BROADBAND CONNECTIVITY

A MUNICIPAL ROADMAP

ROMA
Rural Ontario Municipal Association

Contents

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The Purpose of the Municipal Connectivity Roadmap

The Rural Ontario Municipal Association (ROMA) has developed a Municipal Connectivity Roadmap for municipal elected officials and staff. It includes tangible steps and initiatives for councils to consider and implement to improve connectivity if they so choose.

Investing in connectivity remains a choice at the municipal level because local governments do not have a mandated role in telecommunications. That said, the pressure that communities are placing on elected officials at all levels of government to act to create better broadband and cellular connectivity is increasing.

Note that this Roadmap does not provide legal advice. ROMA encourages its members to engage with their staff and legal counsel as it considers the advice provided.

ROMA has also created the *Municipal Connectivity Primer* which serves as background for this Roadmap and should be read as a companion piece to this document.

About the Rural Ontario Municipal Association (ROMA)

ROMA is the rural municipal voice of the Province of Ontario. It promotes, supports, and enhances strong and effective rural governments. ROMA members work closely with the Association of Municipalities of Ontario (AMO). AMO is a non-partisan, non-profit association that advocates for Ontario's 444 municipal governments. Together, these associations work together to achieve shared goals and meet common challenges, of which one is connectivity.

Acknowledgements

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Introduction

As the *Primer* lays out, the regulatory and funding roles for telecommunications fall primarily with the federal and provincial governments. Despite not having a mandated role in telecommunications, local governments have increasingly made strategic decisions to invest time and resources to improve connectivity in the last decade.

Local governments understand that communities that are connected and productive are more likely to have economic prosperity, recover faster, and compete in a global market. The recent announcements of public funding programs like the province's investment of nearly $1 billion including doubling the investment in the Improving Connectivity in Ontario (ICON) program,[1] and the $1.75 billion Universal Broadband Fund (UBF) from the Government of Canada[2] validate this assertion.

Municipal governments should not feel behind if they have not discussed telecommunications policy until now. After all, core municipal infrastructure takes priority and taxpayer dollars only stretch so far. That said, there are multiple activities that municipal councils can start on to build better connectivity in their communities.

The Roadmap is Not Linear

The Roadmap is not a linear pathway toward connectivity, but rather a set of components that councils can consider as it determines what is most helpful for their community (see Figure 1). It is not linear because some components will take longer than others, while others may need to be repeated based on changing local circumstances. Timing is another layer. While some components should start in the short-term, it does not suggest that all others should happen in sequence.

Figure 1: Components of a Municipal Roadmap (ROMA, 2020)

[1] Government of Ontario. News Release. Ontario Investing Nearly $1 Billion to Expand and Improve Broadband and Cellular Access. November 4, 2020.

[2] Government of Ontario. ISED. Universal Broadband Fund. Accessed November 2020.

Component 1 Identify the state of connectivity in the municipality and understand what assets exist within its municipal boundaries

To build connectivity it is important that the municipal government start by learning the basics and gain a better understanding of what currently exists in their community.

Elected officials and senior staff can start by learning the basics by reading the *Primer* and the glossary of terms in this Roadmap (see **Appendix A**). Other sources could include Information Technology (IT) departments or consultants, if applicable, and industry representatives in your area. The terminology is not intended to have councils get "into the weeds," but rather to get a sense of the overall landscape.

At the same time, municipal councils and staff can start gathering the appropriate information to determine the current state of connectivity within the municipality. Knowing this at the outset is important as information gaps can be identified early. Data points that are helpful include, but are not limited to:

- What current connectivity infrastructure exists within municipal boundaries (i.e. towers, fibre-optic cables, Wi-Fi hotspots, etc.);
- Where that infrastructure is located (i.e. within municipal buildings, on top of municipal infrastructure like water towers, on rights-of-way, etc.);
- What the municipality is planning for this infrastructure in the future (i.e. public works' plans).

This data can be collected through a variety of methods, two of which are described below.

Cross-Department Working Group

Data collection on connectivity is likely to be more effective if it is a cross-departmental exercise. Creating a staff working group with representatives across the municipal corporation is one way to solicit and coordinate this information. It could include departments such as:

- Economic development;
- Engineering and public works;
- Finance; and
- Information technology.

Establishing a corporate-wide connectivity group will help coordinate the data that exists and will ensure that each division knows what the others are doing so that broadband infrastructure can be integrated into any planned infrastructure.

It may also be of benefit to have a working group of community representatives (i.e. business owners, students, seniors, etc.) once this group is established to feed information in and provide on-the-ground expertise about connectivity needs in the community.

The Use of Mapping

Mapping the external layers of connectivity that exist within municipal boundaries should be integrated into the existing infrastructure maps that the municipality's working group has built. This should include data from Telecommunication Service Providers (TSPs) and Information Service Providers (ISPs), as well as utility companies (i.e. Local Development Companies or LDCs) who have granular data on what information exists. The National Broadband Internet Service Availability Map and the Province's ICON Mapping Tool are excellent places to start, but may require meetings with TSPs, ISPs, and LDCs.

Municipal governments should also be interested in knowing what connectivity is being experienced on the ground compared to where the maps say there is service. For example, ISED's internet performance test was created in conjunction with CIRA as a free tool to help residents and businesses upload their own data to record how their internet is actually performing.

Having this data is important to ensure that the limited funds available can fill gaps in service according to the priorities laid out by council. It will also identify what barriers stand in the way to better connectivity, which can inform advocacy.

NEXT STEPS: LEARN THE BASICS

- Read ROMA's *Primer* and understand the terminology and terms.
- Establish a cross-department working group on broadband connectivity.
- Use mapping tools to understand existing service levels – both advertised and experienced.
- Identify early on what stands in the way of better connectivity.

Component 2 Understand the true drivers and needs for connectivity and be open to creative solutions

Once the existing assets have been mapped out and there is capacity within the municipality, it is important to understand why improved connectivity is important to the community.

To get this information, municipal governments could develop a survey of needs for constituents in the area. It could include asking what the highest priorities are according to the community itself. Understanding their needs will help to affirm or refute what the cross-department working group has found to date. For example, the survey could gain an understanding of connectivity needs such as:

- Businesses on main street wanting e-commerce/create websites to compete on a regional and global scale.
- Students wanting to be able to connect and upload their schoolwork without having to travel to a neighbouring municipality.
- Seniors wanting to connect to their loved ones through a reliable and affordable system.
- Farms wanting to adopt precision agriculture (i.e. using new technologies to increase crop yields and profitability while lowering the levels of traditional inputs needed to grow crops) to be more competitive.

- Entire low-income neighbourhoods and underserved residents that are not connected to future-proofed technology. This leaves them at a disadvantage, and likely with higher bills for comparable service.
- A combination of the above.

Gaining an understanding of connectivity needs will help to illustrate what service gaps exist within the municipality and help justify the use of public funding for priorities.

Another challenge is adoption of technology vs. access/availability. The distinction is important because having access is different than it being affordable and thus adopted by users.

There are also two ways to distinguish access/availability. The first is in the connectivity to the community itself meaning establishing or maintaining a point-of-presence (PoP) in the community that links to the internet. This requires some sort of internet backbone running over a long distance, which is more costly than the second type – namely, the copper or fibre that connects the PoP to distribution nodes including businesses and households.

This complexity is why municipal governments should be open to creative solutions.

Be Open to Creative Solutions

As mentioned in the *Primer*, TSPs and ISPs respond to market signals to provide value to their shareholders and seek to achieve the highest return on investment as possible. They will respond to public sector funding if there is a business case for doing so.

In the long-term, it will be important to advocate for public funding to make business cases for "future-proofed" technology palatable. It is important to keep these technology solutions top of mind as they are most likely to fit the needs of the community in the long-term. However, in the short-term, municipal governments should work with incumbent TSPs and ISPs in the area to find creative solutions.

Again, creative solutions chosen today should be future-proofed wherever possible to ensure that government investments leverage taxpayer dollars. It is also possible that building in the short-term may delay public sector funding to upgrade those networks in the future. Ultimately these are decisions that local councils will have to consider based on the needs of the communities.

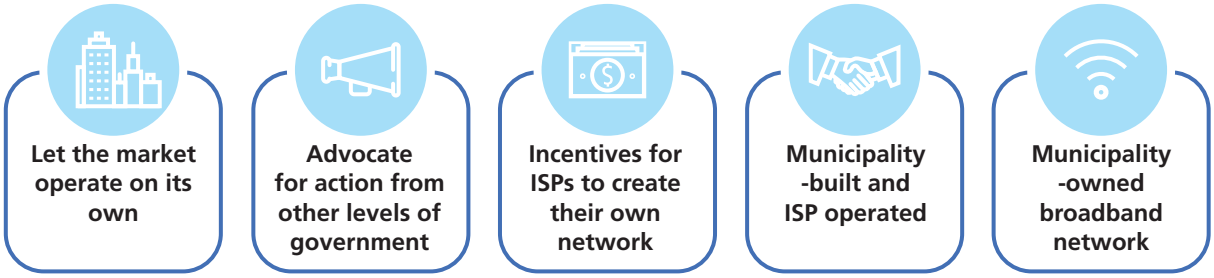
NEXT STEPS: ASSESS THE NEEDS

- Conduct a needs assessment and evaluation of local connectivity drivers.
- Identify what benefits broadband would bring if those needs were met.
- Determine what neighbourhoods or areas within your municipal boundaries are of greatest need for connectivity.
- Match solutions depending on what requirements those connections need.

Component 3 Determine what role, if any, your municipality wants to play in connectivity.

There are many roles that municipal governments can play in broadband connectivity. The framework below sets up the spectrum of possible options.[3]

Figure 2: Spectrum of Broadband Options (Erin Britnell, 2020)



On one end is the option to let the market operate on its own, which is what has largely existed. At the other end is for the municipal government to own and operate its own broadband network. In between are the options to advocate for action from other levels of government, create incentives for TSPs and ISPs to create their own networks, and the last is to build a network and let a TSP or ISP operate it.

Municipal governments should determine early where on the spectrum they wish to be. There are many considerations for municipal governments to understand:

- Is there enough digital literacy and capacity to build, maintain and sustain such a system at the municipal level?
- Are there economies of scale that can be leveraged to build enough demand that ISPs would be interested?
- What level of control and risk is the council comfortable with?

It is important that municipal governments do not assume that the problem will be solved entirely for them by the provincial and federal governments, or the private sector. That means that although connectivity is not a core municipal service, all municipal governments ought to understand the role that they want to play – and to be realistic about how difficult it may be to maintain.

[3] Erin Britnell. AMO Conference. "Supporting Rural Broadband Development." August 2020.

Learn from Existing Models

Before any decisions are made, it is best to consult with experts and peer municipalities who have undertaken similar pathways and investigations into their roles. A few models that exist already, include but are not limited to:

- Blue Sky Net
- Eastern Ontario Regional Network (EORN)
- Southwestern Integrated Fibre Technology Network (SWIFT)
- Waterloo Region Education & Public Network (WREPNET)
- YorkNet

More information on each of these (and some international examples) can be found in Appendix C of the *Primer*. Municipal governments are encouraged to have leaders from these groups come in to provide information on their experience.

The key here is to know that municipal councils can be effective at whatever role they wish to play. And that knowing the capacity limitations and being honest about the financial commitment necessary to sustain a network are important. That is because whatever role is chosen will need to be sustained over the long-term.

NEXT STEPS: EVALUATE POSSIBLE MUNICIPAL ROLES

- Be honest about the level of digital capacity and resources available to municipal governments as the different options are evaluated.
- Learn from other municipalities who have grappled with this question and leverage their expertise wherever possible.
- Once the role has been established, recognize the importance of sustaining that role.

Component 4 Use and leverage potential tools municipal governments already have to manage connectivity needs

Municipal governments should employ the levers that they have to manage connectivity needs, regardless of what role they wish to play in connectivity. Below are some examples.

Broadband Levy

Municipal councils can approve the establishment of an annual broadband tax levy as the Town of Caledon has done.[2] In this case, the Town was able to use their levy to award Vianet to build 8.2km of fibre-optic trunk cable in the Industrial Park in Caledon and to build a 35km backbone along the Caledon Trailway.

The key is for the municipal council to determine what financial tools can be used to help incentivize private ISPs to the community.

Managing and Protecting Municipal Assets

A key means of reducing the cost of broadband deployments is for the municipal government to have 'dig once' policies that require the construction of fibre-optic conduit as part of any construction project. Proponents of these policies see this as a key part of an enabling framework to empower rural and remote communities to advance broadband connectivity at the local level.[3]

Another tool is to use municipal access agreements (MAA). It is the most widely used tool to grant consent and set the terms for individual carriers to access to the municipal rights-of-way and put in wireline connections.[4] There is also an antenna siting protocol that has been established to make sure that municipal rights are protected.[5]

For both MAA and antenna siting, the Federation of Canadian Municipalities (FCM) has established a committee on Rights-of-Way. ROMA encourages your municipal government to contact them directly for more details about these agreements.

[2] Town of Caledon. "Broadband in Caledon."

[3] Van Horne Institute. "House of Commons Standing Committee on Industry, Science and Technology – Broadband Connectivity in Rural Canada." Dr. Michael McNally. p. 12. Accessed September 2020.

[4] Federation of Canadian Municipalities. "Telecommunications and Rights-of-Way Handbook." 2018.

[5] FCM and CWTA. "Antenna System Siting Protocol Template." December 2014.

Explore How Existing Policies Can Be Simplified

The streamlining of existing processes is something that should be explored in tandem with creating these new policies. Some ISPs create coordinators to navigate through municipal laws and regulations, and there are no reasons why municipal governments could not create that connector role itself. A staff person could be delegated to work across departments to determine the various procedures that exist. A survey to telecommunication companies could also help to determine what issues are most problematic from a process standpoint. The results of the survey could become the basis for the degree of possible change.

NEXT STEPS: LEVERAGE EXISTING TOOLS

- Consider implementing broadband levy or other financial tools to invest.
- Explore the use of Municipal Access Agreements, bylaws, and permits to protect municipal assets.
- Identify a staff person responsible for collecting current procedures and processes across departments for the purpose of simplifying, where possible.
- Create rules that make new builds mandatory to lay conduit/fibre at the time of construction.

Component 5 Champion the need for connectivity in your community as council to a variety of stakeholders

No one knows the broadband needs of communities more than the students, families, businesses, and seniors themselves. It will be important for municipal governments to create a compelling narrative and use data to drive the business case for why building connectivity is important.

Important facts for the community to have ready include:

- Number of households and communities that are currently not served or are served, but not reliably
- Areas or neighbourhoods that are priorities to build new connectivity (e.g. low-income, social housing, etc.)
- What local universities, school boards, hospitals, long-term care homes, children's aid societies and police services are not connected
- What assets already exist that new connectivity could be attached to
- What partnerships the municipality has, or are in the works

Advocacy should be an ongoing process and depend on the business case created based on the preceding steps. It will be important to identify champions for connectivity that include municipal governments but also key leaders in the business, academic, and resident associations. These individuals will be invaluable to tell the community's story.

Tactics for advocacy depend on individual circumstances, but could include:

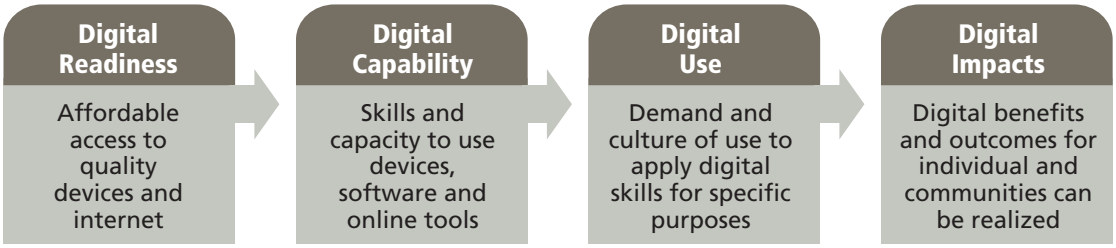
- Holding "solution town halls" where TSPs and ISPs come to present on how they would propose to fill these gaps (in whole or in part) and at what costs
- Meeting with Members of Parliament (MP) and Members of Provincial Parliament (MPPs)
- Sharing data collected from surveys conducted with residents and business needs

Building Digital Capacity

The advocacy piece is one part of a larger puzzle. That is, connectivity must be sustainable no matter the path chosen. Public funding will certainly help with capital costs, but operating costs and upgrade campaigns will need to be considered.

To that end, communities should be working to improve the digital literacy both within the municipality and across the community. One way to do this is to adopt a "digital readiness" strategy.[6] This will make sure that the skills and capacity necessary to use the devices, software and online tools will be possible once access to quality devices and the internet is available and adopted.

Figure 3: Digital Readiness Roadmap (Kelly, 2020)



Once the capability is created, digital use is important. That involves building the demand and culture of use to apply digital skills for specific purposes. Together the combination will allow for individual and communities to realize the digital benefits and outcomes that public funding has helped build.

NEXT STEPS: CHAMPION NEED FOR CONNECTIVITY

- Use local data to identify the gaps in connectivity and connect them to the lost opportunities for your communities.
- Identify local champions that can tell your story.
- Leverage the advocacy power of your associations (ROMA, AMO) and other organizations locally.
- Meet with federal Members of Parliament (MPs) to discuss matters related to funding and CRTC and ISED. Meet with Members of Provincial Parliament (MPPs) to advocate for community needs and resources.
- Work to build digital capacity and advocate for systems that enhance digital inclusion and are viable and sustainable for end users.

[6] Canadian Rural Revitalization Foundation. Ashleigh Weeden and Wayne Kelly. "Addressing the Digital Divide; COVID-19 and the Importance of Connecting Rural Canada." June 2020.

Component 6 Invest strategically in 'shovel-worthy' projects

Investments in telecommunications have been based largely on where the benefits and coverage are maximized. As the *Primer* suggests, advocating for more public sector funding is a long-term advocacy strategy. In the short-term, municipal governments should focus on identifying strategic and 'shovel-worthy' projects. These projects may not be 'shovel-ready' now but could be built into a business case with support from neighbouring municipalities.

The reality is that public funding will also track behind the technological advancements available, meaning that municipal councils should consider whether the investments made at the local level are being in done in a way that is scalable and future-proofed, wherever possible. Of course, these investments do not have to just be financial. Municipal governments could opt to dedicate staff resources to identify and build business cases in the first place.

NEXT STEPS: INVEST STRATEGICALLY IN 'SHOVEL WORTHY' PROJECTS

- Identify and invest in projects that are 'shovel-worthy' instead of 'shovel-ready' projects.
- Think strategically about building projects that are scalable and use future-proof technology, wherever possible.
- Advocate for MPs and MPPs to request the CRTC tie telecommunications companies to performance measurement targets.

Component 7 Partner, partner, partner

It is critical to partner with neighbouring municipal governments, local institutions, and public sector organizations to build a case for connectivity demand (i.e. economies of scale).

Relationship building with TSPs and ISPs in the community is also a useful exercise for municipal staff as they gather information about options for council to consider. Starting this step early is important as it will help when mapping and identifying the existing assets.

Creating a line of communication between area of TSPs, ISPs, and LDCs is important but should be at the appropriate time (i.e. when the business case and mapping is further along). Partnering with local companies is something to explore as they can likely provide connectivity closer to the home (i.e. PoP to the node), and better understand the terrain that is involved in bringing connectivity to that area. For example, fixed wireless ISPs often exist in communities on a much smaller scale than the larger incumbents.

Municipal governments are encouraged to reach out to existing municipal groups for advice on template Requests for Information, Requests for Proposals, etc.

NEXT STEPS: PARTNER, PARTNER, PARTNER

- Identify and gather information from neighbouring municipalities, local institutions and public sector organizations to leverage economies of scale.
- Build relationships with TSPs and ISPs in the community as the mapping and identification of existing assets is underway. That way, when the data is collected councils can move quickly to identifying service providers in the area.

Quick Tips to Get Started

For municipal councils who want to get involved, but who have limited resources to do so, here are three quick tips to get started:

QUICK TIP GUIDE

- Build leadership from the inside. Someone already embedded in the community with networks and relationships is a great start. Finding local champions in the community is key to connectivity.
- Increase institutional awareness by developing staff expertise within the municipality.
- Understand the many initiatives that your community can undertake to be infrastructure ready.

For More Information

ROMA encourages members with questions or suggestions on this *Municipal Roadmap* or the *Connectivity Primer* to contact ROMA at roma@roma.on.ca.

Appendix A: Glossary of Terms

5G: Fifth-generation of mobile technology. These technologies provide faster broadband speeds and greater data capacity because it uses high-frequency millimetre (mm) waves. 5G will provide significant bandwidth improvements over the current 4G, which is also known as long-term-evolution (LTE) technology. This technology allows for connectivity with multiple devices and drives automation and artificial intelligence in sectors such as agriculture and manufacturing.

700 MHz spectrum: With respect to telecommunications, it is a frequency range allocated to mobile use. The majority of it has been allocated to commercial carriers, but a specific section known as Band 14 has been allocated to the Public Safety Broadband Network in both Canada and the U.S.

Active Ethernet: Type of access service that provides fibre to the home through dedicated fibre between the home and the central office.

Alternative Service Provider (type of ISP): Is any entity that is not an incumbent TSP. For example, providers like Rogers, Shaw, Videotron, Distributel, and TekSavvy.

Analog or Analog Signal: A signal where the information is transmitted in a continuous wave form, as opposed to digital signal where the information is sampled.

Antenna: Are small cells and other infrastructure used to deliver LTE, 4G or 5G networks. It is an exterior-transmitting device – or group of devices – used to receive and/or to transmit radio-frequency (RF) signals, microwave signals, or other federally-licenced communications energy transmitted from, or to be received by, other antennas. The system includes the antenna and an equipment shelter. The placement of transmission antennas is subject to the approval of ISED Canada and the approval process is set out in the Antenna Siting Procedure.

Areas of Need: Refers to communities that are unserved or underserved (do not meet the CRTC's basic service objective of 50 Mbps download/10 Mbps upload).

Attachment Rates (Hydro Pole): Annual fees paid by telecommunications companies to attach equipment to hydro poles owned by utility companies. Ontario has the highest hydro pole attachment rates in Canada.

Backbone Infrastructure: Refers to infrastructure built to connect to technologies. Also known as major data routes that connects a telecommunications service provider's infrastructure using a point of presence as an access point. It is often fibre optic based but it can be comprised of a range of technologies including microwave and satellite service.

Backhaul Infrastructure: Portion of the network between the backbone and the access edge. In the mobile context it refers to the network between the tower and the backbone and may be either wireless or fibre.

Band 14: The 20 MHz of 700 MHz spectrum allocated to public safety.

Bandwidth: Maximum rate of data transfer across a given path. Bandwidth may be characterized as network, data or digital bandwidth and is expressed in bits per second. Example: 50Mbps/10Mbps and 25Mbps/5Mbps.

Bit: Basic unit of digital information used in communication.

Broadband: Refers to high-speed internet access that is always on and faster than traditional dial-up access. It is the ability to transmit information over a wide (broad) range of a larger variety of frequencies (band). It is made available through the use of several high-speed transmission technologies (e.g. Digital Subscriber Line, cable, fixed and mobile wireless, satellite, and fibre). It is a technique that enables many messages to be communicated simultaneously.

Byte: Unit of digital information or data consisting of eight bits.

Cable: Insulated wire, sets of wires, or fibre optic strands, used to carry telecommunications signals. Provides an internet connection through a cable modem and uses the same cables that transit cable TV services (e.g. coaxial cables). It may refer to a type of access technology protocol to access telecommunication provider services.

Cable-Based Carriers (type of ISP): Former cable monopolies that also provide telecommunications services (e.g. wireline voice, internet, data and private line, and wireless service). Examples include Rogers, Shaw, Videotron, and Quebecor.

Canadian Internet Registration Authority (CIRA): A non-profit organization responsible for administering the country code top-level domain (ccTLD). Any internet domain with an ".ca" is operated either by CIRA or one of their certified registrant partners. The role of CIRA is also to support small projects through grants, secure Domain Name System services and in partnership with private-sector cybersecurity services. CIRA has developed an advanced internet performance test for Canada, and in 2019, ISED included CIRA's performance test as part of their customer feedback.

Canadian Radio-television and Telecommunications Commission (CRTC): Federal agency that reports to the Minister of Canadian Heritage with a mandate to regulate and supervise broadcasting and telecommunication services to the best interest of Canadians. CRTC ensures that all policies objective established in the Broadcasting and Telecommunication Acts are achieved. The CRTC coordinates public hearings to understand market changes and reacts accordingly. Also, it sets the baseline of speed, wholesale price and decision concerning all telecommunications players.

Capacity: Ability of the network to provide a specific level of data service or a defined number of users.

Cellular Network: Used interchangeably with mobile to refer to a communication network where the last link to the user is wireless, and the user's receiver or handset may be portable.

Central Office: Location where historically the telephone switching equipment or exchange was located. It is now often the site of point-of-presence and fibre connections.

Cloud and Cloud-Based Services: Applications, services and other resources provided over the internet using equipment and software maintained offsite by third parties.

Coax: Coaxial cable, a type of insulated cable.

Co-Location: It refers to the location of a service provider's radios and equipment on another provider's tower.

Coverage: The geographic area where a wireless tower can provide service, or the area serviced by a wireline service.

Coverage gap: The geographic area where users are unable to access the internet due to limited infrastructure (synonymous with areas of need).

Dark Fibre: Unused fibre-optic cable. For example, this happens when companies install more cable than necessary to allow for growth.

Data Cap: Used to describe the practice by service providers of limiting the amount of data that a subscriber can transmit or receive on a monthly basis.

Dial-Up Internet: It cannot support broadband, because the signal is sent over a landline serviced by a public telephone network. A computer or other device shares the line as the telephone, so they cannot be active at the same time. The average download speed is 0.056 Mbps.

Digital Subscriber Line (DSL): Wireline transmission technology that transmits data faster over traditional copper telephone lines already installed to homes and businesses. Unlike dial-up, DSL is always "on" because it uses two lines. That means the phone is not tied up when the computer is connected. The download speed averages 1.5 Mbps – 15 Mbps.

Direct-to-Home (DTH): Refers to satellite service providers.

Download Speed/Throughput: Measure of the capacity of the user's broadband connection. Higher speeds are more desirable, as it allows the user to retrieve data more quickly.

Ethernet: Technology protocol commonly used to allow computers and devices to talk to each other on networks.

Fibre: It is the fastest type of broadband technology that exists today, at download speeds of between 1,000 and 10,000 Mbps. It converts electrical signals carrying data to light and sends the light through transparent glass called fibre-optic cables. The technology enables 5G connection speeds and can simultaneously deliver voice and video services.

Fibre-to-the-Home (FTTH): Refers to fibre optic communication delivery system where fibre extends from a concentrator, remote or central office to a residence.

Fibre-to-the-Premises (FTTP): Installation of optical fibre direct to individual buildings (e.g. single-family units, multi-unit residential, and businesses) to provide high-speed broadband access. FTTP dramatically increases connection speeds and reliability for broadband networks compared to legacy copper infrastructure.

Fixed Broadband: Home or business internet connections using technology where the consumer is located a fixed location. The receiving device is fixed in place. Technology includes fibre, DSL, fixed wireless and satellite.

Fixed Wireless: Uses point-to-point connection; typically used by one party. Any entity that provides its services over a wireless network (radio) that uses either licensed (owned by the major carriers) or unlicensed (shared) spectrum to provide communications services, where the service is intended to be used in a fixed location (e.g. modem). One example is Xplornet.

Frequency: Refers to the particular wave band at which a system broadcasts.

Geosynchronous: Refers to the orbit of a satellite that is positioned and remains over a specific area of the Earth.

Gigabit (GB): Currently the fastest upload and download speeds available, and is a measure of data size equal to a billion bytes or 1,000 megabytes. The speeds will make the Internet of Things possible, and allow for multiple internet users and simultaneously connected devices in a household.

High-Speed Transmission Technologies: Inclusive of DSL, cable, satellite (which are all legacy infrastructure), wireless, and fibre-optics.

Hybrid Fibre Coaxial: Refers to the cabling infrastructure used by cable companies to provide internet service.

Incumbent Telecommunications Service Provider (type of ISP): A company that provides local telecommunications services on a monopoly basis prior to the introduction of competition. Examples include Bell, TELUS, and SaskTel. They also include small incumbent TSPs as Sogetel and Execulink.

Independent Internet Service Provider: ISPs that are not cable-based carriers or incumbent TSPs. Examples include TekSavvy, Xplornet, Distributel, and Verizon.

Internet Service Providers (IPSs): Those that enable you to connect computers, tablets and other devices to the web. Many ISPs offer in-home equipment that allow you to access the internet. They also offer Wi-Fi equipment so you can connect to the Internet wirelessly on mobile devices such as smartphones and laptop computers anywhere in your home.

Innovation, Science and Economic Development (ISED): Federal government department with a broad portfolio and mandate of promoting and fostering knowledge-based innovation of the Canadian economy. The Connecting Canada Branch is responsible for managing public broadband.

Internet of Things: The network of physical devices, vehicles, buildings and other items that are embedded with electronics, software, sensors, actuators, and network connectivity to enable them to collect and exchange data.

Internet Protocol (IP): A set of rules governing the format of data sent over the internet or other networks.

Jitter: The variation in time between packets arriving at their destination, caused by network congestion, timing drift, or route changes.

Large incumbent TSPs: As defined by the CRTC, they serve relatively large geographical areas, including both rural and urban populations, and provide wireline voice, internet, data and private line, wireless, and other services. Examples include Bell, SaskTel and TELUS.

Last-Mile Infrastructure: Is the final leg of a telecommunications network that delivers internet access from the backbone to retail end users (customers), through familiar wired or wireless technologies, such as cable, DSL, fixed wireless or satellite. Without adequate last-mile infrastructure, end users are not able to take advantage of the backbone infrastructure that may already exist in a community.

Latency: Is the measure of the time of delay that occurs between when a digital file or signal is sent and when it is received at its destination. A low latency is required for high-quality real-time applications.

Lit Fibre: Fibre-optic cable that has been installed and activated.

Long-Term Evolution (LTE): Is a standard for wireless broadband communication for mobile devices and data terminals. It increases the capacity and speed using a different radio interface together with core network improvements.

Low-Earth Orbit (LEO) Satellite: An orbit that is relatively close to Earth's surface (e.g. between 500km and 2,000kms). The trip around the Earth is shorter because their orbit is closer, so the latency is lower than LEO satellites than for those further out. They have the potential to rival or possibly exceed the fastest ground-based networks (fibre). They also travel faster, completing a full circuit of the planet in 90 to 120 minutes. That means each individual satellite is only in direct contact with a ground transmitter for a brief period. That is why LEO projects involve so many satellites and require so many in operation to ensure connection does not drop (e.g. redundancy).

Middle Mile: Segment of a telecommunications network linking a network operator's core network to the point of presence.

Mobile: May refer to portable internet-capable devices, or to access to the internet via smartphones or other portable devices.

Mobile Broadband: Term used to describe the delivery of internet services from an antenna usually on a tower to a mobile location (e.g. mobile handset), where the service will continue to function uninterrupted as the user moves location.

Mobile/Cellular Network: Refers to a communication network where the last link to the user is wireless, and the user's receiver or handset may be portable.

Mobile Wireless: Uses cell towers; will be available to everyone in the vicinity of a tower. This leads to less bandwidth and higher (worse) latency. It was made for small bursts of internet usages (compared to fixed wireless). This device can transition to any part of the network. Examples include cellphones, table and mobile USB sticks.

Modem: A device that connects a personal or home network to the service provider's infrastructure.

Municipal Access Agreement (MAA): Reflects the terms under which a municipality gives consent to the individual carriers to access their right-of-way.

National Broadband Internet Service Availability Map: Comprehensive online map describing retail broadband internet services and wholesale backbone infrastructure in Canada. The data is derived from

the National Broadband Data and focuses on the internet service availability. The map shows: availability of internet services by technology and speed and availability of high capacity transport services in each community location in Canada. Capacity of transport services or rural road coverage layer can be viewed on a granular scape of this map. This layer is derived from the pseudo-household model and correlated with the Ontario Road Network data to illustrate the speeds of road segments.

Other Facilities-Based Carriers (type of ISP): Refers to providers of telecommunications services that are not incumbent providers, but which own and operate telecommunications networks. An example is Xplornet.

Packet: A sequence of bits arranged in a specific format, containing control data and possibly user data, that is transmitted and switched as a whole. Packets are separated and then regathered together to move information faster.

Packet Loss: The failure of a packet to travel through the network to its destination. Internet traffic is carried as Internet Protocol packets. Due to network congestion or impairments, some packets do not reach their destination intact. These are considered to be lost packets.

Point-of-Presence (POP): Refers to an access point to the core or backbone network.

Point-to-Point (P2P): Refers to a broadcast from one place or point to another single point (different from point-to-multipoint, P2MP, PTMP, PMP).

Public Safety Network: Telecommunications mobile network used by public safety workers such as police, fire, paramedics and public works.

Radiocommunications: Any transmission, emission or reception of signs, signals, writing, images, sounds or intelligence of any nature by means of electromagnetic waves of frequencies lower than 3,000 GHz propagated in spaces without artificial guide (i.e. physical things, such as wires or cables). It refers to the means of transmission as opposed to the content or nature of the transmission (e.g. broadcasting or telecommunications), which is why it is treated quite differently than the *Broadcasting Act* or *Telecommunications Act*.

Resellers: Companies that provide services using the network infrastructure of telecommunications common carriers. Resellers obtain access to such network infrastructure on a wholesale basis and use it, often combined with other services and facilities, to provide retail service to the public.

Rights-of-Way: The legal right, established by usage or grant, to pass along a specific route through grounds or property belonging to another.

Rural Communities: Defined by the CRTC as areas with a population of less than 1,000 or density of 400 or fewer people per square kilometre. The Institute for Competitiveness & Prosperity uses a different definition - any territory lying outside population centres. By that measure, an estimated 10.4% of Ontario's residents live in rural areas.

Satellite: Satellites are stationed far from Earth (e.g. 36,000 kms), and travel in so-called geostationary orbits, moving at the speed of Earth's rotation and appear to float motionless above a fixed point. The signal travels from Earth, providing a delayed connection compared to cable and DSL. The speed depends on a customer's line of sight to the orbiting satellite and the weather. Contrast that with LEOs who are not impacted by weather as much.

Service Providers: There are many different types of service providers for communications. They include: i) Incumbent TSPs, ii) Cable-based Carriers; iii) Television and Radio; iv) Other facilities-based service providers; and v) Wholesale-based and Non-facilities-based TSPs.

Small incumbent TSPs: Serve relatively small geographical areas. Due to the limited size of their serving areas, these companies do not typically provide facilities-based long distance services. However, they provide a range of wireline voice, internet, data and private line, and wireless service. An example is Execulink.

Spectrum: The radio frequencies used to transmit wireless signals. Also known as the airwaves along which wireless signals travel. More use of spectrum leads to increased congestion. As a result, the Minister of ISED is responsible for spectrum planning, the allocation of spectrum to specific uses or services, and the assignments of spectrum to specific users.

Symmetrical: Refers to a telecommunications signal that is transmitted in equal speeds in both the download and upload direction.

Telecommunications: Any emission, transmission, or reception of intelligence by any wire, cable, radio, optical, or other electromagnetic systems. Some examples include landline, internet communications, fibre optics, cables, etc. Basic telecommunications services are: i) fixed and mobile wireless broadband internet access services, and ii) fixed and mobile wireless voice services.

Telecommunications service provider (TSP): refers to any entity providing telecommunications services, such as telephone service, internet and mobile service, usually through their own infrastructure. Examples include Bell, Rogers, and Koodo.

Terrestrial Service: Used to describe internet service that is provided through ground-based infrastructure, as opposed to satellite.

Universal Service Objective: Defined in Telecom Regulatory Policy 2016-496, it is defined as the availability of a fixed broadband internet access service with at least 50 Mbps download, at least 10 Mbps, as well as the option for unlimited data allowance (i.e. 50/10/Unlimited).

Unserved/Underserved Communities: Refers to communities that do not have service that meets the CRTC's basic service objective of 50 Mbps download and 10 Mbps upload speeds. They are also referred to as areas of need.

Upload Speed/Throughput: Measure of how fast data can be transmitted from the residence or subscriber to the internet. Higher speeds allow for more pictures, music and documents to be uploaded and shared faster. Fast upload speeds are critical for video conference, cloud storage, and other popular productivity applications used by Canadians working and learning from home.

Urban Centres: The CRTC defines as small (1,000-29,999 population); medium (30,000-99,999); and large population centres (100,000+).

Wholesale-based service providers or non-facilities-based service carriers (type of ISPs): Refer to companies that generally acquire telecommunications services from other providers and either resell those services or create their own network from which to provide services to their customers. A company that owns a small number of facilities but has vast majority of its operations on leased facilities may also be classified as non-facilities-based. Examples include Distributel and TekSavvy.

WiFi: Refers to a facility that allows computers, smartphones, or other devices to connect to the internet or communicate with one another wirelessly (without wires) within a particular area. Hotspots are provided by telecommunication service providers (TSPs) to differentiate their services from each other and extend their brands. An unlicensed short-range method of connecting devices to a network wirelessly using radio links.

Wireless: Technology providing broadband service through a radio link to premise.

Wireless Internet Service Provider (WISP): Any entity providing fixed wireless services. The infrastructure used is a network that was invested in and built as their own last mile, not reselling someone else's network. There are over 250 WISPs in Canada, and one-third are in Ontario. They often have between 200 and 20,000 subscribers.

Wireline: Technology providing broadband service through a fibre or cable direct to a premise.

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