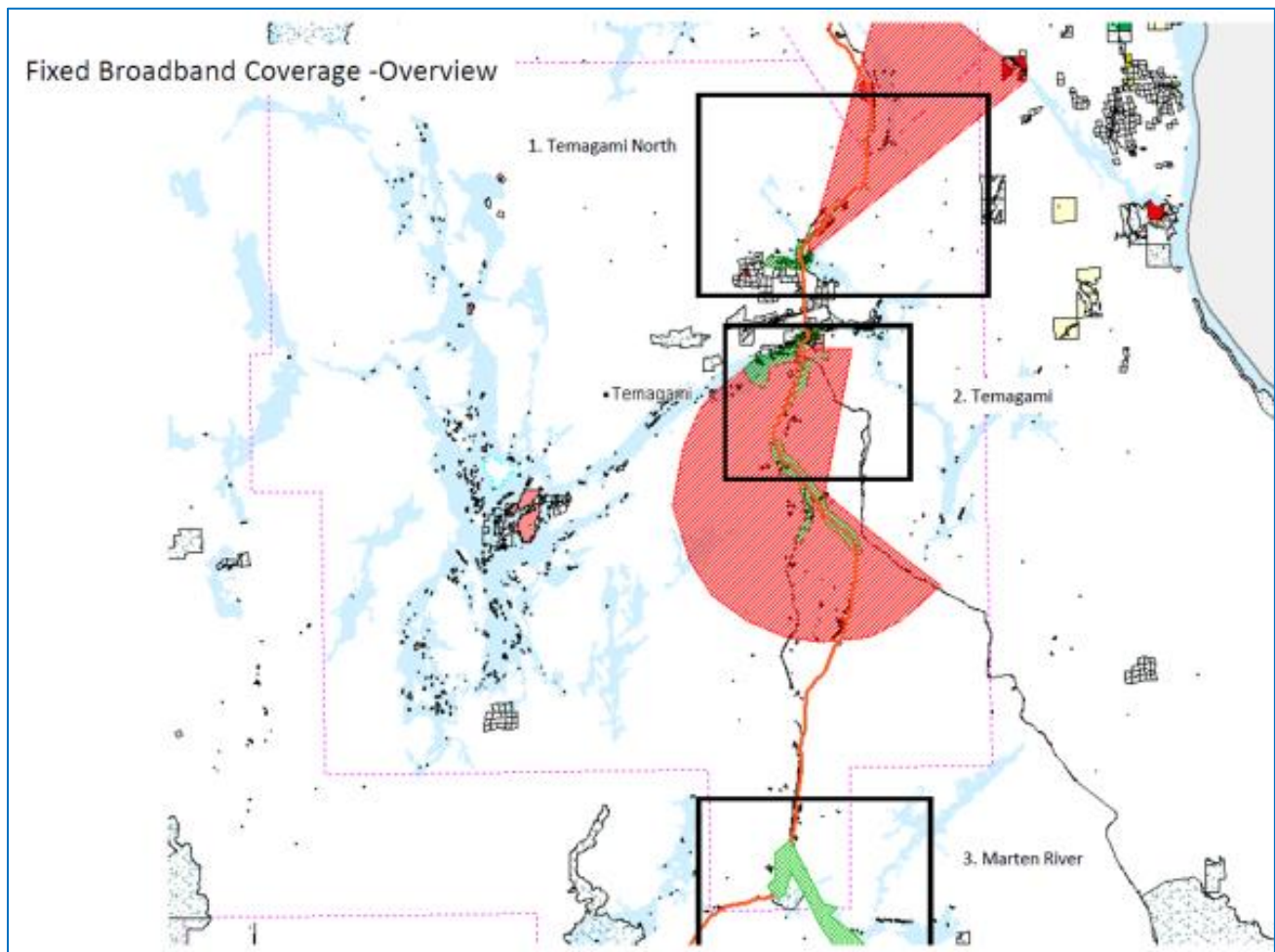
It is critical however to “ground truth” any such data as was done in this study since carriers may not provide fully accurate information (competitive information, errors) and it is a prerequisite of most current funding bodies such as the recently published SWIFT call for funding (Southwestern Ontario only) and Broadband Gap Far North applications. The community gap analysis performed as part of this study (Needs and Gap Overview) addresses this requirement confirming that there are no apparent terrestrially capable 50/10 service locations in the footprint. It is important to note that the Xplornet mapping data shown below provides their planned wireless

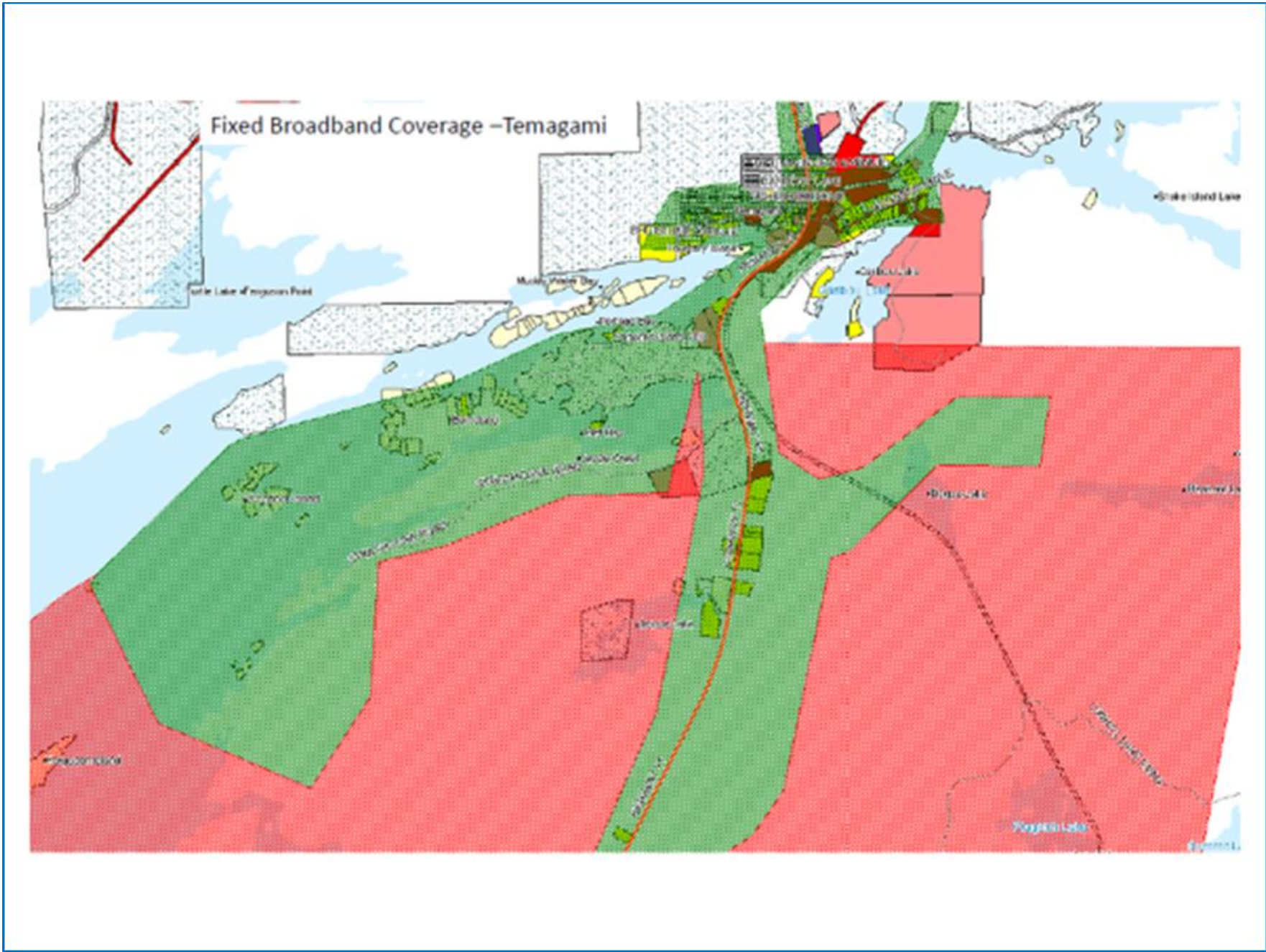
propagation which was not confirmed as part of this study. It is possible that Xplornet can report speeds that meet or exceed 50/10 in the future which could nullify certain hexagons within Temagami's eligibility areas.

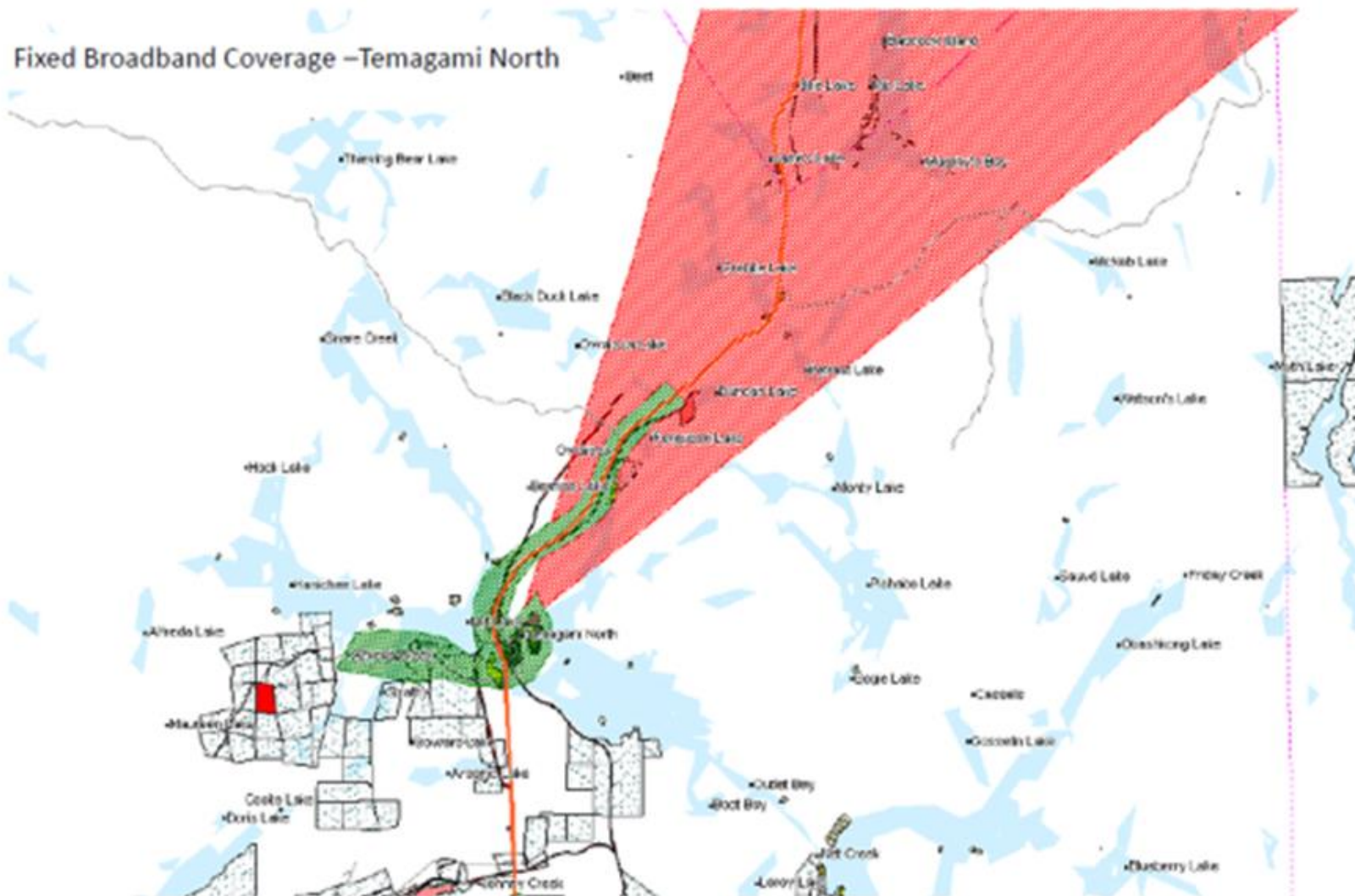
Legend:

RED = Less than 5Mbps - These networks deliver high speed, but cannot consistently deliver 5Mbps down and 1 up.

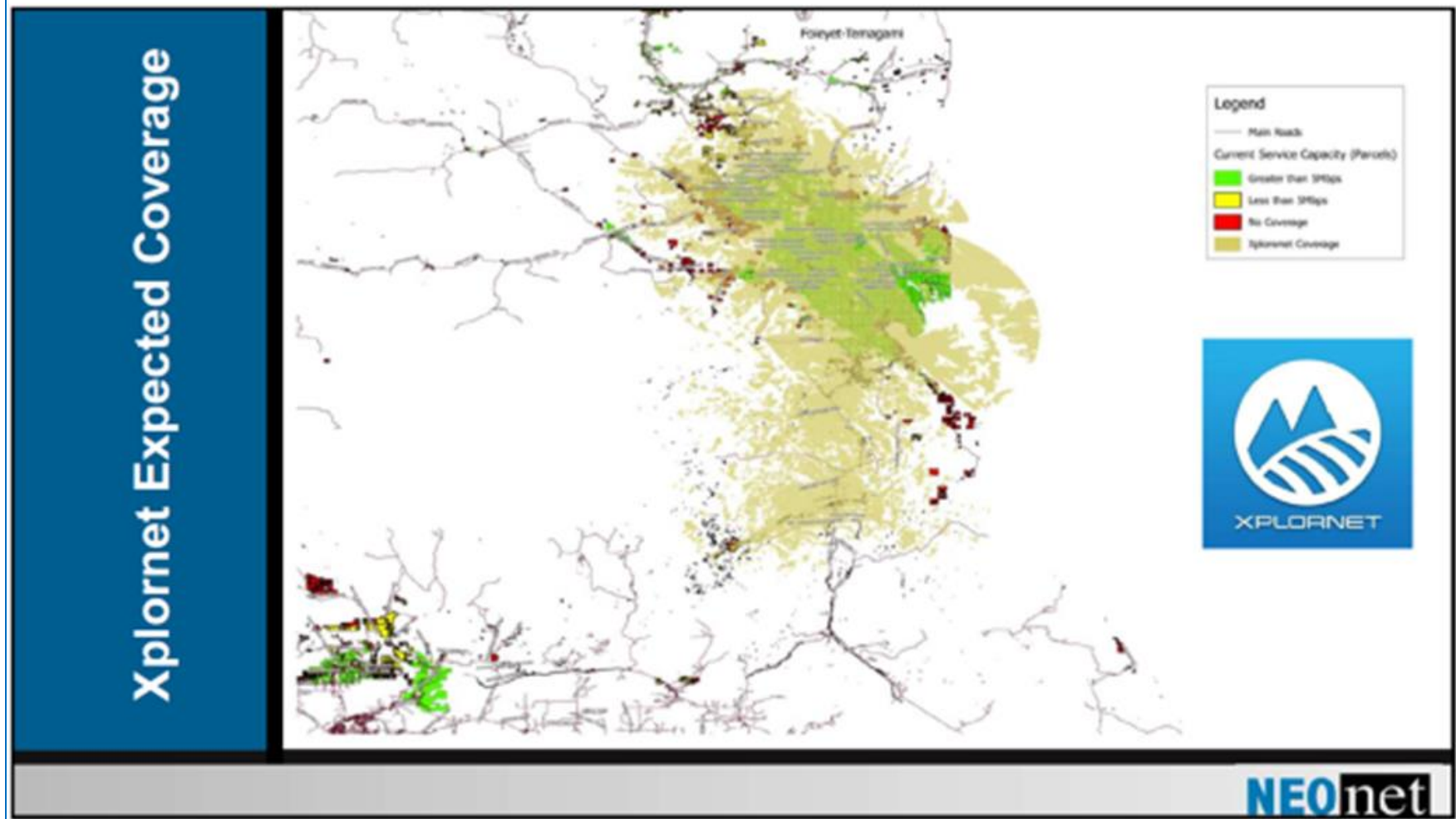
GREEN = Better than 5Mbps - Describes high speed services that constantly deliver 5 Mbps down and 1 Mbps up. These networks likely deliver better service and different packages/rates.











NEOnet presentation March 7, 2019

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Exhibit F – Reference Material

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www.ftthcouncil.eu / info@ftthcouncil.eu

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The Intelligent Community Forum, <https://www.intelligentcommunity.org/>

Exhibit G – Revision Check Page

RESERVED

End of document

April 4, 2019

To: Municipality of Temagami Mayor and Council

Update #3 Cell and Broadband - as at April 2/19

Research and notes jointly gathered and reported by Dave MacDonald and Margaret Youngs

Summary of information gathered at NeoNet, Timmins March 2019

- In attendance at meeting
 - council members Dan O'Mara, Margaret Youngs
 - ad hoc community volunteer Dave MacDonald
 - NEOnet Director of Operations Paul Ouimette
 - NEOnet Project Coordinator Laura Imhoff
- NEOnet is an agency, funded through FedNor, that offers consultant services to communities wanting to upgrade to the CRTC stated universal standard of 50 Mbps download and 10 Mbps upload speeds. They offer assistance with applications. It is also a teaching facility.
- Their territory is Martin River to Cochrane. They work co-operatively with their counterpart, Blue Sky that covers the territory North Bay to Martin River.
- Power Point presentation provided clear information on who they are, what is 5G and info on Expression of Interest by communities - **Attachments 1,2 and 3**
- Main take-a-ways
 - The CRTC announced a \$750M fund for rural broadband with the objective of ensuring 90% of Canadians can access speeds of 50 Mbps and unlimited data allowance, as well as employ the latest mobile wireless technology available by 2022 (CRTC 2016-496).
 - our current infrastructure for internet through Ontera (owned by Bell) is outdated and will not be upgraded. It will therefore not be able to support the community to reach the level of service as mandated in the CRTC.
 - NEOnet is offering alternative providers to communities that can supply this service so that they can participate in this level of standard national service by 2022.
 - they identified consultants for us to work with - **Attachment 4**
 - an interesting point is that one consultant they have identified Amedeo Bernardi Consulting has been recommended to us as this gentleman has experience with upper management of Ontera. He is a communications consultant and is an expert on Ontera's infrastructure across the north which would be essential to us moving forward to an improved infrastructure.
 - Infrastructure improvement to meet the new CRTC standard is high priority for all communities and there is an abundance of high level support for communities to tap into. The time is now!

- Bernadette Jordan - Minister of Rural Economic Development as of Jan 14/19. Her new ministry has been set up ***to bring broadband internet service and jobs to rural communities***. This is a government priority.
- This was also brought up at ROMA (Rural Ontario Municipal Association) annual conference in Toronto in January. The top priority for the 444 Ontario municipalities is to have broadband service as soon as possible.

Next information gathering conferences

April 8 - Teeny Tiny Summit - Matheson

May 30- June 2 - FCM Annual Conference and Trade Show - Quebec City

Status update

- **Spectrum**
 - In conversation with Paul Ouimette as a followup to our visit to Timmins, we had discussion on suppliers for the infrastructure.
 - The one company that he raised a caution with was Spectrum, the company that the town's current computer services person works for. Caution was raised with respect to challenges in other communities that are using Spectrum.
 - In conversation at the town office with municipal staff, there was great enthusiasm at the offer of "FREE" internet to be provided by Spectrum at no cost to the town.
 - That, in my experience is the fools game. There is no such thing as free. Somebody will pay and I highly suspect that should the town sign away the infrastructure, the rate payers will be left holding the bag within a short time.
 - There are warnings out there now, not the least of which is NEOnet and others on what Spectrum offers.
 - At the very least, go to the Matheson conference and get input on this company.
 - There are many resources being made available through the 5G initiatives. These initiatives are providing education support, best practices, funding to ensure maximum coverage for the whole region, support for disadvantaged as well as combining the internet and cellular options.
 - With all this well informed support out there to assist us in making a well informed decision, it would be very short sighted to automatically go with the person the town is currently using to do computer repair work to solve the internet and cellular issues of the municipality because of the offer of "FREE" .
 - The Matheson summit is an ideal place for participants to find out first hand the track record of the different suppliers that are available.

Below comments are personal comments from Dave MacDonald

- **My vision, until the past few weeks has been**
 - Final report to council within 3 weeks of the FCM conference in Quebec City (May 30-June 2). This would have included
 - list of community partners,
 - any vetted consultants and
 - project partners (hardware etc)
 - costs and
 - application
 - As many options as possible would have been included so you could then have struck a committee of your choosing to work with providers or move forward as a council.
 - I have worked toward providing you a well researched document on high speed internet and cellular service that I expected would be helpful so that council could make informed decisions based on well researched information relevant to our community.

- **I now have a growing uneasiness** with the continued value added that I can contribute to council
 - In my original submission to council offering to work collaboratively with council on improved service, I stated that
 - "..... each new council will take on this issue, correspond with various phone providers and agencies and will experience total frustration on finding that no one group will take responsibility for the overall provision of services. The issue eventually gets dropped or put on the back burner with other more immediate and "pressing issues taking the time of council"
 - In all my interaction with outside resources including other municipalities I experienced only open communication and willingness to share any information that would assist us in making an informed decision for our community.
 - On returning to Temagami, I often experienced a stark contrast to this willingness to share either through refusal of information or just "put on ignore". I can provide a list of examples over the past many weeks if it would be productive. If being on a committee didn't give me the authorization to ask and receive information, which should have been sufficient on its own. The Municipal Freedom of Information Act provides for this right for all citizens. Even on contacting Ministry of Municipal Affairs and Housing, we were referred back to our own municipal office to get the information.
 - Margaret Youngs and I have worked very well together in the gathering of and sifting through copious amounts of information.
 - Despite our best efforts, we were not successful in obtaining available and necessary information required to prepare for the expression of interest for Northern Ontario Residential Broadband Program (deadline now past - March 31/19).

- There will be other opportunities to apply but this experience has left me aware that the frustration level I am experiencing in working within our municipal environment is taking the pleasure out of this for me.
 - My experience now is that we are standing in our own way with process and procedure that is not conducive to expediting decisions. As an "ad hoc" volunteer and member of the community I learned that I am in no position of authority, in Temagami, to ask for information or expect that I would receive it.
 - Further, and most frustrating to me, is from my "business world" view, this does not have to be the long process it is turning into. I am hearing that process has to be followed but the process that we seem to be moving into will not work, in my view, for timely delivery of this project.
- **It is good news** to hear that the councillors that work on Bear Island have let you know that Bear Island was looking to a partnering arrangements for service through a satellite link. They are using Explornet as their provider and are already getting the 50+ service in their trailers which is the new minimum standard that we are seeking to achieve.
 - Perhaps an alternative that you may already be exploring is instead of town supplying these services, have a business discussion with Bear Island on using their infrastructure for the district. The upside to Bear Island as I am sure they are aware, could be monetized to their benefit and provide the necessary infrastructure to the region as a whole.
 - There is so much external support and expertise "out there" right now that it is an exciting opportunity to be able to take advantage of that.
 - With the interest of so many of council members in the Matheson Summit it is great to see that council is taking part in the education that is so important for us to understand to make good decisions for our community.

At this point, I believe my value added to this project is now complete. Margaret is now well apprised of the approach I was taking towards this project. I found her to be an extremely valuable resource person to work with on this project. I will continue to offer any support I can by way of comment or explanation when asked. I have kept a binder of all research and related information that I have gathered to date. I will turn this over to you for your reference if you would like it.

Respectfully submitted

original signed by

Dave MacDonald

BROADBAND INTERNET & CELLULAR COMMUNICATIONS



**Assisting Northeastern Ontario to implement technology
to become more innovative.**

- Non-profit organization established in 1999
- Acts as the region's information and communications technology **ICT** champion
- Promote and develop ICT **education** and awareness, **application** and **infrastructure**



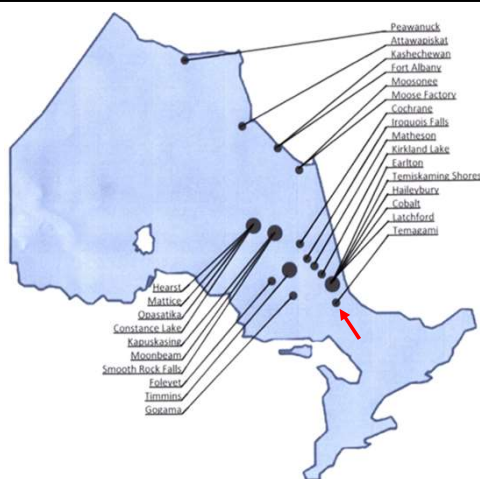
NEOnet CATCHMENT



The
NEOnet catchment
includes over sixty
communities in a
200,000-square
kilometer area.

NEOnet

NEOnet CATCHMENT



The NEOnet catchment covers
over sixty communities in a
200,000-square kilometer area.

Attawapiskat *	Gogama	Moonbeam
Barbers' Bay	Hallébourg	Moose Factory *
Bear Island	Harley	Moosonee *
Beaverhouse *	Harris	Opasatika
Belle Vallée	Harty	Peawanuch *
Black River-Matheson	Hearst	Porquis
Brethour	Hilliard	Ramour
Calstock	Holtyre	Seskinika
Chamberlain	Hoyle	Shining Tree
Chaput Hughes	Hudson	Smooth Rock Falls
Charlton/Dack	Iroquois Falls	South Porcupine
Cobalt	Jogues	Swastika
Cochrane	Kapuskasing	Temagami
Connaught	Kashechewan *	Temiskaming Shores
Constance Lake *	Kenogami	Thornloe
Earlton	Kerns	Timmins
Elk Lake	Kirkland Lake	Tunis
Englehart	Larger Lake	Vai Gagné
Evanturel	Latchford	Vai Rita
Fauquier/Strickland	Matachewan	Virginiatown
Foleyet	Matachewan *	Washoshig *
Fort Albany FN	Mattagami *	Westree
Gauthier	McGarry	

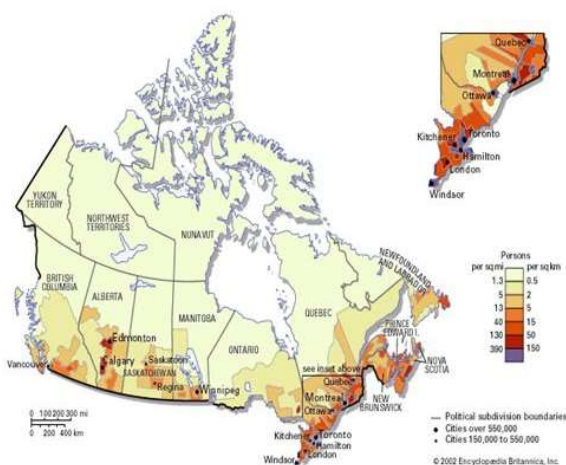
Communities marked with (*) are First Nation Communities

NEOnet

NEOnet

- **CRTC** New Standard 50Mbps
- Canadian homes and businesses to have access to broadband Internet speeds of at least **50 Mbps for downloads** and **10 Mbps for uploads** by **2021 90% of Canadians** are expect to have access to these speeds.

NEOnet



- Population –**33 million**
- Small compared to its land area
- The US has about **9 times** the number of people in Canada
- About **90%** of Canadians live within **100 miles** of the border with the **US**. Most of these are towards the east and central parts of the country.

Public – Private – Partnerships (P3)

INFRASTRUCTURE

(Broadband Internet & Telecommunications)



Innovation, Science and
Economic Development Canada



Ontario

Northern Ontario Heritage
Fund Corporation



cira
BUILDING A BETTER
ONLINE CANADA

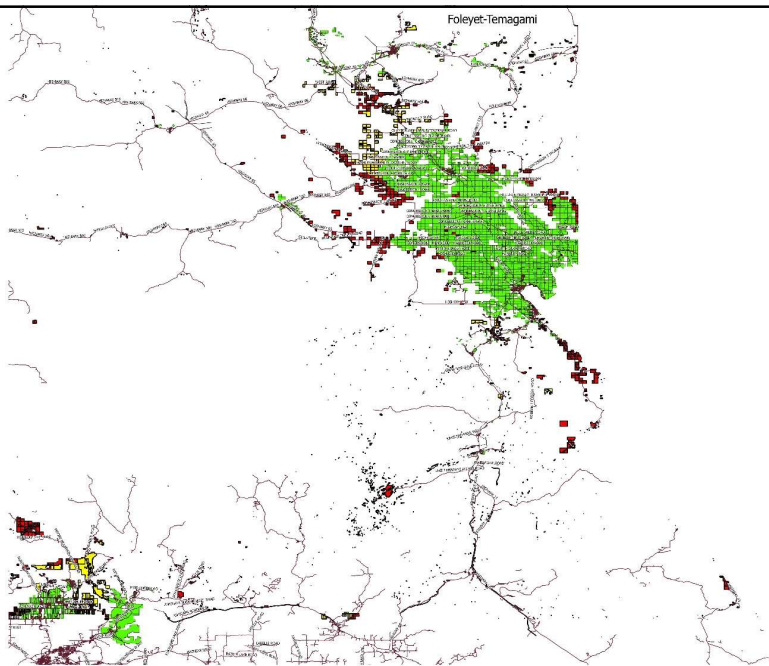


Internet

**50+ mbps Download
10 mbps Upload**

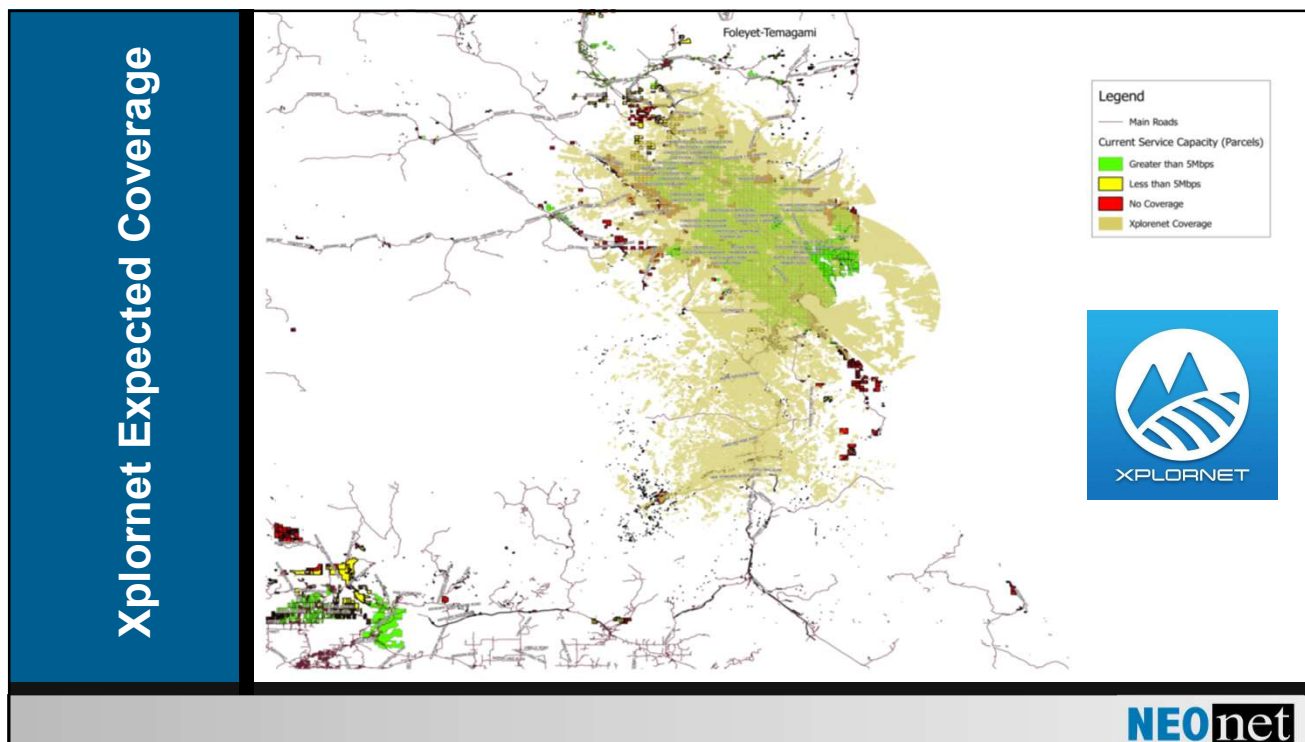
NEOnet

Coverage for Temagami



Legend
— Main Roads
Current Service Capacity (Parcels)
Greater than 5Mbps
Less than 5Mbps
No Coverage

NEOnet



NEOnet

Connected North

ConnectedNorth.ca

CONNECTED NORTH

Home Learn Communities News Contact

Connecting Northern Communities

Community: Smooth Rock Falls, Town of Address: 142 FOURTH ST Speed: NorthernTel DSL Greater than 5Mbps <http://northernTel.ca/> Map It →

cira BUILDING A BETTER ONLINE CANADA <https://performance.cira.ca>

FedNor Canada

Government
of CanadaGouvernement
du Canada

The Prosperity and Growth Strategy for Northern Ontario is focused on:

- Supporting innovation
- Growing companies
- Building stronger communities

#PGSNO

Canada

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\$750-million fund to improve broadband Internet access services in underserved areas

- The CRTC set *new targets* for these services:
- speeds of 50 Mbps download/10 Mbps upload for fixed broadband services
- an *unlimited data* option for fixed broadband services
- the latest *mobile wireless technology* available not only to all homes and businesses, but also along major Canadian roads

Federal: Connect to Innovate?

Provincial: In its 2018 Fall Economic Statement, the Government of Ontario committed to releasing a broadband and cellular strategy in early 2019. Investing in digital infrastructure across the province is critical to our competitiveness.

A new FUND
for projects
that will help
ensure that...

by 2021, 90% of Canadian homes and small businesses have access to fixed broadband services that offer:

SPEEDS OF
>50 Mbps DOWNLOAD
>10 Mbps UPLOADUNLIMITED
DATA
ALLOWANCE

Canadians have access to the latest wireless technology at their homes, small businesses and on the road.



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Merci.

What Is 5G?

**Understanding The Next-Gen
Wireless System Set To Enable
Our Connected Future**

2019

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The next generation of wireless technology will offer new consumer and business applications, with near real-time connectivity.

In the last decade, 4G wireless technology has become the standard for many mobile consumers around the world.

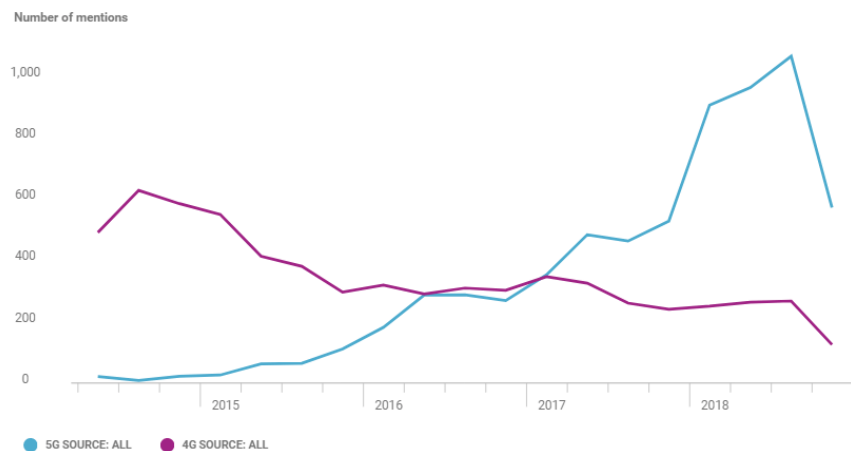
From social media platforms like Snap and Instagram to transportation apps like Uber and Lyft, many companies have benefited tremendously from the reliable connectivity and speed provided by today's 4G systems.

While this fourth generation of wireless technology has paved the way for new mediums of mobile consumption, it does have limitations. Over the next decade, the rise of connected (IoT) devices will require networks to [transmit massive sums of data in near real-time](#).

The next generation of wireless technology, known as 5G, will allow just that.

Early 5G deployment began at the end of 2018 when AT&T launched 5G wireless networks in 12 cities, but widespread implementation of the technology may take the better part of a decade.

Mentions in Earnings Calls



Even so, corporates are increasingly focused on this technology: according to CB Insights' Earnings Transcript tool, at its peak in Q3'18, "5G" was collectively mentioned over 1,000 times, up more than 100% from Q4'17.

Corporates like Nokia, Qualcomm, Ericsson, Broadcom, and Verizon have all discussed the implications of 5G, as well as plans for technology and/or service deployment.

We dive into the background of wireless technology, the introduction of 5G, and how the next generation of connectivity will come to be.

History of wireless technology systems

Wireless communications have existed for over a century, but it wasn't until the late 1970s and early 1980s that they became a commercially viable consumer service.

The first generation (1G) of wireless technology systems came with the introduction of cell phones. These devices and networks allowed for mobile voice calls, but nothing more.



The second generation (2G) provided improvements to voice calling and introduced text messaging via SMS (and later media messaging via MMS), which ultimately helped the cellular industry to gain widespread adoption in the early 2000s.

Later iterations of 2G introduced data transmission, but it wasn't until 1998 that 3G allowed for media-rich applications like mobile internet browsing and video calling. The most recent iterations of 3G are able to reach speeds up to 4 Mbps.

The most recent generation of wireless technology, known to consumers as 4G (now 4G LTE), is able to reach real-world speeds between 10 – 50 Mbps, depending on the carrier. These speeds allow for mobile online gaming, live streamed HD-TV, group video conferencing, connected home solutions, and even emerging experiences like AR/VR.

That said, downloading or buffering is typically required at 4G speeds. For most consumers, this is a small price to pay for media-rich wireless freedom. But for industries like transportation or healthcare, latency (the delay before data transfer) can have a direct impact on system outcomes.

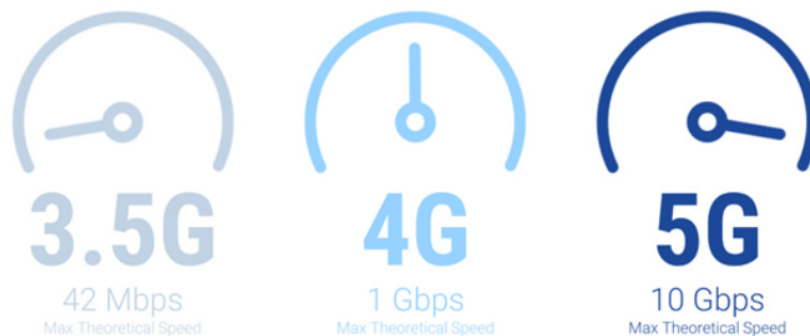
For example, 5G will enable near-instant communication between autonomous vehicles – communication that may prevent fatal accidents.

5G will have the biggest impact on these mission-critical systems while also providing the necessary infrastructure for tomorrow's connected technologies.

What is 5G?

5G is the next (and fifth) generation of wireless technology systems. It will provide speeds faster than any previous generation, comparable to those delivered via fiber-optic cables.

Early testing of this technology shows real-world speeds of 700 – 3025 Mbps (3.025 Gbps), which consumers may experience once 5G becomes commercially available. Movies that took minutes to download with 4G will take seconds with 5G.



While smartphones and other mobile devices are the obvious use cases for 5G, there are many other applications for the technology.

The Internet of Things (IoT), for example, [will benefit tremendously](#) from the speed and bandwidth provided by 5G, especially as the industry grows: Gartner estimates over 20.4B IoT units will be installed by 2020, while IoT-related spending will reach nearly \$3T.

Autonomous vehicles, robotic surgery, and critical infrastructure monitoring are just a few of the potential applications of 5G-enabled IoT.

Industries being disrupted by 5G

5G's quantum leap in connectivity creates tremendous opportunity for numerous industries, but also sets the stage for large-scale disruption. Industries such as healthcare, manufacturing, and auto are already adopting technologies and becoming more connected.

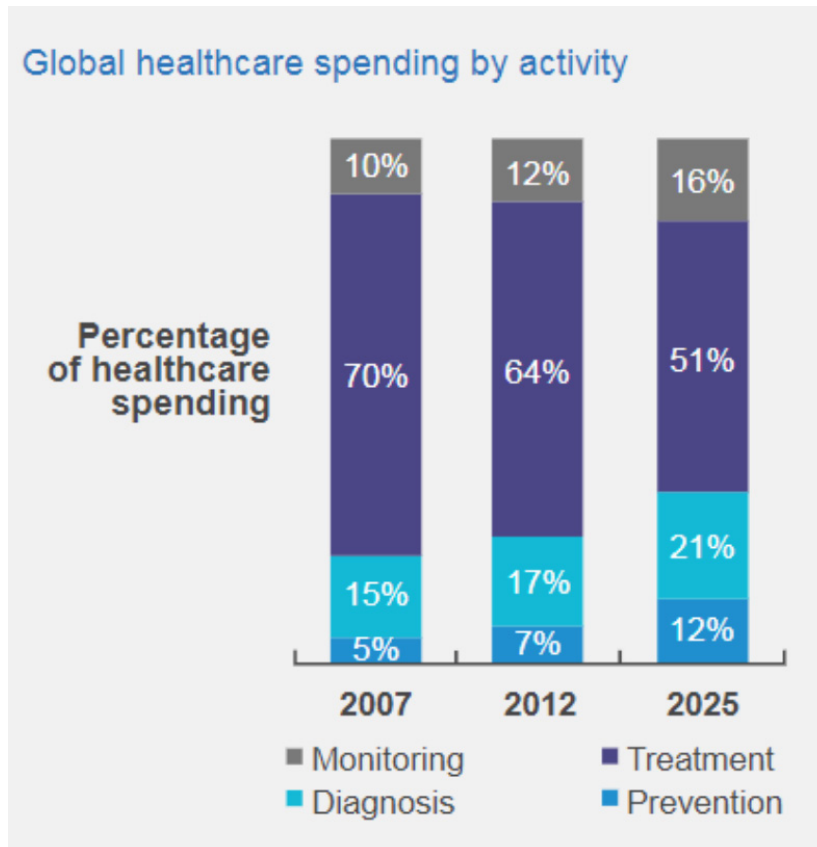
Once 5G becomes widespread, the effect on these industries could be transformative for 3 main reasons:

1. 5G devices are **lower latency**, enabling faster transmission of larger data streams
2. 5G devices are **more reliable**, enabling better transmission of data in extreme conditions
3. 5G is **more flexible** than Wi-Fi and can support a wider range of devices, sensors, and wearables

We dive into several industries that could see a drastic impact from 5G technology below.

HEALTHCARE

In an attempt to reduce costs and improve overall health, western medicine is shifting towards preventative care.



Source: Principal Global

5G offers enormous opportunity for expansion of both preventative and monitoring practices via wearable devices. Such devices are already being used to track everything from sleep to blood glucose levels to physical activity, among other things.

5G's faster speeds and greater network reliability will allow for the development of more complex devices, including those implanted directly into a human body rather than worn externally.

Microscopic cameras equipped with 5G will be able to provide real-time streaming in and out of patients' bodies, setting the groundwork for more remote diagnoses and other more complex telehealth practices.

Today, for example, recovering stroke patients for whom repeated hospital visits are a burden often suffer from a lack of home monitoring and care. New kinds of wearables that track patients around their daily lives — not possible today with 4G — could allow for such patients to get more personalized monitoring and care without having to visit a hospital.

In the field of robotic surgery, 5G has the potential to dramatically expand the ability of doctors to bring critical and specialized care services to patients worldwide.

Robotic surgery is feasible today, especially in dense urban areas with access to fast broadband internet, but doctors generally have to be located in the same operating theater as the patient for it to work. By allowing for low latency and jitter-free communication over long distances, 5G could enable operations to take place from anywhere in the world. In January 2019, a team in China tested 5G remote surgery for the first time, removing an animal's liver in the province of Fujian.

MANUFACTURING

The manufacturing industry has already started adopting artificial intelligence and IoT technologies to increase efficiency, improve data collection, and build better predictive analytics.

With 5G, manufacturers gain a faster, more reliable means of collecting and transmitting that data, as well as a broader range of sensors and devices they can integrate into their factories and workflows.

One major potential improvement with 5G will be augmented reality for manufacturing. Ericsson began testing augmented reality troubleshooting in its Tallinn, Estonia factory in January 2018. With an AR app, technicians can observe a part that needs maintenance and pull up the relevant schematics and instructions within their field of vision, drastically shortening the time it takes to complete the repair.



A technician repairs a circuit board using an augmented reality overlay at Ericsson's Tallinn factory. (Source: [Ericsson](#))

While the higher latency of 4G and lower reliability of Wi-Fi make such technology limited today, 5G's ability to transmit low latency video at a high resolution could potentially make it much more broadly usable.

Other industrial use cases for 5G (according to AT&T) include:

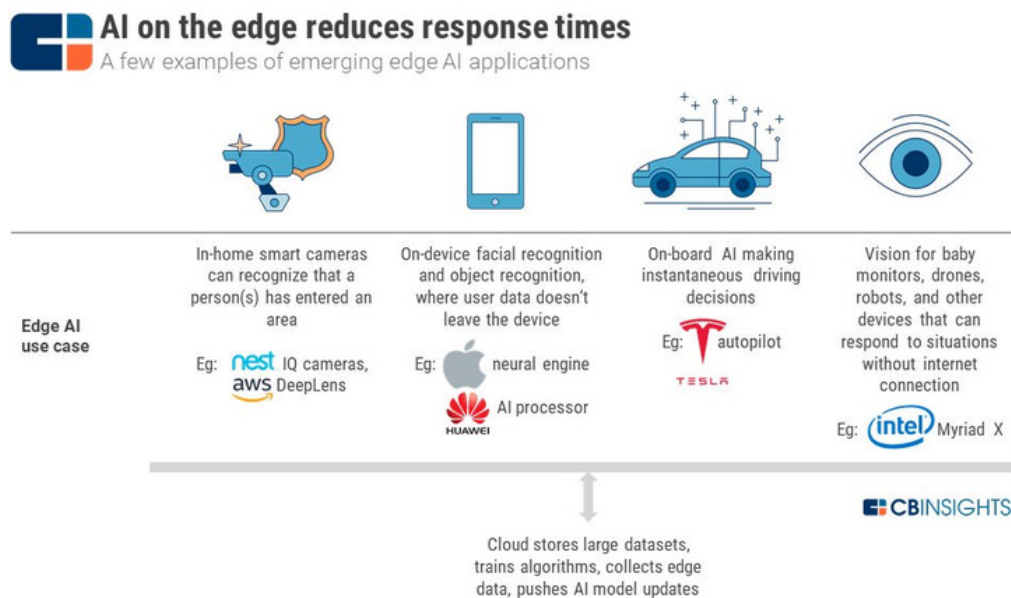
- Continuously monitoring equipment performance
- Robotic visual recognition that autonomously performs quality assurance on products
- Predictive analytics to tell when a part is going to fail

AUTOMOTIVE

Tesla, Google, and others have been racing for years to build the first viable autonomous vehicle capable of navigating all environments without the input of a human driver.

Their primary approach to the problem thus far uses onboard computers and radar to scan the environment around the vehicle, and decide a car's next movement based on the information.

Other companies, including Qualcomm, Ericsson, Huawei, and Nokia, are looking to 5G and edge computing as a potential solution to the problems faced by autonomous vehicles.



Their consortium, the 5G Automotive Association (5GAA), began work on “cellular-vehicle-to-everything” or C-V2X technology in 2016. Rather than cars determining individually how to act, in the C-V2X system, vehicles communicate with one another and with parts of the physical environment like traffic lights and construction signs in order to coordinate movements safely and efficiently.

The system is in a testing phase today, but researchers believe 5G could permit truly autonomous driving in the future.

5G availability would mean a greater density of sensors in the environment and faster data transmission from centralized servers to those sensors and vehicles — and as a result, faster improvement via machine learning algorithms.

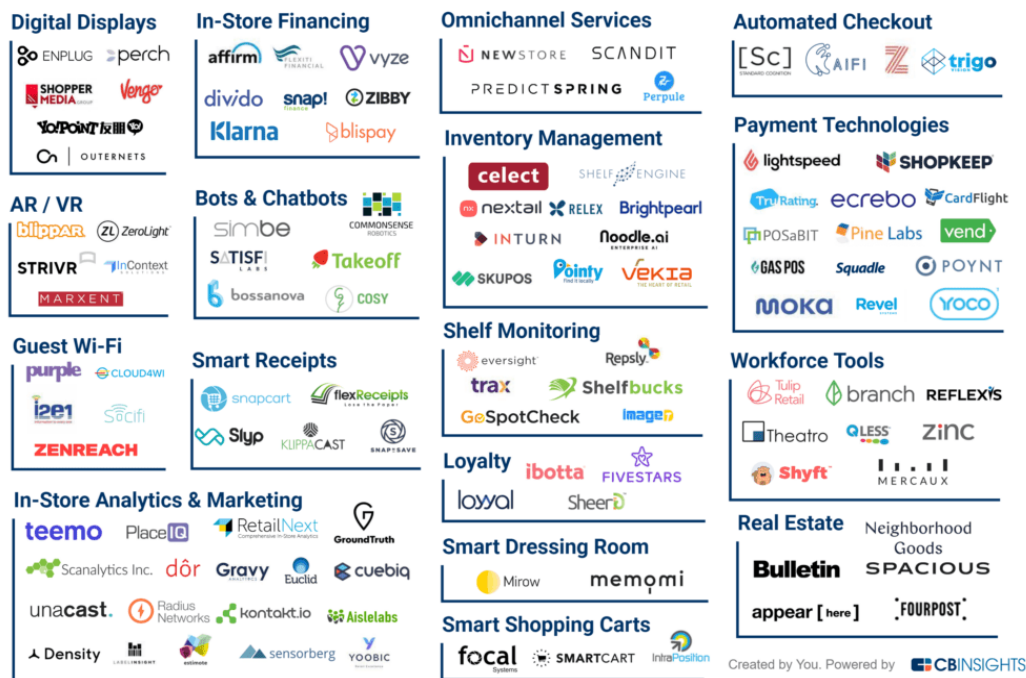
The average autonomous car of the future could produce as much as 2M gigabytes of data per week, and moving all of that data to the cloud or a regional server isn't feasible today with Wi-Fi or 4G.

RETAIL

Over the last several years, retailers have invested [millions in smart technologies](#) to help customers shop more efficiently and check out faster, while collecting more data on the customer experience.

Emerging retail technologies, from in-store analytics to visual recognition-driven shelf monitoring, depend on or benefit from the ability to quickly transmit large amounts of data, which is why 5G technology stands to have such a large impact on the way retailers operate.

The Retail Store Tech Market Map



Current “smart shelves” incorporating RFID technology, for example, can tell a business owner the ratio of item pick-ups to sales and display dynamic prices. With 5G technology, shelves equipped with sensors could determine low stock on a product, ping a distribution center to restock its inventory, and dynamically monitor the progress of that shipment.

Today, companies like Sephora use virtual try-on technology to help in-store customers see what a particular makeup would look like on them before they buy, but the product is constricted by data streaming limits. 5G technology eliminates such limits – we could one day try on our clothes in augmented reality with such accuracy that it would be hard to tell apart from reality.

5G also has the potential to create entirely new types of shopping experiences that would be unthinkable with today's technology: an augmented reality application on your smartphone, for example, that triggers when you enter a store and guides you directly to the shelf where you can find your items of choice. The physical groundwork for these kinds of experiences is already occurring with cashier-less retail (e.g. [Amazon Go](#)).

ENTERTAINMENT

Media giants such as Fox and Warner Brothers have already begun to explore the use of 5G technology.

5G channels will be able to offer live streaming of unparalleled quality. Amazon and Dish Network are already in negotiations to jointly build and support a 5G network.

Download speeds will also increase dramatically over 5G, making movie, game, and TV downloads possible in seconds rather than minutes. This could propel a shift away from streaming and towards mobile downloads, as downloaded media can be accessed and enjoyed with or without connectivity.

5G could have an even more transformative effect on augmented reality (AR) and virtual reality (VR). VR and AR applications have a higher field of view, resolution, and frame rate than conventional media, and as such require a significantly higher level of bandwidth and lower level of latency in order to transmit a consistent experience to the viewer.

Your typical 4G connection has about 60ms of latency, far too slow for the VR experience, which can become disorienting and jarring even at 15ms. 5G, on the other hand, promises potential latency of between 1-4 milliseconds.

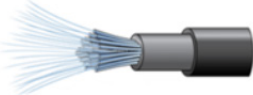

Four drivers paving the way for 5G

Below, we identify 4 primary drivers that will bring widespread 5G adoption to reality, and highlight how they will contribute to the deployment and use of 5G systems.

FIBER-OPTIC INFRASTRUCTURE

While sometimes perceived as competing technologies, fiber-optic networks and wireless networks often work in tandem. In the case of 5G, fiber is required to reach the multi-Gbps speeds promoted by wireless carriers because fiber-optic cables can quickly transport large amounts of data across long distances.

Fiber-optic cables are faster than coaxial copper cables

	Fiber-Optic Cables	Coaxial Copper Cables
Cable Types:		
Typical Bandwidth:	More than 1 GB/s	Up to 1 GB/s
Benefits:	Immune to electromagnetic and radio frequency interference.	Inexpensive
Limitations:	Expensive	Affected by electromagnetic and radio frequency interference.

Source: cbinsights.com

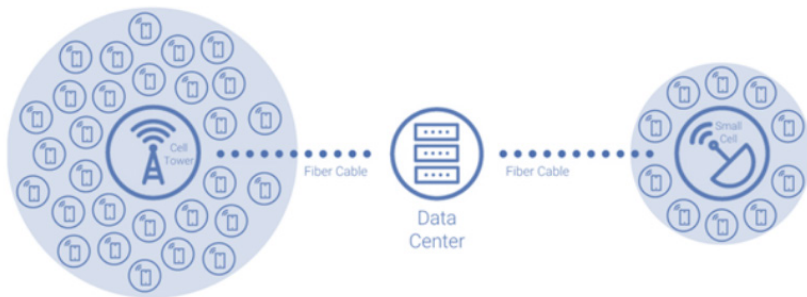
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Data travels through wires the majority of the time, with wireless antennas typically completing the last few miles of delivery.

In this way, fiber functions as the nervous system to the mobile network. Connecting data centers to cellular antennas (cell towers or small cells) with fiber will allow for the near real-time speeds expected from 5G.

Fiber-optic infrastructure is prevalent today and used by current 4G systems, but more will be required to support widespread 5G.

Fiber-optic cables are necessary for 5G speeds



Source: cbinsights.com

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Wireless providers are leveraging different strategies to scale their 5G networks. For example, Verizon is looking to own its fiber backhaul (underlying connective infrastructure).

The company has worked with specialty glass manufacturer Corning and fiber provider Prysmian to design and install fiber-optic cables for 5G.

In April 2017, Verizon announced a three-year purchase agreement with Corning to buy 12.4M miles of optical fiber each year for the next three years.

T-Mobile, on the other hand, leases “dark fiber” (unused or underutilized fiber) to support its small cells deployment. While the company may not own the fiber, it can provide 5G services sooner as much of the leased backhaul is already installed.

Both providers aim to further roll out 5G services in 2019.

Most of these 5G deployments will probably look to support urban centers before expanding to rural areas. However, areas already infused with pervasive fiber — urban or rural — are likely candidates for early 5G deployments.

SMALL CELL DEPLOYMENT

Much of today's wireless data is delivered through macrocells, known more commonly as cell towers. They provide the foundation for wireless connectivity and can serve thousands of mobile users within a radius of up to 40 miles.



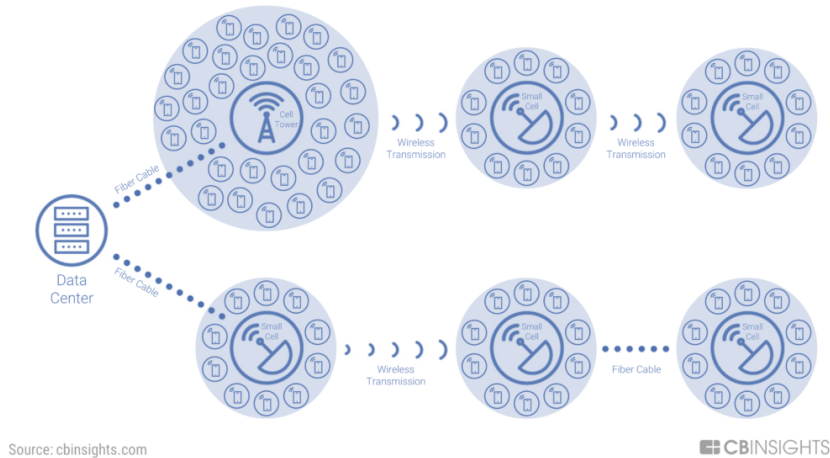
While macrocells continue to serve the telecom industry well, they're difficult to deploy and maintain. The costs of regulatory approval, construction, power, and maintenance make traditional macrocell towers a necessary burden for wireless connectivity.

Small cells (or microcells) are growing contributors to wireless connectivity, supporting the wireless systems of the present and future. They serve fewer mobile users but are much easier to install and maintain. They're also cheaper, more energy efficient, and require less red tape than macrocells.

Small cells communicate wirelessly with macrocell towers, other small cells, and individual mobile devices. Certain small cells connect directly to fiber cables while others provide support to wireless mesh networks that improve wireless coverage.

In rural areas, small cells can help extend coverage; in densely populated areas, they can strengthen capacity.

5G requires data centers, fiber, cell towers, and small cells



Some of the newest small-cell technology is hidden in plain sight. In Los Angeles, small cells have been deployed as part of smart streetlights to strengthen 4G networks.



In deploying these small cells, LA has also installed some of the necessary infrastructure required for tomorrow's 5G networks.

5G will only be able to travel short, unobstructed distances. A number of small cells will be required to serve the same area that a single macrocell can cover — though the small cells will provide much faster speeds.

T-Mobile has already installed 15K small cells, with plans to deploy another 25K in the near future. These cells support the rollout of the company's 5G services in 30 cities, including Los Angeles, New York, and Dallas.

In October 2018, the FCC announced a new set of guidelines that restrict the ability of states and local communities to charge carriers for deploying small cells colocated with public infrastructure, a step expected to speed up the rollout of small cell technology across the country.

In addition to the successes with small cell deployment, there have been a string of complications.

Wireless carriers are beginning to realize that small cells will have to comply with a host of new regulations and meet certain demands from local residents who are concerned about the pervasive new technology.

Sprint paid an \$11.6M fine for failing to secure the appropriate permits. AT&T received pushback due to the “needlessly messy” design of certain small cells, and the city of Santa Rosa, CA, suspended Verizon's deployment for similar reasons.

The city of Hillsborough, California charged AT&T \$60,000 in application fees for sixteen nodes. It rejected the applications. Some of these roadblocks led to the FCC's decision to reduce states and localities' ability to charge carriers for small cell deployment.

Small cell deployments are still in their earliest stages. That said, many carriers will offer their first 5G services in 2019. Mobile users should expect major carriers to offer 5G services in the largest US cities by the early 2020s.

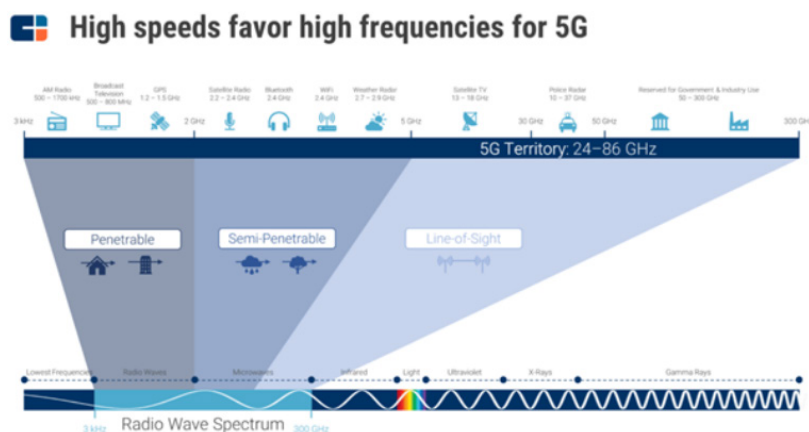
HIGH-FREQUENCY SPECTRUM AVAILABILITY

In addition to fiber infrastructure and small cell deployment, 5G speeds also require radio waves with extremely high frequencies. These frequencies need line-of-sight within a small radius to successfully communicate.

In other words, increasing demand for wireless coverage, speed, and consumption requires the use of new bands within the radio wave spectrum. A band is a specific frequency range on the radio wave spectrum. They range from very low (3 – 30 kHz) frequencies to extremely high (30 – 300 GHz) frequencies.

For context, AM radio uses the medium frequency band (300 kHz – 3 MHz), leveraging the specific frequencies between 500 and 1700 kHz (or 1.7 MHz).

Wi-Fi and Bluetooth, on the other hand, use the ultra-high frequency band (300 MHz – 3 GHz), leveraging the specific frequency of 2.4 GHz. Mobile devices are designed to communicate on both the 2.4 and 5 GHz frequencies for Wi-Fi.



Source: cbinsights.com

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While higher frequencies allow for faster data transmission, they're unable to pass through certain structures. For example, satellite TV, which typically uses frequencies between 13 -18 GHz, requires a direct line-of-sight to prevent disruptions. Heavy rainfall or an overgrown tree could impact viewing quality.

For most 5G networks, the super high (3 – 30 GHz) and extremely high (30 – 300 GHz) bands will be used to deliver the Gbps speeds promised by wireless carriers. Frequencies between 24 and 86 GHz will be particularly popular.

The FCC began auctioning off the rights for the 28 GHz 5G band in November 2018 to a total of 40 telecoms, wireless carriers, and other entities.

Verizon did not take place in the auction because it already owns a license for part of the 28 GHz band, which it obtained through the acquisition of [XO Communications](#).

By mid-December, total bids in the auction had reached more than \$688M.

The agency has never distributed this volume of spectrum at auction previously, and is doing so now since “wireless carriers have been talking up the need for speed and bandwidth for an internet of everything, 5G world,” according to the FCC.

Auctions for additional bands will begin later in 2019.

Certain spectrum will be allocated for shared access. With the use of a Spectrum Access System (SAS), carriers can dynamically access shared frequencies based on availability. This will allow carriers to scale bandwidth up and down based on network demand.

It will also provide spectrum access to smaller commercial users that don't license dedicated spectrum of their own. SAS providers like [Federated Wireless](#) ensure secure, interference-free bandwidth using proprietary software.

Shared or licensed outright, these higher frequencies will require small cells to be arranged in a way where they maintain line-of-sight between mobile users or other small cells. While an abundance of small cells will help to maintain 5G coverage, another wireless configuration called "fixed wireless" will help deliver wireless coverage indoors.

BRINGING 5G INDOORS WITH FIXED WIRELESS

Though the high frequencies of 5G require direct line-of-sight, “fixed wireless” will allow for cellular coverage within buildings and homes, without the use of cables/lines.

Fixed wireless antennas are placed on top of homes and buildings to communicate with nearby small cells or macrocell towers. While these fixed wireless antennas must maintain line-of-sight with the nearby cells, they are able to extend cellular coverage into homes and buildings.

These antennas may be connected by fiber to internal picocells or femtocells, which are used to relay wireless coverage to a small number of mobile users indoors. The wireless signal can also be converted to conventional Wi-Fi with the use of specially designed modems and routers.

5G may also provide stationary internet with fixed wireless



The ability to convert a cellular signal to Wi-Fi may enable wireless carriers to compete with traditional ISPs like Comcast and Time Warner.

Verizon, which already provides internet access to homes and businesses, rolled out fixed 5G wireless services in a handful of cities in 2018. These services will provide an alternative to internet access delivered via fiber while maintaining comparable speeds.

The company is partnering with Samsung for its fixed wireless 5G routers, which will convert wireless 5G signals and enable Wi-Fi compatibility.

While Verizon plans to offer fixed 5G wireless access before any of its mobile 5G services, the infrastructure will help to support both mediums.

In September 2018, Verizon unveiled its first service offering in this space, named “Verizon 5G Home.” The service became available for residents of Houston, Indianapolis, LA, and Sacramento, with advertised speeds between 300 Mbps and 1 Gbps: slower than initially promised by the company.

AT&T, while initially skeptical of the fixed wireless opportunity, announced in September 2018 that it would begin to rollout a fixed wireless service by late 2019.

Both companies are working with Samsung for the delivery of critical infrastructure for their 5G launches.

On the other end of the spectrum, companies like Google may start to build a mobile 5G network using the fixed wireless assets installed as part of its growing [Webpass](#) business (acquired in 2016).

Ultimately, fixed wireless is early in its progression to extend mobile 5G service into buildings beyond line-of-sight or to provide internet access to homes and businesses.

What's next for 5G

As numerous wireless carriers plan to offer 5G service in the coming year, the entire telecom industry is hard at work to capitalize on this shift to higher radio wave frequencies:

- Qualcomm recently unveiled the Snapdragon 855 chipset, which grants smartphones 5G capabilities. The Snapdragon 855 will roll out in early 2019.
- Verizon launched its first 5G broadband internet networks in 4 cities during late 2018 and plans to release 5G wireless service in 2019 after its first 5G-ready phones hit the market.
- AT&T rolled out 5G mobile hotspots in a dozen cities in 2018 and will be adding at least 9 more in 2019.
- Sprint and LG plan to release the first 5G smartphone in the first half of 2019. Sprint will have its 5G network in place in at least 9 cities by the time the smartphone launches.
- Motorola unveiled its new 5G Moto Mod in 2018; the mod snaps onto the back of the Moto Z3 and turns it into a 5G-capable device. The 5G mod will be available for purchase in 2019.

Companies like [Zayo](#) are helping to lay the necessary fiber to support these 5G networks, while others like [Siklu](#) are providing fixed wireless antennas and small cells.

Manufacturers of 5G devices also play one of the more important roles in 5G adoption: device manufacturers need growing coverage, while wireless networks need a growing number of compatible devices.



It is likely that the new technology will affect device design. Some prototypes currently exist, but it may take some time before manufacturers can properly — and aesthetically — integrate new 5G antennas into mobile devices.

But with so many companies working to make the technology a reality, consumers should expect to see a range of 5G-enabled devices in the near future. Once carriers activate 5G in a minimum viable number of cities, compatible phones will soon follow.

While 5G service may start to become more broadly available in the coming year, 4G will still remain the default service in areas outside of a select few densely populated cities. Widespread 5G coverage could take over a decade — and as for the broader industrial applications of 5G, estimates suggest that adoption will take off in the early 2020s.

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Call for Community Expressions of Interest: Northern Ontario Residential Broadband Project #1

Focus

Northern Ontario Communities which need to extend broadband or high-speed internet access out to a secondary Point of Presence (POP) that is 3-10 km away, for a low cost, high-capacity middle-kilometer solution. The required solution will extend broadband capacity from one part of the community to a remote site 3-10 km away such as a residential cluster, adjacent community, tourism site, mining site, forestry site, industrial park, etc.

Residential broadband service is defined as a high-speed internet access service to the home, that is faster than dial-up, and is “always on”. A POP is a high-capacity internet access point brought into a community building or equipment room from an Internet Service Provider (ISP). A POP can provide internet access supplied from an optical fibre backbone connection, a fixed wireless link from a tower, or other high-speed data transport technologies.

CENG, Canada’s Centre of Excellence in Next Generation Networks, under the Next Generation Network Program (NGNP), is looking to fund innovative technology projects across Northern Ontario that demonstrate flexible, cost-effective, and enhanced residential broadband technology solutions. Through this current call for a community “Expression of Interest” (EOI), CENG is looking for a Northern Ontario community interested in working with one or multiple technology applicant(s) to prove their solution will provide a lower cost, and high-performance solution meeting or exceeding the transport of 10 Gbps capacity levels to a secondary POP within 3-10 km of the primary broadband internet POP in the community.

Process

The EOI responses from the interested communities will be evaluated by an independent External Review Panel (ERP) which will offer recommendations to a CENG Internal Review Panel (IRP) on best community candidates for this project.

One or more communities may be awarded a chance to host a middle kilometer (3-10 km) secondary POP extension technology project through this EOI evaluation. A separate EOI process will be issued to select a number of candidate technology applicants to propose technology solutions for the selected community(s).

The community and the technology applicant(s) that are selected through these EOI processes, will then be encouraged to work closely together to enable the selected technology applicant(s) to respond to a subsequent Request for Solution (RFS) process. The RFS process requires a more detailed technical response, which will be evaluated to determine which of the candidate technology applicant(s) selected from the EOI process, will be awarded the CENG funding to install a solution in the selected community(s).

For more details on the EOI process, please refer to the CENG document titled “Northern Ontario Residential Broadband Program - EOI and RFS Process Document - Project #1”.

Investment

CENG will be providing funding for individual projects up to \$500,000 from its Northern Ontario Residential

Broadband Program as part of the NGNP. Eligible technology applicant(s) must agree to co-invest by contributing cash and/or in-kind to the project of an equivalent amount to the CENG funding.

Technology applicants are welcome to submit proposals not exceeding a CENG ask of \$500,000. These funds must be expensed by the technology applicant to be applied against eligible expenses associated with supporting a 3-6 month project in the community.

Application Focus

Technologies under consideration must address the requirement for lower-cost, higher performance residential broadband last-kilometer or middle-kilometer access technology solutions for Northern Ontario communities. These communities often have either no broadband internet residential access, or limited access to only part of the community, and often at performance levels far below 50/10 Mbps. In addition, the business case for getting broadband internet services into these communities is very difficult since the population density is very low, and the size of the resident populations is often well below 1000 residents. With the increasing demand for real-time video, voice-over-IP communications, tele-medicine, distance-learning, and home-based on-line businesses, there is an increasing need for broadband internet support to the home (last kilometer) infrastructure that can meet all of these needs.

The objective for this CENG project will be to provide equipment/technology that will prove and document installation, equipment, and/or operational costs that are significantly lower than other commonly available technology solutions, while supplying a middle-kilometer POP extension solution with sufficient capacity (meet or exceed 10Gbps throughput) to meet or exceed the new CRTC recommendations of 50 Mbps Download, and 10 Mbps Upload performance levels per residence supported from that remote POP location.

In order to provide a real-world environment to effectively demonstrate the value of the technology proposed by the candidate technology applicant(s), CENG will select a Northern Ontario community, through this call for a community EOI which is intended to receive applications from communities interested in participating in a residential broadband project. The purpose of the installed equipment deployment will be to demonstrate the effectiveness of the proposed middle-kilometer POP extension residential broadband technology, but also provide a proven solution that works for the selected community. The live network installation allows the technology applicant to measure and document performance levels that are designed to meet or exceed the target internet access performance levels, provide 10Gbps or higher throughput capacity, while reducing installation complexity/cost, lower equipment cost, and/or lower operational cost targets.

It will also be important that the solution includes tests and use cases that proves the technology would be able to scale to meet the community's needs through wider residential deployment after the project is complete. The proposed technology solutions and associated infrastructure must be flexible and scalable, so that the demonstrated system can be shown to be adaptable enough to be used across a range of communities with a similar residential broadband middle kilometer POP extension business-case, and technical challenges.

In order to be considered as a project site, community applicants must respond with the following details:

Northern Ontario Community Middle-Kilometer Residential Broadband Needs

- Where this community lacks broadband internet residential access (whole or part of community)
- The type(s) of residential internet access currently available in the community and the desired remote POP location
- Identify if a broadband POP currently exists in the community and where

- Identify where the desired POP extension location(s) are that the project will need to address
- The population of the community, current level of broadband service, and population of remote location

Community Commitment and Readiness to Support a CENGN Project

- State the level of municipal or community government support that will be available for the project
- Identify which POP location and remote candidate POP extension locations in the community would be available for equipment supporting the project
- Availability and location of a secure climate-controlled equipment room(s) for project equipment/racks at both locations
- Willingness to consider tower or other outdoor installations, and ability to make two sites available if necessary
- Ability to work with one or more technology applicants to provide the detailed community site information needed for the technology applicant(s) to accurately access the estimated costs of the project
- Propose how the community is prepared to work with the selected technology applicant to be “shovel ready” by June of 2019

Other Considerations for the Project

- Any community partner(s) that would be available and interested in participating or supporting the project
- Any bylaw or regulatory issues that could delay start of the project
- Other existing or planned broadband projects for the community
- Willingness to work with CENGN and the selected equipment/technology technology applicant(s) to promote the successful project results and technology solution used in your community, as a proof-of-concept showcase network approach for other Northern Ontario communities

Community Commitment Beyond the Project

- Interest in working with one or more technology applicants to develop a plan to keep the equipment in the community and plan subsequent expansion phases following the successful completion of the technology project

Application Details

CENGN is soliciting EOIs from communities interested in participating in a Northern Ontario Residential Broadband Project, which will provide a high-capacity, lower-cost, residential broadband 3-10 middle-kilometer POP extension solution.

The EOIs must be submitted by 5:00pm on Friday, March 29, 2019. Submissions are to be provided by email to info@cengn.ca in the form of a written proposal not to exceed three (3) pages.

The Expressions of Interest must succinctly describe any unique technical challenges, community or bylaw challenges, and/or community access issues. Due to the unique nature of the installation of the equipment in your Northern Ontario community, it is important that the applicant clearly indicates any things the community can do to ensure installation and operation of this project technology can be completed successfully within 3-6 months.

Preference Will be Given to EOIs That

- Are from a Northern Ontario community (defined as north and west of a line, from Parry Sound, east to Huntsville, and across to Renfrew Ontario)

- Demonstrate a complete lack of broadband residential internet support or extremely limited support that could be solved through a POP extension to the remote or separate part of the community or adjacent community
- Demonstrate clear economic, health, and education benefits to their Northern Ontario community
- Have broad Northern Ontario community applicability and impact (economically and/or socially)
- Demonstrate the ability and willingness of your community to work directly with one or more selected technology applicants to enable each technology applicant to propose a subsequent RFS solution that solves the specific middle kilometer residential broadband internet access issue for your community
- Confirm a willingness to work with technology applicant(s) to provide the community-specific information on how to scale or expand the original project solution configuration/installation to more completely meet the on-going residential broadband needs of your community after completion of the project.

Eligibility

All Northern Ontario communities.

Next Steps

All interested parties are invited to submit their written EOIs as noted above.

All applicants will be informed about the status of their EOI submissions by 5:00pm, Tuesday April 30, 2019. If you have any questions, please email us at info@cengn.ca.



Dave MacDonald <otwdave@gmail.com>

Temagami and Broadband Internet & Telecommunications...

1 message

Paul Ouimette <pouimette@neonet.on.ca>

Wed, Mar 27, 2019 at 11:57 AM

To: "dan.omara@temagami.ca" <dan.omara@temagami.ca>, "margaret.youngs@temagami.ca" <margaret.youngs@temagami.ca>, "otwDave@gmail.com" <otwDave@gmail.com>

Cc: Laura Imhoff <LImhoff@neonet.on.ca>

Good morning,

Firstly, sorry for the delay in getting this email to you following our meeting a few weeks back.

I have attached a copy of the slide deck we presented as part of our conversation as well as supporting information to provide additional information regarding the various technologies as well as some contact information regarding some resources.

Cellular Engineer and cost-conscious solution provider:

I have been in contact with Marko (contact details below) – you might be interested in getting a GPS coordinate for an area that does not have good cellular coverage to do some preliminary research to determine distances between towers as well as topology review to determine the varying elevations in play.

Marko Koskenoja / (705) 541-8490

Telecommunications Consultant

www.northlandconsultants.ca

I have attached a case study document that describes a particular small community cellular challenge and also include a summary of Northland Consultants that came from their Facebook page. The attachments were provided by Northland Consultants. You can also refer to <https://www.facebook.com/NorthlandConsultants/>.

Give me a call if you have questions on the above. I invite you to reach out to Marko Koskenoja at 705-541-8490 or at marko@northlandconsultants.ca. NEOnet is also available to assist in the process or at least be kept in the loop as there are definitely other communities that face similar challenges; at this time, we may not have access to public financial resources to propose public-private projects but believe this type of situation is critical to resolve for economic development. With the newly announced Ministry of Rural Economic Development, we have a role to play in advocating for funding to address such challenges

5G cellular technology

I have attached the document 'CB-Insights_...' which provides a great overview of the upcoming 5G technology; testing has begun but my opinion is that it is best suited for higher density areas which would benefit from the Internet of Things capabilities or high population densities where high speed data transfers warrant the high cost of deployment of this type of network.

Broadband Internet

NEOnet has submitted a project proposal to NOHFC called BIRA – Broadband Internet for Remote Areas; we are awaiting a decision on this Stage 2 application which could potentially provide SMEs (businesses) up to 2,500\$ in subsidy to connect to Internet services. This opportunity may benefit the several Tourist Camps in your area if we are successful in being awarded this project funding.

I have researched Spectrum Internet <https://www.spectrum.com/> and was unable to ascertain that they are a 'core' ISP and not just a reseller; I will ask Laura to continue the investigation.

Morden, MB – I have taken a look at <https://morenet.ca/> and their 'utility' model for city taxpayers; interesting model for a revenue neutral scenario in delivering alternate Internet options for the community over the other 4 ISPs. I did not locate details regarding 5G but will further my investigations.

EnhBEAM – Technology Adoption – NEOnet has a FedNor project proposal (Phase 2 detail) for a subsidy program up to 25,000\$ related to Technology Adoption for SMEs. We believe a portion of this initiative could be leveraged to businesses to connect to the Internet – generally, technology adoption to scale up or grow a business cannot be done 'without' access to the Internet...

CRTC, Closing the Broadband Gap – Broadband Fund <https://crtc.gc.ca/eng/internet/internet.htm>

<https://www.canada.ca/en/radio-television-telecommunications/news/2018/09/crtc-announces-details-of-the-broadband-fund.html>

The Federal Budget can be accessed here: file:///C:/Users/PaulOuimette/Documents/budget-2019-en.pdf

Hearst: Began a rollout of a hybrid network based on fibre where feasible and wireless connectivity to reach out beyond the core area of the community. Take a look at Hearst Connect: <http://www.hearstconnect.com/> and Hearst Wi-Fibe at the same website. (Name may be changing due to Bell WiFibe).

Cochrane: Here is the weblink to their offerings – most are based on Fibre: <http://www.cochranetel.ca/>

Ontera, Eastlink contacts,

Low Orbit Satellite: Here are some links to information on this technology and related to Canada:

- <https://www.spaceq.ca/2019-canadian-federal-budget-provides-new-funding-for-low-earth-orbit-satellite-capacity/>
- <http://spaceq.ca/13-canadian-commercial-satellite-constellations-in-development/>
- <https://globalnews.ca/news/4670203/spacex-telesat-canada-fcc-global-satellite-network/>
- <https://spacenews.com/canadas-leo-constellation-fund-draws-interest-from-telesat-mds/>

CENGN: I have attached a PDF that summarises the Northern Ontario Residential Broadband Program and Expression of Interest. The weblink for more details is <https://www.cengn.ca/ontario-broadband-program/>

Xplornet Satellite, Fixed Cellular – Laura has contacted Jeff at BlueSkyNet regarding BAIMAP GIS Data, we are awaiting for this data to share with you, showing where the actual Xplornet Fixed LET Internet is available.

Emergency Response; Lifeline issues – Government: This could be an additional justification of the need of improved telecommunications sooner rather than later. Highway 11 is a transport corridor that is vital for all communities of the North (and beyond). It may be of interest to get data on annual numbers of transports (and what they carry) over any given year; a disaster interrupts significantly the economic viability of many communities – including likely fuel delivery...

Finally, here is the contact details of a communications consultant; he had previously worked for Ontera before the company sale to Bell and is a subject matter expert with knowledge on the available infrastructure across the North.

Telecom Consultant: **Amedeo Bernardi Consulting** www.amedeobernardi.ca

Regards, Paul



PAUL OUIMETTE

Director of Operations

705-360-1353 x 32 | 705-360-8537 fax | 705-266-5589 mobile

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3 attachments

NEOnet-Temagami 20190307 Slide Deck.pdf
1215K

CB-Insights_What-Is-5G.pdf
1377K

Community-Northern-Ontario-Broadband-EOI (CENGN).pdf
130K