

# How it Works: Technology Backgrounder

This section will provide some clarity to the many technical terms used when discussing broadband and relate the relevance of these terms to decisions for planning in the community.

## Broadband

The term broadband commonly refers to internet access via a variety of high-speed wired and wireless networks, all of which are vastly faster than the earlier analog dial-up.

However, as highlighted earlier in this handbook, broadband does not always include access to the internet.

It is important to understand that over the past thirty years, broadband has become a fundamental and essential infrastructure. High-speed broadband internet for all communities, all businesses, all farms, and all residents is essential to the socioeconomic growth and well-being of our communities and of our province.

## Networks

The foundation of broadband is the network—the connection of computers and smart devices through the various wire, wireless or satellite medium. To understand two terms often used when referring to networks—backbone and last-mile—a water analogy may be helpful.

The big pipes, the main lines, or the backbone of the network are referred to as the **backbone**. The backbone has a high capacity and is almost exclusively fibre optic cable (more on this later). Backbone is the component of the network that connects the community to other communities and the world.

The component of the network that connects the individual households, the businesses, and the farms to each other and the backbone is referred to as the **last mile**. There are several last-mile connection mediums—wire, wireless, and satellite—each with pros and cons.

However, one of the biggest differentiators is the capacity or speed of each medium and it is important to understand these terms and the impact.

## How fast is fast?

A commonly asked question when it comes to the internet, is: How fast is fast? According to some experts, the answer is: It depends on what you need—now and in the future. Will my broadband internet serve my needs, my community's needs—tomorrow, five years from now, and beyond? If you have been living with minimal internet for some time, then any improvement is likely good. However, the reality is that it has likely constrained your business and way of life, and this pent-up demand will far outstrip any incremental improvements.

Canada has a high adoption rate for broadband internet in the world, but only at the current definition of broadband. According to the US Federal Communications Commission, “an internet service must deliver at least 25 Mbps download speed and at least 3 Mbps upload speed to qualify as broadband.” A low bar to be sure. In addition, the Canadian Radio-television and Telecommunications Commission (CRTC) has been criticized by countries in the Organization of Petroleum Exporting Countries for establishing a low minimum standard—50 Mbps as a target for 90 percent of Canadians to achieve by 2021 and all to achieve by 2030.

### Defining Speed

Internet speed is measured in Megabits per second (Mbps) and is the rate that data is transferred to your computer or smart phone. 1000 Mbps is 1 Gigabit per second (Gbps).

Bandwidth is how much data can be downloaded to your computer or phone.

To complicate these standards and objectives, the internet speed you think you might get may not be consistent or the **usable speed** that you do get. This may be further compounded by the actual network design of your service provider and possibly oversubscription of the network by a large number of customers. And the more people in your household or business using the internet at the same time, the lower the speed (going back to the water analogy, think flushing the toilet and showering).

Some internet providers cap or limit the amount of data you can receive over the internet. **Data caps** control the amount and rate of flow of data across an increasingly overloaded network. Data caps are not only restrictive but excessively expensive.

## But what is the current need for speed?

The demand for faster, higher bandwidth internet speeds is growing exponentially. According to the National Cable and Telecommunications Association (NCTA) graphic (Figure 1), Canada's standard of 50 Mbps was considered a top speed in the USA in 2009, over 10 years ago. Fibre-rich networks now provide 80 percent of America with 1 Gbps and these same networks are delivering 10 Gbps to many customers. Put another way, there has been a 12,400 percent increase in top available internet speeds in the last 10 years! And to give you an idea of how fast technologies change, remember that the iPhone was introduced in the USA in 2007 and Saskatchewan in 2010 – basically, just 10 years ago.

A typical family working from home, with a SMART TV and multiple screens are now at 300 Mbps, when it is available. That is six times the minimum 50 Mbps standard. Many farms, businesses and institutions need 20 times the standard 1 Gbps. Some larger operations with many users are moving to 10 Gbps—highlighting the digital divide between those that have access to these higher internet speeds and those that do not. It is especially discouraging and isolating for those that are not yet even at the 50 Mbps base minimum standard speed.

12,400% increase in internet speeds in the last 10 years

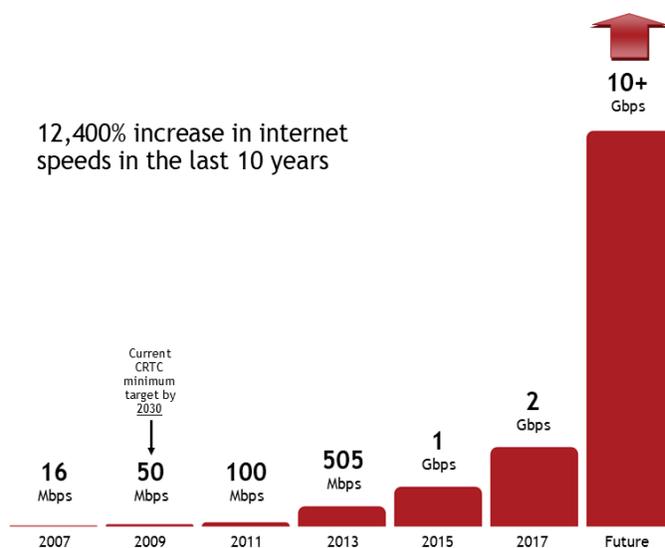


Figure 1: Planning for the Future

National Cable and Telecommunications Association

## Our future needs: Abundance or scarcity?

If we are successful in expanding our new world economy, the demand for faster internet will continue to grow. Soon, a 10 Gbps platform will become the new standard. Imagine an abundant 10 Gbps broadband technology that freely facilitates innovation, enables the wireless 5 Gbps future. Kids could be doing their homework via virtual reality, entrepreneurs could develop new different software products from anywhere in the province and most importantly unleash innovation to developing and creating new markets, new services, new products that until now we have either not considered or deemed impossible. Autonomous farming is now becoming a reality. And an array of rapidly emerging technologies—the internet of things and sensory technologies, to name but two.

We have been so conditioned to just get by or make do with what we have—scarcity thinking. But we need to think in abundance. If we shift our thinking to what is possible with an abundance of bandwidth rather than try to rationalize the current scarcity of bandwidth, we become open to new and exciting new possibilities. We build and grow, not constrain and make do.

# So how fast is fast?

It is all relative. It depends on whether we are looking in the past with constrained thinking where we make do with the bandwidth and internet access we have. Or are we looking to the future, where we innovate, we build, and we grow? We need to shift our thinking on bandwidth from scarcity to abundance.

## The Medium—Wired

There are three primary types of wire medium currently in use—DSL or copper, coaxial cable, and fibre optic cable.

### DSL or Copper

- DSL stands for Digital Subscriber Line.
- Speed: up to 100 Mbps per user with the latest technology; however, performance deteriorates depending on the distance between the end-user and the DSL Access.
- Developed by telecoms to leverage long-standing voice (telephone) copper investment.
- DSL, while in use across Saskatchewan, is considered obsolete and is being replaced by fibre to the premise (FTTP).

### Coaxial Cable

- Speed: up to 160 Mbps in the aggregate, can decline with concurrent users.
- Developed by cable companies to leverage long-standing video (television) cable investment.
- Primarily used in major centers or for local distribution of satellite in rural/remote communities.
- Like DSL, the cable is being replaced by fibre to the premise.

### Fibre Optic Cable (Fibre)

- Speeds: Limited only by the optical equipment at each end of the fibre. Residential, small businesses are using speeds of 100 Mbps to 1 Gbps (1000 Mbps) and larger commercial, institutions to 40 Gbps (40,000 Mbps). CANARIE, the national research network connecting Saskatchewan post-secondary and research institutions with others

across Canada and around the world, operates its backbone connections at 100 Gbps and is in the process of upgrading. In theory, fibre can transmit at speeds up to 27 Tbps or 27,000,000 Mbps.

- Fibre has enough carrying capacity to meet foreseeable future demands, and the transfer technology used in fibre networks is constantly improving and becoming more efficient, allowing for ongoing improvements.
- Fibre is more expensive initially, but much less expensive over the life of the fibre than any other option.
- Once capital costs (including conduit deployment) are paid, fibre is relatively cheap to maintain and upgrade.
- Fibre lasts quite a long time—several estimates suggest an operational lifespan of 40–50 years, with some estimates as high as 100 years. This depends on the quality of the fibre cable and the conditions it is installed in.
- Fibre supports other forms of wireless network—fixed and mobile wireless.
- Distance is not a barrier in fibre networks—the data transfers just as quickly over long distances.
- Fibre is a symmetric connection, which means that upload and download speeds are the same.
- Future-proof: As speeds of fibre connections are limited by the electronics attached to the end of the fibre optic cables, there is no need to upgrade the network infrastructure itself.

## The Medium—Wireless

There are three types of wireless medium currently in use: fixed wireless, mobile wireless, and satellite.

### Fixed Wireless

- Speed: up to 100 Mbps in the aggregate; however, this has to account for a download/upload split (e.g., 80 Mbps download, 20 Mbps upload), and this aggregate is further divided by several concurrent users (e.g., five concurrent users mean 16 Mbps download and 4 Mbps upload each).
- Typically slower than wired connections; however, in some cases, wireless can outperform DSL.
- Fixed Wireless Broadband is a system that transmits information via radio waves from towers to fixed points.
- For most spectrum bands, the receiver must be within the line of sight of the tower to connect.
- Towers connect to backbone infrastructure either through wireless microwave backhaul, which is more commonly used, or by wired connections (e.g., fibre), which are less common.
- Ideal for remote and sparsely populated areas.

### Mobile Wireless

- Connections are provided by licensed wireless spectrum from towers to mobile devices (e.g., smartphones or mobile broadband hubs).
- Range of standards for mobile wireless communication (e.g., High-Speed Packet Access—HSPA and Long-Term Evolution—LTE).
- Speed: 4G LTE advanced technologies can achieve speeds up to 100 Mbps.
- Requires licensed spectrum and a supporting ecosystem of devices (handsets/mobile distribution hubs).
- Mobile wireless also requires a fibre backbone network to connect the towers.
- The next generation of mobile wireless is

5G. It has extremely high capacity but exceedingly small coverage. It is unlikely that 5G will be relevant outside of major cities or potentially trade routes (TransCanada, Yellowhead).

- Data caps are typical with the corresponding service plans from providers.

### Satellite (ground-based dish)

- Available anywhere: A solution for remote locations or when other alternatives are not immediately feasible.
- Speeds: typically, 10 Mbps but up to 25 Mbps.
- High latency: the time it takes for the signal to go from your computer to the source computer and back. This service is not ideal for voice applications such as video conferencing because of high latency.
- Useful in disaster scenarios but can be vulnerable in bad weather.
- Expensive with prohibitive data caps and often involve long-term contracts.

### Satellite (Low earth orbit—LEO)

- High-tech, low-flying satellites, and lots of them could be the answer to current limitations with traditional satellite internet service.
- Currently under development by several companies: Starlink (Elon Musk), Transat, and others.
- Speeds: to be determined but expected to be faster than traditional satellite; in the range of 100-150 Mbps but much lower than fibre.
- Somewhat portable: you can take it with you, but clearly not as portable as mobile.
- Unmatched availability providing there is visibility to the sky.

## A comparison of capability

As illustrated by Figure 2 fibre optic cable provides the ability to handle significantly more bandwidth, more data at higher speeds than any of the other technologies. DSL and cable are being replaced by fibre and wireless, and satellite technologies have niche applications.

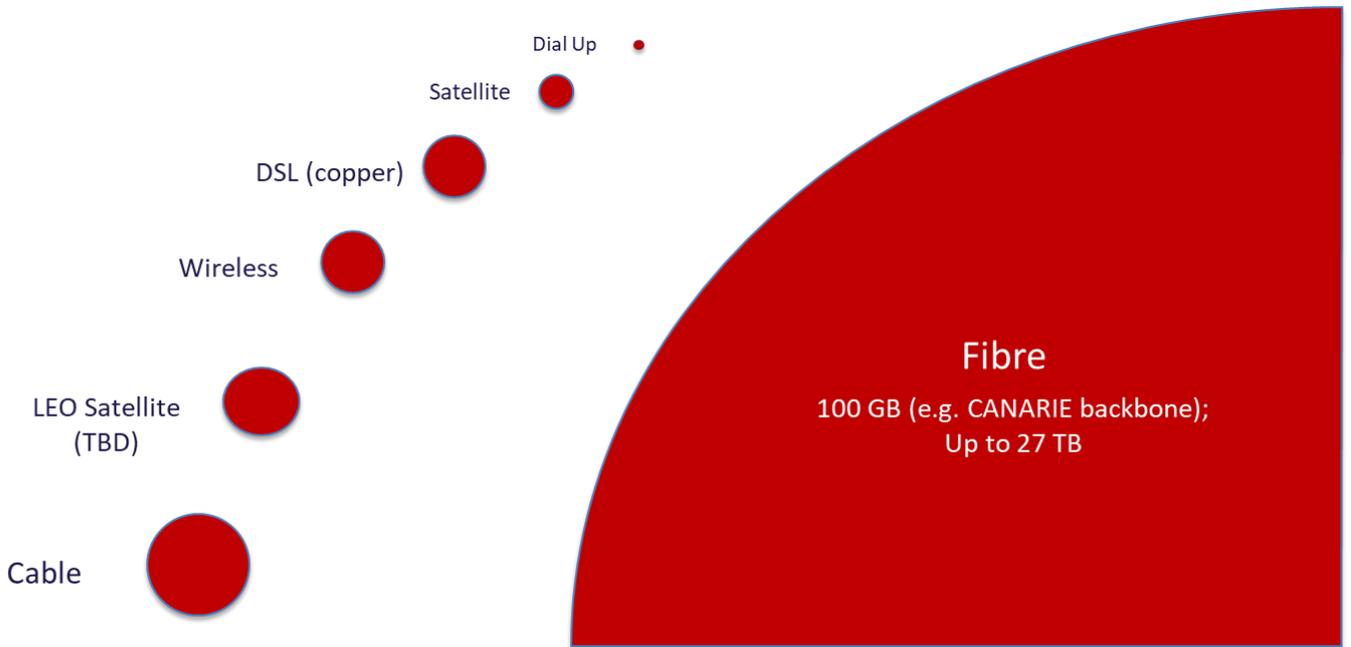


Figure 2 Comparison of speeds



# Glossary of Terms

**5G:** Fifth-generation of mobile technology, 5G will provide significant bandwidth improvements over the current 4G, which is also known as long term-evolution (LTE) technology.

**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 central office.

**Aerial Deployments** Deployment of cables using above ground utility poles.

**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.

**Anchor Tenant or Institution:** One or more key early customers on a network, often a business or government entity that provide a base revenue stream for the service provider. Anchor tenants are important to identify for network sustainability and business stability.

**Antenna:** 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 radiofrequency (RF) signals, microwave signals, or other federally licensed communications energy transmitted from, or to be received by, other antennas. Includes an antennae an equipment shed.

**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).

**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 made up of a range of technologies including microwave and satellite service.

**Backhaul or Transport:** A network connection that transports data traffic from one point-of-presence to another or from a point-of-presence to a location that contains the internet gateway. An example would be a fibre connection that transports data between a small town to another location where it is offloaded to the internet.

**Bandwidth:** Bandwidth refers to how fast data flows through the path that it travels to your computer; it's usually measured in kilobits, megabits or gigabits per second.

**Bit:** Basic unit of digital information used in communication.

**Broadband (or High-speed internet):** A high-capacity internet connection that enables quick and reliable online services.

**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).

**Cable Modem:** Refers to a type of broadband connection that brings information to homes and businesses over ordinary television cable lines.

**Canadian Internet Registration Authority (CIRA):** A non-profit organization responsible for administering the country code top-level domain (ccTLD). Any .ca internet domain 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.

**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.

# Glossary of Terms

**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.

**Coaxial or Coax:** Copper cable used by cable and telephone companies. Coaxial cable is sometimes used by telephone companies from their central office to the telephone poles near users. It is widely installed for use in Ethernet and other types of local area networks.

**Co-Location:** An agreement between telecommunication service providers to share their facilities or infrastructure.

**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).

**CRTC or Canadian Radio-Television and Telecommunications Commission:** An independent public authority in charge of regulating and supervising Canadian telecommunications.

**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.

**Demarcation Point:** A point that separates the customer premise equipment and network from the service provider's network infrastructure equipment.

**Dependencies:** Also known as order of build, this is where separate projects depend on the completion of other projects to proceed and become operational.

**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:** Data traffic travelling from the internet to the end user.

**Downstream speed:** Refers to the speed at which data flows from the information server to your computer.

**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:** Refers to the fibre optic medium and the technology associated with the transmission of information as light impulses along a glass, plastic wire or fibre. Fibre can carry much more information than copper wire and is less subject to electromagnetic interference. It can also send data over longer distances than copper wire.

**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.

# Glossary of Terms

**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, satellite.

**Fixed Wireless:** Refers to a type of broadband connection where information is sent between computers through transmission towers by way of high frequency radio signals. Technology typically does not support roaming or mobility of the user connection.

**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):** It is a measure of data size equal to a billion bytes or 1,000 megabytes. It is quickly becoming a standard offering speed by many ISPs.

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

**High-Speed Internet:** Also referred to as broadband. A high-capacity internet connection that enables quick and reliable online services.

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

**Internet Gateway:** A network connection that provides access to the internet for the service provider's network or last-mile distribution system.

**Internet of Things (IoT):** The inter-networking of physical devices, vehicles (referred to as connected devices and smart devices), buildings, and other items embedded with electronics, software, sensors, and network connectivity which enable these objects to collect and exchange data via the internet.

**Internet Service Providers (ISPs):** 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 and computers in your home.

**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.

**Kbps:** Stands for Kilobits per second, or thousands of bits per second. For example, most analog modems transmit at 56 Kbps or 28.8 Kbps.

**LAN or Local Area Network:** A data network intended to serve an area of only a few square kilometers or less.

**Last Mile or Last-Mile Infrastructure:** The final leg in connecting homes, businesses and other institutions to a high-speed network connection (Point-of-Presence). This may include routers, towers, antennae, fibre optical, cable, Digital Subscriber Line (DSL) equipment, cable modems etc.

**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.

**Locale:** Can refer to a neighbourhood, community, subdivision, town site, reserve or village in a rural or remote area.

**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 500 and 2,000 kilometres). 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.

**Mbps:** Stands for Megabits per second, or millions of bits per second. This is a measurement of how much data can be transmitted through a connection. For example, 6 Mbps is approximately 200 times faster than a 28.8 Kbps analog modem.

# Glossary of Terms

**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, where the service will continue to function uninterrupted as the user moves location.

**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, tablets, and mobile USB sticks.

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

## **National Broadband internet Service**

**Availability Map:** Online map describing retail broadband internet services and wholesale backbone infrastructure in Canada.

**Network:** A computer network is a data communications system that interconnects computer systems at different sites. A network may be composed of any combination of local area networks (LANs), metropolitan area networks (MANs) or wide area networks (WANs).

**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):** A facility where internet service providers house servers, routers, switches, and other communications equipment. A POP is where an internet service provider's last-mile infrastructure connects to an internet gateway or extends to another point-of-presence that has an internet gateway.

**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.

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

**Router:** A router is a device that communicates between the internet and the devices in your home that connect to the internet. As its name implies, it "routes" traffic between the devices and the internet.

**Satellite:** Satellites are stationed far from Earth (e.g., 36,000 kilometres), and travel in geostationary orbits, moving at the speed of Earth's rotation. 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.

# Glossary of Terms

**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.

**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.

**SWOT:** SWOT analysis is a strategic planning technique used to help a community or organization identify strengths, weaknesses, opportunities, and threats related to business competition or project planning.

**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.

**Terabyte (TB):** 1,024 gigabytes (GB), while a petabyte consists of 1,024 TB.

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

**Universal Service Objective:** Defined in CRTC 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.

**Wholesale-Based Service Providers or Non-Facilities-Based Service Carriers:** Companies that generally acquire telecommunications services from other providers and either resell those services or create their own network from which to sell services.

**Wi-Fi:** 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.

**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.

