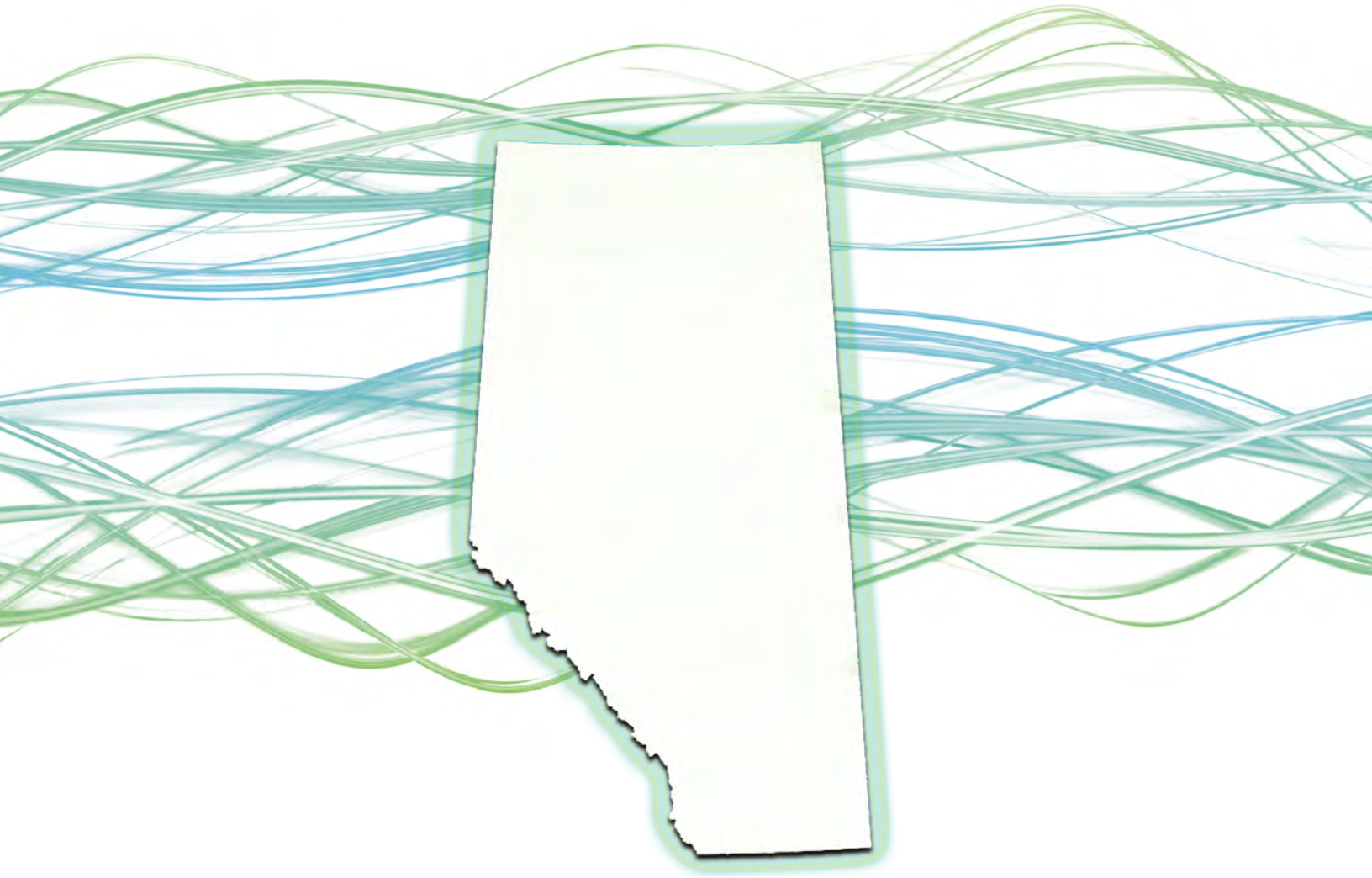

Understanding Community Broadband: The Alberta Broadband Toolkit

CONTENTS

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Vision

Vibrant, thriving, enjoyable – these words describe where we all want to live and what we desire our communities to be. But realizing this objective requires many elements, among them a clear, achievable vision.

Infrastructure is a key enabler of vibrant and thriving communities. While we now take for granted that infrastructure like safe roads and clean drinking water are a necessity, one new infrastructure is becoming increasing central to life in the 21st century – digital broadband networks. Broadband provides essential connectivity for individuals and organizations to use for a variety of purposes.

Whether your community lacks broadband or seeks to improve existing connectivity, a broadband solution is necessary. This toolkit aims to provide information to start and further discussions on how to achieve such a solution. A viable broadband solution consists of many necessary elements – from appropriate technology to an effective business model – but perhaps the most important one is developing a vision that can be supported by diverse members of the community. This toolkit provides information and planning tools to help community leaders and broadband champions build a broadband vision with their communities and improve connectivity across the province.

Introduction – About the Toolkit

The toolkit has been designed for use by Alberta communities to assist in developing broadband solutions. The toolkit is organized into three general sections - learning about broadband, thinking about broadband and planning broadband. Together these sections aim to identify the key knowledge and actionable steps that a community and its leaders can use to develop and achieve local broadband solutions. The toolkit also contains case examples of broadband solutions from communities across the province.

We realize that no two communities in Alberta are the same. Factors such as population size, geography, demographics and more reflect the diversity of urban and rural Alberta. In this regard, the toolkit does not offer a "one size fits all" approach. Instead, it identifies the range of options available, and aims to empower community leaders to identify the technologies, policies, issues and steps necessary to achieve a broadband solution that best fits local needs and desires. Realizing the importance of learning from others, the toolkit also highlights several solutions that communities around the province have already implemented in their own broadband development journey. We invite you to share your community broadband success story with the **Digital Communities Broadband Portal** [see URL 1 in URL References] by emailing: **digicom@ualberta.ca**.

LEARNING ABOUT BROADBAND

What is Broadband?

Broadband is often used as a synonym for the Internet; however, the two are not the same. A more accurate, inclusive description of broadband is connectivity. That is because connectivity transmits all kinds of data beyond web pages or streaming videos on the Internet. Whether it is used for doing homework online at home, having a business meeting using video conferencing or remotely managing farm sensors from across the field or across the globe, broadband connectivity increasingly impacts more aspects of our lives.

One use of broadband that does not involve the Internet is digital municipal services. A municipal broadband infrastructure can be used to connect traffic cameras or facilitate communication between government facilities without routing data through the broader Internet. This allows local governments more control over how municipal data is captured, stored, measured and reported. At the outset it is important to keep in mind such differences between broadband and the Internet. Some critics may suggest that the time, cost and effort of installing community broadband infrastructure is not worth it if it only results in more people watching Netflix or playing faster online games. However, broadband connectivity goes much further than entertainment uses, and for this reason, the toolkit addresses the full range of uses and benefits.

Sometimes broadband connectivity is defined by various speeds measured in Megabits per second (Mbps) (e.g. 5 Mbps, 25 Mbps), but it is better understood as an always-on, high capacity data transmission connection that facilitates a range of uses and services of which the Internet is just one element. Furthermore, broadband involves both upload and download speeds. In this regard broadband can either be symmetrical – the maximum speed for upload and download is equal, or asymmetrical – the maximum speed is different

for upload and download (usually with higher download speeds). For example one could have symmetrical 100 Mbps connection that provides the same upload and download speed, or an asymmetrical connection offering 100 Mbps download speed with only 20 Mbps upload speed. Symmetrical speeds are important because they ensure users can send and receive information at equal speeds, which is important for applications such as videoconferencing or uploading files. Asymmetrical connections that prioritize download speed can make it more difficult for users to share information since they are designed to support consumption. High upload speed capacity may be particularly important for business uses of broadband.

Sometimes broadband connections are contrasted as a choice between wireless or wired technology; however, this is not the case. Ultimately wireless connections rely on wired infrastructure – a Wi-Fi signal in your home and a tower providing wireless access to a whole community both require a connection to a wired point-of-presence (POP). We use the phrase 'fibre to the antenna' to capture this point.

Even if your community already has access to broadband, this toolkit may prove useful for fostering a conversation about what next steps can be taken to improve existing connectivity. As discussed below, due to ongoing innovation and increasing usage, the demand for greater broadband capacity is consistently rising. Now is the time to start a discussion within your community about how to address future needs in ways that best meet locally-determined development goals.

At a national level, Canada was once a world leader in terms of broadband. In fact we were the first country to connect all our public schools and libraries to the Internet. However, over the past 15 years many other countries have outperformed us. In 2003 the Organisation for Economic Cooperation and Development (OECD) found that Canada ranked second in terms of broadband subscriptions per 100 inhabitants based in 2001 data, but by 2014 we had fallen to 12th. According to the Canadian Radio-television and Telecommunications Commission (CRTC), roughly 16 percent of Albertans still lack broadband subscriptions, and rural Canadians are at a particular disadvantage when it comes to having access to higher speed connections (10 Mbps or greater).

Key Resources for Broadband Statistics

Federal

Canadian Radio-television and Telecommunications Commission (CRTC): Communications Monitoring Report (2016)

Cybera: State of Alberta Digital Infrastructure Report Networking in Alberta

International

Organisation for Economic Cooperation and Development (OECD): Broadband Portal

International Telecommunications Union (ITU): The State of Broadband 2015

According to the United Nations' International Telecommunications Union (ITU), broadband is crucial for countries to stay competitive in a global economy. Broadband also expands the ability of governments to offer citizen services and can improve quality of life for individuals. The following section expands on the numerous benefits that broadband can provide for communities in different domains of life.

Broadband Benefits

In the same way that electricity and roads were key drivers of community development in the 20th century, broadband is the new infrastructure paradigm shaping the growth and sustainability of communities, households and businesses in the 21st century. Broadband connectivity is crucial at three levels: it is essential communication infrastructure, it is an enabling technology that can be used in all sectors, and it is critical as the economy and society transform from the industrial era to the information age.

Broadband is not only a catalyst, but also increasingly essential for economic and social development to sustain thriving communities. The benefits of broadband extend across all aspects of life, from improving economic competitiveness to enabling enhanced opportunities for learning, health delivery and overall improvements in quality of life.

Economic Growth

Broadband has the capacity to drive, enable and/or sustain economic growth in a number of ways, including:

- Communities with broadband infrastructure may find it easier to attract investment and information technology intensive jobs, particularly in the midst of increasing global competition.
- Broadband is especially appealing to attract information and communications technology (ICT) and digital media industries since they are prone to utilizing small businesses, independent contractors, and remote workforces.
- Within OECD countries, research conducted by telecom firm Ericsson in 2013 shows that gaining 4 Mbps of broadband increases household income by $2,100 USD per year. Upgrading broadband from 0.5 Mbps to 4 Mbps increased income by approximately $322 USD per month.
- Broadband improves productivity by promoting the adoption of more efficient business practices (e.g. marketing and inventory optimization).

Business

Broadband helps businesses in a range of ways, such as:

- Automates and streamlines business operations and transactions, reducing procurement, warehousing, labour and administrative costs.
- Enhances management and operational efficiency by improving internal and external communication among stakeholders.
- Increases revenue streams by providing opportunities to expand into new global markets.
- Increases customer satisfaction and loyalty by improving customer services and identifying valuable customer insights.
- Provides opportunities for use of cloud computing.
- Connectivity is increasingly important for business travellers whether insurance agents, sales representatives or long haul truck drivers updating log books.

Agriculture

Benefits of broadband for the agricultural sector are numerous, including:

- Increases communication and business opportunities in agricultural communities.
- Helps to eliminate the distance between producers and commodity markets, allowing producers to obtain real-time information on prices.
- Fields and equipment can be monitored remotely using connected devices and applications.
- Precision agriculture technology enables agriculturalists to collect data on weather variability, crop yields, soil moisture levels, plant health, insect damage, and weed competition per acre of land.
- When an issue arises, text messages, e-mails, or other electronic alerts can be generated, removing the need for regular on-site inspections.
- Enables the collection and transmission of a wealth of real-time data that farmers/ agriculturalists can use to make better management decisions.

Government

Government can benefit from broadband in range of ways, such as:

- Encourages interaction between residents, businesses, and the municipal government.
- Increases the efficiency of municipal operations and management, improving decision-making.
- Enhances government performance at various levels and locations, improving coordination across local, provincial, and federal levels.

Health

Delivery of health services can be greatly improved though broadband, including:

- Creates a more efficient and potentially cost-effective way to deliver health care.
- Improves speed and access to health information, including the transmission of high-quality images and videos (e.g. X-ray images and CAT scans).
- Remote consultations allow rural residents to consult with medical professionals from distant medical centres, avoiding the expense and inconvenience of hospital visits.

Education

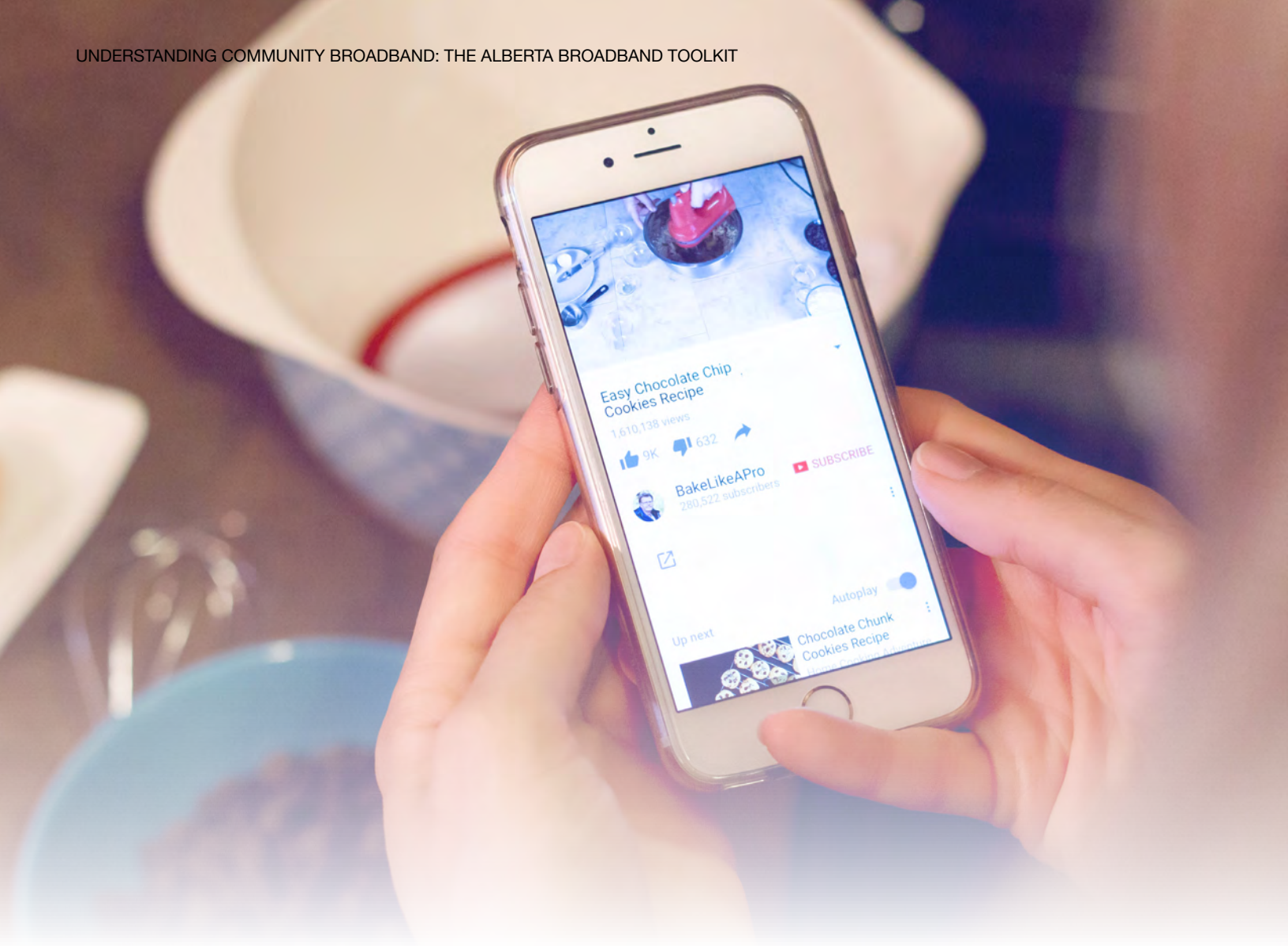
From primary school to college or university, education benefits of broadband are numerous, including:

- Offers increased flexibility and access to learning.
- Removes time and location constraints on learning and studying.
- Reduces the cost of producing, updating, and distributing course materials.
- Facilitates collaboration and interactivity among students.

Public Safety

Benefits to public safety stemming from broadband include:

- Provides the public with new ways of seeking help and accessing emergency information.
- Enables public safety personnel to prevent or respond swiftly to emergencies.
- Allows first responders anywhere in the country to send and receive critical data (audio, image, and video) to save lives and prevent acts of crime.
- Well-structured and protected broadband options could reduce threats to e-commerce and online applications.



Transport

Broadband helps improve the efficiency and management of transportation services, including:

- Modernizes transportation systems, allows more efficient route planning, and reduces greenhouse gas emissions.
- Through access to online scheduling and real-time transit information, broadband can make public transit more attractive.
- Improves transport management via more detailed and more frequent traffic information. This is useful for trip planning and congestion avoidance. For example, shifting from still images to videos and from hourly reports to second by second updates.

Teleworking

Teleworking benefits of broadband include:

- Improves the ability of employees and entrepreneurs to connect remotely using videoconferencing and transferring large files. This has the potential to increase teleworking and reduce travel time and associated expenses.
- Reduced traffic congestion helps to eradicate the environmental impacts associated

with travel. For example, in the U.S., it is estimated that every additional teleworker reduces annual CO2 emissions by up to 3.6 metric tonnes per year.
- Offers employment opportunities and improved access to services at home for people with disabilities.

Entertainment

Enhanced broadband offers many benefits for personal entertainment, such as:

- Greatly improves the quality of online audio and video.
- Considerably reduces the time required for downloading music or movies on the Internet.
- Facilitates a range of new media and entertainment services such digital movies and multi-player interactive video games.
- Substantially reduces movie distribution costs by replacing costly traditional methods of sending celluloid film prints across nations to transmitting digital copies.

Tourism

Broadband helps to promote and support tourism services to consumers. The benefits include:

- Information is key to supporting tourism. Within a fiercely competitive global tourism environment, accurate and timely information relevant to consumers' needs is often crucial to satisfying tourist demand.
- Broadband options help to attract and retain tourists in rural areas. Customers expect high-speed Internet even while camping.
- Faster and more reliable broadband services allow businesses to operate consistently and efficiently, delivering a world–class visitor experience.

Beyond Short Term Thinking

Moving forward on a broadband solution requires long-term thinking. This can be particularly challenging if a community already has some sort of broadband infrastructure in place. Along with understanding growing demands for broadband capacity, vision and community engagement are also key factors. See the section on Community Engagement for more information in this regard.

Considering Future Use and Demand

When considering a broadband solution for your community it is important to think beyond current uses and consider future use and demand. Over the last two decades demand for broadband capacity has grown steadily as more devices and uses have become available - from the need to send email and visit simple web pages to demands for multiparty video-conferencing and high definition streaming video.

It is already evident that in the near- to middle-term there will be substantial demands for much greater broadband capacity at household, government service and business usage levels. Cisco, a leading global information services company, estimates that global Internet protocol traffic will triple over the next five years, the number of devices connected to the Internet in Canada will almost double by 2018, and global streaming video in 2020 will be the equivalent of 86 billion DVDs annually. In developing a broadband solution for your community it is crucial to have capacity that is scalable enough to meet whatever future uses may emerge.

One key trend driving future demand is the emergence of the Internet of Things (IoT). The IoT describes an environment where individuals connect to the Internet through computers and smartphones, while billions of networked 'smart' devices are simultaneously exchanging information. Some of these devices are already available, such as smart thermostats that can be managed remotely. Many more connected devices are coming online in all sectors including home and household use, health and medical devices, building infrastructure, agricultural equipment and municipal infrastructure. Having the broadband capacity to ensure that households, businesses and farmers can take full advantage of the IoT is important, and the IoT also offers municipal governments new ways to manage public infrastructure that can lower costs and improve services and safety. For example the U.S. White House estimates that with LED bulbs and smart lighting systems linked by broadband, communities can save as much as 70 percent on outdoor lighting costs.

"All Canadians will need the capability to transmit gigabits per second of data and process terabytes of information. While this scenario will not be the case tomorrow, we maintain that this is the future our communications infrastructure must be prepared to handle. New infrastructure builds must anticipate and accommodate future needs."

- Alyssa Moore, Policy and Strategy Analyst, Cybera, appearance at CRTC hearings into broadband, April 27, 2016

Communities are at different stages of broadband development. Your community may already have one or more Internet service providers and you may be trying to assess how broadband connectivity can be improved, or you may be starting with little in the way of existing service providers and infrastructure. The following section outlines various broadband technologies that you can consider when planning a broadband solution for your community.

Olds: Economic Benefits

The Town of Olds, home to Canada's first community owned Fibre-to-the-Premises network, has demonstrated proven benefits for the local community and economy since the $6 million dark fibre network started in 2011. As an initiative of the Olds Institute for Community and Regional Development (OICRD), the fibre network was the answer to their question from a 2004 workshop with city leaders, business people and senior government ministers "what do we need to do to make our community sustainable, vibrant, and what is in the future for us to gain a competitive edge?" and reflects the Institute's philosophy that economic development should be driven by the community. O-NET, the ISP, created by the community to light and bring services onto the dark fibre, offers internet, telephony and video TV services as well as free Wi-Fi access in the Olds Hospital and Care Centre and throughout the community with over 80 hotspots. This network granted Olds College the distinction of the first gigabyte campus in the nation, and enables the use of cutting edge connected technologies to support teaching and learning. In addition to uptake by major public institutions, the network and O-NET has enabled the retention of major employers such as Olds Soft Gels (previously Banner Pharma Corps), the attraction of new engineering firms and professionals, companies including Mistras Canada and Mountain View Credit Union. Not only does the network save citizens money, but services not available from incumbents. Telephone cost savings for local small businesses are approximately $300,000 per year.

The Internet of Things


GEO-FENCING
Virtual Barrier that uses tags. When livestock or equipement moves past the barrier it sends an alert.
WATER SENSORS
Monitors the quality of the main drinking supply. Alerts to any irregularities in water levels.
SMART STREETLIGHTS
Weather and light adaptive street lights.
EPARKING
Customers can pay with a mobile device using their license plate number.
SMART HIGHWAY SIGNS
Traffic signs that monitor traffic and weather conditions and keep motorists appraised of changes.
TRAFFIC MONITORING
Traffic lights use traffic information to determine switching frequency.
SMART FARMING
Sensors monitor moisture, heat and pests and send notifications.

Technology Background

With regards to broadband technologies, there are two important connections that a community must consider as part of an overall broadband solution. Firstly your community must have a connection to the broader Internet infrastructure (backhaul), and specifically an interconnection with an Internet Exchange (IX) or with another third-party network through a transit, peering or interconnection agreement. This backhaul connection provides the link between your community and the rest of the world.

Secondly your community will also need a means of connecting the individual households and businesses within the community – also known as the last or final mile. This connection serves to link buildings inside your community with one another and with the backhaul infrastructure that connects to the broader Internet. It is important to note the point at which these two connections meet is normally known as a Point of Presence (POP). For some communities in Alberta the SuperNet provides "Meet Me Facilities (MMF)" instead of POPs, and there are some technical differences between MMFs and POPs. For further information contact Service Alberta.

Connecting Your Community to the Rest of the World

In Alberta there are two Internet Exchanges or IXs - one in Calgary (YYCIX) and one in Edmonton (YEGIX). Your community must have either some means of connecting to one of these two exchanges or an agreement to connect with a third-party transit network. For many communities across the province, there may be a SuperNet connection in place that provides a community connection to YYCIX through intermediaries. In addition, incumbent telecommunications service providers (TSPs), namely Shaw, Bell and Telus, may be able to lease their infrastructure to a third-party ISP (Internet Service Provider) to make an interconnection in Calgary or Edmonton. Since much of the Internet traffic routes through YYCIX, getting to an Internet Exchange in Alberta is sometimes referred to as "Getting to Calgary."

Connecting Inside a Community (Households, Businesses, Community Anchor Institutions)

In addition to connecting to an Internet Exchange (IX), communities also need to determine how to connect households and businesses to the community POP, which then connects, or backhauls, to the larger IX.

Connections come in two major categories - wired (e.g. copper, coaxial cable and fibre) and wireless (fixed wireless, mobile wireless and satellite). Each of these different connection types has various advantages and disadvantages, which are outlined below.

Fixed Wireless

- Also called Fixed Wireless Access (FWA).
- 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 number of concurrent users (e.g. 5 concurrent users means 16 Mbps download and 4 Mbps upload each).
- Typically not as fast as wired connections; however, in some cases wireless can out-perform DSL.

- Fixed Wireless Broadband is a system that transmits information via radio waves from towers to fixed points.
- For most spectrum bands, receiver must be within line-of-sight of the tower to connect.
- Towers connect to backhaul 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.

DSL

- DSL stands for Digital Subscriber Line.
- Speed: up to 100 Mbps per user with latest technology; however, performance deteriorates depending on the distance between the end user and the DSL Access Multiplexer (usually a telephone exchange centre).

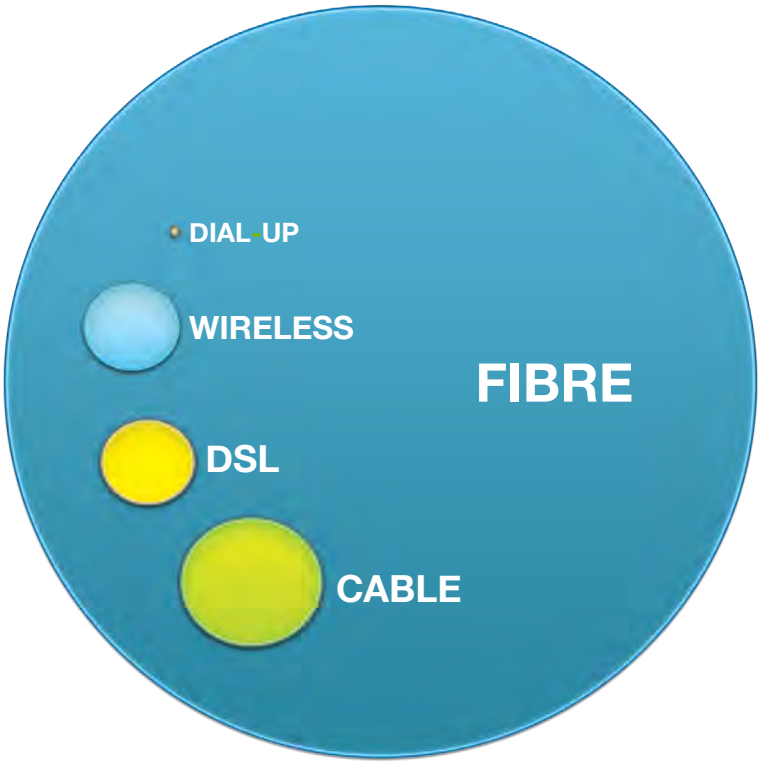
- Developed by phone companies to replace dial-up; unlike dial-up phone lines can be used for both Internet and voice calls at the same time.
- While both DSL and dial-up use copper phone line technology, note that dial-up is capable of only very limited speeds (56 Kbps) and as such is considered a "narrow-band" rather than broadband technology.

Coaxial Cable

- Speed: up to160 Mbps in the aggregate, can decline with concurrent users.
- Based on Data Over Cable Service Interface Specification (DOCSIS).
- Modem separates the Internet signals from the television signals.
- Faster than DSL.
- Speeds can suffer from high numbers of concurrent users at peak times.

Connection Type Comparison

Type	User Types	How it Works	Advantages	Disadvantages
Fixed Wireless	Transmission by tower to fixed points, using wireless spectrum	Costs include tower deployment and maintenance and radio antenna infrastructure	Less intrusive to deploy; doesn't require wired connections with each home/ business	Requires line of sight to receiver; can face capacity constraints with multiple users
DSL	Transmission over copper telephone lines	Requires access to copper telephone lines	Uses existing and ubiquitous infrastructure	Slowest of the wired broadband connection types; performance declines with distance
Coaxial Cable	Transmission over coaxial cable	Requires access to coaxial cable lines	Fastest of legacy wired connection types (copper and coaxial cable)	Performance declines with congestion from multiple users
Fibre	Transmission over fibre optic cables	Costs include fibre deployment (trenched or aerial); potentially electronics at ends of fibre cables	Fastest of all connection types; allows symmetrical connections (same upload and download speed)	Expensive to deploy at first (compared to fixed wireless towers)



Internet Speed Comparison Chart

Adapted from the New York State Broadband Strategy Toolkit

Fibre

Sometimes also called fibre-to-the-home/business/premises (FTTH/B/P).

- Speeds: Generally 1 Gbps (1000 Mbps), though some communities in the U.S. are now deploying 10 Gbps networks. Corning, an optical fibre manufacturer notes that current fibre can transmit data up to speeds of 10 Terabits per second (Tbps) (10,000 Gbps or 10,000,000 Mbps).
- Signals travel through fibre optic cable.
- Allows symmetrical (equal) upload and download speeds, but most implementations tend to be asymmetrical.
- Future-proof – speeds of fibre connections are limited by the electronics attached to the end of the fibre optic cables, not by the network infrastructure itself.

Mobile Wireless

- Connections 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. HSPA (High Speed Packet Access) and LTE (Long Term Evolution)).
- Speed: LTE advanced technologies can achieve speeds up to 225 Mbps
- Requires licensed spectrum and a supporting ecosystem of devices (handsets/mobile distribution hubs).

Local Last-mile Technology(ies)

While there are six different broadband connection types (DSL, cable, fibre, fixed wireless, mobile wireless, and satellite) a number of factors limit the degree to which communities can develop, implement or rely on these technologies.

In regards to DSL and coaxial cable, both of these solutions require specific types of wired infrastructure (copper or coaxial cable). While this infrastructure may be present in your community, these networks tend to be privately owned and operated by incumbent telecommunication companies. With respect to broadband, both copper and coaxial

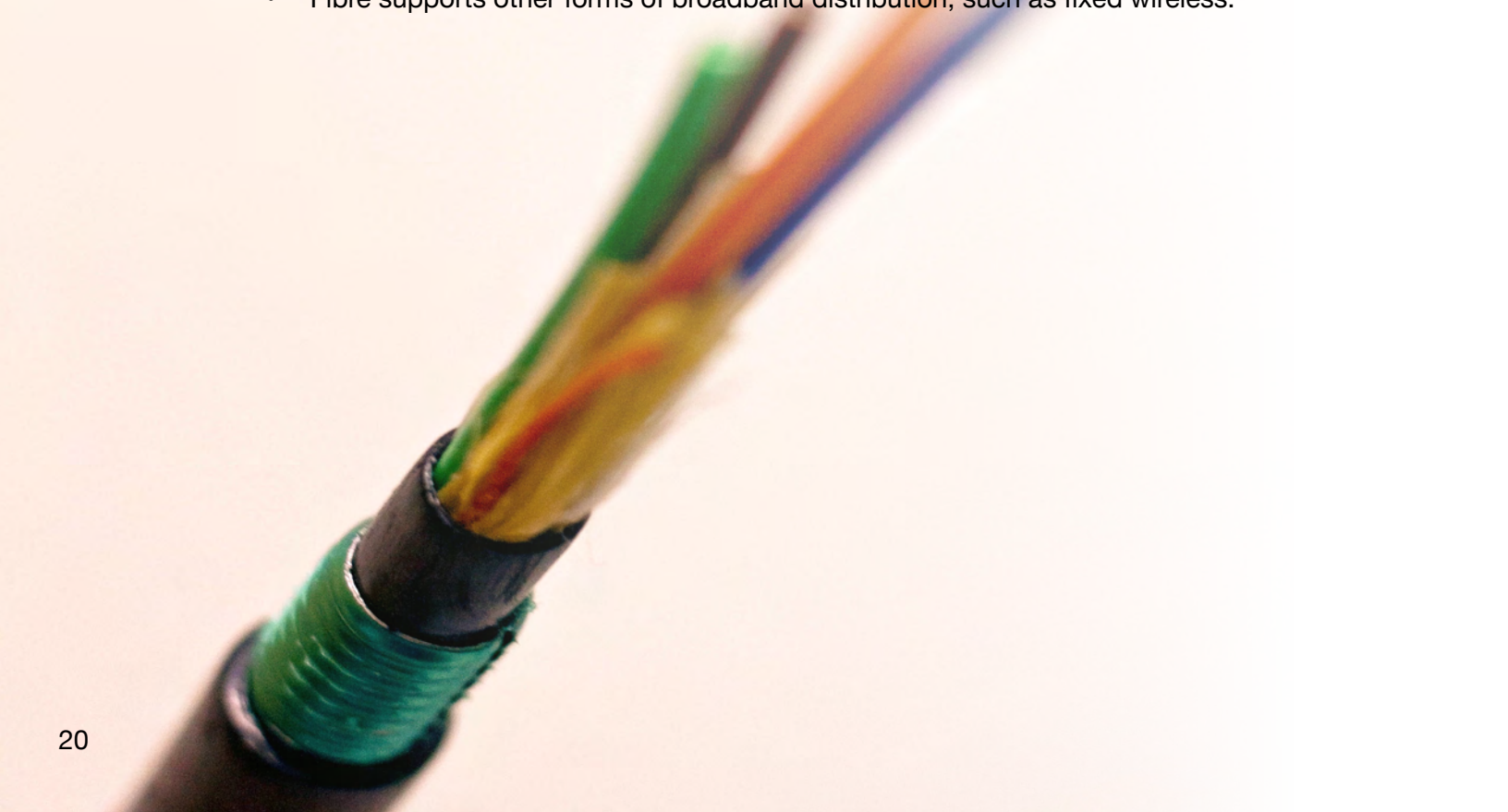
cable are considered legacy infrastructures in comparison to fibre. For communities considering wired broadband solutions, fibre is the best option for long-term planning and scalability.

At some point you may wonder why a community should not develop a solution focused on mobile (cellular) wireless. Mobile wireless has many advantages; however, at this point in time, it is not a practical solution for most community initiatives. This is for many reasons. Mobile wireless broadband - the type used by smartphones - requires the acquisition and use of specific radiospectrum frequencies (also known as 'licensed spectrum') that are governed by the federal government, as well as handset infrastructure and transmission towers. Prices for equipment and spectrum licenses are out of the reach of most local governments and small telecommunications service providers.

Satellite can be a feasible means of connecting geographically isolated communities that lack a connection to adequate terrestrial broadband networks. However, satellite also suffers from the greatest number of limitations as a connection type. In addition it also requires access to expensive satellite capacity (space segment) and earth stations.

Given the limitations of DSL, coaxial cable, mobile wireless and satellite, communities working towards a broadband solution can consider fibre and fixed wireless as options. Of these two technologies, fibre has some advantages, which are outlined below.

- 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.
- Once capital costs (including conduit deployment) are paid, fibre is relatively cheap to install, maintain and upgrade.
- Fibre lasts quite a long time – several estimates suggest and operational lifespan of 40-50 years, with some estimates as high as 100 years.
- Fibre supports other forms of broadband distribution, such as fixed 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.

Initially a full scale fibre deployment within a community will be more expensive than a fixed wireless solution. Furthermore, these two technologies are not mutually exclusive – it is possible to use fibre to support a local fixed wireless network. The Best Practices section discusses how a community can adopt a fixed wireless to fibre plan.

In addition to different technical elements, the policy and regulatory environment for wired and wireless options is varied. The following section provides a brief overview of the policy and regulatory environment governing broadband in Canada.

Policy and Regulatory Background

In Canada one federal department and one federal agency hold primary responsibility for telecommunications – Innovation, Science and Economic Development Canada (ISED) (formerly Industry Canada) and the Canadian Radio-television and Telecommunications Commission (CRTC).

ISED is the federal department directly responsible for telecommunications. It administers federally funded broadband programs, including Broadband Canada (2009-2012); Connecting Canadians (2014-2017); and the new $500 million Connecting Communities program. ISED also regulates much of the wireless sector and administers radio-spectrum licenses.

The CRTC is Canada's arm's length telecommunications regulator. It has regulatory authority over most of Canada's telecommunication ecosystem and acts as a quasi-judicial independent body.

Canadian Radio-television and Telecommunications Commission (CRTC)

While the CRTC's regulatory authority is extensive and a complete discussion of the role of the CRTC with respect to broadband is beyond the scope of this toolkit, communities should be made aware of two CRTC initiatives. The first is changes to the way wholesale access is regulated in Canada. While the CRTC does not directly regulate rates in the retail Internet sector, it does practice wholesale rate regulation. As part of recent changes to its wholesale Internet regulation [see URL 2 in URL References], the Commission decided to phase in tariffed access to some wholesale infrastructure including fibre-to-the-home connections. This decision will slowly be phased in across the country, beginning in Ontario and Quebec. Interested parties can contact the CRTC directly for further information. A short summary of the decision is available from the Van Horne Institute [see URL 3].

The second important development at the CRTC is the upcoming decision as part of the Commission's review of basic telecommunication services. The CRTC conducts reviews of basic telecommunication services approximately every five years. The most recent review

started in April 2015, with the final decision released in December 2016. In its decision, the Commission defined broadband as a basic or essential service that all Canadians should have access to, and established a new fund to support its development. A variety of organizations - from telecommunications companies to municipal governments and community organizations - are eligible to apply for this fund. More details will be released in the future. [see URL 4].

The Van Horne Institute has committed to provide a high level summary of the decision and implications for Albertan communities.

Innovation, Science and Economic Development (ISED)

Innovation, Science and Economic Development (ISED) Canada plays a key role in Canada's broadband landscape, administering federally funded broadband programs. The current program, "Connecting Canadians," was launched in 2014 with plans to spend $290 million across the country to ensure 300,000 households have access to connection speeds of at least 5 Mbps download. As of an April 2016 update on the project, two Alberta companies have received funding to connect households. ISED's most recent broadband funding mechanism was announced as part of Budget 2016 with a total budget of $500 million. The "Connect to Innovate" program aims to improve connections in 300 rural and remote communities and will primarily fund backbone networks, though some money may be available for last-mile connections. For more information contact ISED.

In addition to overseeing federal funding of broadband, ISED also regulates the radiospectrum system in Canada. Radiospectrum, or simply spectrum, is an essential element in wireless broadband communication. In addition to mobile wireless and satellite uses of spectrum, ISED regulates the use of fixed wireless connections, which includes both connections from a tower to households and business (last mile connection) and microwave backhaul links between towers.

Provincial Departments Involved in Broadband

At the provincial level there are several Government of Alberta departments with responsibilities related to broadband. The lead Ministry is Service Alberta is responsible for the province-wide Alberta SuperNet backbone network and administers the Central Alberta Satellite Solution program. Agriculture and Rural Development was responsible for the Final Mile Rural Community Program, which funded 27 projects in 2012 and, in conjunction with Service Alberta, was responsible for the Final Mile Rural Connectivity Initiative. Economic Development and Trade recently provided funding to Regional Economic Development Alliances (REDAs) for regional broadband preparedness studies and has provided funding for this toolkit.

THINKING ABOUT BROADBAND

Basic Economics of Broadband

Improving broadband service in a community takes both time and money. During the consultations we held to inform the development of this toolkit, participants frequently identified cost as one of the most significant barriers to improving connectivity in their communities. This section of the toolkit aims to introduce major considerations in the economics of broadband. It is not intended to replace a feasibility study that your community will have to conduct with the help of outside experts; rather it aims to provide community leaders and broadband champions with background information to initiate conversations around cost and feasibility.

As your community begins to think about various broadband solutions there are several important considerations to be made, with implications in areas such as infrastructure, financial and economic viability of broadband, and overall quality of access to broadband. The considerations include:

- Technology – what type of technology do you want to use?
- Ownership – who will own and maintain the infrastructure?
- Service Provision – who will provide services over the infrastructure?
- Business Model – what will be the revenue/cost model to support the broadband system?

In Alberta there are a wide range of answers to these questions. Some communities have partnered with existing ISPs to undertake the deployment of infrastructure and operation of Internet service. For example the Town of Taber partnered with Telus for its fibre deployment, and in the Town of Vulcan, Axia was responsible for fibre deployment. In other cases communities have decided to do this work themselves. In the Town of Olds, the Olds Institute undertook a fibre deployment and established its own ISP (O-NET). O-NET pays the institute a connection fee per customer and then the Olds Institute pays the loans and any extra funds stay for community use. Other communities have chosen other solutions. In Grande Prairie the municipality set up a program facilitating tower deployment for Grande Prairie Networks to operate a WISP (Wireless Internet Service Provider). In Waterton Lakes the community deployed fibre by partnering with Parks Canada and launched Internet service through an agreement with O-NET from the Olds Institute.

To achieve a broadband solution your community will have to conduct a detailed feasibility analysis. Undertaking this analysis will require input from outside experts or consultants, and can be facilitated through a Request for Proposal (RFP) process.

Economics of Technological Considerations

Each technology has its own economic considerations. At the present, there are primarily two approaches for communities to decide between – fixed wireless or fibre. Deploying fibre can be done aerially or laid in trenches (via conduits). Aerial deployments are cheaper, while trenched fibre is less prone to disruption of service. Costs for either aerial or trenched fibre can be reduced through effective planning (see the Best Practices

Lakeshore

Lakeshore Internet, created and owned by the Lesser Slave Lake Indian Region Council, has been providing high speed wireless Internet service (presently up to 10 Mbps download and 1.5 Mbps upload) to local First Nation and surrounding communities since 2005. Lakeshore Internet purchases bandwidth from Arrow Internet, a fellow First Nations provider based in Edmonton that includes the First Nations Technical Services Advisory Group as an investor with a 51 percent ownership stake. Now connecting 8 communities including 4 reserves in the Lesser Slave Lake region, Lakeshore Internet's expansion creates the challenges of upgrading network infrastructure to meet customers' bandwidth demands and increasing human resources, which they aim to solve through continued hiring and training of local talent. As a small northern ISP, they also face the challenge of securing government funding against competing applications by larger ISPs in order to support new equipment and infrastructure.

Even as this provider expands its geographical reach, customer service and fair pricing remains a priority. For example, in February 2016 a hurricane-level storm blew down one of Lakeshore Internet's towers, but thanks to the quick work of local technicians, the tower was rebuilt and operating at partial capacity just 6 days later. With a strong focus on public services, such as supporting online education on the reserves, Lakeshore Internet meets community needs not only through infrastructure but also by providing flexible payment plans. In the future, Lakeshore Internet will continue to focus on providing Fibre-to-the-premises (FTTP) on the reserves since fibre is seen as more cost-effective and reliable than wireless over the long term.

section). For example, in Calgary 'brownfield' trenched fibre deployment costs roughly $200/m. In other places brownfield costs can be considerably cheaper. Use of best practices such as a 'dig once' policy (see Best Practices section for further details) can substantially reduce costs in the long term.

With regards to fixed wireless, a community will have to assess the costs versus benefits for different types of tower construction (e.g. tower heights). You will also have to consider how the tower is connected to your community POP. Backhaul to the POP can be achieved through microwave (wireless) or by a wired (fibre) connection. Generally fibre fed towers are preferable, but are also more expensive.

In both cases it is also important to consider the costs of the electronic equipment associated with various connection types. Fibre connections require electronics that have to be replaced more frequently than physical fibre. For fixed wireless options there are costs associated with the various radio/antenna options.

Another important set of factors to consider are the density, geographical spread and topography of your community. For lower density communities or communities with considerable spread between residences and businesses, fibre will be more costly. However, fixed wireless solutions can be undermined by topographical factors. It is not uncommon for some fixed wireless subscribers to have their signal impeded by trees.

Ownership, Service Provision and Emerging Business Model Considerations

Like all infrastructure projects there are two broad categories of expenses for broadband: one time capital costs, and ongoing operating and maintenance costs.

Capital Costs

Capital costs are a one-time allocation for capital infrastructure. This includes the procurement and installation of infrastructure required for deployment of broadband services. This can include the costs to build connections to household and/or organizational users. Examples of capital expenditures include: land, buildings (towers and/or exchange infrastructure), fibre deployment, labour, equipment, and materials. In addition there may be capital costs associated with network and service provision.

Operations and Maintenance Costs

Operations and maintenance costs refer to the ongoing operating costs required to operate broadband facilities. This includes the expenses to maintain and upgrade equipment and networks as new digital technologies are required, infrastructure ages or user demand increases. It also includes human resources costs, such as for technical, administrative, marketing and support staff. Depending on the type of business model, it can include costs associated with operating a network, such as purchasing wholesale bandwidth, marketing and outreach, maintaining a help desk, setting up billing systems, etc.

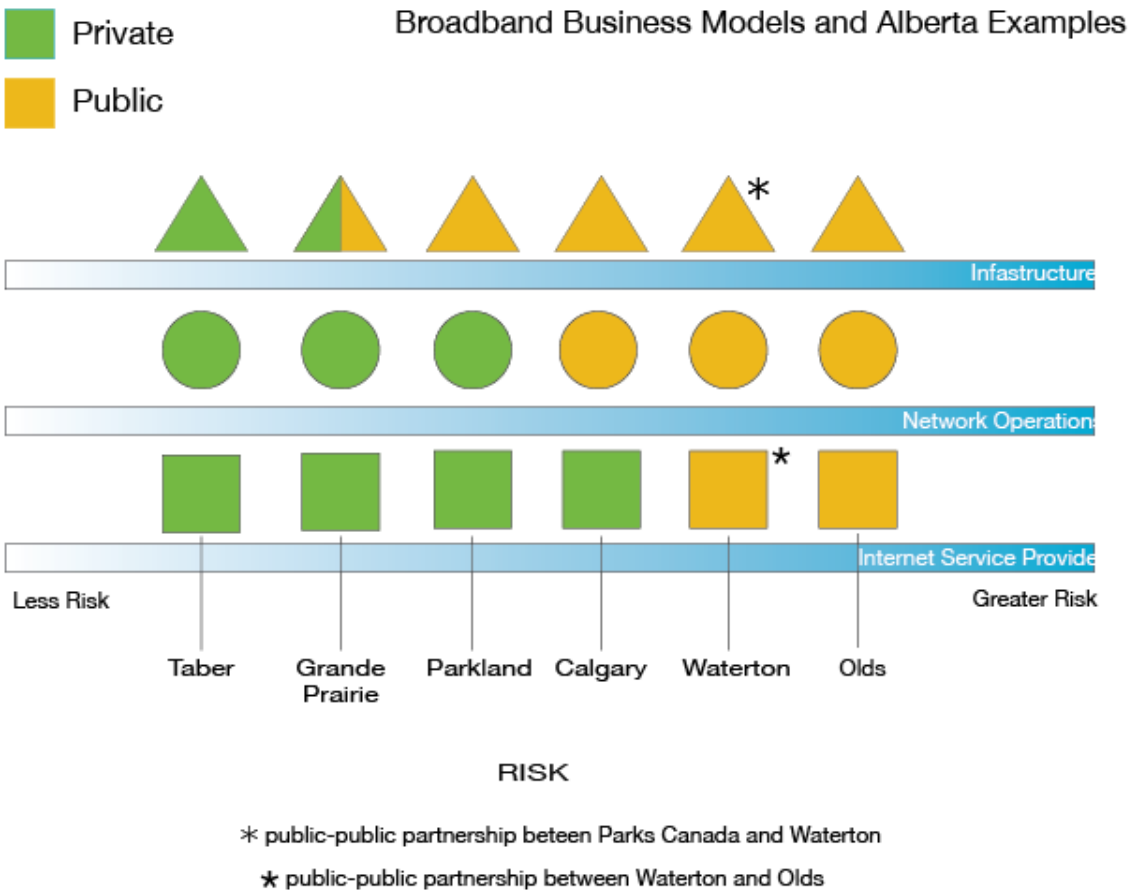
If your community chooses to build infrastructure you will have to determine a model for amortizing the capital expense. A key element to consider includes the amortization time frame. Specifically, what time frame you plan for covering the costs (10 years, 15 years, or 25 years). Another option may be to consider the infrastructure costs as a utility and to pay for the infrastructure from local tax revenues. Note that this may result in some ratepayers paying for service that might not be available to them.

If your community wants to provide service as an ISP, you also need to consider two other factors - cost of the service to users (and more importantly the ratio of average revenue per user (ARPU)), and what share of your community will take up the service. The latter ratio is known as take rate. Take rate and ARPU are inversely related - the lower the cost of the service the greater the take rate, but the ARPU will fall. A higher ARPU will reduce take rate. Note that any delays in deployment can create a need to revise the broadband network's revenue structure. For example, the Town of Olds assumed a 30 percent take rate and amortized their build over 10 years; however, initial delays meant that they needed a higher take rate to meet the 10 year amortization. The model below illustrates different approaches to owning and operating broadband networks and provides illustrative examples from communities in Alberta.

You can learn more about these examples in the vignettes spaced throughout this toolkit. The model is technology agnostic; that is, it can be applied to any kind of broadband technology, including fibre or fixed wireless.

Broadband systems can be conceptualized as consisting of three layers: infrastructure; network operations; and Internet Service Provider (ISP).

Infrastructure refers to the physical components of the network, such as fibre optic cables or wireless towers. Network Operations refers to the operations and administration of



this infrastructure. Specifically which entity has control over the data flowing through the network. The ISP layer refers to which entity is providing Internet services.

In terms of ownership, different aspects of broadband networks can be owned by different entities. We created a high-level diagram to illustrate these different ownership models. Please note that this diagram is for illustrative purposes only – it does not capture the full range or details associated with these models. The different models are illustrated using three explanatory components: private sector entities (green), public sector entities (yellow), or public-private partnerships (green/yellow). Private sector entities include telecommunications and cable companies, while public sector entities include municipal governments and community owned groups (e.g. the Olds Institute for Community and Regional Development).

In some cases, different public sector entities have partnered to support shared ownership of components of a network. For example, in Waterton Lakes, Parks Canada and the local municipal government partnered to set up the network infrastructure, while the Waterton Lakes municipal government partnered with the O-NET to provide Internet service to residents (note that while O-NET is a for profit company, it sole shareholder is the Olds Institute).

In some cases communities have chosen public-private partnership approaches. For example, the County of Grande Prairie partnered with Grande Prairie Networks to assist in the development of tower infrastructure by coordinating development approvals.

The diagram on the previous page also indicates the differing levels of potential risk/reward for communities involved in these ownership choices. The ownership structure on the far left (private sector) represents less risk for municipal governments, but also less potential reward. The far right represents the opposite: community owned and operated infrastructure presents potential revenue streams, but also introduces more risk to local leadership. For these reasons, it is important to carefully consider what degree of ownership works best for your community.

Calgary: Municipal Uses of Fibre

Since 2001, The City of Calgary has been deploying fibre not with the aim of providing Internet to residents and businesses, but for connectivity to support municipal services, a mentality that is applicable to communities both large and small elsewhere in the province. Often, councils will disprove of a municipal broadband infrastructure case when broadband is perceived as a retail service. Calgary's strategy was not about broadband, but about developing sustainable communications infrastructure for the delivery of next generation municipal services. The City is deploying fibre down almost every avenue downtown to enable traffic controllers and intelligent intersections, and leverages large infrastructure projects to install conduits when the roads are being built – reducing the costs and preserving the roads from being dug up in the future. The City is also deploying fibre down major roads in greenfield communities and business parks to ensure City services can be delivered deep into the community while providing Network/Operator neutral fibre that is attractive for high tech businesses and the providers that serve them. The City has also licensed its fibre to other carriers to prevent duplicate overbuilds.

Calgary has 24 different networks for applications by water services, public transit, police, fire, parks, roads, etc. These networks connect over 150 sites with various protocols and speeds. Isolating the networks on different fibres combats cyber security threats. Calgary does not want to be an ISP, but rather to have ownership control over their infrastructure in order to protect the public interest and effectively support municipal services in a cohesive manner, such as traffic camera footage that can be accessed for crime investigations. No matter their size, government agencies need to think about outcomes such as delivering next-generation municipal services, building safe communities, and ensuring digital inclusion. Communities should not fall into the trap of becoming a gigabit City, as that is a short term vision. A far more sustainable solution is building accessible fibre that is open access and inclusive for the community. Municipalities should recognize the importance of choice, competition and inclusion when evaluating broadband or connectivity models for their community. In Calgary, the City is building excess capacity in its fibre infrastructure to enable SmartCity technologies and applications while bringing together each business unit to discuss future utilization of these technologies.

For more information on the City of Calgary's approach to broadband please see David Basto's presentation "Building the Business Case for a Connected City" [see URL 5].

Technology Specific Considerations

Fibre optic networks can be either ‘open’ or ‘closed’, meaning that owners can choose to lease access to third-party entities on a wholesale basis, or not. Open access ensures non-discriminatory or transparent access for all service providers wanting to make use of the network.

Access to fixed wireless towers is similarly starting to be regulated by government (specifically ISED). Whether constructing a new tower or aiming to use an existing one there are several factors that need to be considered. Further information on tower sharing and construction information can be found in ISED’s Client Procedures Circular: Radio communication and Broadcasting Antenna Systems [See URL 6].

There are two important concepts associated with fibre based infrastructure - ‘lit’ and ‘dark’ fibre. If a fibre network is ‘lit’, the fibre cables are connected to electronics that allow digital traffic to flow through the network; if it is ‘dark’ there may be no electronics installed and so digital traffic is not moving through the network. An entity like a municipal government can own ‘dark’ infrastructure and generate revenue by leasing it to a third party. However, a municipality can also lease ‘lit’ fibre infrastructure to a third party, presumably for a higher rate, so that third party can use it to sell Internet service or other applications.

With regards to fixed wireless there are two important concepts associated with the type of spectrum used – licensed spectrum and license exempt spectrum, which is also

sometimes called unlicensed spectrum. When developing a fixed wireless solution the WISP (Wireless Internet Service Provider) that will provide Internet service over the infrastructure will determine the type of spectrum to use.

Regardless of connection type and business model, there are several common strategies central to ensuring a successful broadband solution. In the next section, the toolkit outlines the importance of community engagement and highlights some key challenges and best practices for all kinds of broadband solutions.

Importance of Community Engagement in Broadband Decision Making

Community engagement is central to decision-making around local broadband initiatives. By working with residents to identify development goals through structured planning and dialogue, engagement initiatives can help communities shape broadband projects to enable widespread adoption and effective use.

Through a “whole community” approach to broadband decision-making, local leaders and administrators can engage in strategic planning regarding how bandwidth is paid for, distributed and managed in each community. This approach to broadband planning enables local residents to make decisions on how infrastructure and bandwidth is made available to deliver essential services such as e-health, e-learning, etc.

Engagement holds a number of benefits for community broadband initiatives:

- It supports leadership by providing information from constituents on local needs and priorities.
- It enables strategic planning, research and business support.
- It helps build technical capacity and digital literacy through targeted training initiatives.
- It educates residents on the benefits and uses of broadband.
- It helps identify community champions.

It is important that community engagement initiatives involve a diversity of users. These include individuals and organizations as well as local services such as schools, health centres and businesses. This whole community perspective aims to ensure that development projects address the needs of a range of community members.

Engagement initiatives should consider both the social and technical components of broadband. This includes discussing the underlying local and transport infrastructure that enables individuals, households and organizations to connect, along with the various uses of connectivity. Consideration should also be given to factors including availability, price, quality of service, interoperability, ownership and accessibility.

The process of engagement can take a variety of forms, including surveys, focus groups, and planning circles. One example of community engagement in broadband decision-making was a citizen planning circle on effective use of rural broadband held in spring 2014 in the Town of Olds. The initiative provided participants with background information about broadband, and offered them an opportunity to contribute to policy development. In a series of facilitated discussions, 13 community members from a diverse range of backgrounds jointly developed action proposals to inform broadband development and use in the agriculture, business, education, and healthcare sectors.

This initiative was facilitated by the Centre for Public Involvement (CPI) at the University of Alberta and was supported through a partnership between Alberta Agriculture and Rural Development, the Olds Institute for Community and Regional Development, and CPI. For more information see the final report from Citizen Planning Circle which resulted in this final report [See URL 7].

Community engagement is central to any successful broadband solution. It is also a key means of addressing many of the common pitfalls and challenges that befall communities discussed in the next section.

Challenges and Pitfalls in Broadband Planning

As your community works towards a broadband solution, a number of challenges and pitfalls can encumber the process. Below, the toolkit identifies several common challenges communities face as well as some mitigating strategies.

Lack of Community "Buy-In"/Defining the "Why"

Lack of buy-in from the community can arise for a number of reasons. There may be insufficient support from major stakeholders for a broadband implementation project, a project may lack a clear champion, or there may be communication challenges between leaders, champions and residents. A successful project will require communities to

Misunderstandings about SuperNet

The province already has SuperNet, so nothing needs to be done

No. SuperNet only provides middle mile connectivity through Axia Connect between the larger Internet backbone (at YYCIX) and connection points (either Meet-me-facilities (MMFs) or Points of Presence (PoP)) in 429 communities in Alberta. Providers – whether private sector businesses or community networks – still need to access this network to access service and connect local homes and businesses.

SuperNet is supposed to connect households/businesses

No. SuperNet only provides a connection in a community (either an MMF or POP). It does not connect individual homes or businesses, nor is it intended to. An ISP can interconnect with SuperNet and the ISP can provide a final mile connection (by various connection types) to a home or business. On its own, the SuperNet is not an ISP and is not intended for end users.

The Government of Alberta Owns SuperNet

No. The GOA committed $193 million to build a network connecting 402 rural Alberta communities in 2001, and Bell committed $102 million to complete an urban network of 27 communities. In 2005 direct government ownership was changed to an Indefeasible Right of Use (effectively a long term exclusive lease) that lasts to 2045 with buy back options for $1 in 2035.

have conversation around why they need broadband. When planning this work, involve a diversity of groups and individuals in discussions as early as possible.

Mitigating Actions

- Identify businesses and community organizations and approach them for their support in the project.
- Identify community leaders who can serve as champions for the project.
- Prepare a proper strategic communication plan for how the project will be presented to the community.
- Where possible, learn from and leverage the expertise of other communities in your area/across the province.

Achieving a Proper Needs Assessment

Determining what type of connectivity needs exist in a community is difficult. It can be particularly difficult to assess future needs of both residents and business. While it is clear that global demand for broadband will rise consistently, determining what kinds of future uses your community will require in the next 10 to 25 years can be particularly challenging.

Mitigating Actions

- Develop awareness of emerging trends in broadband usage, in particular the Internet of Things (IoT).
- Consult with residents and businesses about future uses.
- Make use of outside expertise – an RFP for a needs assessment and feasibility study is an essential part of a successful broadband solution.
- Champions and community leaders should stay engaged on emerging trends, which can be done through attendance at relevant conferences (e.g. Van Horne Institute's Digital Future Symposium and Broadband Communities Annual Summit) and/or through monitoring information sources such as Broadband Communities magazine [See URL 8].

Implementation Costs

Cost can be key barrier for any broadband project. It is certainly easy to envision a community where every household and business has a fibre connection. However, after a feasibility study the cost may be beyond what a community can afford. As a point of reference, the Town of Olds, a rural community of roughly 8,200 people, the cost of the dark fibre network was $6 million.

Mitigating Actions

- Use best practices such as a 'dig once' policy to defray costs over time.
- Examine opportunities for regional partnerships – it may be the case that as demand is aggregated over a larger geographic area and population base costs become more manageable.
- Remain aware of granting opportunities whether federal (Infrastructure Canada or ISED) or provincial.
- Consider setting up revenue streams such as leasing community-owned infrastructure to third-party providers, or partnering with an ISP to sell Internet service.
- Consider partnering with an ISP during implementation.

Competition or Uncooperative ISPs

While partnering with an ISP can be an effective way to reduce costs, it also reduces community control over broadband assets and limits the potential for revenue streams that can come from locally-owned and/or operated infrastructure. It is also important to be mindful of fine print in contracts. In some cases sunset clauses in agreements with ISPs may result in ownership of the infrastructure reverting to the ISP after a certain term (e.g. after 10 years).

Mitigating Actions

- See if other communities in your region have partnered with ISPs and contact them to see what the experience was like and what advice they have.
- Have a dedicated staff person, ideally within the local government, who can act as a primary point of contact with the ISP.
- Connect with technical experts and other communities to exchange information about regulatory and policy issues, legal agreements and undertakings, and contract limitations and term lengths.
- Your community holds many valuable assets that benefit third-party ISPs, such as customers (residents), rights-of-way and granting opportunities associated with municipal governments. Identify these assets and use them in your negotiations.
- Consider the long-term impacts of contract terms – how will the partnership address future needs? Will the contract allow for increased local ownership and/or management

of infrastructure over time?

- Remember that infrastructure is only one element of an overall broadband solution. If your community decides to develop or deploy infrastructure (towers or fibre) you will still need an ISP to provide service to residents and businesses (unless your community also wants to start an ISP). The type of infrastructure technology you choose will shape which ISPs can and want to provide services over your infrastructure.
- These represent some common challenges communities face in developing a broadband solution. In many cases proper planning can help mitigate these risks and make broadband more achievable over time. The next section addresses broadband best practices.

Broadband Best Practices

In developing a broadband solution there are a number of steps a community can take to either mitigate costs over the long term, or strategically deploy and develop infrastructure assets that support the solutions, which will meet future as well as current needs.

Dig Once

- Adopt a "dig once" policy whereby fibre conduits are installed at the same time other municipal infrastructure (road, water and sewer) projects are undertaken.
- Dig once policies can reduce the cost of future fibre deployments by as much as 90 percent.
- Adding fibre conduits as part of another construction project results in cost increases of just a few cents for every dollar spent.
- Dig once policies can also be coordinated with building codes and development plans so that fibre is put in place in new communities and business parks.
- Consider a dig once approach when working on regional projects to develop broader fibre capacity.

Toolkit Design and Consultations

This toolkit was developed to help communities across Alberta start or further conversations about broadband. As part of the design process Economic Development and Trade, in conjunction with Drs. McMahon and McNally from the University of Alberta, conducted a series of workshop consultations in June and July of 2016. During eight workshops, participants from all regions of the province provided insights on how the toolkit could be most effectively designed and discussed key content to highlight.

One of the key questions that was asked of participants in the consultation workshops was what kind of comparison or analogies they thought were most appropriate for broadband. Repeatedly broadband was compared to other essential infrastructure - electricity, phone lines, water and sewers - and one person went so far as to compare the information providing ability of the Internet to the importance of having a set of eyeballs.

We want to acknowledge and thank all workshop participants for their time and insights.

Aerial Fibre Deployment

- To avoid the cost of trenched fibre, consider aerial deployments (such as on utility poles).
- Depending on ownership and existing contracts it may be possible to coordinate the use of existing utility poles for aerial fibre.
- Where possible ensure deployment of new utility poles includes space for future attachments including fibre lines.

Fibre Fed Towers

- Towers used for fixed wireless still require a connection back to the community POP.
- Microwave backhaul solutions may be more inexpensive in the short term but are less reliable - they can suffer from line of sight issues and weather effects. They may also raise potential capacity concerns in the future.
- Fibre fed towers are more expensive to build but address the concerns of microwave backhaul and have other advantages (as discussed in the Technology section).
- Fibre fed towers also put in place fibre infrastructure that can be used for future fibre deployments.

Transition Planning

- If a full fibre deployment is too expensive, consider using a combination of the above strategies along with municipal strategic planning to develop a transition strategy whereby fixed wireless is used in the short term with a longer term goal of deploying fibre.
- A strategy for fibre fed towers, a dig once policy and planning regionally can be used in combination for a wireless to fibre transition plan.

Demand Aggregation

- When planning for community broadband, engage in exercises to determine demand – even if you partner with an ISP, they may require some evidence of demand within the community.
- Demand aggregation can serve as a way of engaging the community – you can even have neighbourhoods hold friendly competitions to see where demand is greatest. There are demand aggregation software tools that can be used to facilitate this process.

Thinking and Working Regionally

- Always consider what neighbouring communities and regions are doing.
- A choice of a specific type of broadband solution in one community may have impacts on its neighbours – how can communities collaborate on a regional basis?
- Regional coordination on broadband best practices (dig once, demand aggregation) may result in cost savings over the long term.

PLANNING BROADBAND

Action Plan - Environmental Scanning and Steps

With an understanding of the various broadband technologies, the policy environment, the economics of broadband, and best practices and pitfalls, developing an action plan is the next step. The following section of the toolkit introduces two key elements in planning a community broadband solution – conducting an environmental scan and developing an action plan to achieve a broadband solution.

Environmental Scan

Conducting an environmental scan requires collecting and analyzing information to identify potential issues, trends, factors and challenges that may impact your community's broadband project. Environmental scanning is even more important in complex environments such as broadband planning. A thorough environmental scan can help mitigate challenges and leads to overall better planning. Relevant factors to scan for are:

Geographical

Examples of key trends and issues to investigate in scanning geographical landscape that are relevant for broadband include:

- Distance to POP/availability of backhaul/connection to YYCIX.
- Density and geographical spread.
- Topology and line of site, climate (fixed wireless solutions).
- Trenching considerations (fibre solutions).

Community and Socio-cultural

Examples of key trends and issues to investigate in scanning community and social-cultural landscape that are relevant for broadband include:

- Community demographics and trends (aging in place, youth retention).

- Attitude toward community/municipal ownership (history of cooperatives).
- Cultural nuances - attitudes towards bootstrapping.
- Local priorities.
- Community engagement.

Regulatory

Examples of key trends and issues to investigate in scanning the regulatory landscape that are relevant for broadband include:

- ISED broadband programs (e.g. "Connecting Communities" and "Connecting Canadians") CRTC decision on wholesale access (CRTC Telecom Policy 2015-326) [See URL 9].
- Modern telecommunications services – The path forward for Canada's digital economy (Telecom Regulatory Policy CRTC 2016-496) [See URL 4].
- SuperNet.
- REDA Broadband Preparedness Studies.
- Other federal/provincial policies.
- Municipal governance, rights of ways and bylaws.

Economic

Examples of key trends and issues to investigate in scanning the economic landscape that are relevant for broadband include:

- Employment patterns/major employers and industry.
- Diversification opportunities.
- Considering small business use/advantages.
- Financials including local municipal budget, funding support, grants, amortization models, willingness to pay.

Technology

Examples of key trends and issues to investigate in scanning the technology landscape that are relevant for broadband include:

- Existing broadband infrastructure and service providers (especially existing dark fibre).
- Backhaul to YYCIX or YEGIX.
- Asset Mapping.
- Potential uses/demands of broadband.
- Both current and future technology trends.

Partnership and Competition

Examples of key trends and issues to investigate in scanning the partnership and competition landscape that are relevant for broadband include:

- Thinking and looking regionally - what are other communities doing; how can we work together?
- Existing service providers (within and outside) - partnering with ISPs.
- SuperNet.
- Negotiating with ISPs/previous best practices.

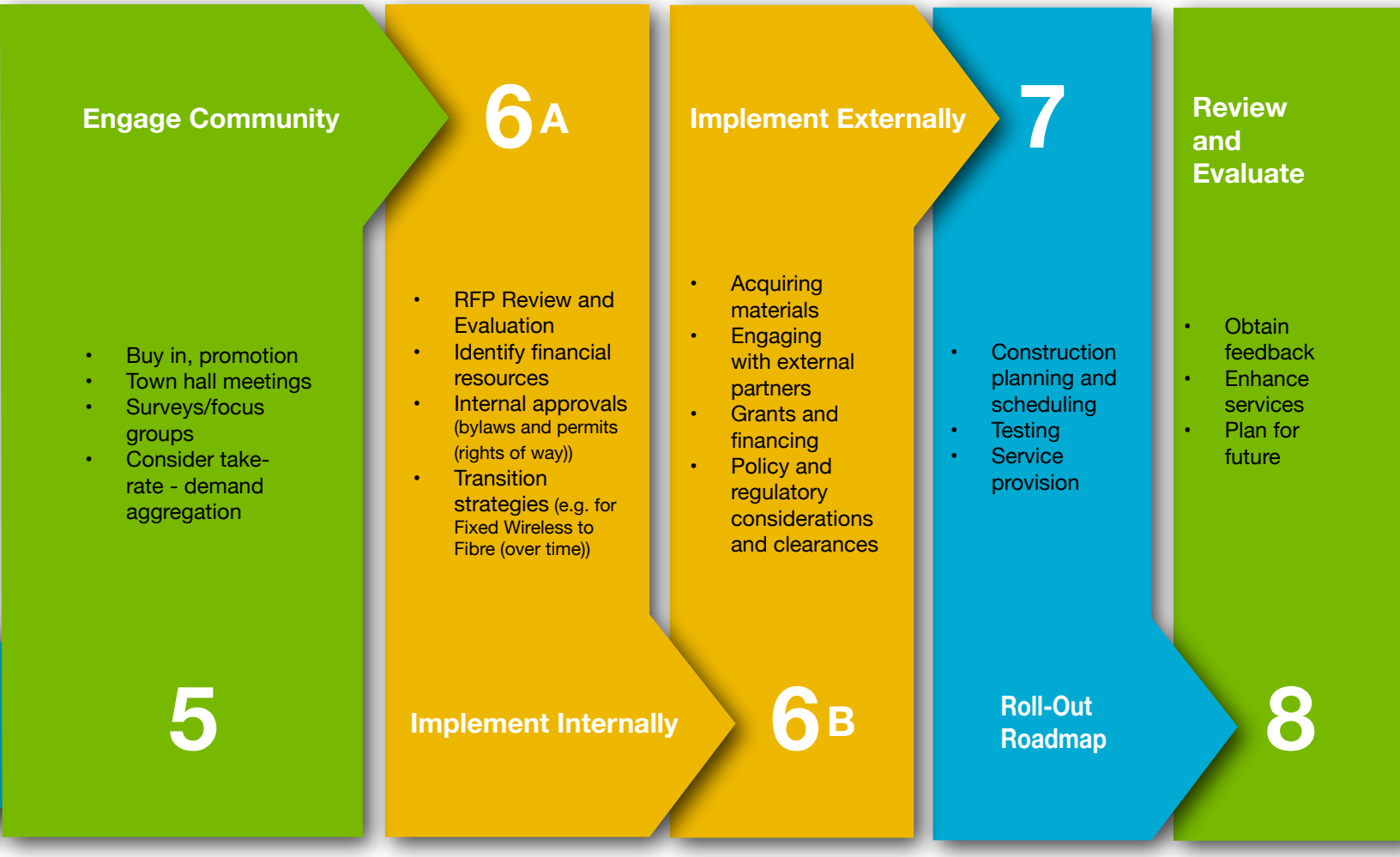
Human Resource

Examples of key geographical trends and issues to investigate include:

- Identifying expertise in different areas relevant for broadband projects such as financial, technical, policy and planning, administration as well as community outreach.

Steps for Developing a Community Based Broadband Solution

The following diagram provides a roadmap for achieving a community broadband solution that is broken down into eight steps. While these actions are provided in a step by step order, it is important to note that they are not necessarily discrete or linear, and can occur at the same time. For example, step five, Community Engagement, can begin at the outset. Therefore, think of this road map as a flexible tool to support planning, rather than a fixed plan.


Engage Community
5
• Buy in, promotion
• Town hall meetings
• Surveys/focus groups
• Consider take-rate - demand aggregation
6A
Implement Internally
• RFP Review and Evaluation
• Identify financial resources
• Internal approvals (bylaws and permits (rights of way))
• Transition strategies (e.g. for Fixed Wireless to Fibre (over time))
6B
Implement Externally
• Acquiring materials
• Engaging with external partners
• Grants and financing
• Policy and regulatory considerations and clearances
7
Roll-Out Roadmap
• Construction planning and scheduling
• Testing
• Service provision
8
Review and Evaluate
• Obtain feedback
• Enhance services
• Plan for future

GLOSSARY

Aerial Deployments	Deployment of cables using above ground utility poles
ARPU	Average Revenue Per User
Backhaul	Connection providing the link between your community and the rest of the world.
Brownfield	Development in an area with existing infrastructure/facilities
BSO	Basic Service Objectives
Closed Network	A network that is not provisioned on a non-discriminatory/ transparent basis. Includes proprietary networks.
CRTC	Canadian Radio-television and Telecommunications Commission
Dark Fibre	Fibre optic cable that does not have a signal passing through it. Fibre is 'dark' because there are no electronics at the ends of the cables putting a signal through
Dig Once	A policy mechanism that requires the construction of conduit for fibre cables when other construction is undertaken. Note that dig once involves the construction of conduits; however, the actual fibre cable may not be deployed in the conduit at the time of construction
DOCSIS	Data Over Cable Service Interface Specification
DSL	Digital Subscriber Line
Fibre-to-the-Home	A last mile connection where fibre is deployed all the way to customer premises (including homes, business and institutions)
FTTH/B/P	fibre-to-the-home/business/premises
Gbps	Gigabits Per Second
Greenfield	Development in an area without existing infrastructure/ facilities (new development)

HSPA	High Speed Packet Access
IoT	Internet of Things
IRUs	Indefeasible Rights of Use
ISED	Innovation, Science and Economic Development
ISP	Internet Service Provider
ITU	International Telecommunications Union
Kbps	Kilobits Per Second
Last Mile	The final portion of the infrastructure that deliver telephone/ broadband services to end-users (e.g., individual households and businesses)
LED	Light Emitting Diode
Lit Fibre	Fibre optic cable that has a signal (light) passing through it. Lit fibre requires electronics at both ends of the fibre
LTE	Long Term Evolution
Mbps	Megabits Per Second
Middle Mile Connectivity	Connectivity between internet exchanges and points of distribution (e.g. Meet-me-facilities or Points of Presence)
MMFs	Meet-me-facilities
OECD	Organisation for Economic Cooperation and Development
POP	Point of Presence
REDAs	Regional Economic Development Alliances
RFP	Request for Proposal
Take Rate	The number of subscribers (measured as a percentage) that have subscribed to a service

Trenched Fibre	Fibre deployed through underground conduits
Wholesale Basis/Services	Wholesale services are distinct from retail services. Wholesale services are regulated by the CRTC
WISP	Wireless Internet Service Provider
YEGIX	Edmonton Internet Exchange
YYCIX	Calgary Internet Exchange

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