FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

Roadmap to connectivity:

A guide to connecting your community to affordable, high-speed Internet

Contents

The production of this guide was made in partnership with Telesat.

24 Clarence Street
Ottawa, Ontario
K1N 5P3

613-241-5221

Introduction

This guide is intended to provide a simplified roadmap for communities across Canada to be able to reach their connectivity goals and ensure access to high-quality, reliable, and affordable broadband for their communities. It is targeted toward communities that have so far been unserved or underserved in terms of broadband network availability; as well as those who find it more challenging to affordably connect their communities. The recommendations below are of special importance to Indigenous, northern, rural and remote communities across Canada.

The process to connect a community is broken down step-by-step, and in turn helps Canadian municipalities come together to bridge the digital divide. In Canada, the digital divide represents a major gap in access to connectivity, with only 41% of rural households and about 25% of Indigenous communities in Canada having access to high-quality, reliable broadband Internet service.[1]

Communities and governments must act as fast and efficiently as possible to provide communities with access to broadband. Reliable Internet is crucial to support essential, everyday services including digital healthcare, government services, remote work, online education, and many others. Following the consequences of COVID-19 and the shift of many essential services and daily activities online, universal connectivity has never been more important.

This guide will provide the basis for any community or municipality to leverage available resources to get connected. Specifically, this guide will focus on assessing the community's needs, the available technology options, the potential funding methods, and the implementation of the overall solution.

1 CRTC Communications Monitoring Report 2019

1. Assessing community needs

The first step in connecting your community is assessing your community's connectivity needs, more specifically, its total demand requirements.

Total demand requirements:

In order to plan for and deploy a broadband solution, a community must know the total demand required for use. Although the exact demand for each community will be different, a good method to estimate the required demand is to use the Government of Canada's 50/10 Mbps standard, which allocates a minimum of 2.4 Mbps per household. The demand for a community can then be calculated by multiplying the 2.4 Mbps minimum requirement by the number of underserved households in a community.

Household demand = 2.4 Mbps x underserved households

A community may already know the number of underserved households or have their own method for determining this metric; however, for those without this information one source to use would be themay wish to consult the National Broadband Data and associated National Broadband Availability Map provided by the Government of Canada.[2] Furthermore, each community should consider the demand required to serve other types of non-residential buildings to deliver a holistic solution. The table below provides a benchmark estimate of how much demand is needed for each type of establishment. It is important to note that the actual demand required for each type of establishment may vary.

Establishment type	Demand estimate per establishment
Households	2.4 Mbps
Schools	4.8 Mbps
Small businesses	6 Mbps
Government building	7.2 Mbps
Rural health centres	10–25 Mbps

2 If you believe your community's state of broadband to be inaccurately represented in the National Broadband Availability Map, please contact the Government of Canada at get-connected@canada.ca.

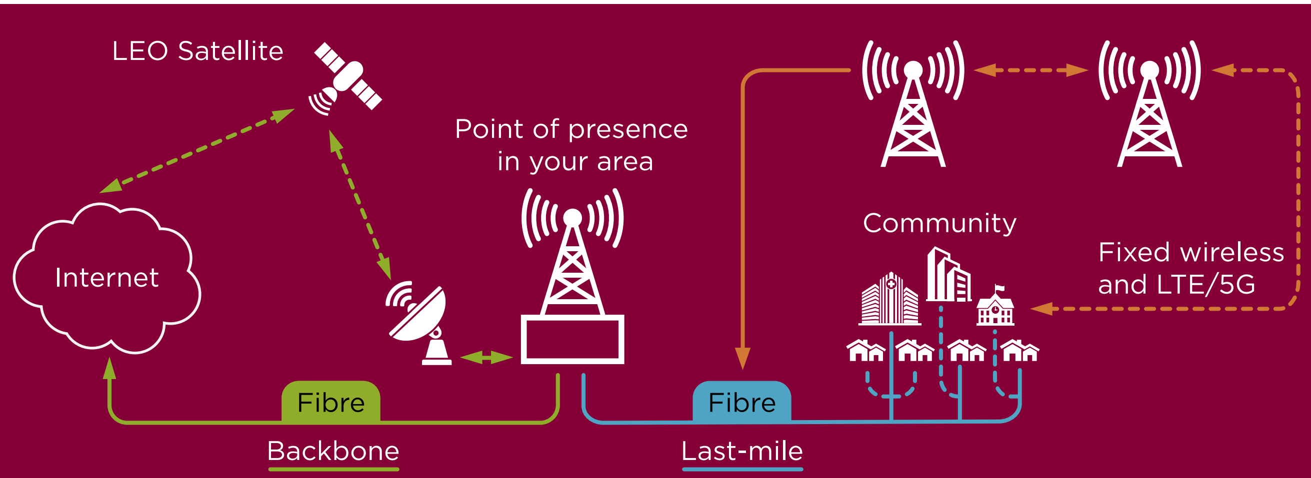
2. Assessing technology options

Once the estimated needs of the community are identified, it becomes much simpler and more efficient to compare the available technology options to best meet the community's needs.

It is worth examining whether or not there is currently broadband service and infrastructure available in the community. You can find information on Internet Service Providers (ISPs) currently operating in or near your community using the National Broadband Data and associated map. If there are no ISPs operating in your area, it will be worthwhile to look around the map to identify the nearest broadband infrastructure. There may be an opportunity to reduce costs by extending the broadband infrastructure from the nearest community, assuming there is sufficient capacity on the existing infrastructure to support the additional demand. This can help in choosing the most suitable and affordable technology for a broadband network.

It is important to note that there are numerous broadband technologies that can be implemented either individually, or combined into a hybrid network, to provide the most suitable broadband solution to meet the community's needs.

Different broadband technologies are more suitable in certain situations and for different purposes. It is important to distinguish between the technologies used for the backhaul or "backbone" network and the technologies used for the access or "last-mile" network. The backhaul network represents the main "Internet pipe" and broadband supply brought into a community, while the access network represents the smaller ramification networks that distribute connectivity from the backhaul link to the end users in the community (i.e. households, businesses, institutions, etc.).



There are a number of existing technologies that can provide Internet services, including (but not limited to):

Fixed wireless: uses either licensed or unlicensed spectrum to provide communications services (voice and/or data) where the service is intended to be used in a fixed location

Pros: easy to connect multiple homes in sparsely populated regions

Cons: can be costly to construct towers, requires direct line-of-sight to customers, issues with terrain and blockage

Fibre: uses glass threads or plastic fibres to transmit data using pulses of light

Pros: high speed, high capacity, long useful life

Cons: expensive to build and maintain, challenging to connect sparsely populated regions, expensive to have redundancy

Geostationary (GEO) satellites: uses an antenna to receive a signal from a space-based satellite located ~36,000 km away from earth

Pros: easy and rapid deployment, ideal for medium to low density areas, available in most regions

Cons: high latency, medium to low throughput, expensive

Low-Earth Orbit (LEO) satellites: next-generation satellites, using innovative technology to support fibre-quality, low-latency and high-speed broadband connectivity.

Pros: economical to connect communities that are medium to low density or are far from the core network, easy to deploy, eliminates challenges related to line-of-sight, terrain and foliage, high throughput and low-latency links

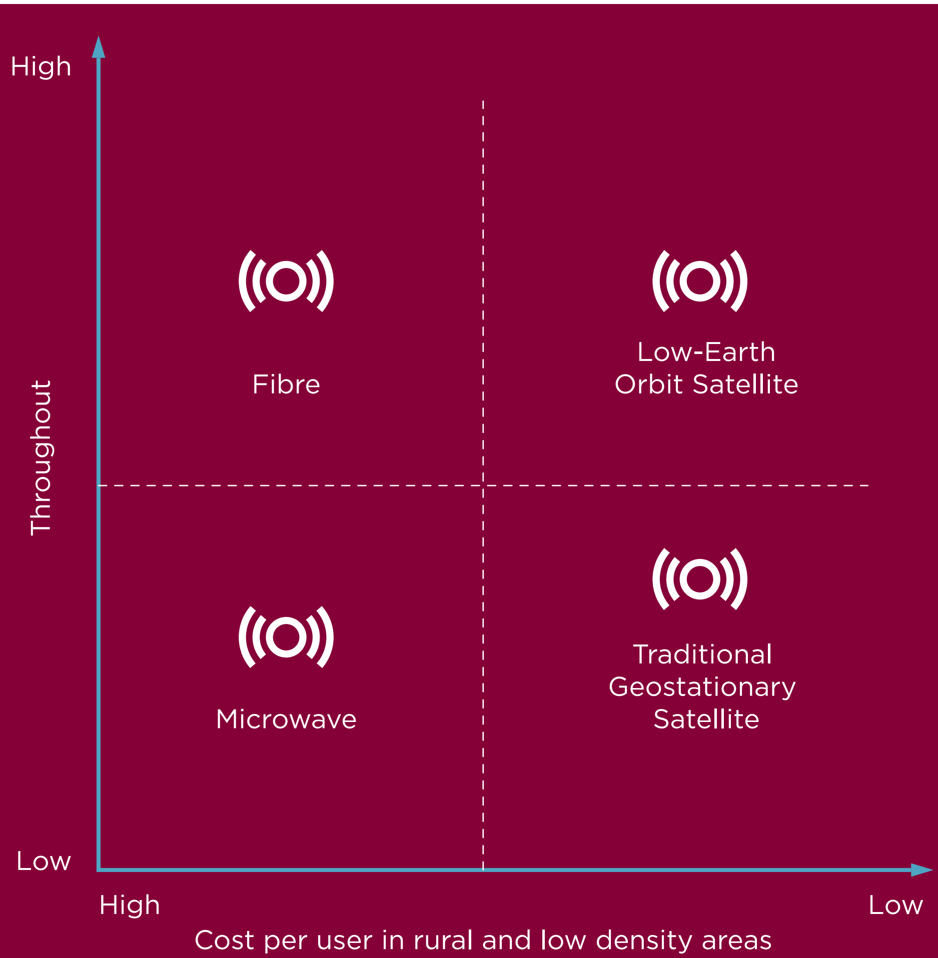
Cons: not applicable for areas close to existing terrestrial infrastructure

Full end-to-end networks can be created using the above technologies, however they can also be combined to create hybrid networks. In the case of hybrid networks, the backhaul network would typically use fibre, Fixed Wireless (FW), or LEO satellites to deliver broadband to a community. Last-mile networks will then typically use FW or fibre to deliver Internet connectivity to end users, generated from the community's main backhaul link.

The optimal broadband technology or combination of technologies for every community will depend on several factors, including cost, timeline of deployment, population density, existing infrastructure availability, technical feasibility, complexity, etc.

For example, due to the high cost of deployment, fibre is a viable option in high density communities and those very close to existing infrastructure; however, as the distance increases or population density decreases, satellite and wireless technologies have distinct advantages.

Every community will have different uses and priorities and must weigh these factors in selecting the best technology to meet their needs.



Furthermore, the following table compares the available technology options for a medium-low density community, far away from existing terrestrial infrastructure. The values in the table will vary for different deployments, however some of the most important factors to consider are the total cost of ownership (TCO), time to deploy, throughput capabilities and latency of each technology option.

	Fixed wireless	Fibre	GEO satellite	LEO satellite
TCO	Medium	High	Medium	Low
Time to deploy	Medium to High	High	Low	Low
Throughput	Medium to High	High	Medium	High
Latency[3]	Low to Medium	Low	High	Low

The above example provides a general comparison of rural broadband technologies for one type of community, however more detailed analysis is required to provide a realistic estimate of deployment costs and network capabilities. Below are some key costs to consider for each technology option. Each may have additional costs associated with it:

Fibre: surveying, fibre design, construction of wireline from core, fibre termination equipment, maintenance and operations, customer equipment installation, etc.

Fixed wireless: equipment and spectrum fees, tower construction, land rental, operations and maintenance on towers, etc.

LEO/GEO satellites: terminal cost, recurring bandwidth cost, maintenance, etc.

3 Latency refers to the time delay over a communications link; low latency is important to ensure a high quality of service for consumers.

3. Planning

After reviewing all the technology options available as well as their characteristics, it becomes easier to identify the right technology to pursue and start building a concrete plan to connect your community.

This step will cover funding options as well as possible business models to plan for the implementation of your broadband strategy.

Funding

To ensure the right broadband deployment is selected, it is important to consider all viable options to fund the broadband project. Often local communities and municipalities might have limited budgets and tight timelines to address their connectivity needs. Furthermore, without government support it can be very challenging for operators or ISPs to close the business case in rural and remote communities. That is why it is fundamental to get informed about the various sources of financing made available by all branches of government, including federal, provincial, and municipal governments, as well as non-governmental organizations and broadband associations.

On a federal level, various government departments offer funding programs for broadband deployment projects. Since 2019, the Government of Canada has made broadband one of its top priorities and committed to getting 98% of Canadians connected by 2026 to high-speed Internet (50/10 Mbps) and all Canadians by 2030 (as highlighted in High-Speed Access for All: Canada's Connectivity Strategy) through leveraging funding from all levels of government, Indigenous and private sector partners.

For example, the Universal Broadband Fund (UBF) is a large-scale program lead by Innovation, Science and Economic Development Canada (ISED), targeting universal broadband coverage. It includes $1.75 billion in funding to support high-speed Internet projects across Canada, particularly in rural and remote communities, with an additional $1 billion committed to the fund in Budget 2021. The funding is available to support connecting Canadians via several streams:

$750M available to fund large, high-impact projects	Up to **$50M** available for mobile projects that primarily benefit Indigenous peoples	Up to **$150M** through a Rapid Response Stream for projects to be completed by November 2021

The fund accepted applications until March 15, 2021 and future intake processes may be announced in the future similarly to previous programs.

The UBF is not only part of the national connectivity strategy but also consistent with the government's roadmap for supporting strong and resilient rural communities.

As part of this program, the Government of Canada committed to securing advanced LEO satellite capacity to help bring reliable, high-speed Internet access to even the most challenging rural and remote homes and communities in Canada, through a $600M capacity commitment with Telesat. This satellite capacity will be used in satellite dependent communities and those without access to high-speed Internet in rural and remote areas. ISPs can apply to receive this capacity at a reduced price under certain criteria, and applications to support LEO connectivity can be made through the Universal Broadband Fund. The Government of Ontario also has a similar partnership in place with Telesat to bridge the province's digital divide and enable 5G connectivity to communities across the entire province.

In addition to ISED, the Canada Infrastructure Bank (CIB) can also be a key partner in broadband projects to offer low-cost loans. For large-scale, high-impact projects, the CIB can also provide capital through senior debt, subordinated debt, or equity investments. These investments can be made alongside contributions from ISED (and potentially provincial programs), as well as private capital from ISPs and private investors to connect hundreds of thousands of households across Canada.

It is important to note that provincial governments, municipalities, local governments, broadband associations, ISPs and other private partners can also be viable sources of capital and/or debt funding. This is why it is worth considering all partnership options with one or various players to ensure the success and affordability of any broadband project.

If you are unsure where to start, the Government of Canada provides a pathfinder service that can help you identify the most suitable program for your needs, by phone (1-800-328-6189) or by email (get-connected@canada.ca).

Business models

In addition to funding, a community might consider a business partner to help start the project and support in its deployment. The process of choosing a partner or partners in any broadband project can take many forms, however, as mentioned above, it is ultimately key to explore all available partnership options. This might include an incumbent, an ISP, or even forming a community ISP to bring the project to life.

This section covers at a high-level some of the different business models that should be considered in the planning of a broadband infrastructure project. It is important to note there may be more business models than those listed below, and there are a number of ways these business models can function.

Operator only model: Large existing operator or ISP builds the full end-to-end network (access and backhaul) and provides service directly to consumers. This model requires low investment and support from the community and offers a high quality of service associated with the incumbent operator. However, it may be challenging to entice an operator to make the large investment required to build a full network. It is also very costly and logistically challenging to serve individual users in a low-density setting.

Established ISP model: Partnership between an existing ISP and a backhaul provider to jointly build a network, where the ISP is responsible for the access network and the backhaul provider is responsible for the backhaul network. This model allows the ISP to use its expertise in all areas of deploying, running and maintaining an internet service in a rural community, which can be challenging for any single operator. This model also decreases the investment needed from each party, which reduces risk on investment and allows ISPs to more easily expand to new rural communities. The major downside of this model is it is not applicable to many communities that do not have an ISP currently operating in the region, or one that is willing to expand to the region.

Community ISP model: In the case where there are no existing ISPs in the region (or willing to expand to the region), the community can form an ISP and operate the access portion of the network. This model offers many of the same benefits as the Established ISP model, but also provides the community with much greater control over the broadband service in their community; this control will allow the community to customize services offered to its residents. The Community ISP model does require much more involvement from the community; it requires direct investment from the community to design, build, and operate the network. Aside from funding, it can also be challenging to find personnel with the necessary technical expertise to design and operate the network, especially in rural and remote communities.

4. Implementation and operation

With the choice of broadband technologies, funding method(s), business partner(s) and model(s) finalized, comes the time to initiate the implementation of the project. Despite planning being a crucial step in the realization of any broadband project, the implementation, operation and maintenance of the project are just as important.

Plans and resources need to be made available to monitor the project and track its way to success. On this final note, this section provides two case studies: an example of a completed, grassroots fibre broadband project in Southwestern Ontario and a second case study targeting rural communities in different Canadian provinces that highlights the benefits of LEO satellite backhaul paired with terrestrial last-mile networks.

Case Study: SWIFT's fibre solution in southwestern Ontario

Southwestern Integrated Fibre Technology (SWIFT) is a non profit, municipally-led broadband expansion project created to improve internet connectivity in underserved communities and rural areas across Southwestern Ontario. SWIFT was initiated by the Western Ontario Wardens' Caucus (WOWC) and is delivered in partnership with member municipalities, the Government of Ontario, and the Government of Canada.

Focused on enabling greater digital equality between rural and urban populations, SWIFT subsidizes the construction of open-access high-speed networks to encourage service providers to expand broadband infrastructure in underserved rural areas.

SWIFT was approved for funding under the New Building Canada Fund–Small Communities Fund (NBCF-SCF), a joint federal and provincial infrastructure funding program established in 2014. It leverages additional funding from municipal partners and private sector investors to support the development of broadband infrastructure in eligible areas across southwestern Ontario.

Specifically, the project leveraged $63.7 million in federal funding, $63.7 million in provincial funding, $63.7 million from private sector Service Providers, and $17.6 million in municipal funding, for a total project investment of $209 million to bring service to more than 50,000 underserved households and businesses and install over 3,095 km of fibre throughout the region by 2024.

The SWIFT case study highlights how organized, cooperative projects can potentially bring high-speed connectivity to suburban and exurban communities via fibre where there is sufficient population density to offset the costs.

Case study: C-Spire Rural Broadband Consortium's LEO backhaul solution for rural communities

The C-Spire Rural Broadband Consortium (CRBC) was created as a partnership between six tech companies (C-Spire, Microsoft, Siklu, Airspan, Nokia and Telesat) to research ways to affordably bring high-speed internet to rural communities across North America.

In Canada, despite the clear benefits of bridging the digital divide, significant economic and technological challenges remain. Many rural communities in Canada have limited or no options for broadband service, which stems from a range of issues including:

- Distance from existing fibre infrastructure
- Geography or topography of the region
- Low population density
- Challenging return on investment for service providers

For that reason, when it comes to connecting more rural and remote communities, the Governments of Canada and Ontario focused on addressing one of the key root causes to poor connectivity to rural communities: affordable backhaul connectivity. Specifically, both governments partnered with Canadian global satellite operator Telesat to provide affordable high-speed LEO backhaul via Telesat Lightspeed to nascent and established ISPs in rural communities in Canada. The goal of these partnerships is to deliver affordable high-speed Internet and LTE/5G connectivity to all Canadians.

One case study, the C-Spire-led consortium explored the optimal way to connect two western-based Canadian rural communities and underlined the benefits of LEO backhaul networks. Both rural communities were characterized by low to very low population densities, low number of households (less than 200 households), and far distance from existing fibre infrastructure.

When taking into consideration the total cost of ownership, the network configuration featuring LEO satellite backhaul and fixed wireless (FW) access was found considerably (up to 80%) more affordable than any other network configuration. By eliminating large infrastructure investments and only requiring an affordable LEO satellite terminal, the backhaul connectivity cost for communities is minimized both in terms of capital and operating expenses.

Conclusion

As underlined in this guide, there are four key steps to follow in ensuring access to broadband and mobile connectivity within a community:

1. **Assessing community needs**
2. **Assessing technology options**
3. **Planning**
4. **Implementation and operation**

As such, identifying your community's needs starts with estimating the total broadband demand required in your community. It is then best to consider various broadband technology options by comparing their pros and cons, including TCO, time to deploy, ease of deployment, and quality of the service provided. From here, it is important to take into account all possible funding sources and business models that could bring the project to life. Lastly, communities should follow up on the implementation closely to ensure a timely and successful deployment of broadband connectivity.

With this structured approach, broadband projects become more affordable, tangible, and efficient, ultimately bringing communities' one step closer to reliable, high-quality broadband connectivity. Although there is a lot of detailed technical analysis required for any broadband project, this guide provides a high-level overview of the steps required to deploy a broadband project.