Northern Alberta Broadband Preparedness Project

Regional Economic Development Initiative for Northwest Alberta

For review. Areas where content is to be added have been identified.

Submitted to Alberta HUB:
By Taylor Warwick Consulting Limited

September 15, 2017

(This page is intentionally blank.)

Table of Contents

List of Figures

List of Tables

(This page is intentionally blank.)

1 Executive Summary

1.1 Introduction

Because of the Internet and related technologies, the world is now transitioning to more complex economic systems built around *knowledge*.[1] As a foundational cornerstone of these emerging systems of wealth creation, access to information and communications technology (ICT) has become critical to sustainable economic development in virtually every community and society on the planet.

For only the third time in history, society's system of wealth is changing. In knowledge-based economies, wealth creation is largely independent of place, local resources, and physical assets compared to the previous industrial era where wealth was based on significant physical resources, access to raw materials, manpower, and efficient transportation. Wealth now arises from human ingenuity, intellectual property, and novel business models. With growth and development timeframes in the new economy largely unconstrained by the building of physical infrastructure and the movement of goods and services, knowledge-based businesses often grow exponentially.

The economic impacts of new broadband infrastructure investment on a community's economy and social framework are felt soon after the investment is made and then continue well into the future. In the short-term, direct effects such as changes in employment, economic production, and behavior are generated during the course of the infrastructure deployment, which then begins to increase the region's contribution to the national gross domestic product (GDP). In the medium-term, indirect benefits become apparent. Examples of indirect benefits include cost savings, cost avoidance, productivity gains, and incremental economic activity. Over the longer term, *'induced effects'* develop. These include the transformative impacts on the economy such as the introduction of new industries/industry clusters and new ways of working.[2] Indeed, the ultimate value of a community's investment in high-speed broadband derives not from the infrastructure itself, but from the economic and social ecosystem that grows and evolves around it.[3]

In spite of the foundational nature of the required underlying connectivity infrastructure, Canada has yet to develop meaningful related technology policy and the results show. Canada, for instance, now ranks 14th in Broadband and in Innovation and whereas at most locations in Canada one may have the option of two wireline providers, in Västerås, Sweden, there are over 30.[4]

Accessible, affordable, and reliable high-speed broadband services, provided in a coordinated and interconnected system, is seen as foundational to supporting economic prosperity locally and regionally, enabling greater social connectedness and well-being of the region's population. High-speed broadband services provide foundational infrastructure for community prosperity, resiliency, and quality of life – not

---

[1] Toffler, Alvin and Heidi. *Revolutionary Wealth.* Knopf. 25 April 2006.

[2] *Socioeconomic Effects of Broadband Speed;* Ericsson, Arthur D. Little, and Chalmers University of Technology; 2013-09.

[3] Smith, Steve; *The Economic Development Benefits of Broadband. Broadband Communities.* Broadband Communities Magazine; 2017-05/06.

[4] Lafleur, B. et al; How Canada Performs – A Report Card on Canada's Innovation Performance; Conference Board of Canada; 2013 04.

unlike roads, electricity, water and wastewater, and other essential utilities that support economic activity and community life.

Advancing a robust, diversified economy in northern Alberta is highly dependent on having the necessary infrastructure in place to access markets, reduce cost of service delivery, and enhance the quality of life. Realizing this, with the support of Alberta Economic Development and Trade (EDT), the Northern Alberta Development Council (NADC) together with Regional Economic Development Initiative for Northwest Alberta (REDI) and the four other Regional Economic Development Alliances (REDAs) spanning northern Alberta partnered to undertake this *Northern Alberta Broadband Preparedness Project*. The study was initiated to quantitatively evaluate the options available to enhance broadband infrastructure within the northern Alberta study area. The overall purpose of this report is to document:

1. Current broadband availability throughout the region (Current State);
2. Where each community would like to be in 3-, 5-, and 10-years (Desired State;
3. Potential benefits that might be realized once the availability of world-class broadband infrastructure became available (Benefits Assessment);
4. The options available to communities and sub-regional areas interested in enhancing the availability of broadband infrastructure within their environs (Opportunities, Options, and Strategy); and
5. The potential financials associated with the more do-it-yourself options (Business Cases).

Parts 1, 2, and 3 were completed and the results released in draft form. Each focused on the entire northern Alberta study region and the NADC area – the NADC area encompassing 60% of the Alberta landmass. To facilitate a greater focus on the opportunities, options, and illustrative financials within each region, Parts 4 and 5 were combined and undertaken separately for the regions covered by each REDA and the NADC. The results for the Alberta HUB region are documented in this report.

1.2 Regional Economic Development Initiative for Northwest Alberta (REDI) – At A Glance

The REDI region is home to approximately 23,000 residents and 826 businesses. Its land supports boreal forest while the flat portions are suitable for agriculture in this remote part of Alberta. Twenty-nine percent of the region's residents live on First Nations reserves.

As shown in Table 1, REDI includes 1 county, 2 towns, 3 hamlets, 4 First Nations, and 1 Métis Settlements. Of the 22,780 residents, approximately a third (37%) live in municipalities, including hamlets) while the remaining 13,955 (63%) are dispersed throughout the rural areas of the region.

Table 1 – REDI Communities

	Towns	Hamlets	First Nations	Métis	Population	% of REDI
MacKenzie County	High Level Rainbow Lake	Fort Vermilion La Crete Zama City	Beaver First Nation Dene Tha' First Nation Little Red River Cree FN Tallcree First Nation	Paddle Prairie	22,017	100.0%
11,171	3,954	Population	6,348	544	22,017	1
50.7%	18.0%	Percent of REDI	28.8%	2.5%	1	
1	2	3	4	1	11	

According to the service level chart in Figure 1, Internet service levels meeting the new CRTC objective of 50 Mb/s down and 10 Mb/s up are not available in any of the 11 municipalities (including hamlets, First Nation, and Métis settlements) in the region.

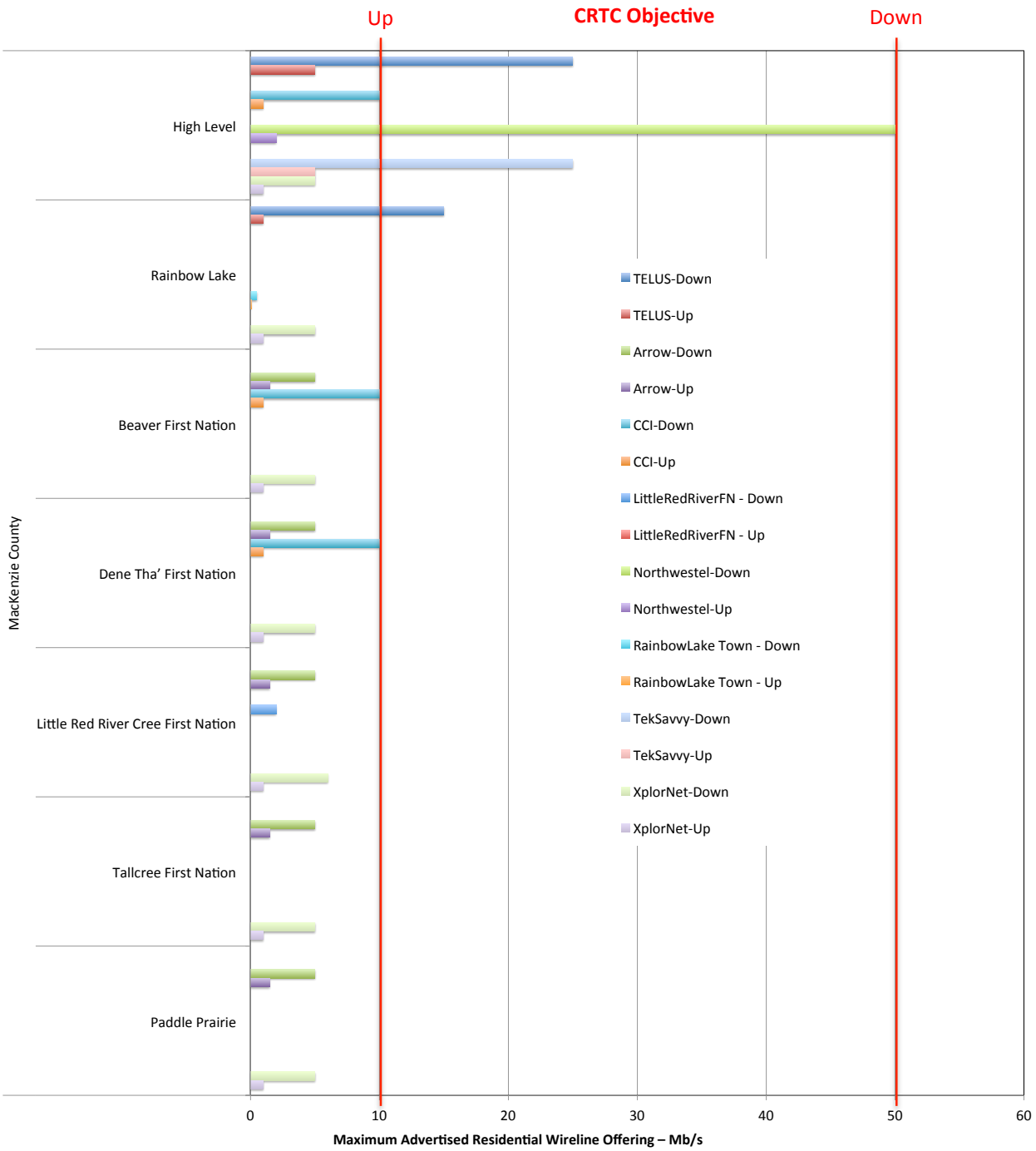


Figure 1 – Internet service levels.

Deployment options and strategies depend on population and density. As is evident in Figure 2, premise densities across the LSLEA region vary widely – from a low of 0.04 homes per square kilometer (or 1 home per 22.6 km^2) in McKenzie County to 46 homes/km^2 in the Town High Level.

As the cost of providing enhanced broadband services increases substantially as the premise density decreases, the quality and availability of these services does so as well. The higher the premise density (red squares) relative to the population (top of the blue columns), the better the capital deployment financials will be. Conversely, the lower the density relative to the size of the population, the

worse they will be. To be operationally sustainable, in the higher density areas, if the top of the blue column is below, say, 5,000 individuals, partnering with other communities will likely be necessary.

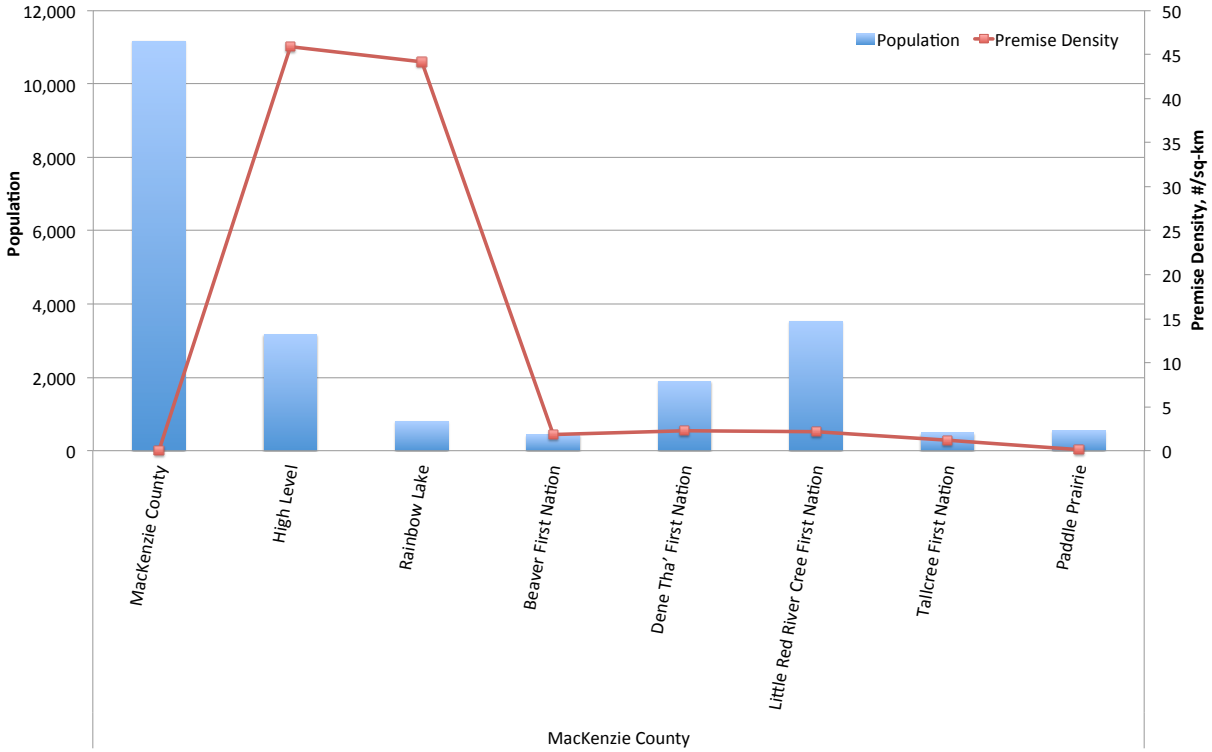


Figure 2 – Premise densities.

With larger populations and negligible densities, the county will have the biggest issue with fibre deployment and unless significant grant funding or novel financing arrangements become available, wireless or hybrid fibre/wireless solutions will be needed. At the municipal level, none of the smaller urban centres in the region are large enough to support a fibre deployment on their own – collaboration with other communities or private industry will be needed.

1.3 Plans for Broadband

Within the Regional Economic Development Initiative for Northwest Alberta (REDI) the communities that have the greatest near-term broadband aspirations (likely a community hybrid fibre/fixed wireless solution) are the Town of High Level and the First Nations' communities of Dene Tha', Beaver First, Little Red River Cree, and Tall Cree.

1.4 Utility Networks in REDI

Each of the communities in REDI has access to SuperNet and the existing fibre routes do pass close to a number of fixed wireless towers. If the communities were interested in establishing an open-access utility network operation to enhance Internet services in the County, it'd likely be best to focus on Fibre-to-the-premise (FTTP) solutions in the communities and fibre to the towers to improve rural coverage. As of this writing the plans for SuperNet 2.0 had not been released so it will be assumed that the existing SuperNet connection sites will remain available and that the terms of their use are likely to become more reasonable. With this approach, the more communities, hamlets, First Nations, and Métis Settlements involved, the better. As broadband needs increase and priorities evolve, this initial focus on the communities could move to a greater focus on the more rural areas. High-level financials developed

indicate that a community focused FTTP play would be financially sustainable, but only if all communities were involved.

1.5 Recommendations

To accommodate both present and future economic development needs, facilitate full citizen inclusion, and help eliminate any digital divides within member communities of the REDI region, a community-driven, utility-based, hybrid fibre-to-the-premise (FTTP) / fibre-to-the-tower deployment capable of enabling symmetric access up to and beyond 1 Gb/s to all is recommended for those communities wishing to move ahead. The fibre infrastructure suggested will cost-effectively scale to meet all foreseeable bandwidth requirements, minimize cost to all potential clients, and enable REDI members to maintain control of critical civic infrastructure. Achieving this will require a variety of approaches and significant investment over a number of years.

1.6 Next Steps

While regional and municipal options do involve more responsibilities and risks than simply transferring control to private enterprise, they come with significant advantages. Though the REDI region would normally be considered too rural to operate a county-wide fibre network on its own, the projected financials indicate that a sustainable operation can be achieved while providing the flexibility to scale and also serve surrounding rural residents, businesses, First Nations, and Métis Settlements. The result would be a fully scalable infrastructure that would benefit the region on many levels, not the least of which would be improved opportunities for both its residential and business communities, increased economic development, and control over critical civic infrastructure.

Should the County wish to pursue this community-based broadband option further, then, once the Business Case work currently underway is completed, moving toward the development of an overall Business Plan would be in order. Whereas this Business Case provides sufficient information for evaluating various business model and governance frameworks, as well as for a go/no-go, decision, the Business Plan goes to the next level of detail and provides a detailed template and guidance for implementation.

2 Introduction

2.1 Project Definition

Advancing a robust, diversified economy in northern Alberta is highly dependent on having the necessary infrastructure in place to access markets, reduce cost of service delivery, and enhance the quality of life. Realizing this, with the support of Alberta Economic Development and Trade (EDT), the Northern Alberta Development Council (NADC), REDI, and the four other Regional Economic Development Alliances (REDAs) partnered to undertake this Northern Alberta Broadband Preparedness project. The study is to quantitatively evaluate the options available to enhance broadband infrastructure within the NADC region. The overall purpose is to document:

1. Current Broadband availability throughout the region (Current State);
2. Where each community would like to be in 3-, 5-, and 10-years (Desired State);
3. Potential benefits that might be realized once the availability of world-class broadband infrastructure became available (Benefits Assessment);
4. The options available to communities and sub-regional areas interested in enhancing the availability of broadband infrastructure within their environs (Opportunities, Options, and Strategy); and
5. The potential financials associated with the more do-it-yourself options (Business Cases).

Parts 1, 2, and 3 were completed and the results were released in draft form. Each focused on the entire northern Alberta study region and the NADC area – the NADC area encompassing 60% of the Alberta landmass. To facilitate a greater focus on the opportunities, options, and illustrative financials within each region, Parts 4 and 5 were combined and undertaken separately for the regions covered by each REDA and the NADC. The results for the REDI region are documented in this report.

2.2 Project Purpose

From a strategic perspective, the purpose of *Northern Alberta Broadband Preparedness Project* is to complete both the current (Phase 1) and desired (Phase 2) state for each community and the region as a whole, as well as identify the potential options available to bridge any gaps. The options of most interest are then used to develop a strategy (Phase 3) with which the Desired State can be achieved. In support of the proposed strategy, preliminary financials will then be developed. In summary, the steps are:

1. Establish the current state for each municipality, county, municipal district (MD), First Nation community, and Métis Settlement within the northern Alberta study area;
2. Establish the desired state for each of the above entities.
3. Using gap analysis, identify the options and opportunities available to realize the desired state, estimate the related capital requirements, and use the results to inform the development of a regional broadband strategy; and
4. Based on the agreed upon strategy, if applicable, develop a preliminary business case.[5]

2.3 Project Leadership and Study Partners

The *Northern Alberta Broadband Preparedness Project* is being led by the Northeast Alberta Information HUB Ltd. (Alberta HUB), one of five REDAs in northern Alberta. REDAs are autonomous non-

[5] Project contract between the Northeast Alberta Information HUB Ltd. and Taylor Warwick Consulting Limited; 2016-08-12.

profit organizations comprised of member communities and regional stakeholders that work together to foster business development and prosperity in a defined geographic area.[6]

Funding for this study is provided by EDT, the NADC, and the five northern Alberta REDAs: Alberta HUB, Grizzly Regional Economic Alliance Society (GROWTH Alberta), Lesser Slave Lake Economic Alliance (LSLEA), Peace Region Economic Development Alliance (PREDA), and REDI.

The study is inclusive of all municipalities, First Nations, and Métis Settlements within the area encompassed by the NADC and the five REDAs. Chief Administrative Officers and their staff (information technology, planning and development, and economic development officers); First Nation and Métis Settlement administrators and managers; and Internet Service Providers (ISPs) were the primary contributors of information and data to this report. Other stakeholders contributing to the understanding of the '*current state*' included elected officials, primary and post-secondary educational institutions, Alberta Health Services, local Chambers of Commerce and Community Futures, business leaders and owners, and industry associations and organizations.

The collection of information, data, and general research took place primarily between October 2016 and March 2017. Attempts were made to contact all communities and ISPs within the study's scope to provide input for the study. Despite efforts by Taylor Warwick, the NADC, and the REDAs, input from some communities and ISPs was not forthcoming. Another challenge was keeping abreast of changes within the communities and ISPs and refreshing the study's databases, analyses, and this report as required. As such, the contents of this report should be viewed as a '*snapshot*' in time, and the reader is reminded that a variety of changes may have occurred since this report was written.

The NADC, along with Alberta HUB, GROWTH Alberta, LSLEA, PREDA, and REDI, focuses on advancing a robust, diversified economy in northern Alberta. Achieving continued economic growth in northern Alberta is highly dependent on having the necessary infrastructure to access global markets as well as providing connectivity for its residents.

2.4 Northern Alberta Study Area

2.4.1 Geographic Borders

The northern Alberta study area is inclusive of the NADC region and the REDA regions (members and non-members of a REDA). The study area is outlined in blue in Figure 3. The NADC region also shares this blue boundary; however, the boundaries and members of Alberta HUB and GROWTH Alberta extend beyond the NADC region, and a red line serves as the demarcation line.

The NADC's geographic borders extend north to Alberta's border with the Northwest Territories and east and west to Alberta's borders with Saskatchewan and British Columbia. It reaches south as far as the southern boundaries of the Municipal District (MD) of Greenview, Woodlands County, MD of Lesser Slave River, Athabasca County, Lac La Biche County, County of St. Paul, the Métis Settlements of Buffalo Lake, Kikino, and Fishing Lake, and the First Nations of Whitefish, Saddle Lake and Frog Lake.[7] The unlabelled, burgundy-shaded areas in Figure 3 are the Athabasca and Wood Buffalo regions located in the northeastern portion of the NADC.

[6] http://communityeconomicdevelopment.alberta.ca/regional-economic-development-alliances-redas/ ; Alberta Economic Development and Trade; 2017-08-08.

[7] NADC; *NADC Area Profile: An Economic Description of the Region*; 2016-05.

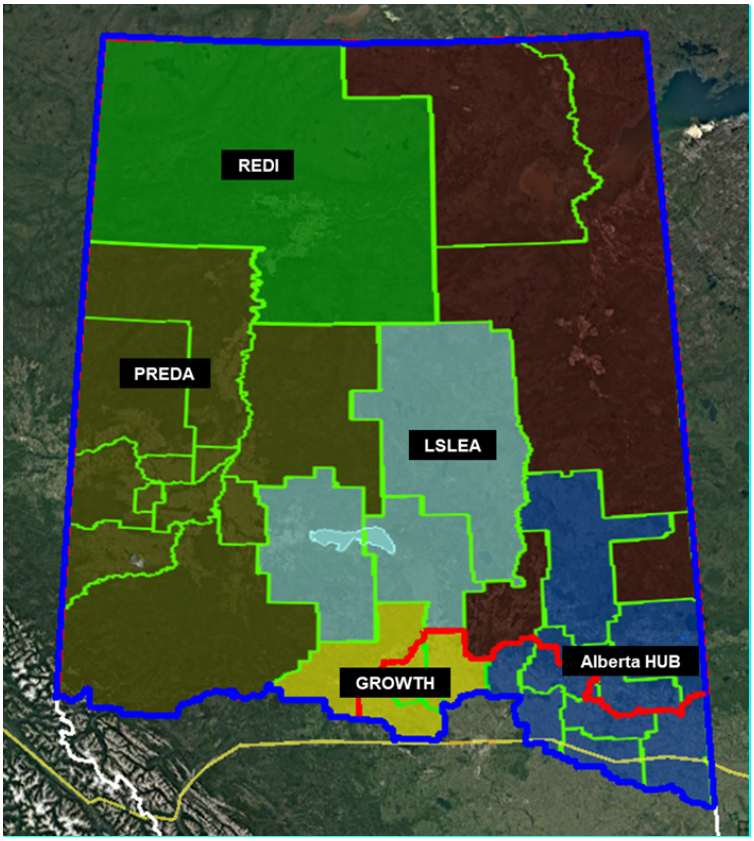


Figure 3 – Northern Alberta study area.

2.4.2 REDA Membership and Grouping of Communities

Most northern Alberta communities are a member of a REDA. There are exceptions and for the purposes of this study, those communities that geographically fall within a REDA but are not a member of the REDA are listed and grouped with member communities of that REDA. This is done to facilitate Phase 3 of this project – broadband opportunities, options, and strategy development at community and regional levels. Specifically, financially viable and operationally sustainable community or regional fibre-based network builds often require partnering with neighbouring communities to increase scale and efficiency. Communities that are not a member of a REDA are identified in each of the REDA-specific sections of this report. The reader is advised to refer to these sections for further information. Also, REDA membership can change over time.

2.4.3 Community Composition, Natural Resources, and Features

There are 32 municipal districts and counties, 2 cities, 35 towns, 23 villages, 24 summer villages, 154 hamlets, 33 First Nations and 8 Métis settlements with a total of 456,811 people in the study area. Approximately 41.9% are urban dwellers while 58.1% live in rural communities. Of the 58.1%, approximately 7.5% live on First Nations reserves or Métis Settlements.

The study area is home to approximately 21,006 businesses (with employees).[8] Approximately 56% of these businesses are engaged in one of five industry sectors: construction; other services (except public administration); retail trade; professional, scientific, and technical services; and transportation and warehousing. The '*other services'* sector comprises establishments that have not been classified in any of the other 19 North American Industry Classification System (NAICS) industry sectors. For example, businesses that repair and maintain motor vehicles and other machinery or provide personal care services fall into this category.

The study area's natural resources of oil, natural gas, agricultural land, and forests are the basis for industry output in the study area.[9] Nichols Applied Management estimated the NADC region (the NADC region can be used as a proxy for the northern Alberta study area giving its footprint is very similar) contributes approximately 17% to 19% of Alberta's total gross national product (GDP).[10] Mining and oil and gas extraction sector is the largest contributor. Other key industry sectors include (1) construction and (2) agriculture, forestry, fishing, and hunting.[10]

A diverse natural landscape characterizes the study area, with five of Alberta's six land classification regions present. Although predominately Boreal Forest, there are pockets of Canadian Shield in its northeast corner and Rocky Mountains in its southwest corner. Its lower southwest has Foothills while its southeast corner and pockets in the west are classified as Parkland.[9] The main boreal forest includes closely spaced evergreen and deciduous trees, as well as shade-tolerant shrubs, which create line-of-sight issues for fixed wireless and mobility service providers. The small portion of Canadian Shield in the Fort Chipewyan area consists of a very thin soil layer on top of the bedrock (granite). This dictates aerial broadband deployments.

[8] Calculations based on data provided by Michael Parkatti, Senior Director. Economic Information & Analytics, Alberta Economic Development and Trade. *Request - Alberta Businesses Counts by Industry*. Message to Doris Regula. 13 February 2017. E-mail.

[9] NADC; *NADC Area Profile: An Economic Description of the Region*; 2016-05.

[10] *Contribution of the NADC Region to the Alberta and Canadian Economies*; Nichols Applied Management; 2012-06.

3 Landscape

3.1 Context

An extensive Landscape document, providing overall perspective and context to a wide range of trends, issues, and concerns relating to broadband, was developed for and released by the Calgary Regional Partnership in September 2016. A copy of the report can be downloaded from the noted website.[11] Among the various other reports written by Taylor Warwick Consulting Limited, the following may also be of interest to the readers of this report:

- *A Business Case for Next Generation Broadband*, completed for the City of Chestermere, April 23, 2017;
- Regional Broadband Investigation – Needs, Opportunities, and Approaches at the Local Level and for the Calgary Region, September 28, 2016;
- *Regional Broadband Strategy – Options & Financials*, prepared for the Alberta SouthWest Regional Alliance, January 16, 2015; and
- *The True Economics of Broadband*, completed for the Regional Municipality of Wood Buffalo, September 2009.

Although the environment and underlying technologies, together with an ever-widening array of applications and impact areas, continue to evolve quickly, the material presented in the Landscape report remains comprehensive and relevant. Since the release of that document, however, there have been a number of developments at the federal, provincial, and service provider levels that are worth noting. These are outlined below.

3.2 Federal Updates

3.2.1 Basic Service Ruling[12]

On December 21, 2016, the Canadian Radio-television and Telecommunications Commission (CRTC) declared Broadband Internet to be a basic telecommunications service. Until now, only voice services were '*basic'.* Existing universal service frameworks will now shift from voice to Internet, with a basic universal service of 50 Mb/s download and 10 Mb/s upload and the option of unlimited data. The CRTC set the deployment target of 90% of Canadian households by 2021 and 100% by 2031.

Whereas in the past, service providers have had to contribute 0.53% of their voice service revenues into a fund accessible to providers to improve services in areas that do not meet minimum voice service levels. These funds will now be used to support meeting the broadband Internet objectives in rural areas where it is not otherwise economical to do so. This fund is expected to grow to $750 million within five years. A further proceeding in 2017 will examine the preliminary fund guidelines established in this ruling. Should this proceeding finish by the end of 2017, money from the fund is unlikely to be dispersed until late 2018.

[11] https://www.dropbox.com/s/i4m68awenkb546d/CRP-Regional%20Broadband%20Investigation-Landscape%20Issues-FINAL.pdf?dl=0

[12] *Modern Telecommunications Services – The Path Forward for the Canadian Economy*; Telecom Regulatory Policy CRTC 2016-496; 2016-12-21.

The ruling also set an objective to have the latest generally deployed mobile wireless technology (currently long-term evolution (LTE)) deployed not only in homes and businesses but along as many major roads as possible.

3.2.2 Connect to Innovate Program (CTI)

Announced on December 15, 2016, the Federal *Connect to Innovate Program (CTI)* from Innovation, Science, and Economic Development (ISED) Canada will provide up to $500 million in support of new high-capacity open-access backbone networks; upgrades to existing backbone networks; improving resilience; and last mile access connections by 2021. The program covers 75% of the costs of new infrastructure and 50% of the costs for upgrades. Applications required significant detail, including design details and costs, the identification of who will build, own, and operate the network. Preferences were to be given to applications with the most community benefit, cover communities with the least service, cover multiple communities and/or provide infrastructure that is scalable and services that are the most affordable. The application deadline for the program closed on April 20, 2017 and the funding recipients are now being announced.

At the March, 2017 Digital Futures symposium in Cochrane, program staff indicated that a follow-up program is likely within an 18-month timeframe. As these programs have historically favoured shovel-ready projects and the application windows are short, interested municipalities would do well to use the interim period to develop suitable projects and have them ready for when the next funding round opens.

3.2.3 Statistics Canada

Statistics Canada released their 2016 Census of Population and Dwelling Counts on February 8, 2017.[13] All related numbers in this document have been updated to reflect new data.

3.2.4 Federation of Canadian Municipalities (FCM)

Working in partnership with the municipal sector, the Federation of Canadian Municipalities (FCM) continues to advocate for the federal government to:

- Adopt a comprehensive and long-term funding mechanism for basic broadband access. The existing arrangement for basic telecommunications services is a good starting point and
- Update the basic service objective to include universal access to affordable high-speed broadband Internet at speeds that reflect present realities and guarantee long-term, reliable connectivity while

[13] http://www12.statcan.ca/census-recensement/2016/rt-td/population-eng.cfm

continually re-evaluate its broadband speed targets to reflect technological advancements, changes in user needs, traffic, and network capacity

The FCM continues to engage with Innovation, Science, and Economic Development to ensure that the needs of rural municipalities are considered in the rollout of the *CTI Program*. For example, FCM shared feedback from the communities that indicated that more time was needed to prepare their applications, and the deadline was extended from March 13, 2017 to April 20, 2017.

The FCM actively participated in the CRTC's 2015-134-5, *Review of basic telecommunications services*. The FCM's submission to the CRTC consultation called for universal access to affordable and reliable high-speed Internet and highlights the significant barriers faced by communities in both rural and northern Canada. In particular, FCM recommended that the CRTC expand its basic service objective to guarantee long-term, reliable broadband connectivity across Canada and to continually evaluate its broadband speed targets to reflect technological advancements and evolving user needs.

The CRTC is currently in the process of consulting on the design of a new broadband infrastructure fund. The CRTC is examining matters related to the fund's establishment including: eligibility and assessment criteria; eligible costs; roles and responsibilities; and governance and accountability. All levels of government are encouraged to participate in these consultations beginning later this year. The FCM will continue engaging with the CRTC to ensure that municipalities are consulted in the design of this program.

3.3 Provincial Updates

3.3.1 Service Alberta and the Alberta SuperNet Contract

The original SuperNet operating contracts expires at midnight, June 30, 2018. According to Stephen Bull, Service Alberta's Assistant Deputy Minister responsible for the SuperNet, Cabinet has made its decision regarding the future direction of the SuperNet. Work is now proceeding to finalize a Request for Proposals. Three service providers have been pre-qualified.[14]

3.3.2 Changes to the Municipal Government Act (MGA)

The *Municipal Government Act (MGA)* currently gives municipalities the option to work together on initiatives with neighbouring municipalities. This is about to change. All municipalities outside of the growth management areas (e.g., City of Edmonton region) will be required to develop an Inter-Municipal Collaboration Framework. The framework will formalize how municipal entities will work together to better manage growth, coordinate service delivery, and optimize resources.[15]

3.3.3 Regional Economic Development Alliance (REDA) Broadband Studies

3.3.3.1 A Provincial View

Courtesy of funding from the NADC (for this project) and EDT, regional broadband studies are underway province-wide – each building on the results of the previous studies. On completion of the

[14] Bull, Stephen – Assistant Deputy Minister, Service Alberta, SuperNet Secretariat; *Northern Alberta Broadband Preparedness Project – Finalizing the Current State Report*. Email message to Doris Regula; 2017-08-01.

[15] https://mgareview.alberta.ca/whats-changing/plan-for-growth/

studies, there will be the opportunity to aggregate the results to create a province-wide broadband view and use the outcome as a basis to influence policy.

3.3.3.2 Alberta SouthWest Regional Alliance

Under the current round of EDT funding AlbertaSW documented the process that Cardston County went through to evaluate various broadband options. Many of their communities continue to wait for notification from Axia. In addition, AlbertaSW recently completed research on the best examples they could find of communities who are promoting their fiber/true high-speed broadband online and how.

3.3.3.3 Calgary Regional Partnership (CRP)

The Calgary Regional Partnership (CRP) study was completed in September 2016 and all recommendations were unanimously endorsed by the Steering Committee, the Executive Committee, and the Board. A number of inter- and intra-municipality initiatives are now underway across the region.

3.3.3.4 Northern Alberta Broadband Preparedness Project

As outlined in the Introduction, the intent of the *Northern Alberta Broadband Preparedness Project* is to, at both the municipal and regional levels,

- Create a common understanding of both the potential benefits of enhanced broadband availability and the options available to realize them;
- Establish where each community is at and which are interested in pursuing broadband; and
- For those interested, which options might best meet their needs.

The work will then proceed to a feasibility review of the regional opportunities of most interest and develop a business case for those that garners the most support.

3.3.3.5 Palliser Economic Partnership (PEP)

The mandate for the Palliser Economic Partnership (PEP) study is similar to the *Northern Alberta Broadband Preparedness* study, in that not only are strategic options to be developed, but also business cases for the options of most interest. Community engagement sessions were completed in June 2016 and by December, a set of options together with deployment cost estimates had been developed. A joint CRP/PEP backbone initiative is underway and business case estimates for the more promising options have been completed.

3.3.3.6 SouthGrow Regional Initiative (SouthGrow)

SouthGrow Regional Initiative (SouthGrow) issued a Request for Proposal for its broadband project in January 2017 and work commenced in February 2017. In this case, the emphasis is more on community engagement and requirements than deployment estimates and feasibility studies.

While the SouthGrow study did not specifically address how much bandwidth is needed going forward, as they considered fibre to be the gold standard, it did make recommendations to communities (privately) and provides an overview of the region. The report also included some research and an outline for a possible summit to get all the players together.

3.3.3.7 Broadband Toolkit and Portal – University of Alberta

Under contract to EDT, Dr. Michael McNally led a team at the University of Alberta to develop a document entitled, *Understanding Community Broadband – The Alberta Broadband Toolkit*. The

document was released in early January 2017. In conjunction with the Toolkit, the group is creating an online portal to serve as a reference centre for related material.

3.3.4 Alberta Urban Municipalities Association (AUMA)

The Alberta Urban Municipalities Associations (AUMA) continues to advocate to the federal and provincial governments to address the lack of sufficient broadband service that affects many communities in Alberta. The AUMA has two active resolutions on broadband: Review of Broadband Internet and Broadband Internet Availability in Alberta. The first one was submitted by the City of St. Albert and requests the province to provide direct funding and support to municipalities for broadband. The second resolution's active clauses request that the AUMA establish a committee on broadband; work with REDAs and other organizations with similar mandates to advocate for affordable fibre optic-based Internet to Albertans; and continue to advocate for a provincial Broadband Policy. In February 2017, the AUMA released a bulletin, *Developing Broadband Solutions for your Community*, to assist members in determining their broadband needs.

The topic of broadband figures prominently during the AUMA's annual convention as well as during the two mayors' caucuses held each year. The AUMA conducted market research related to broadband with its members in 2016.

3.3.5 Alberta Association of Municipal Districts and Counties (AAMDC)

The Alberta Association of Municipal Districts and Counties (AAMDC) provides an advocacy voice for rural municipalities seeking ways to enhance rural broadband in their communities. It regularly engages with Service Alberta and ISED Canada to provide the rural Alberta perspective on challenges with rural broadband, funding programs, and existing infrastructure such as the Alberta SuperNet.

Over the past year, the AAMDC has worked with its members to gather a better understanding of their challenges, priorities, and initiatives related to developing rural broadband (e.g., AAMDC Broadband and SuperNet survey) and used the information to provide input into the development of the federal CTI program; the new Alberta SuperNet operating agreement; and the CRTC's review of whether broadband should be considered a basic telecommunications service.

Looking forward, the AAMDC plans to engage further with the CRTC when they begin the public proceeding related to the $750 million fund to support projects in areas that do not meet the CRTC's targets of speeds of 50 Mb/s download/10 Mb/s upload for fixed broadband Internet access services; an unlimited data option for fixed broadband access services; and the latest mobile wireless technology available not only in homes and businesses, but also along major Canadian roads. It will also engage with Service Alberta as they move forward in finalizing the new SuperNet operating agreement.

3.4 Service Provider Updates

TELUS Corporation (TELUS) is deploying fibre to mobility/cell towers and recently launched a SmartHub product that enables high-speed Internet using the 700 MHz spectrum to serve rural areas. TELUS' new SmartHub for rural customers offers speeds of 12 Mb/s to 25 Mb/s download. Three monthly plans are available (two-year contract) – progressively more expensive as the GB monthly data usage increases: $60 for 50 GB; $75 for 250 GB; and $110 for 500 GB. The Whitecourt Chamber of Commerce recently selected the higher-end service and is pleased with the results.

Bell Canada's (Bell's) Turbo Hub offers a similar service to rural communities with up to 150 Mb/s download and up to 50 Mb/s upload speeds with typical download speeds of between 12 Mb/s and 25 Mb/s (comparable to the TELUS offer). Monthly prices and data usage maximums are provided in Table 2.

Table 2 – Bell Turbo Hub Pricing & Data Usage Maximums

Price ($)	GB
$60	Up to 5
$75	5 to 10
$90	10 to 20
$110	20 to 50
$145	50 to 100

Rogers Communications' (Rogers') Turbo Hub offers '*light'* user and '*heavy'* user options, ranging from $10 for up to 100 MB monthly usage to $145 for between 50 GB and 100 GB usage per month.

4 Benefits of Broadband – Socioeconomic Effects

4.1 Overview

The ultimate value of a community's investment in high-speed broadband derives not from the infrastructure itself but from the economic and social ecosystem that grows and evolves around it.[16] Figure 4 depicts the complex web of effects and interrelations that exist between the economy and society that stem from increased broadband speeds. Very diverse economic and social benefits are apparent.[17] The map is a simplification – in reality there are even more factors and linkages.

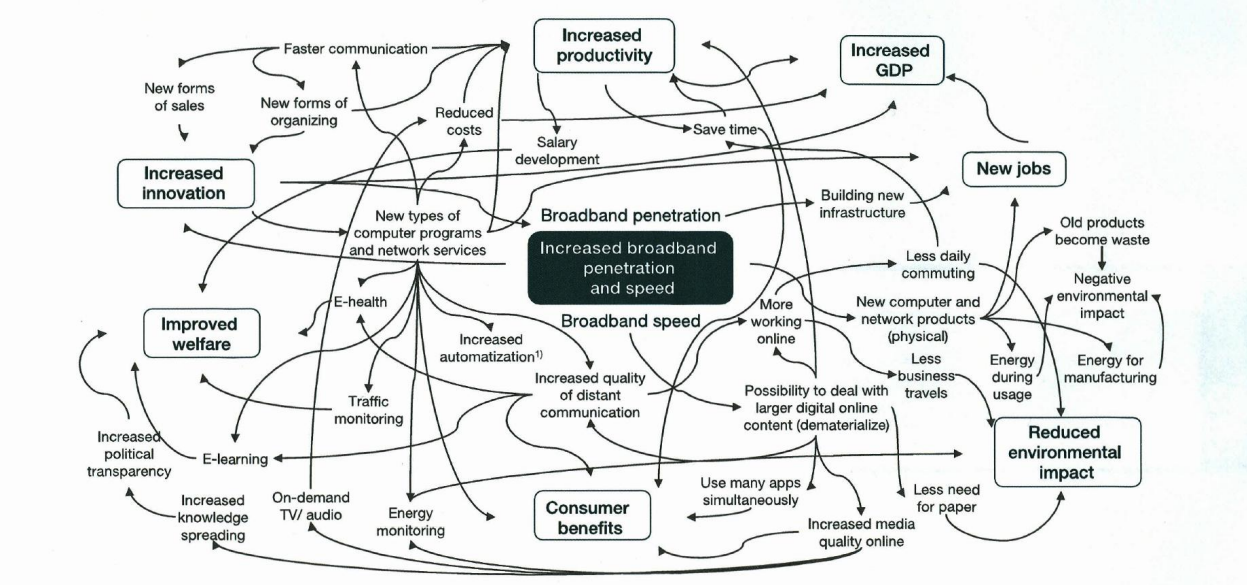


Figure 4 – Effect and interrelations that stem from increased broadband speeds.

Many economic and social benefits have been correlated with having access to broadband. In the late 1990s, Internet connectivity was transformed by '*always-on*' digital subscriber line (DSL) and cable modem services provided by the telephone and cable television companies, respectively. These first-generation broadband services dramatically improved broadband connectivity to the Internet, which led to the development of new inventions, processes, and business models; new and improved goods and services, and increased competitiveness and flexibility in the economy. While these first-generation technologies led to an estimated incremental economic benefits of 1.1% GDP to the United States economy, the Analysis Group predicts the next generation of connectivity, '*gigabit broadband*,' will provide an additional 1.1% GDP.[18]

Houlin Zhao of the International Telecommunication Union (ITU) Broadband Commission describes the importance of broadband networks to global social and economic development as follows:

> *"Broadband networks offer perhaps the greatest opportunity we have ever had to make rapid and solid advances in global social and economic development – across all*

[16] Smith, Steve; *The Economic Development Benefits of Broadband. Broadband Communities;* Broadband Communities Magazine; 2017-05/06.

[17] *Socioeconomic Effects of Broadband Speed;* Ericsson, Arthur D. Little, and Chalmers University of Technology; 2013-09.

[18] Sosa, David; *Early Evidence Suggest Gigabit Broadband Drives GDP*; Analysis Group.

sectors, including healthcare, education, new job opportunities, transportation, agriculture, trade and government services. In the twenty-first century, broadband networks therefore need to be considered as basic critical infrastructure, like roads, railways, water and power networks." [19]

4.2 Wealth Creation and the Knowledge-based Economy

For the third time in history, society's system of wealth is changing. In knowledge-based economies, wealth creation is largely independent of place, local resources, and physical assets compared to the previous industrial era where wealth was based on significant physical resources, access to raw materials, manpower, and efficient transportation. Wealth now arises from human ingenuity, intellectual property, and novel business models. With growth and development timeframes in the new economy largely unconstrained by the building of physical infrastructure and the movement of goods and services, knowledge-based businesses often grow exponentially. For example, Instagram, a social networking application (app) developed for sharing photos and videos from a smartphone, was developed in 18 months by 13 people. On April 9, 2012, the company was sold to Facebook for $1 billion US. Noteworthy is that those 13 people could have been located anywhere Internet access was available (and not necessarily in the same physical location). Also, with the availability of cloud computing resources such as Amazon Web Services (AWS), no local server farms were required and the service could be rapidly scaled globally. Instagram could have been developed in any community within the northern Alberta study area. There may be more to be gained from nurturing entrepreneurs than in creating traditional employment.

The presence of high-speed broadband in a community enables it to think globally. Remote work is one of the most immediate and obvious benefits – residents can be employed with companies in distant cities, and therefore, creating new opportunities beyond the reach of the local economic base. As well residents can remotely acquire the skills necessary to participate in the knowledge-based economy. Light manufacturers and specialty retailers even in small towns are afforded the opportunity to connect to a global marketplace through electronic commerce, which is vital to community sustainability and growth.[20] The development of manufacturing and retail economies are possible in more rural settings. High-speed, reliable broadband is a significant enabler for small businesses participating in manufacturing and professional services sector – especially, where there is a need to move significant volumes of data such as engineering designs and high-resolution colour product images on a regular basis. For example, entrepreneurs in a rural northern Alberta community could set up a 3D printing farm implement (toy, boat, parts, etc.) manufacturing facility in an old barn or other suitable vacant building. Alternatively, car enthusiasts in the region might sign on to Local Motors[21], the maker of the first 3D-printed car, and help design cars in their spare time. For approximately $20,000 US, a small urban community could send a person with high potential to Singularity University[22] (SU) and have him/her trained in how to establish a billion-dollar business in five years. Ten years ago, this prospect would have been a joke. Today, it is not and SU is a serious institution created to support entrepreneurial initiatives in a knowledge-focused economy.

---

[19] Zhao, Houlin – Secretary General of the ITU and Co-Vice Chair of the Broadband Commission for Sustainable Development, ITU;. 2017-08-23.

[20] Smith, Steve; *The Economic Development Benefits of Broadband. Broadband Communities;* Broadband Communities Magazine; 2017-05/06.

[21] Local Motors; https://localmotors.com

[22] Singularity University; https://su.org

From this perspective, the correlation between a community's economic development and its local capabilities and assets will likely decrease with time. If so, then perhaps what is more important than economic development premised on a local strengths, weaknesses, opportunities, and threats (SWOT) analysis,[23] is the ability of the community to be able to recognize, utilize, and leverage the types of capabilities and opportunities that digital technologies and networks are making possible. This new reality is being harnessed by a number of municipalities in the Calgary region.

4.3 Economic

4.3.1 Economic Impacts of New Broadband Investments

Research conducted by Ericsson in collaboration with Arthur D. Little, and Chalmers University of Technology found that increased broadband speed contributes significantly to economic growth. Doubling broadband speeds for an economy can add 0.3% to GDP growth.[24] The benefits of faster broadband can have both economic (e.g., increased innovation and productivity in business) and social effects, (e.g., better access to services and improved healthcare).

The study's authors further categorized the economic and social effects over three different timeframes: short-, medium-, and long-term (Figure 5).

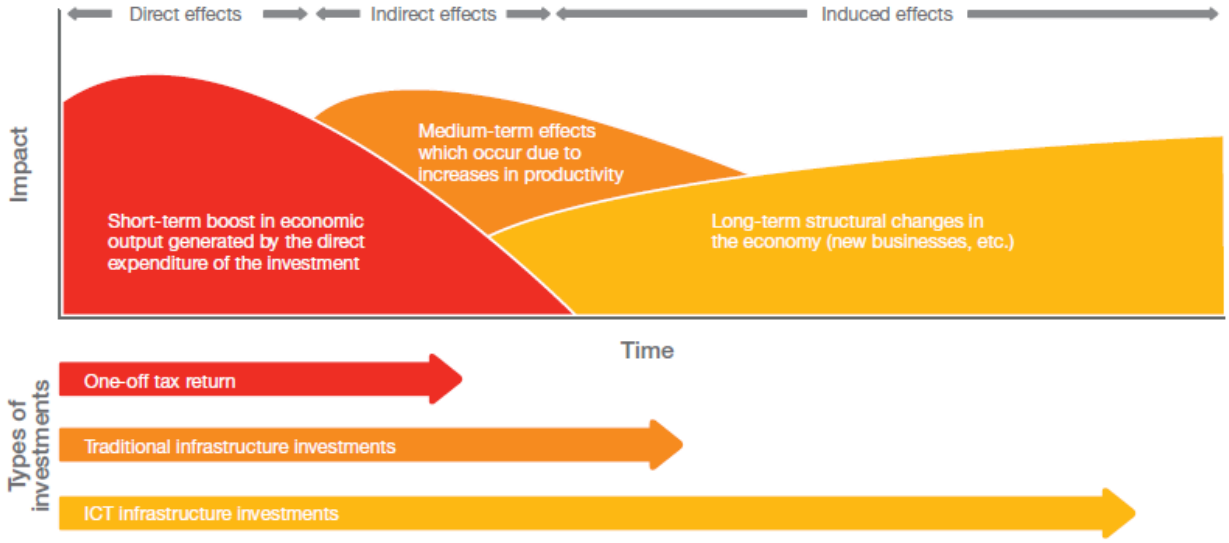


Figure 5 – Economic impacts of broadband speed upgrades over time.

In the short-term, direct effects such as changes in employment, economic production, and behavior are generated during the course of the deployment of new infrastructure and rise GDP. In the medium-term, indirect effects are apparent. Examples of indirect benefits include cost savings, cost avoidance, productivity gains, and incremental economic activity. The third category, termed '*induced effects*', occurs

[23] A SWOT analysis is a traditional business tool that first evaluates one's internal strengths and weaknesses and then uses the results as context and in addition to an analysis of its external strategic environment to identify its opportunities and threats. Ideally, the one's strategy would build on its strengths to exploit opportunities, counter threats, and resolve weaknesses.

[24] *Socioeconomic Effects of Broadband Speed;* Ericsson, Arthur D. Little, and Chalmers University of Technology; 2013-09.

over the long-term and include transformative impacts on the economy such as the introduction of new industries/industry clusters or new ways of working.

4.3.2 Digital Adoption and its Impact on GDP

Canadians require more bandwidth for activities that require high-speed (such as telecommuting, telehealth, and videoconferencing), above-the-network services (such as cloud storage of digital files) and as more devices become Internet-enabled. Examples of important telecommunication services needed to participate in the digital economy include the following: telehealth, distance-learning, e-commerce, software and video game development, photo and video sharing, data analysis sharing and processing, telepresence robots for remote working and virtual tourism, and contributing to global work and research projects using shared software, and open network technologies and topologies. [25]

A study by the McKinsey Global Institute (MGI) estimated the potential impact the adoption of digital technologies could yet make on business productivity in various economic sectors – Figure 6.

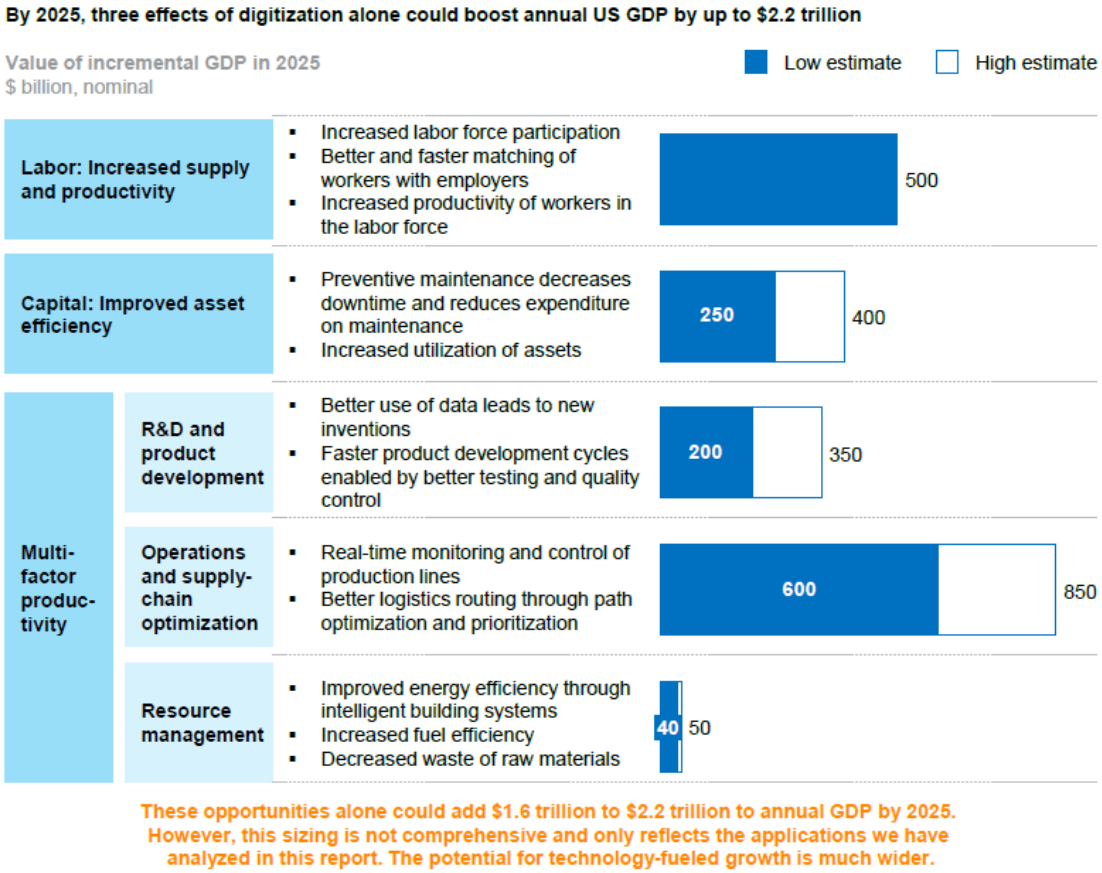


Figure 6 – Industry digitization & growth of annual GDP in the United States by 2025.

Examples include decreasing the costs of service delivery for education, healthcare, land and resource management, and many other sectors. Digital technologies also enable the virtual workplace – where a company can work with employees from anywhere and, equally important, enables local residents to freelance (instead of being employed by a particular company) and market their capabilities globally. The

[25] Submission to Review of Basic Telecommunications Services; CRTC Telecom Notice of Consultation 2015-134; Cybera.

MGI study identified three effects of digitization and estimated that these three effects would be capable of boosting US GDP by up to $2.2 trillion by 2025.[26] Scaling MGI's estimates to Canada, Taylor Warwick Consulting Limited estimated the potential impact of a wider adoption of digital technologies by Canadian industry could boost Canadian GDP by up to CAD$330 billion dollars. Assuming Canadian impacts to be 10% of those in the US, but 2025, three effects of digitization alone could boost Canadian GDP by $330 billion.

Over the past 200 years, automation has eliminated 99% of the farming jobs.[27] Advancing technology, however, has created far more jobs than it displaced and, as a result, society as a whole has moved forward. With the maturing of many digital related technologies, society is at the cusp of a profoundly new era and an era in which the possibilities are limited only by our imaginations.

4.3.3 Agriculture

While there are many futuristic videos available to highlight the potential of high-speed broadband for agriculture, a more currently grounded view can be viewed at the following website:

https://www.youtube.com/watch?v=Fr29UKzm2CI, starting at 1:48.

A growing global population coupled with the expectation that climate change will make food harder to produce, the agriculture industry is at the cusp of a new industrial revolution.[28] According to the United Nations, global agricultural output will need to increase by as much as 70% by the year 2050.[29] Globally, this challenge has been recognized. For example, the central theme of EXPO 2015 was *Feed the Planet, Energy for Life*. Each participating country was asked to examine its own position and offer solutions regarding the major challenges related to the future of food. To feed the forecasted population levels identified to the right (i.e., 9.7 billion), the agriculture industry will need to increase efficiency in growing food or increase the acreage allocated to food production and

[26] Manyika, James, et al; *Digital America: A Tale of the Haves and Have-Mores;* McKinsey Global Institute; 2015-12.

[27] Friedman, T.; Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations; Farrar, Straus and Giroux; 2016-11-22.

[28] Tunney, Catharine; *To Take Advantage of Coming Agriculture 'Revolution' Canada Needs Investment, Says Expert*; CBC News; 2017-02-18.

[29] Penn, J. B. – Chief Economist, John Deere; *Agriculture's Past, Present and Future*; John Deere Journal; 2016-03-31. https://johndeerejournal.com/2016/03/agricultures-past-present-and-future/

the landbase for agriculture is shrinking.[30] Farmers are also looking for ways to farm more precisely and profitably. The same technology that's propelled growth in other industries, such as robotics and data analytics, hold the promise of producing more food on less land.

Technological Change and Advancement

Farmers initially adopted the Internet to access discussion forums, social media, commodity prices, weather forecasts, and shop for parts. Recent advancements in wireless capabilities allowing farmers to wirelessly evaluate irrigation systems, weather stations, field equipment, and employees. Those making the most of broadband connectivity are transferring data between a variety of strategically located sensors on the farm and cloud-based storage, pushing prescriptions to applicators, and monitoring real-time alert systems for immediate pest threats.[31]

It is interesting to note that in Statistics Canada's most recent census, the 2016 Census of Agriculture, agricultural operators were queried about their use of emerging digital devices, including those associated with Precision Agriculture (PA) as well as those devices that require wireless and wireline technologies.[32] The Appendix 13.1 provides the Statistics Canada applications and technologies usage data for northern Alberta producers. For farm management, 52% of farms in the region are using computers or laptops while 42% reported using smartphones or tablets.

What is changing is the connectivity of agricultural equipment and the variety of sensors providing raw data to cloud-based analytics services. This is evident at the farms in southwestern Ontario, where wireless devices and technologies feed data from multiple access points on the farm, such as the residence, barn, and fields, to cloud services. Figure 7 – The Connected Farm, provides a schematic diagram of the various data transmission paths. Accessing cloud services will only be possible (or at least work more effectively) when fibre comes closer to the rural areas/farms or when more advanced wireless technologies become available. The cloud will support farmers with other technologies and services such as decision support services. In addition to farmers, the data and analytics can be sent to analysts and others with access rights. New lines of business, businesses, and jobs are being created, often by intermediaries (i.e., information or data brokers). As more data is re-purposed and sold, agriculture product and food value chains are becoming more heavily data driven.[33] A recent study of field crop producers in southwestern Ontario found that the three access points mentioned above compete for bandwidth and as a result some businesses are subscribing to more than one service provider to ensure

[30] Mark, Tyler, Whitacre, Brian, and Griffin, Terry; *Assessing the Value of Broadband Connectivity for Big Data and Telematics: Technical Efficiency*; selected paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting Atlanta, Georgia; 2015-01-31 to 02-03.

[31] Mark, Tyler, Whitacre, Brian, and Griffin, Terry; *Assessing the Value of Broadband Connectivity for Big Data and Telematics: Technical Efficiency*; selected paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting Atlanta, Georgia; 2015-01-31 to 02-03.

[32] Hambly, Helen; *Release of 2016 Census of Agriculture – Relevance to Rural Broadband in Ontario*; Rural and Remote Broadband (R2B2) Project blog; 2017-05-12.

[33] Hambly, Helen – R2B2 Project Lead and Associate Professor, University of Guelph; Telephone Interview; 2017-04-12.

mobility and reliability.[34] It should be noted that most PA data needs to be uploaded rather than downloaded.[35]

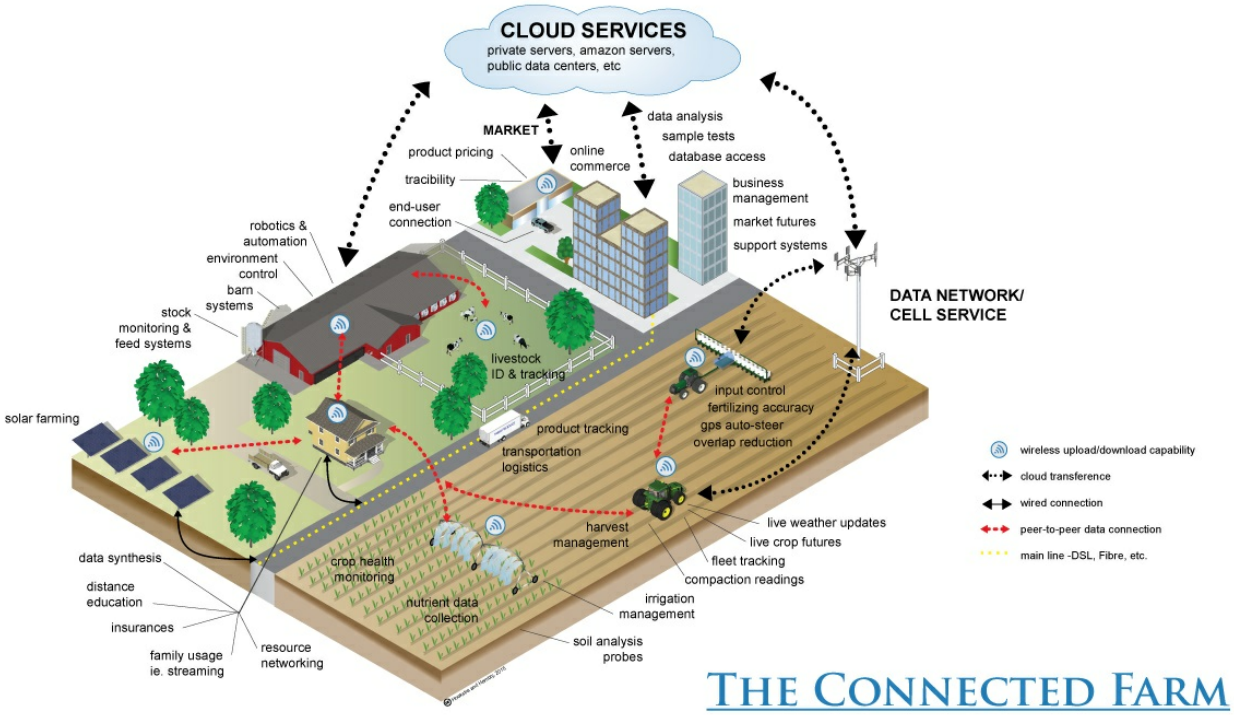


Figure 7 – Next generation farms and rural communities.

Trimble, provider of advanced location-based solutions that help various industry sectors maximize productivity and enhance profitability using core technologies in positioning, modeling, connectivity, and data analytics, identified the following trends in agriculture technology (Figure 8).

[34] *Role of Broadband Internet Access in the Adoption of Precision Agriculture Applications;* Executive Summary, Draft Report. R2B2 Project.

[35] Mark, Tyler and Griffin, Terry; *Defining the Barriers to Telematics for Precision Agriculture: Connectivity Supply and Demand;* selected paper prepared for presentation at the Southern Agricultural Economics Association's 2016 Annual Meeting, San Antonio, Texas; 2016-02-06/09.

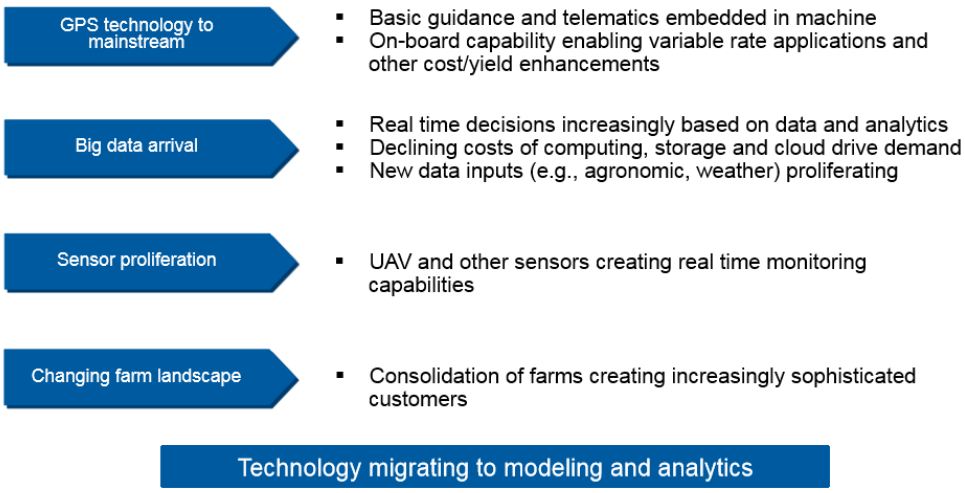


Figure 8 – Trends in agriculture technology.

Patchy rural wireless and broadband coverage is a barrier to the adoption of PA as shown in Table 3.[36]

Table 3 – Adoption of Precision Agriculture - Technology Drivers and Barriers

Drivers	Barriers
• M2M-based monitoring and tracking becoming more mainstream across industries • Reducing costs of sensors, connectivity • Improving data management technologies to manage tidal wave of M2M data • Farmers becoming more familiar with everyday IT use	• Rural wireless and broadband coverage patchy • Standards for sensor networks and data communications still under development • Specialist agricultural software still maturing • Uncertainty as to how to treat and safeguard data

Quantifying the Indirect Benefits of High Speed Broadband to Agriculture

Quantifying the value of high-speed broadband to the agriculture industry, specifically the level of efficiency that can be created at the farm level, is not an easy task. Agricultural economists Tyler Mark, Brian Whitacre, and Terry Griffin, used simulation data and envelopment analysis to assess the increase in efficiency and net producer income for grain producers who would be able to fully implement telematics - made possible by broadband connectivity. They found that if producers were able to adopt PA technology along the continuum to data and data use (i.e., Big Data), average net farm income would increase by 9.8%.[37]

[36] *Towards Smart Farming, Agriculture Embracing the IoT Vision*; Beecham Research Ltd.

[37] Mark, Tyler, Whitacre, Brian, and Griffin, Terry; *Assessing the Value of Broadband Connectivity for Big Data and Telematics: Technical Efficiency*; selected paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting Atlanta, Georgia; 2015-01-31 to 02-03.

4.4 Social

4.4.1 Connected Communities

To quote Thomas Friedman: *More people than ever can now compete and collaborate on more things, for less money, with more ease and equality than ever before*.

4.4.2 Education

In Alberta, K-12 and advanced education learning environments are adopting cloud-based computing and service delivery (e.g., Google Cloud, Microsoft Office 365, and other cloud-based providers).[38] Cloud-based services require broadband connections. Figure 9 shows the evolution of broadband in a typical K-12 educational system – basic connectivity needs give way to more advanced and scalable connectivity needs.[39]

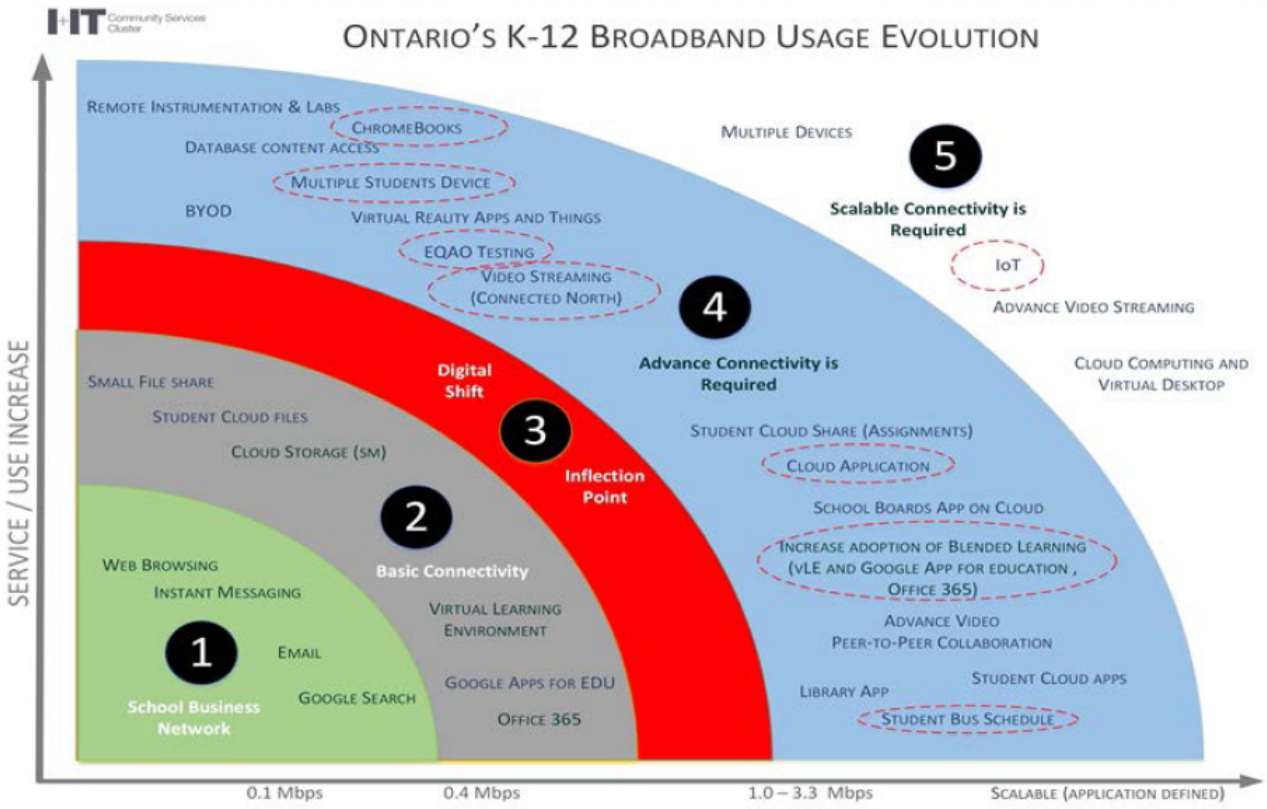


Figure 9 – Evolution of broadband in K-12 schools.

[38] Luedtke, Ralph – Senior Manager, Education Technology and Hauschildt, Dave – Education Manager, Technology Leadership Branch, Field Services Sector, Alberta Education; Telephone Conversation; 2017-05-04. Sokolowski; Carol – Director, External Stakeholder Relations, Information and Technology Management Sector, Alberta Advanced Education; Telephone Conversation; 2017-05-09.

[39] Education Funding Engagement – Digital Education presentation; Ontario; 2016-11-10.

Olds College is prime example of how the benefits of gigabit networking can be leveraged in an educational environment. An overview is available in the video produced for the College's 100th anniversary:[40]

https://www.youtube.com/watch?v=55iJvk57nrQ&list=PL-Ua1K2KRZdmaXPlqEv-Is1c51ykrib3l&index=4

Robust, reliable broadband is a necessity for achieving excellence in 21st century learning - information, media, and technology skills have become the foundation for learning. Equitable broadband access means that all students have the same learning opportunity regardless of where they live.[41]

Today in Alberta, web-based products, such as Google G Suite,[42] are being used by school communities for such things as word processing and document storage (i.e., stage 2 in the figure above). Even the Stage 2 advancements of this increasingly complex array of technology solutions and tools is very reliant upon adequate Internet connections for students, parents, teachers, and administrators in schools and at home.

Improving equity in education is a high priority for Tallcree First Nation's Chief – it is his goal and his ambition.[43] Located in remote northeastern Alberta, education and employment opportunities are limited.

To compete in today's economy, you must have a skilled workforce with specialized training. The education attainment levels among Indigenous (First Nation, Métis, and Inuit) people are lower than non-indigenous people. The graph on the left side of Figure 10 indicates that 29% of Indigenous people in Canada did not attain a certificate, diploma, or degree while 13% of non-Indigenous people did.[44] Data specific to Alberta was not available from Statistics Canada.

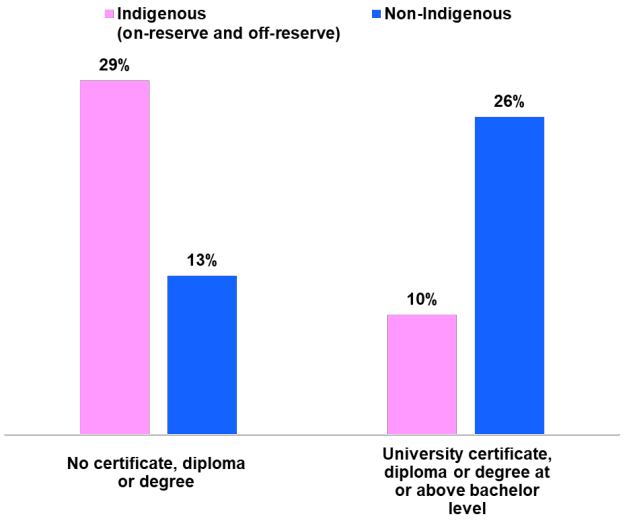


Figure 10 – Comparison of education attainment levels – indigenous verses non-indigenous.

[40] Olds College; *iPad Integration*; YouTube; 2013-02-22.

[41] Ontario; *2017-18 Education Funding Engagement Guide*; Ministry of Education.

[42] Google G Suite is a set of intelligent apps including Gmail, Docs, Drive, and Calendar.

[43] Cardinal, Mike – Band Manager, Tallcree First Nation; Telephone conversation; 2017-04-13.

[44] *Distribution of the population aged 25 to 64 (total and with Aboriginal identity), by sex and highest certificate, diploma or degree* – Table 477-0096; Statistics Canada; 2011.

The Tallcree First Nation is interested in providing more educational opportunities for its people (which will lead to more employment opportunities). They are redesigning and implementing a new curriculum and training opportunities, which will be based on communication with post-secondary institutions using videoconferencing and platforms such as Skype and Facetime. They need to confidently know that their system is capable of the required bandwidth and streaming. After distance learning with the Northern Alberta Institute of Technology (NAIT) failed due to inadequate Internet bandwidth, Tallcree First Nation and NAIT collaborated on a pilot program, involving NAIT deploying mobile education units to the Tallcree reserves in the High Level area for trade-related training (e.g., electrical, millwright).

The use of learning management systems is proliferating in Alberta.[45] These software applications support administration, documentation, tracking, reporting, and delivery of educational courses or training programs. In some cases, access is made available for parents to review a student's assignments, progress, or other content and provide feedback. Enabled by technology, teaching and learning is moving away from '*point-in-time-assessment'* to a more continual assessment of learning. It is estimated that 80% of the districts in Alberta's K-12 system is moving towards some degree of Google-based platform. Google developed a blended learning platform, Google Classroom, for schools that aims to simplify creating, distributing, and grading assignments in a paperless way. It was introduced as a feature of G Suite for Education 2014.

For students, high-speed broadband can offer a higher level of authenticity as they gain access to '*real-world'* audiences for collaboration or feedback.

4.4.3 Entrepreneurship

Three generations ago, for example, the opportunity was to electrify everything (i.e., take manual product X (say, a manual pump), add electricity, and obtain new, enhanced, and more valuable product Y (electrical pump)). Now, the opportunity is to add intelligence to everything (i.e., take dump product X (laundry), add intelligence, and obtain a new, enhanced, and more valuable product Y (clothes that tell a washing machine how to wash them)).[46] Likewise for many other services:

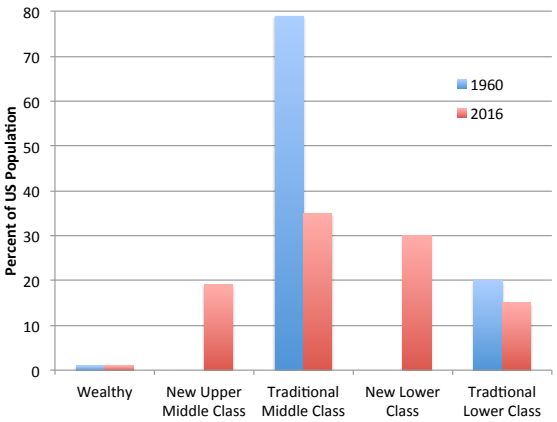
- Medical: after winning Jeopardy in 2011, Watson was repurposed to do medical diagnoses. It has since moved to the cloud and variations are being developed to provide the services to medical practitioners world-wide;[47]
- Stock Portfolios: manage stock indices and currency exchanges to optimize and balance portfolios in real time vs once a year;
- Real Estate: match buyers and sellers and suggest optimal financing packages; and
- Project Management: take into account change orders, weather, traffic, currency exchange rates, and so on.
- Law: sift through mountains of evidence and legal arguments and suggest lines of defense.

[45] Luedtke, Ralph – Senior Manager, Education Technology and Hauschildt, Dave – Education Manager, Technology Leadership Branch, Field Services Sector, Alberta Education; Telephone Conversation; 2017-05-04.

[46] Kelly, Kevin; The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future; Penguin; 2016-06-07.

[47] Watson has also been made available as a general purpose artificial intelligence (AI) engine that can be harnessed by going to: https://www.ibm.com/communities/analytics/watson-analytics/

4.4.4 Employment



Within this changing environment, the days of good, stable, middle-class jobs and the age-old advice, '*go to college, get a job, get married, buy a house, raise kids, and retire on a good pension*' are over. Of the jobs left, one in three will be converted to software, robots, and smart machines within eight years, half will be susceptible within 20 years, and both high and low skilled members of the workforce will be affected.[48] To thrive, it's becoming more about '*go create a job*' than the traditional '*go find a job*'.[49]

All the tools one needs are online – help[4,50], computing, and storage resources[51] are available at scale and are virtually free – all you need is a capable network. A small sampling of the resources available in key categories appears in Table 4 below. All you need is a capable fibre network to support the digital traffic.

Table 4 – Online Resources

Computing Resources	Intelligence on demand	https://www.ibm.com/communities/analytics/watson-analytics/
	Unlimited computing power	https://aws.amazon.com/ec2/
	Quantum computing	https://aws.amazon.com/ec2/
Education	Tailoring skills to employment requirements	https://www.coursera.org https://www.khanacademy.org
Employment / Hiring	Contingent work	https://www.freelancer.com/
	Matching individuals to traditional jobs	http://www.careerbuilder.ca https://www.linkedin.com https://www.monster.ca
Product Development	Design	https://99designs.ca
	Invention platform	https://www.quirky.com
Venture Funds		https://grow.indiegogo.com https://www.kickstarter.com

4.4.5 Healthcare

Need for Productivity Improvements in Healthcare

In 2016, Canada's total health expenditures reached an estimated $228.1 billion—representing 11.1 per cent of total GDP or $6,299 per Canadian. Despite the recent slowdown in health spending

[48] *The Americans We've Left Behind;* Trends Magazine; 2016-03.

[49] Friedman, Thomas L.; Thank you for Being Late; Farrar, Strauss, and Giroux; 2016-11-22.

[50] Quirky, for examples, provides all the resources needed to turn an idea into an actual product – https://www.quirky.com

[51] For traditional computing, see: https://aws.amazon.com/ec2/ ; for quantum computing, see: http://1qbit.com

growth, Canada's looming baby-boom bulge is likely to have a major impact on health and social service demand and expenditures.[52]

As future health care funding is estimated to consume between 44% and 55% of provincial and territorial revenues, there are concerns that without additional strategic funding, Canada's provinces and territories will need to find substantial annual productivity improvements to maintain the health care spending and service levels.[52]

Alberta is moving towards community-based care, which includes shifting from a focus on hospitals and facilities to more community-based care closer to home, planning and structuring health care around people and their community, and enabling Albertans to be active partners in their own health.[53]

Health system capacity in rural and remote areas

There is a need for trained healthcare workers to provide continuing care and other health services if the transition of the system from '*hospital to community'* is to be successful. In professions where staff levels are sufficient, unequal distribution across Alberta remains a factor, with particular difficulty in recruiting to rural and remote areas where the planned expansion of home and community care services is most needed.[54]

The percentage of physicians practising in rural and remote areas in Alberta has decreased. Despite growth in Alberta's overall physician supply, physician access continues to be an issue in many rural and remote areas as well as in some urban areas. These trends also impact the affordability and sustainability of the health system.[55]

Digital Health Technologies

The following short video by Canada Health Infoway (Infoway) describes some of the digital innovations in healthcare, which assist in tackling some of the issues mentioned above:[56]

https://www.infoway-inforoute.ca/en/component/edocman/resources/videos/3068-innovation-in-health-care?Itemid=101

Infoway defines digital health technologies as telehealth and remote patient monitoring (RPM) (also know as telehomecare); drug information systems; diagnostic imaging systems; and physician office and electronic medical records (EMRs).

The Alberta SuperNet supports telehealth in Alberta. Currently this model of healthcare delivery or tool primarily uses videoconferencing technology with the equipment located at videoconference sites in the communities or in nearby communities. The evolution of this remote service would allow for '*virtual visits'*, where consultations would take place directly in the patient's home and on any device. The ability to provide virtual care has significant cost saving for providers and patients.

RPM is transforming traditional healthcare service delivery models in Canada and has the potential to improve patient outcomes through self-management and home-based care and decrease the use of

---

[52] Brichta, Jessica, Dinh, Thy, and Stonebridge, Carole; *A Road Map to Health System Sustainability, CASHC Compendium Report, 2011-16.* Conference Board of Canada; 2017-05.

[53] Alberta Budget 2017, Fiscal Plan 2017-20, Expense.

[54] Alberta Health Business Plan 2017-20.

[55] *Physician Resource Planning*; Alberta Health. 2017-02-14.

[56] *Innovation in Healthcare*; Canada Health Infoway; 2017-08-28.

health system resources. Figure 11 shows the relationship between technology complexity and patient acuity as well as the associated impact on the use the healthcare system resources, both in health resource intensity and per capita costs.[57]

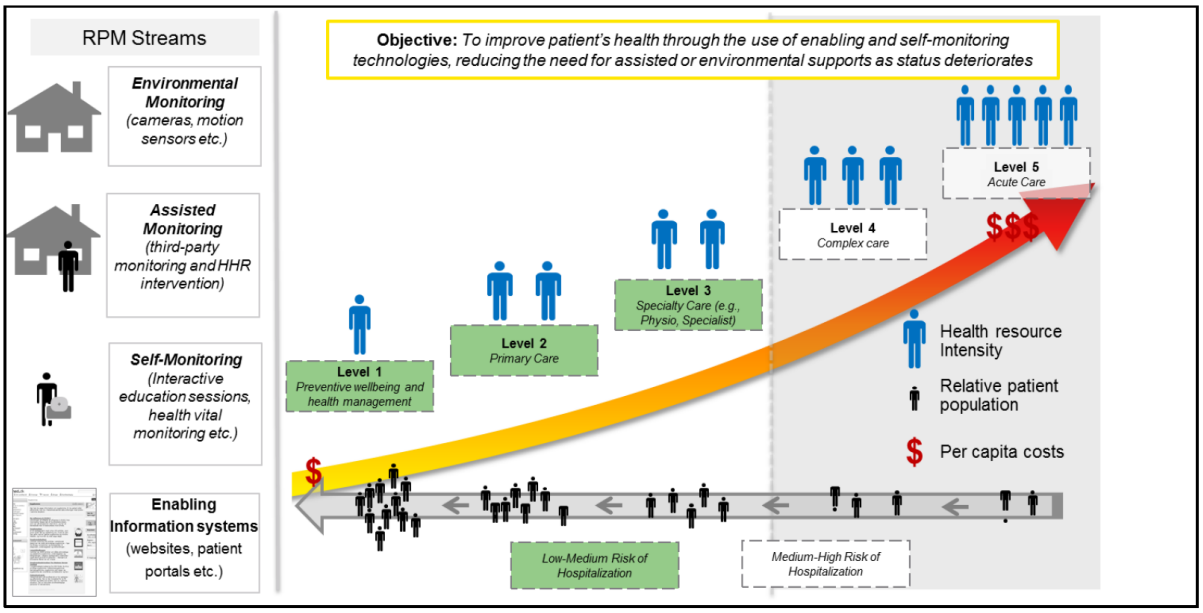


Figure 11 – Continuum of patient acuity and use of healthcare system resources.

Infoway's RPM study found evidence of the benefits shown in Table 5.[58]

Table 5 – Benefits of Remote Patient Monitoring

	Benefits
Quality	▸ ↑ **Patient satisfaction** ▸ ↑ **Patient compliance** ▸ ↑ **Quality of life** ▸ Promote integrated care
Access	▸ ↓ **Caregiver burden** ▸ ↑ Access to specialists ▸ ↑ Dissemination of health data
Productivity	▸ ↓ **ED visits/hospitalizations** ▸ ↓ **Per client health $** ▸ ↓ Per client care time

The increasing adoption of the Internet of Things (IoT) technology is resulting in the convergence of mobile, social, and sensors. By integrating data collected from IoT sensors, wearables, and connected patient monitoring devices with applications such as EMR, clinical professionals can focus on leveraging that data to apply the most appropriate clinical protocols. Computer-based intelligence will also play an

[57] *Connecting Patients with Providers – A Pan-Canadian Study on Remote Patient Monitoring;* Ernst & Young for Canada Health Infoway; 2014-06.

[58] *Connecting Patients with Providers – A Pan-Canadian Study on Remote Patient Monitoring;* Ernst & Young for Canada Health Infoway; 2014-06.

important role in turning data collected via IoT-enabled sensors into actionable information and insights for both patients and clinicians.[59]

Recently Infoway selected TELUS Health to be the technical solution provider for PrescribeIT, a e-prescribing service. The multi-jurisdiction e-prescribing service will promote medication safety and greater convenience and efficiency for patients and providers. Infoway describes the benefits of e-prescribing in the following video:[60]

https://www.infoway-inforoute.ca/en/component/edocman/resources/toolkits/knowing-is-better-for-clinicians/videos/3093-the-benefits-of-e-prescribing?Itemid=101

According to Canada Health Infoway, digital health technologies result in an estimated $2.5 billion in annual benefits (2015 study) for Canada. Figure 12 shows momentum building in the adoption and use of these technologies. As well it breakouts out each technologies' contribution, with telehealth and telehomecare contributed an estimated $407 million in 2015. Extrapolation of these telehealth and telehomecare data to estimate the annual benefits for 2017 resulted in $681 million. Softer benefits include improved patient quality of care, outcomes, comfort, and safety; access to specialists, timeliness, and productivity.

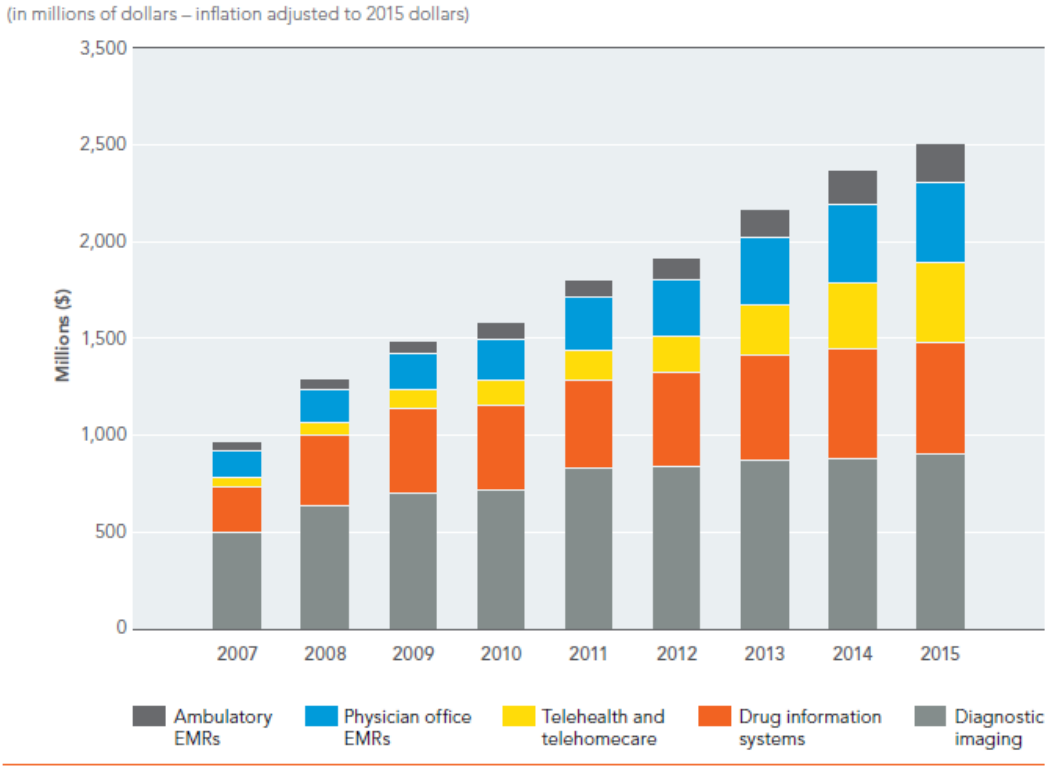


Figure 12 – Adoption and use of digital health technologies in Canada.

Quantifiable rural telehealth benefits include potentially generating local revenues for lab work and pharmacies as well as savings in travel cost, lost wages and hospital costs. These were the findings of the

[59] *Vendor Spotlight – Making Digital Transformation Real for Healthcare and Life Sciences Organizations;* IDC Health Insights; 2017-01

[60] *The Benefits of e-Prescribing*; Canada Health Infoway; 2017-08-28.

National Telephone Co-operatives Association (NTCA) – The Rural Broadband Association. National average estimates of annual cost savings were done on a per medical facility basis and after conversion to Canadian dollars are as follows:[61]

- Travel savings - $7,654;
- Lost wages - $4,593;
- Hospital cost savings - $27,898;
- Increased lab work revenues - $12,320 to $53,386 per type of procedure; and
- Increased local pharmacy revenues - $3,104 to $8,352, depending on the specific drug prescribed.

4.4.6 Government Delivery of Public Services

Organizations around the world are riding the digital transformation wave to drive innovation. In addition to innovation, the government sector is also looking to digital transformation to improve operational effectiveness and efficiency, often leveraging SMACi technologies. Astute governments are integrating ICT in their operations across multiple domains and jurisdictions to generate sustainable public value.[62] Figure 13 shows four key areas of focus for governments.

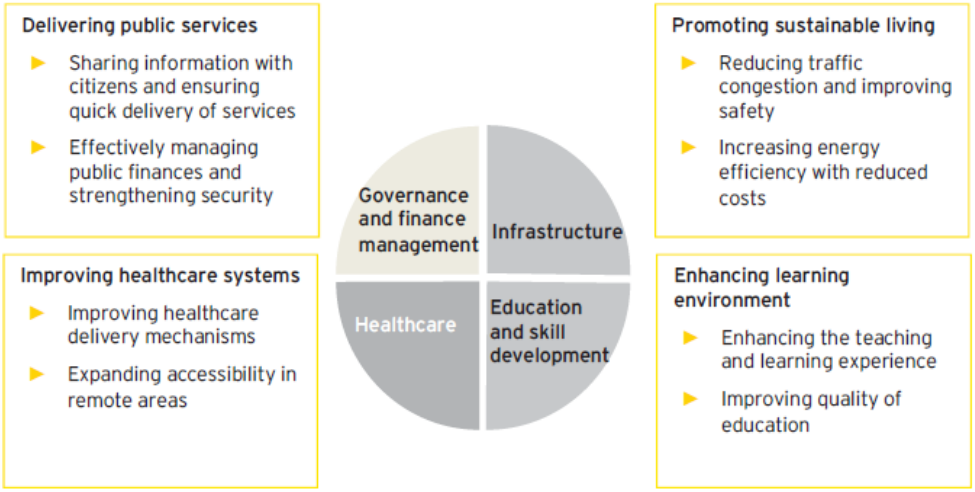


Figure 13 – Government sector – areas of digital transformation.

With advent of social media, citizens are now communicating and interacting differently than ever before with each other, the companies they do business with, and the service providers they rely on for healthcare, education, and other services. Public service delivery needs to accommodate these changes and embrace new channels and approaches. And this is why delivery is shifting away from specialized agencies and discrete services towards more streamlined, citizen-centric processes, as demonstrated in Figure 13.[62]

[61] Estimates were converted to Canadian dollars using the Bank of Canada's average exchange rate for the month of March 2017.

[62] *Imagining the Digital Future – How Digital Themes are Transforming Companies Across Industries;* Ernst & Young; 2015-02.

5 Current State

5.1 Context

The current state establishes the present situation ('what is') – an inventory, as it relates to broadband – current service providers; assets that could potentially be leveraged to support enhancing broadband infrastructure; and current and planned civil infrastructure and works that can significantly reduce the cost of laying fibre conduit. Essentially, the starting point and premise of the *Northern Alberta Broadband Preparedness Project* is to build on what's already or soon to be in place.

Specifically, the current state data collection and analysis focuses on the following:

- Determining the population size and number of dwellings (and growth/decline rates) of each community and business counts by REDA and municipality. Estimating the percentages of aerial and buried utility (power) infrastructure by community. Identifying relevant economic, industrial, political, and social developments. Communities include all types of municipalities (urban, rural, and specialized) as well as First Nations and Métis Settlements.
- Identifying the current state of community plans and strategies – i.e., is broadband included in current municipal, First Nations, and Métis Settlements plans; what factors impact each community's capability to pursue broadband/fibre initiatives; what role could broadband play in addressing individual community's challenges; and where would each community like to be with respect to broadband in the near- and long-term? Where possible, local issues, barriers, and constraints relevant to potentially deploying fibre infrastructure are documented, and the level of broadband policy and planning support established by the entities are identified.
- Developing a clear picture of the broadband service providers and the service options that are available to communities on a community-by-community basis. Service providers can be classified as Wireless Internet Service Providers (WISPs)/fixed wireless, mobility/cellular, wireline ISPs and serve residential, business, and wholesale customers. Services can be provided using radio frequency, optical fibre, copper twisted pair, and coaxial cable.
- Creating an inventory of local and regional assets – community- or privately-owned. Communications towers, fibre networks, and utilities transmission/distribution lines can potentially be leveraged to support enhanced broadband and extend broadband infrastructure deeper into a community.
- Identifying planned public and private sector major projects within northern Alberta as well as planned community/local capital projects and civil works, which can provide an opportunity to incorporate fibre conduit during construction to save network deployment costs.

The methodology used to develop the current state is described in Appendix 13.2.

5.2 Regional Profile

As shown in Table 6, the current state data collection and analysis focuses on two towns, one county, four First Nations, and Paddle Prairie Métis Settlement within the Regional Economic Development Initiative for Northwest Alberta (REDI) region. A map of the REDI region is shown in Figure 14. Please visit REDI's website for more information http://www.rediregion.ca/.

The region is geographically located in the northwestern corner of Alberta. Its land supports boreal forest while the flat portions are suitable for agriculture in this remote part of Alberta. There are many active grain farmers in the La Crete area. The La Crete area has a unique growing climate, with extended daylight hours during the summer growing season, which result in improved crop yields.

Table 6 – REDI Communities

Towns	Counties	First Nations	Métis Settlement
High Level Rainbow Lake	Mackenzie	Beaver* Dene Tha'* Little Red River* Tallcree*	Paddle Prairie

*Community resides within the northern Alberta study area and the NADC region but is not presently a member of a REDA.

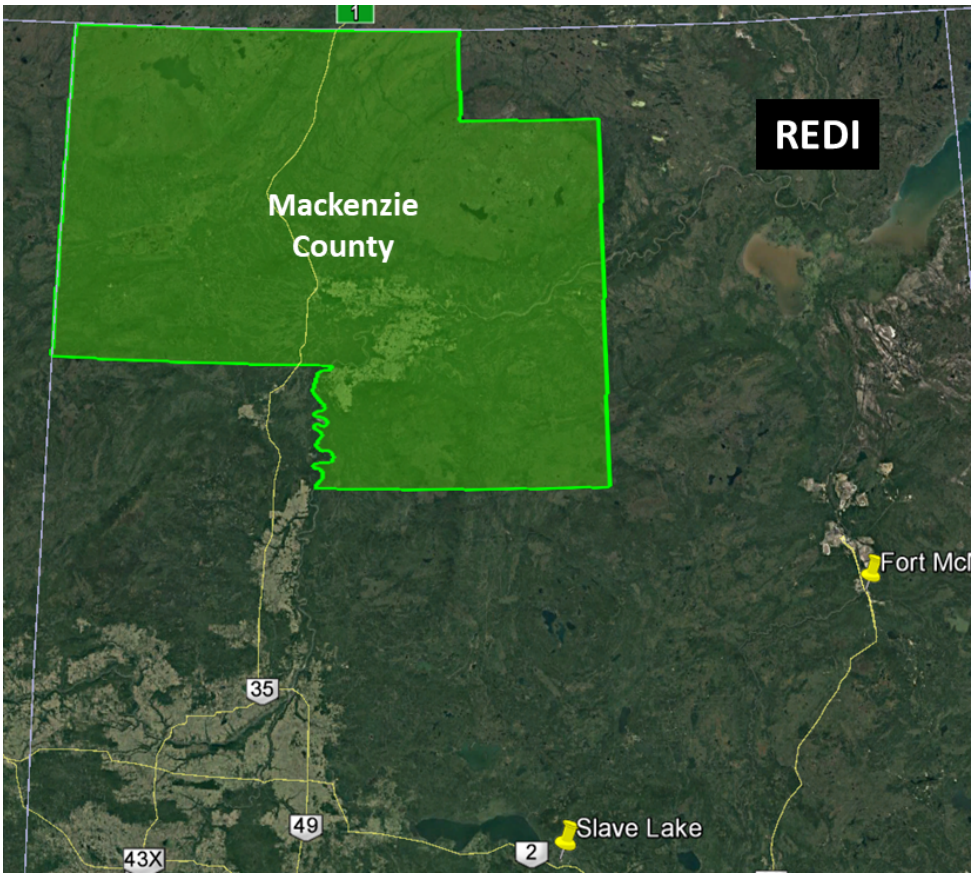


Figure 14 – REDI region.

The region is home to approximately 23,000 residents. Table 7 provides a breakdown by municipality (rural and urban), and First Nation as well as five-year population growth trends and compound annual growth rates (CAGRs). Twenty-eight percent of the region's residents live on First Nations reserves.

Although the 2016 Statistics Canada Census indicates that the population of Mackenzie has increased slightly (2.2%), the County's own 2015 Census shows an increase of 7.5% over the five-year period of 2011 to 2015.[63] The Town of High Level completed its own population census subsequent to the Federal census. Population growth was 2.6% compared to its earlier municipal census in 2015.

[63] Mackenzie County; *2015 Municipal Census*.

The hamlet with the largest population is La Crete (3,376 people) and represents almost 30% of the population within the County. Realizing the rich farmland in the La Crete area, a large number of Mennonites relocated to the area in the early 1930s. They have large families - household size of 10 to 14 are common and population growth has been described as '*intense*'. Youth find employment within the community and, therefore, stay in La Crete. These factors fuel the demand for housing (50 to 80 houses are built annually), and the price of property in the La Crete area.[64]

Most of the First Nations populations have grown between 2011 and 2016, especially the Tallcree First Nation (approximately 30%). The Little Red River Cree First Nation is also growing and has a population comparable to High Level.

Table 7 – Population & Population Growth Trends

Municipality	Rural				Urban					First Nations (FN)				
	Population (2016)	CAGR (%) (2011-2016)	5-Year Trend (%) & Direction		City/Town/ Village	Population (2016)	CAGR (%) (2011-2016)	5-Year Trend (%) & Direction		Reserve / Settlement	Population (2016)	CAGR (%) (2011-2016)	5-Year Trend (%) & Direction	
Mackenzie, County	11,171	0.4	2.2	▲	High Level	3,922	na	na		Beaver First	434	1.6	8.2	▲
					Rainbow Lk.	795	-1.8	-8.6	▼	Dene Tha'	1,900	na	na	
										Little Red River	3,530	na	na	
										Tallcree	484	4.9	29.9	▲
Northern Lights, County										Paddle Prairie (Métis)	544	-0.6	-3.2	▼
Total	11,171					4,717				**Total - FN**	6,348			
										Total - Métis	544			

CAGR – Compound Annual Growth Rate

Total Population = **22,780**

Source: Statistics Canada Census 2011 and 2016, High Level Municipal Census 2017, Little Red River Cree.

There are 826 businesses (with employees) in the REDI region. As shown in Table 8 and Figure 15, almost 50% of the businesses are involved in three industries: (1) construction; (2) agriculture, forestry, fishing, and hunting; and (3) transportation and warehousing. The North American Industry Classification System (NAICS) was used to classify the industries. '*Other Industries'* segment (14.5%) shown in the Figure 15 chart includes industries that individually contribute between 3.0% and 0.1% to the category.[65] The Tolko Industries Ltd.'s lumber sawmill in the High Level area received a temporary permit from the government to operate its incinerator to burn their accumulating '*hog'* pile. Hog is a co-product of the lumber milling process. It is the bark that is removed from the logs when they first come into the sawmill. The company now has a plan in place.[66] The provincial plan to protect caribou herds in the area will have

[64] Neufeld, Larry – Manager, La Crete and Area Chamber of Commerce; Telephone conversation; 2017-03-10.

[65] Real estate and rental and leasing; manufacturing; wholesale trade; finance and insurance; information and cultural industries; educational services; arts, entertainment and recreation; public administration; management of companies and enterprises; and utilities.

[66] Dolling, Joe, Woodlands Manager, Tolko Industries Ltd. – High Level; Telephone conversation; 2017-05-11.

a socioeconomic impact as 1.8 million hectares is being proposed for conservation and permanent protection by the end of 2017.[67]

Table 8 – Number of Businesses (with employees) by Industry

Industry	Businesses	Percent (%)
Construction	143	17.3
Agriculture, forestry, fishing, and hunting	140	16.9
Transportation and warehousing	112	13.6
Retail trade	90	10.9
Other services (except public administration)	67	8.1
Healthcare and social assistance	34	4.1
Administrative and support, waste management and remediation	34	4.1
Accommodation and food services	31	3.8
Mining, quarrying, and oil and gas extraction	29	3.5
Professional, scientific and technical services	26	3.1

Source: Calculations based on dataset provided by Alberta Economic Development & Trade, Economic Information & Analytics, Feb. 13, 2017.

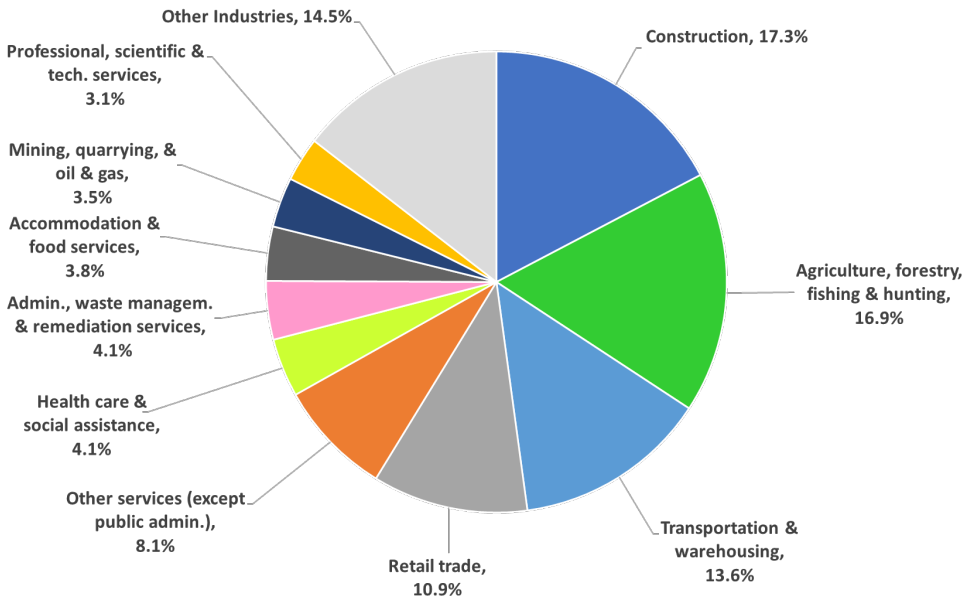


Figure 15 – Industry mix (based on business counts).

Agriculture and Agri-Food Canada has a research facility at Fort Vermilion. The site focuses primarily on the adaptation of technologies for this northern agricultural area. Additionally, the producer-

[67] *High Level Mayor Wants Socioeconomic Impact Assessment of Alberta Caribou Plan;* YL Country; 2016-09-05.

sponsored Mackenzie Applied Research Association (MARA) conducts applied agricultural research and demonstration trials in the REDI region.

Post secondary and continuing education in the REDI region are provided by the Northern Alberta Institute of Technology (NAIT), Northern Lakes College, Kayas Cultural College, and Athabasca University. Kayas Cultural College is an adult academic upgrading and training center, operated by the Little Red River Cree Nation.

5.3 Municipal, First Nations, and Métis Settlements Broadband Interests

Communities within REDI are at different stages in recognizing the importance of broadband services and connectivity to economic diversification, municipal sustainability, regional competitiveness, public service delivery, and quality of life.[68] Table 9 identifies the awareness and current state of municipal involvement and interest in broadband.

Table 9 – Involvement & Interest in Broadband[69]

Community	Enthusiastic	Interested *'Maybe'*	Need Help Too Small	Too Expensive	Status Quo	Don't Know[70]	No Response[71]
Towns							
High Level		X					
Rainbow Lake					X		
Counties/MDs							
Mackenzie	Very interested in improving Internet service delivery within the County. Its strategy is to support the local ISPs						
First Nations							
Beaver							X
Dene Tha'		X					
Little Red River	X						
Tall Cree	X						
Métis Settlement							
Paddle Prairie							X

[68] The five elements of broadband's importance were identified by the Calgary Regional Partnership. Economic Prosperity Steering Committee. *Request for Decision*. 8 September 2016. 3.

[69] Communities were asked to rate their involvement and interest in broadband. Broadband was defined as follows: In telecommunications, broadband is a wide bandwidth data transmission with an ability to simultaneously transport multiple signals and traffic types - the medium can be twisted-pair copper wiring, optical fibre, coaxial cable, or radio. Broadband service is characterized as offering symmetric bandwidth between 50 Mb/s and 1 gigabit (Gb/s)/1,000 Mb/s and higher (really unlimited bit rates) (symmetric meaning the upload bit rate is as fast as the download bit rate).

[70] Don't Know – the respondent was unable to rate their community's interest and involvement in broadband.

[71] No Response – the community did not respond to the inquiries regarding their community's interest and involvement in broadband.

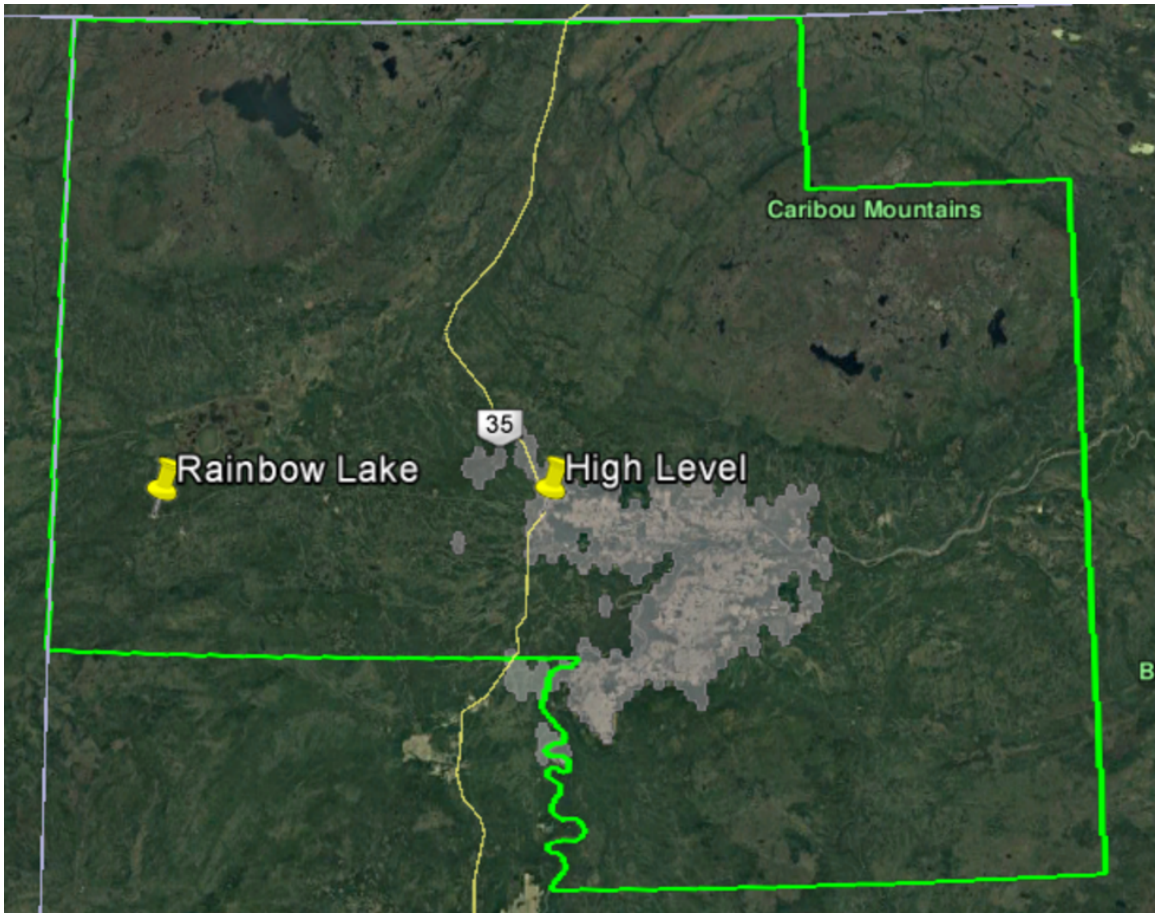
5.4 Current Service Providers, Services, and Infrastructure

5.4.1 Fixed Wireless-based

Current ISPs using fixed wireless technology in the REDI region include the following. Appendix 13.3 provides the details of their service offerings (Internet only – no bundling unless otherwise stated) and geographic coverage. The coverage maps of the individual service providers are those that were available on their websites at the time of the writing of this report.

- Arrow Technology Group,
- Corridor Communications (CCI),
- Little Red River First Nations, and
- XplorNet (fixed wireless and satellite-based).

According to the CRTC website[72], minimal 5 Mb/s down (toward the end-client) by 1 Mb/s up (from the end-client to the network) service is only available in the High Level area (i.e., the Town of High Level and to the west and southwest of the town) of the REDI region. A combined view of the fixed wireless coverage is shown in Figure 16 (light gray areaa).



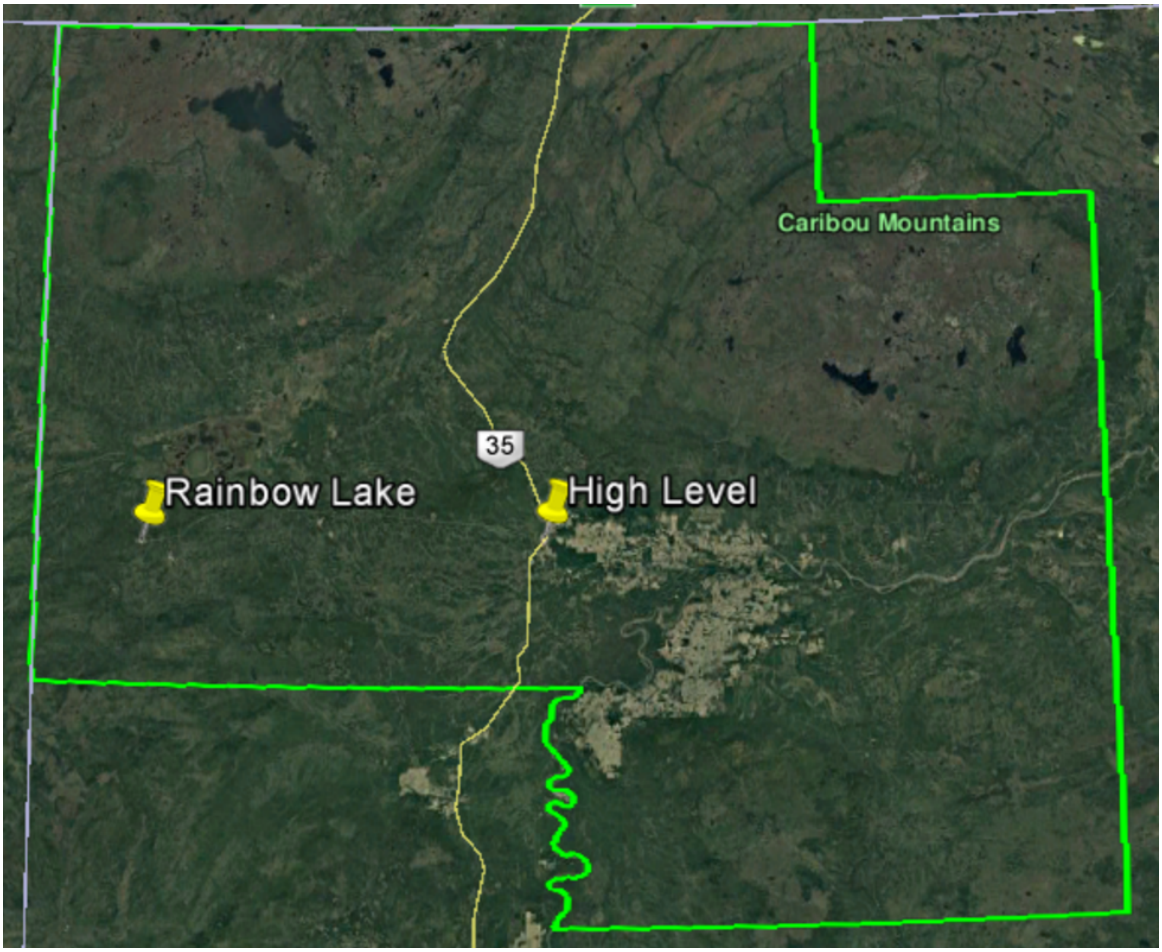
Source: http://www.crtc.gc.ca/eng/internet/internetcanada.htm

Figure 16 – Fixed wireless coverage.

[72] http://crtc.gc.ca/eng/internet/internetcanada.htm

5.4.2 Mobility

The lack of yellow areas in Figure 17 indicates that mobility data services are not available; however, the coverage maps in Appendix 13.4 suggest there is some coverage.

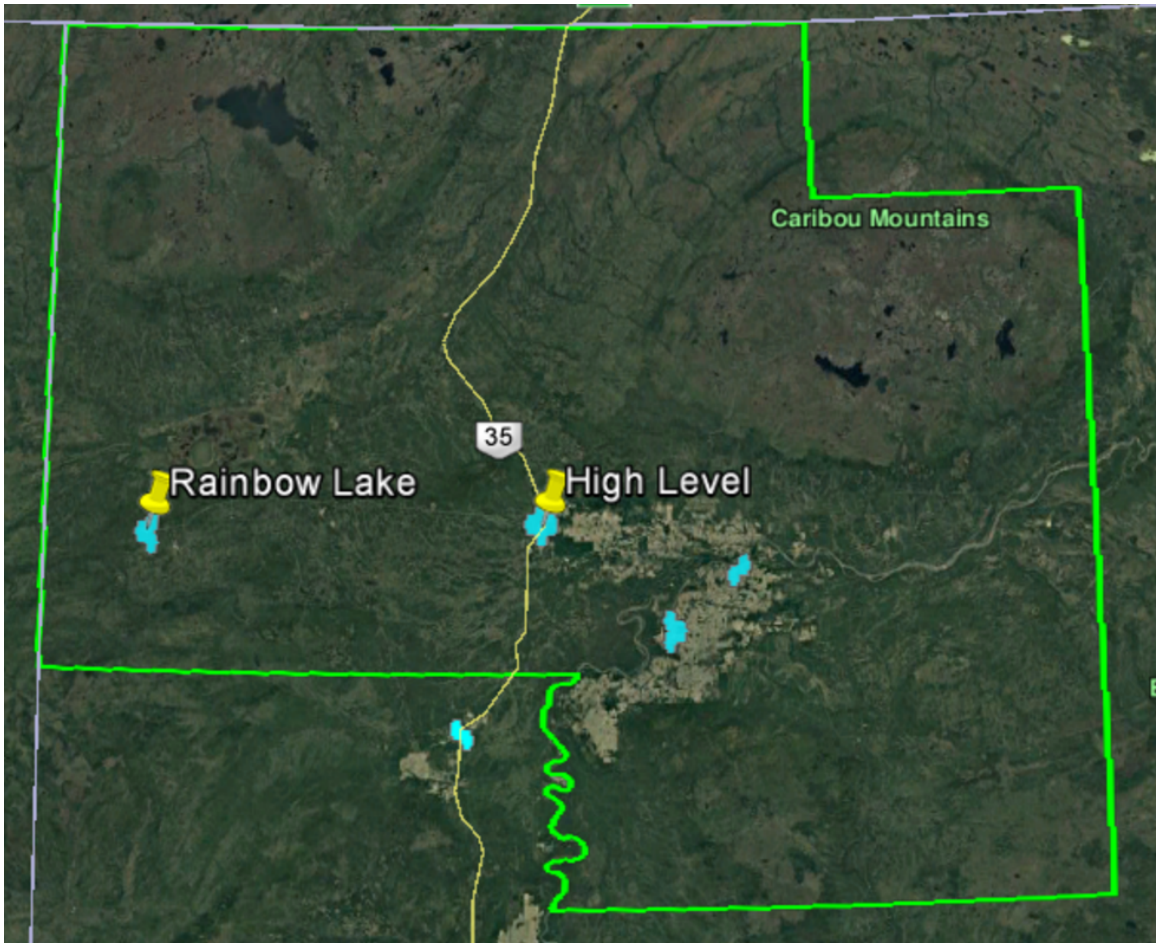


Source: http://www.crtc.gc.ca/eng/internet/internetcanada.htm

Figure 17 – Mobility data coverage.

5.4.3 Wireline-based – DSL

Digital Subscriber Line (DSL) refers to a group of last mile technologies that are used by wireline-based service providers such as TELUS in Alberta to provide broadband services over twisted-pair copper wiring. The local copper wire loop is a remnant from the days when (and how) the telephone company connected residential and business premises to the telephone company's network for the purposes of providing local and long-distance telephone services (and dial-up Internet services). Since DSL's performance degrades with distance, the technology is only deployed in urban areas where access distances are less than about two miles. In Figure 18, areas served via DSL technologies are shown in blue.



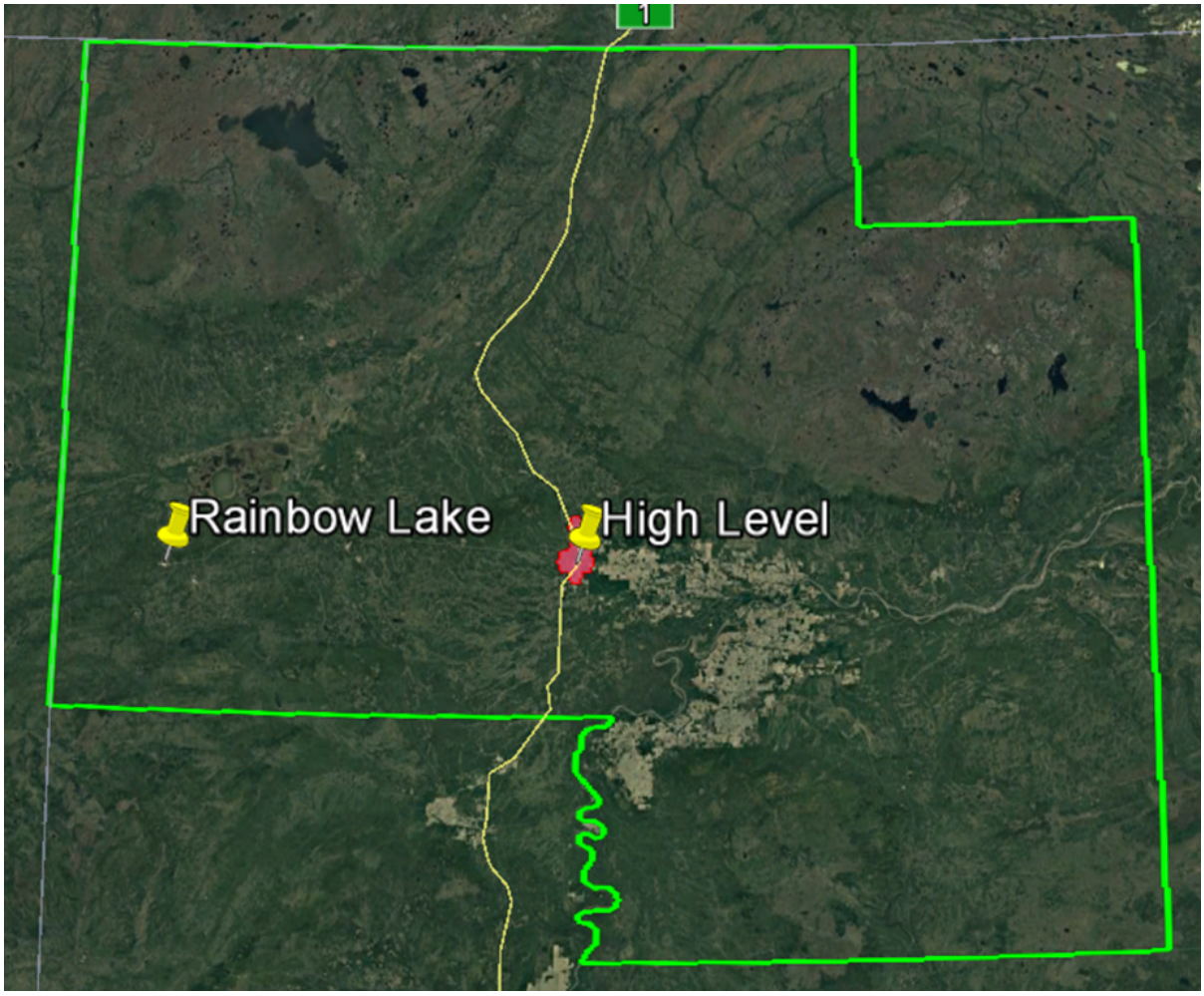
Source: http://www.crtc.gc.ca/eng/internet/internetcanada.htm

Figure 18 – DSL coverage.

5.4.4 Wireline-based – Coaxial Cable

NorthwesTel Inc. (NorthwesTel) and the Town of Rainbow Lake, originally television broadcast companies, use coaxial cable and modern cable modem technology to provide broadband services in the REDI region (red areas in Figure 19). The cable companies currently use the Data Over Cable Service Interface Specification (DOCSIS) 3.0 standard to achieve broadband speeds of 100 Mb/s or more over coaxial cable. According to the Cybera, *State of Alberta Infrastructure Report*, *"The next-generation DOCSIS 3.1 standard is expected to revolutionize hybrid fibre-coaxial cable connections by providing up to 10 Gb/s download and 1 Gb/s upload network throughput and significant improvements in latency."*[73]

[73] *State of Alberta Digital Infrastructure*.



Source: http://www.crtc.gc.ca/eng/internet/internetcanada.htm

Figure 19 – Coaxial cable coverage.

Maximum advertised wireline offerings are shown in Appendix 13.3. Since these are '*up to'* bit rates, during high usage periods, actual bit rates will be less. The offerings are highly asymmetric – upload and download bit rates differ significantly.

5.4.5 Internet Service Provider Wi-Fi

TELUS offers two WiFi locations in High Level and one location in Fort Vermilion.

5.4.6 Axia Fibre

Axia NetMedia provides retail services to corporate clients and, through AxiaConnect, provides fibre-based retail Internet services in a number of smaller communities. In exchange for access to a community's rights-of-way, Axia will consider investing in fibre-to-the-premise (FTTP) infrastructure in communities that can demonstrate that at least 30% of its residences and businesses are interested in purchasing Internet services from Axia once the '*closed-access'* network is built. To date, Axia has not announced any plans for FTTP deployments in any REDI community.

5.5 Backhaul Availability

5.5.1 Alberta SuperNet

The extent of the SuperNet within the REDI region is shown in Figure 20. The green lines represent the Bell-operated Base Area Network (BAN) portion while the blue lines represent the Axia-operated Extended Area Network (EAN) segments. A more general discussion about the SuperNet is presented in Appendix 13.5.

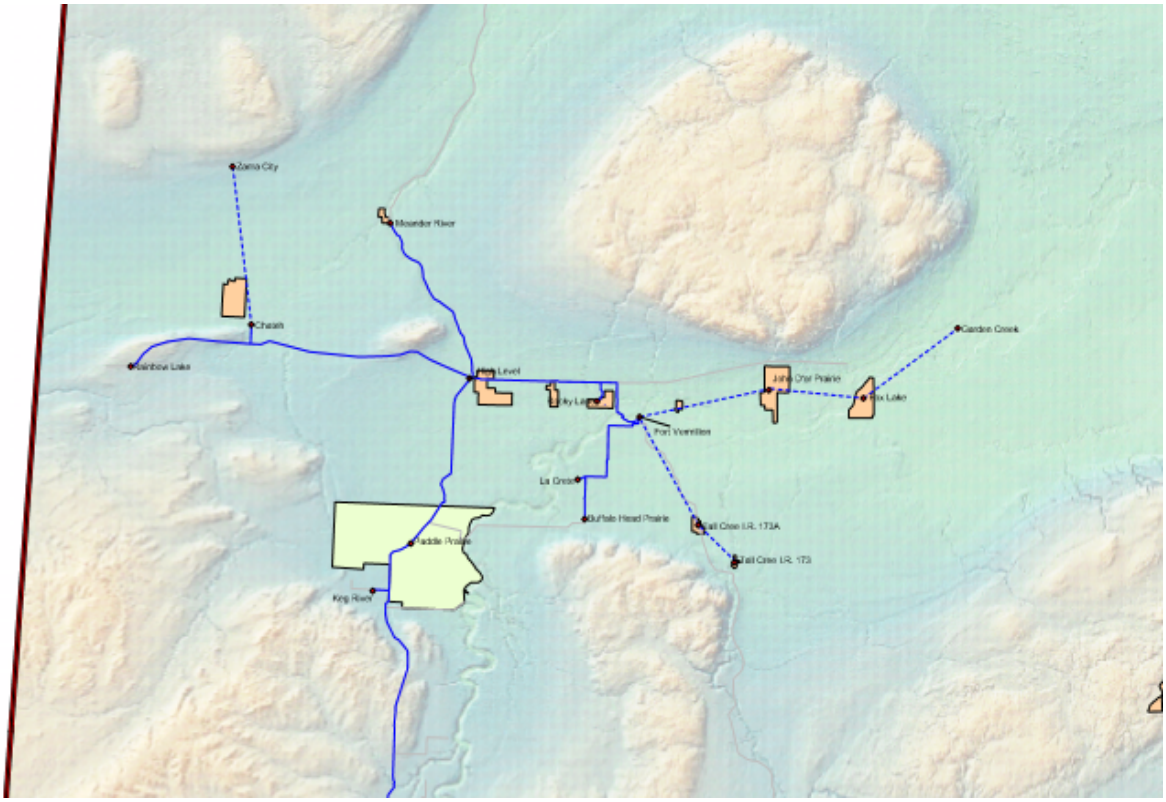


Figure 20 – SuperNet infrastructure.

In 2018, municipalities, First Nations, and Métis Settlements requiring access to fibre transport for backhaul to Edmonton may want to consider Bell or TELUS.

'Reliability of the Internet and cellular service are both big concerns for the region. There is only one fibre optic line feeding most of northwest Alberta including the entire County.

NorthwesTel is the only service provider that has their primary infrastructure north of the County and does not rely on backhaul fibre facilities coming from the South. This positions NorthwesTel uniquely as a possible alternative to the current service providers and offers potential redundancy solutions, especially in case of emergencies.[74]

5.5.2 TELUS Wholesale

Except under a non-disclosure agreement, TELUS does not provide maps of fibre assets.

[74] Mackenzie County; *Mackenzie County, Sustainability Plan 2015 – January 2016*, Approved, 2017-01-12.

5.6 Existing Infrastructure

5.6.1 Towers and Other Tall Structures

When planning a broadband build-out it is important to build on what is already in place. The key inquiry for the current state analysis is what assets does the community have that can be provided at little or no incremental cost that improve the economics of the broadband deployment and operations? Assets include existing towers, fibre and community networks, which the community might be using for communications or asset management. Existing and possible access to tall structures or buildings are also important to inventory for the potential placement of wireless equipment.

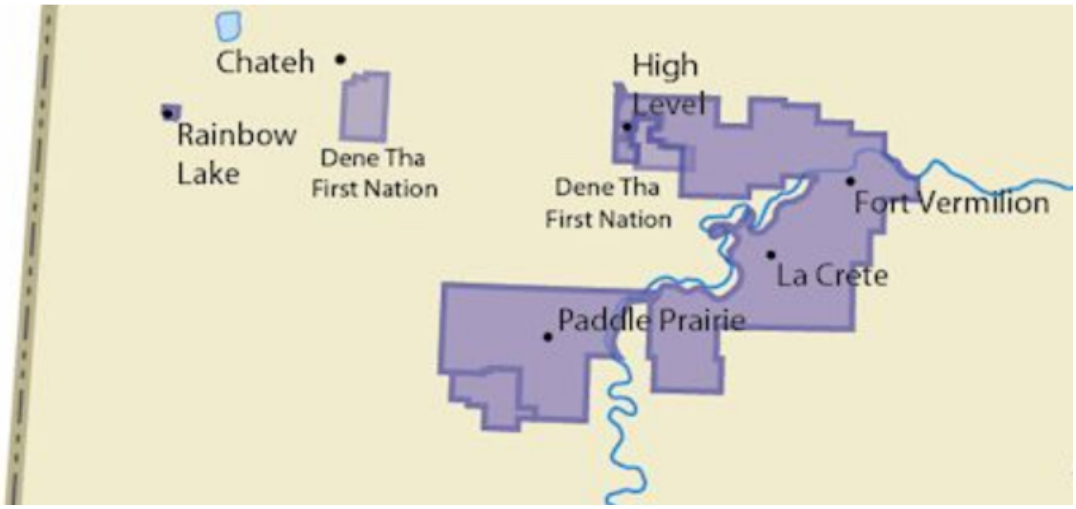
The Dene Tha' and Tallcree First Nations received grant funding to expand high-speed Internet access to unserved areas and address gaps in coverage from Alberta Agriculture and Forestry's *Final Mile Rural Community Program* in the 2012/2013 timeframe. High Level has the following taller buildings which can potentially be used to support broadband hardware: the High Level Arena Complex, the administration building, the swimming pool, and the fire hall.

5.6.2 Utility Infrastructure

The existing overhead and underground transmission and distribution lines of electric utility companies (ATCO Electric) and natural gas co-operatives (co-ops) present deployment options for community broadband builds - access to and installing fibre cables to travel along utility poles, in ducts and conduit, and along rights-of-way can significantly improve the economics of broadband service expansion projects and network deployments. Inquiries about the availability of communications spaces on utility providers' poles and where multi-party trench agreements exist will be made during the preliminary infrastructure design phase of a broadband network. Appendix 13.6 shows ATCO Electric's and Fortis Alberta's respective service areas in northern Alberta. s

5.6.2.1 Gas Co-operatvies

In the 1960s, non-profit gas co-ops were formed to supply natural gas to rural Alberta - franchise areas were designated. Mackenzie County's rural gas co-operative's distribution infrastructure is being used to expand broadband coverage throughout the county and its First Nations communities (Figure 21).



Source: Federation of Alberta Gas Co-ops, http://www.fedgas.com/Map. Accessed Feb. 1, 2017.

Figure 21 – Gas co-operatives.

5.6.3 First Nations Fibre Infrastructure

First Nations Technical Services Advisory Group (TSAG) is a non-profit organization established by the Chiefs of Alberta to provide technical support and training to First Nations in the Treaty 6, 7, and 8 regions. In 2008, TSAG partnered with Health Canada to develop the network components (fibre connections) at First Nations health centres to support First Nations' telemedicine. With Health Canada funding and TSAG project management, community fibre networks connections were made to the Alberta SuperNet points-of-presence on each or close to each First Nations in 2011. Upon completion, each First Nations became the owner of its local fibre network. As shown in Figure 22, First Nations' schools, health centres, band administration offices, and water treatment plants are now connected.

TSAG operates a state-of-the-art Network Operations Centre (NOC). The NOC's real time network monitoring ensures availability, network security/SPAM filtering, telehealth bridge management, and support, and applications (high-speed connectivity and remote water monitoring system for water treatment plants, OneHealth.ca, and FirstNationsTH.ca). Onehealth.ca is a national health portal that provides information and services to health care professionals working in First Nations communities. FirstNationsTH.ca – Telehealth provides education and travel-free patient and health care assessments via video-conferencing.

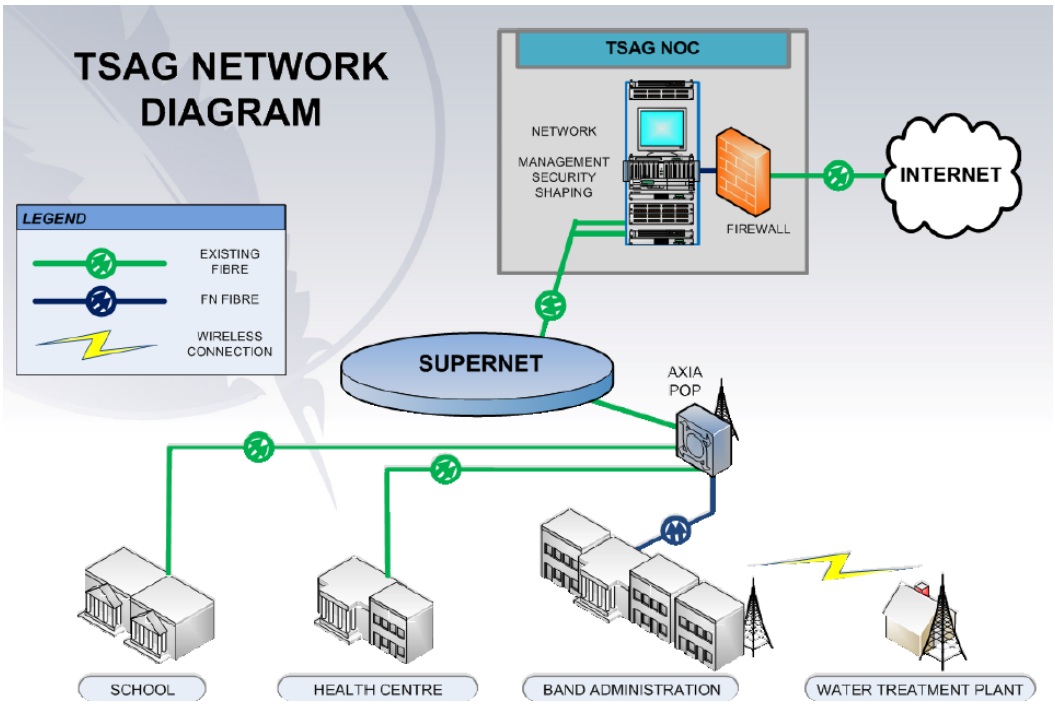


Figure 22 – TSAG network diagram.

5.7 Planned Infrastructure

5.7.1 Major Projects

Private and public sector capital projects in the REDI region include school modernization and road work. Where possible these projects maybe leveraged to reduce the costs associated with the deployment of broadband infrastructure. Figure 23 shows the capital projects in the within the REDI regions.[75]

[75] Alberta Major Projects, Economic Development and Trade; 2016-12; http://majorprojects.alberta.ca/

Figure 23 – Major projects.

5.7.2 Electricity Transmission Development Plans

As shown in Figure 24, local electricity load is supplied by 138/144 kV transmission lines in the REDI area.[76] In the long-term the rebuild the 144 kV line from Blumenort (near the Hamlet of La Crete) to High Level is proposed.

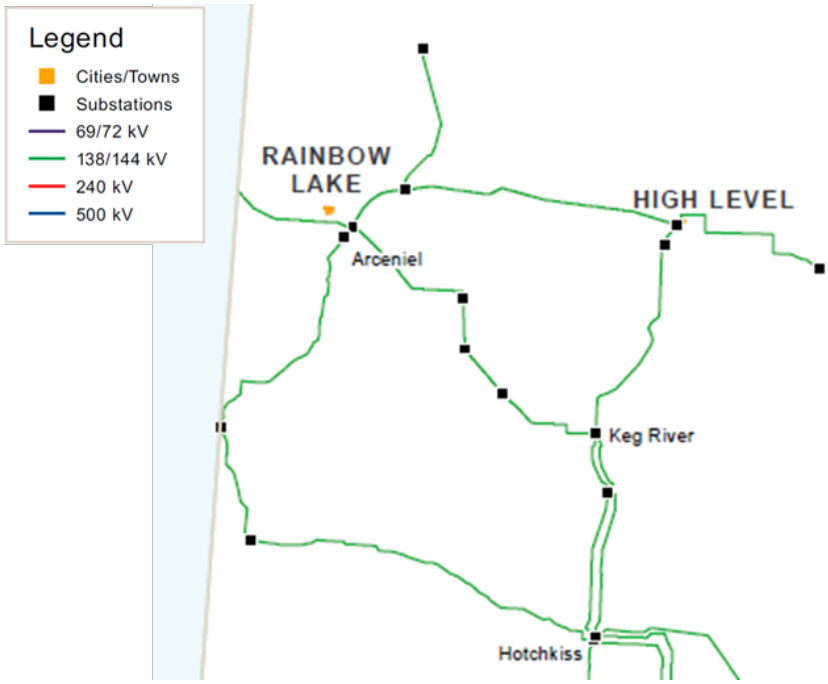


Figure 24 - Existing electricity transmission system.

[76] AESO.

5.7.3 Municipal Capital and Civil Works Projects

Leveraging civil infrastructure projects can reduce broadband deployment costs by 75%. Given civil infrastructure costs typically account for 70% of buried deployment costs, this is significant. Capital projects that involve trenching or erecting towers or poles such as during the development of new subdivisions, road construction, or the construction of rehabilitation of water or sewer lines are typical projects that can improve the economics, of community broadband projects.

The County of Mackenzie received approximately $1.8 million from the *Alberta Municipal Water/Wastewater Partnership (AMWWP)* for the La Crete sewage lagoon expansion**.**

The Federal *Small Communities Fund* (part of the New Building Canada Fund) for infrastructure projects, now includes a '*Connectivity and Broadband*' category. 2016 approved non-broadband projects within the REDI region include (figures shown are the Total Eligible Project Cost - Federal, Provincial, and Municipal).

- Rainbow Lake – Water distribution system rehabilitation $2.1 million, and
- Mackenzie County – Rural potable water infrastructure $5.3 million.

Table 10 shows the capital and civil works projects that the municipalities self-reported.

Table 10 – Municipal Capital & Civil Works Projects

Towns	
High Level	Road upgrades – on Highways 35 and 58 and on 100 Avenue
Rainbow Lake	Nothing planned
Counties	
Mackenzie	La Crete – commercial subdivision

6 Desired State

6.1 Context

The desired state establishes each communities' broadband vision, specifically within the next decade with each community breaking down their progress (within 3-, 5-, and 10-years) to realizing their vision.

Specifically, the desired state data collection and analysis focuses on the following:

- The most significant issues and challenges facing each community over the next five years and whether broadband can play a role in addressing these issues and challenges.
- Whether broadband is on each community Council's agenda.
- The factors that directly impact each community's capability to pursue a broadband/fibre initiative.
- Communities' short- and long-term broadband visions.
- Identifying communities, cluster of communities, or regions wishing to move forward with their broadband plans in the near-term (within three years).

The desired state informs the gap analysis and provides direction to the strategic options phase of the project, Phase 3. There are several options to close the gap between a community's current state and desired state. Although not exhaustive, the following is a list of options:

- Incorporating fibre network requirements during local and regional planning.
- Seek additional investment from the incumbent services providers in the urban centres.
- Support WISPs in rural areas.
- Subsidize private providers.
- Establish a community or regional broadband network (various models of ownership, governance, operation, and service provision, including laying fibre as basic infrastructure but leases the network to a private party to provide the electronics, marketing, and retail services).

The views expressed by those that participated in the community sessions and contributed during the research phase may not be inclusive of the entire community; however, this report is based on the knowledge gained and the information received as well as the author's ability to synthesize and summarise the same at the time of writing. More detail about how the desired state was developed can be found in Appendix 13.7.

6.2 Key Observations and Conclusions During Research and Analysis

This project has promoted conversations, questions, and general thinking about community broadband networks and their roles in urban and rural communities' futures. Broadband is recognized as a topic for today's conversations and discussions. Communities are asking questions such as the following:

- Do residents and businesses in my community want or need enhanced broadband?
- What will the network cost? Who will pay for it and who will own it?
- Will the network build be done in collaboration with the incumbents/ISPs?
- What happens to current ISPs?
- Will a current memorandum of understanding (MOU) with an incumbent provider or similar agreement with a prospective provider restrict a community's options in the future?
- How will the changes coming to the Alberta SuperNet operations contract affect us?
- Why isn't the provincial government providing incentives for communities to work together?
- How do you predict where technology is going to take us in the future?

6.2.1 Segmentation

During this project, it became increasingly evident that northern Alberta communities' interest in community-based broadband network concepts and models can be segmented based on population size. Larger urban centres (with populations greater than 5,000) comprise the first segment, largely '*selected*' already by the larger incumbent wireline-based ISPs. These communities generally do not see the benefits of a community-fibre initiative for themselves and prefer to leave the evolution of enhanced broadband services to the local incumbents.

Urban centres, with populations between approximately 1,000 and 5,000 people, represent the second segment. This segment is typically looking for solutions and expresses interest in working on regional solutions. The thought of doing their own community network build is too challenging and they have the perception that it would be too expensive. Furthermore, they do not believe they have the funding power, skills, or capacity needed for a community fibre initiative. AxiaConnect offers a compelling solution - seen as presenting a solution that requires the least cost and community involvement (learning, skills, capacity) in the short-term – often the longer-term implications (e.g., monopoly control of critical civic infrastructure) have not necessarily been envisioned at the time of the community's decision.

The third segment, and the segment with the most to gain from a community-led broadband effort, are towns and villages with populations less then approximately 1,000 people, counties, MDs, First Nations, and Métis Settlements. Today, they receive the poorest quality Internet services (if they receive service at all) and pay the most for these services. Their options are limited. Larger incumbent service providers do not have the financial incentive to serve this segment because its potential subscriber base is too small and too spreadout geographically (i.e., low population density). The concerns of this segment are attaining coverage for all residents and businesses; improved bandwidth/capacity; and securing access to affordable and reliable service.

6.2.2 Issues and Challenges

Typical issues and challenges identified by municipalities include the following:

- From an economic development perspective – the ability to attract and retain residents, businesses, and industry.
- From rural communities' perspective – the lack of access to reliable high-speed Internet restricts business opportunities and, in turn, negatively impacts the community's overall quality of life.
- Internet bandwidth and speeds and lack of connectivity to high-speed infrastructure (fibre) as well as limited availability and interest of broadband service providers.
- Retention of young people and entrepreneurs.
- Other critical infrastructure such as water, wastewater, and roads are aging and in need of repair, upgrading, or replacement.
- Maintaining current taxation levels.
- Addressing the requirements of the modernized *MGA*.
- Financial.
- Learners having sufficient bandwidth to do homework at home and the ability to access distant learning.
- Social (high unemployment rate and the ability to access employment opportunities online, youth leaving, and addiction).
- Loss of industry leads to the loss of the community's assessment/tax base, which is needed to fund critical infrastructure projects. As infrastructure declines, residents move away and the subsequent population decline translates into reduced core municipal grant funding (e.g., Municipal Sustainability Initiative (MSI)). If this vicious circle, as depicted in Figure 25, gains momentum it can spell the decline of a community.

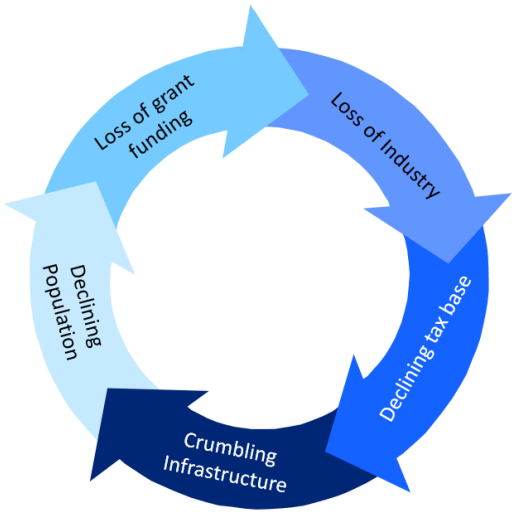


Figure 25 – Lack of high-speed broadband connectivity causes many issues.

In addition to several of the above challenges, some people living on First Nations reserves and Métis Settlements have the following challenges:

- Access to critical infrastructure and essential services such as roads, safe drinking water, and wastewater and waste disposal.
- Access to economic and business opportunities.
- Housing and living conditions.
- Financial stability.
- Bridging the socio-economic gap – lower labour market participation and employment rates.
- Lack of First Nations' capacity (i.e., people and skill sets).
- Access to educational opportunities and digital literacy (youth). "It's a well understood cycle. A good education leads to greater financial stability, which leads to increased opportunities for the next generation." [77]
- Maintenance and subject expertise and knowledge.

There is a need and the demand for improved and enhanced broadband services in northern Alberta communities; however, the key factor holding the majority of communities back from pursuing community-based broadband infrastructure is cost.

6.3 Broadband Visions – the Next 10 Years

Over the next 10 years, participation in the knowledge economy will become mandatory. To participate, fibre will be required either to directly connect to homes and business or to interconnect high bandwidth wireless access systems. During this period, current telecommunications infrastructure will largely be replaced with fibre, whether constructed on a private, public/private partnership, or on a public fibre utility basis and whether it is done with or without REDI involvement. REDI's municipalities and the region therefore have the option to be involved, shape their future, and ride the wave – or be drowned by it. Either way, the existing copper and coaxial cable infrastructure is about to be replaced and, depending on how that takes place, broader public benefits may be widely achieved or more limited as a

[77] Kronyk, Rhonda; *Indigenous on Campus*; New Trails. Spring 2017.

result. While progress is exponential, infrastructure deployment is not. To stay ahead of the curve (Figure 26), the decision time is now.

Figure 26 – Okay, Future … I'm Ready.

The range of interest in broadband varies considerably throughout the region, but even the most enthusiastic of the municipalities are still in the early stages of deciding which options to pursue and how. While a formal '*Desired State*' has not yet been agreed to in any of the municipalities, what follows is based on the assumption that, over the next five years, the majority may choose to facilitate the deployment of infrastructure to support a fully scalable broadband network ubiquitously available throughout their municipality and, if possible, the region as a whole. This would typically include a combination of an underlying fibre infrastructure with upgraded wireless services where fibre is not yet practical. Market-wise, the infrastructure would be available on an open-access basis to all service providers interested in serving municipal and regional businesses and residents. Whereas the municipalities do not wish to interfere with private enterprise in the services marketplace, they will entertain options relative to facilitating the underlying lit open-access fibre utility infrastructure.

Within the Regional Economic Development Initiative for Northwest Alberta (REDI) the communities or community clusters shown in Figure 27 have the greatest near-term broadband aspirations (likely a community hybrid fibre/fixed wireless solution). Specifically, they are the Town of High Level and the First Nations' communities of Dene Tha', Beaver First, Little Red River Cree, and Tall Cree.

Appendix 13.7 provides the details of each community's issues and challenges; whether fibre/broadband is on their Council's agenda; the factors impacting their community's capability to pursue a fibre/broadband initiative; and the 3-, 5-, and 10-year visions each community has as it relates to broadband.

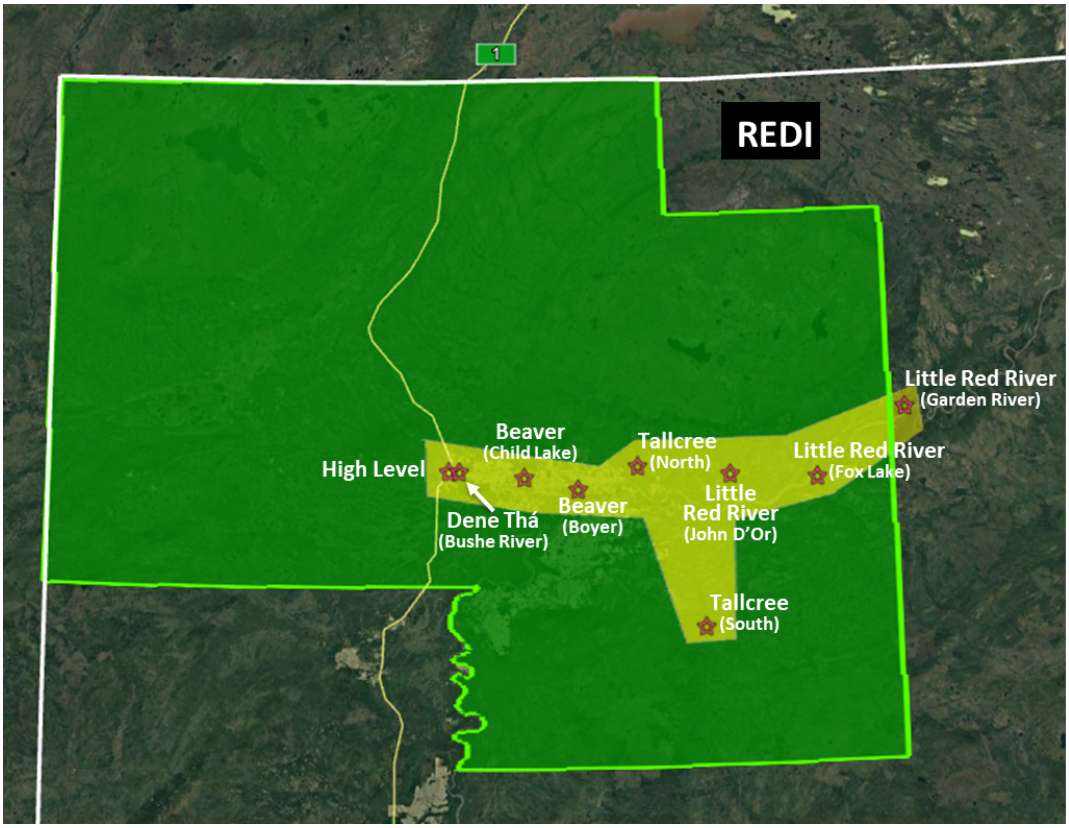


Figure 27 – Communities with near-term broadband plans.

7 Areas of Opportunity

7.1 Overview

The REDI region and its constituents have many options available to facilitate enhanced, more inclusive, and more affordable broadband infrastructure within its environs. Indeed, the options range from simply accelerating any currently planned broadband initiatives, to negotiating with the incumbents and potentially subsidizing private operators, to do-it-yourself (DIY) initiatives as exemplified by O-Net in Olds and Q-Net in Coquitlam.

In considering the options outlined below, note that in the broadband infrastructure game, a land-grab of sorts is currently underway and time is of the essence. The longer it takes communities to debate their options and assemble the required resources, the more time the traditional telecom and cable service providers have to replace aging infrastructure in their most profitable markets – the cities and towns – with fibre, which then removes valuable cashflow from more inclusive community-wide plays. To move forward quickly, REDI will likely need to take an active role with those communities most interested in moving ahead. As momentum develops and the issues are resolved, other communities could come onboard.

To be most effective, collaboration will also need to include both distribution and access networks within municipalities as well as the backhaul networks that link the communities together – an issue that will blur the more traditional REDI modus operandi in which their role is solely focused on coordination between communities and not on what each community elects to do itself.

7.2 Status Quo

For reasons ranging from a lack of resources, more important priorities, a belief that municipalities should not be in the infrastructure game, to satisfaction with current service levels, communities may elect to leave broadband to the existing players and not get involved. While this approach may work well for those in the more populated areas, experience to date suggests that those in the more rural areas could be waiting a long time.

Given the CRTC's recent framework decision, money to support infrastructure upgrades in the most rural areas will become available over the next fifteen years.[78] Indeed, the objective is to enable ubiquitous 50 by 10 Mb/s services by 2031. Proposed funding levels in support of this program are insufficient and affordability criteria have yet to be established.

7.3 Incremental

Should the REDI region or its constituents not have the support to '*jump in with both feet*', but position for a possible broadband play later, interim straightforward and inexpensive approaches include:

- Broadband Facilities Master Plan:
  - Carry out high-level boundary connections assessment to potential future back-haul locations;
  - Carry out high-Level Feeder Network assessment for development, re-development, and capital project inclusion of conduit/fibre/tower locations and/or ROW protection and agreements; and
  - Use as informed decision support when working with service providers, development community, and/or regional partners.
- Municipal Planning:

[78] http://www.crtc.gc.ca/eng/internet/internet.htm.

- Work with REDI and your neighbours to leverage staff capacity and resources;
- Develop a Broadband Services Strategic plan specific to your community;
- Embed fibre network requirements in internal IT planning processes; and
- Accelerate currently planned IT infrastructure deployment.

- Leverage Planned Civil Works:
  - Develop a policy for including installation of fibre conduit as part of applicable and appropriate town and county linear infrastructure projects, such as road (re)construction and water / wastewater projects.
- Position for the future
  - Require that the inclusion of fibre conduit be a mandatory requirement in all applications for new residential and businesses development permits; and
  - Adopt an inside wiring standard with Cat-5 wiring as the minimum standard.

As the civil construction accounts for some 70% of the cost of buried infrastructure deployment, leveraging civil works can reduce the deployment costs significantly. The only catch is that an overall plan is required upfront, thus the baseline need for a Broadband Facilities Master Plan, particularly if the work is to take place over a number of years – fibre ducting must be appropriately sized, have breakout points in suitable locations, and mesh with other components deployed.

7.4 Negotiate with Current Providers

7.4.1 Work with the Carriers and Seek their Investment

Over the past few years, both TELUS and Axia have been interested in and indeed installing fibre-to-the-premise (FTTP) networks in communities throughout Alberta. As shown in the adjacent summary slide of TELUS deployments, since 2014 and at a cost of $430M, TELUS' fibre has been deployed to 107,000 Alberta premises.[79] In addition to those in the table, TELUS has laid fibre in Cold Lake, Grande Prairie, Slave Lake, and Fort McMurray. TELUS plans to spend another $1.2 billion by year-end 2019.

Community	Premises	Community	Premises
Blackfalds	3.1k	Peace River	3.3k
Bonnyville	1.3k	Ponoka	0.9k
Calgary	33.3k	St. Paul	2.7k
Coaldale	2.8k	Stettler	2.6k
Didsbury	1.7k	Taber	3.6k
Drumheller	2.9k	Vegreville	3.1k
Edmonton	17.5k	Wainwright	3.3k
Edson	3.4k	Westlock	2.0k
Hinton	5.0k	Wetaskiwin	5.3k
Innisfail	3.2k	Misc Communities	13k

TELUS fibre in the selected communities is deployed at no cost to the municipality. Home and property owners are under no obligation to obtain services when granting permission for TELUS to place the fibre drop directly to their premises. Over fibre, TELUS offers Internet services at rates up to 150 by 150 Mb/s. Axia offers symmetric 1 Gb/s business and 100 Mb/s residential services[80] together with an option for other service providers to lease their fibre access lines. On the other hand, the CRTC will require TELUS to provide wholesale access to their fibre on some yet to be determined basis, whereas Axia will not be so encumbered.

[79] Mawji, Zainul. *Expanding Broadband Networks.* 12 September 2016.

[80] On Sept. 6, 2017, Axia began upgrading all 50 and 100 Mb/s subscribers to a symmetric 1 Gb/s service at no charge.

At this point, TELUS does not provide their retail service offerings over community fibre networks, even in smaller centres in which TELUS has not upgraded their plant to fibre, and in which community networks could provide TELUS with significantly more capacity than is available on TELUS' aging copper plant and do so with no requirement for a capital outlay. Given the momentum for community approaches that is developing within the province, though, TELUS' appears to be revisiting their approach and has recently expressed a renewed interest in working with communities to find an arrangement that works for both.

On the other hand, in return for access to a municipality's rights-of-way, Axia is offering to deploy fibre infrastructure throughout individual communities and offer Internet services at up to 1 Gb/s for residential and business clients should 30% of the addressable premises in the municipality show interest in subscribing to Axia's services. The offer is contingent on due diligence by Axia and the towns of Barnwell, Hanna, Fort Macleod, Nanton, Nobleford, Stirling, Raymond, and Vulcan now have town-wide FTTP service. Axia has also announced FTTP services for Fairview, Magrath, and Pincher Creek. Though Axia has approached a number of towns and villages in northern Alberta, as of yet, none are moving forward.

While merits of an essentially hassle-free and free, fibre infrastructure are self-evident, the Axia offer is neither without cost nor risk. All revenues from the network would accrue to Axia's shareholders and once deployed, Axia would have monopoly control over critical civic infrastructure. No infrastructure would be deployed into the surrounding MD and the network would not be open in the traditional sense of the term.

7.4.2 Establish a Private-Public Partnership (PPP)

While there is a lot of merit to PPP arrangements, care must be taken to ensure ongoing alignment of private and public interests. The two largest broadband deployments to date are in Ontario – the Eastern Ontario Regional Network (EORN) and the SouthWest Integrated Fibre Technology (SWIFT) initiative – and are both PPP arrangements. While in both cases, significant public money was/is involved, after seven years, the EORN network assets vest to the private partners while the SWIFT funding recipients gain the option to divest some or all of their network assets at that time. Once control of the infrastructure moves to private industry, the communities may lose many of the gains made.

A second more subtle concern is that of minimizing conflict of interest and ensuring a level playing field when the focus of the PPP arrangement is to deploy and operate infrastructure on an open-access basis and when the private partners are vertically integrated players wishing to utilize the network to deliver their own service portfolios. To maintain transparency and ensure a level playing field, operators of open-access networks must be structurally separate from those providing retails services over the network.

7.4.3 Subsidize a Private Partner

The traditional market driven, private sector led business model is not providing many municipalities within the REDI region with the infrastructure they desire due to a lack of financial incentives. By directly subsidizing a private operator, municipalities could provide that operator with adequate incentive. Given that this approach in essence anoints a select supplier, it does provide the supplier with a market advantage in an area where market forces do not prevail and municipalities need to carefully consider the terms under which these arrangements are made. On the plus-side, the arrangement keeps the infrastructure deployment and operations in the hands of private sector players and minimizes Council involvement and resources. On the other hand, the selected supplier will end up with a defacto monopoly in the municipality.

When the arrangements involve fixed wireless players, additional issues arise from the fact that the infrastructure does not scale well. While an upfront subsidy may result in infrastructure adequate for current requirements, additional capital infusions will likely be required to meet ever increasing capacity demands.

In lieu of a direct subsidy, some counties reduce the cost of services deployment in rural areas by providing tower infrastructure for the ISPs to use. The Special Areas Board in south east Alberta adopted this approach and then contracted a single provider, Netago, to provide services. With input into where the towers were located, the arrangement has been a successful one. Parkland County, on the other hand, wished to promote competition amongst ISPs in the County and operate the tower infrastructure on an operating cost recovery basis. To attract mobility and the Alberta First Responders Radio Communications System (AFRRCS) equipment onto the towers to help cashflow, robust (expensive) towers were constructed at sites which were a compromise amongst the requirements of the Mobility, ISP, and AFRRCS providers. Few liked the locations, competition amongst the ISPs did not materialize, and the County is now struggling to find a way to make things work.

7.5 Develop a Community or Regional Fibre Network

Given the lack of interest from the incumbent telecom and cable operators to serve REDI region, the municipalities – including the Counties and MDs – in the REDI region may wish to consider establishing their own community and/or regional fibre network. Indeed, with an appropriate and sustainable business model, individual municipalities and/or sub-regions could establish, either on their own or in partnership, a fibre-based community and/or regional broadband network and operate it as a fourth utility. Indeed, inclusive, county-wide initiatives are currently being established in Big Lakes County, the County of Vermilion River, and the County of Grande Prairie. Potential business models are shown in Figure 28.

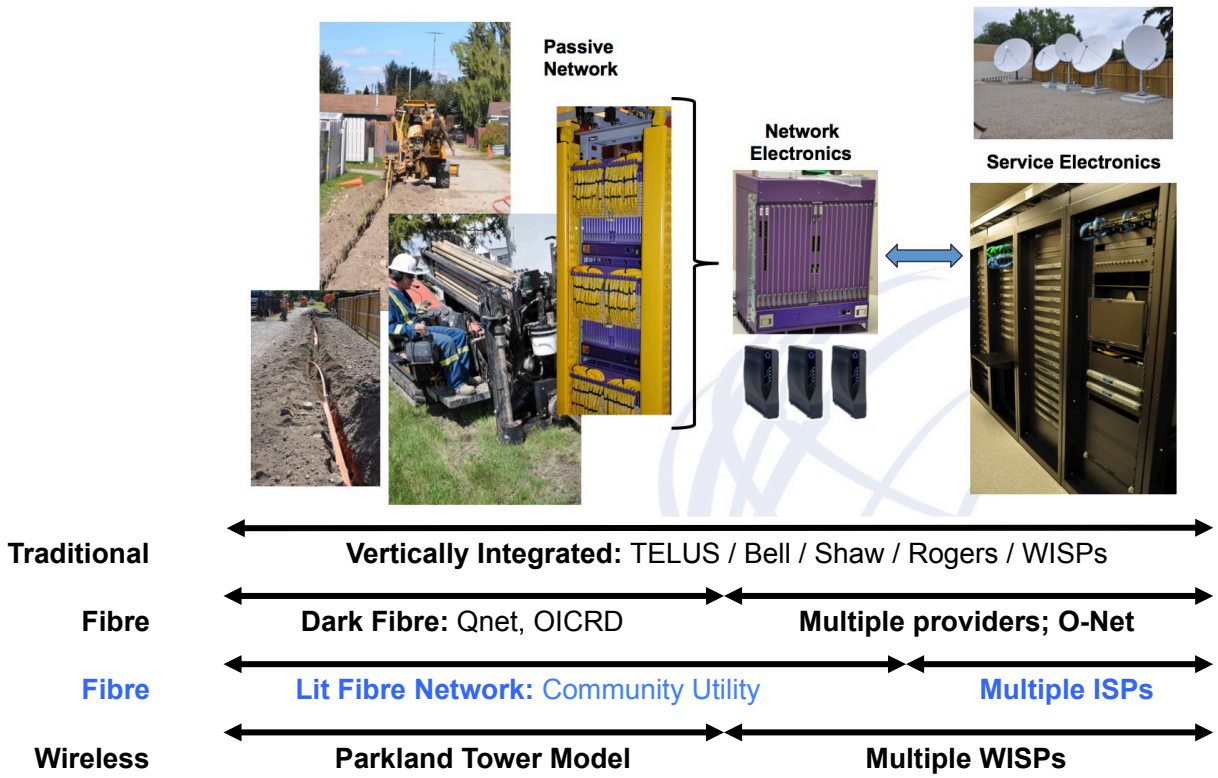


Figure 28 – Types of business models.

As shown by deployments throughout Europe and the Far East, utility infrastructure could enable a municipality to provide competitive service providers equal access to unmatched symmetric bandwidth capabilities and thereby enable the delivery of a variety of novel community-based intelligent community services (as well as entertainment services such as HDTV) to its residents and businesses.

Should a municipality wish to consider this option, a number of the more common business model, financing, and governance options available to help make it happen appear in Table 11. Common models are outlined in more detail in Appendix 13.8. Should either a community or group of communities elect to move forward, these options are typically evaluated as part of the business case / business planning process.

While regional and municipal options do involve more responsibilities and risks than simply transferring control to private enterprise, they come with significant advantages. As well, to manage the level of their involvement, close to turn-key options do exist and can be easily incorporated into regional, sub-regional, and community deployment programs – once the community has decided upon the business and governance structure, operational arrangements, and financing.

Table 11 – Common Business Model, Financing, and Governance Options

Business Model	Funding	Governance
• Conduit only • Wholesale fibre: dark or lit • Retail: open or closed and with or without service partners	• Debt financed via ACFA • MSI Funding / Grants • Co-operative • Utility/Power • Private-public partnership (PPP) • Private Equity • Combinations of the above	• Commission • Municipality • Municipal Services Corporation • Co-operative • Not-for-profit • Private

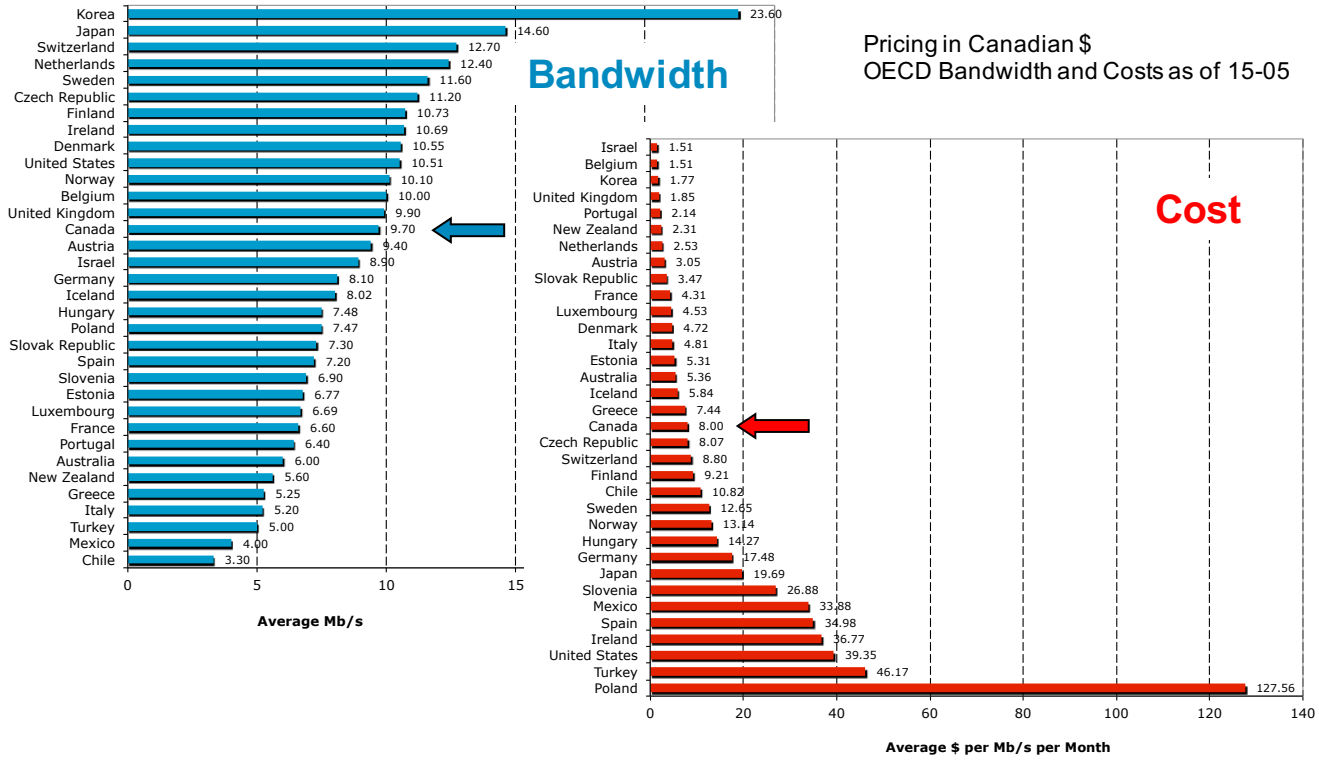
8 Community and Regional Fibre Networks

8.1 Learning from Abroad

As foreign governments recognize the merits of open utility-based fibre infrastructure, Canada is falling increasingly behind. To date, neither the federal nor provincial governments have yet placed the emphasis on technology policy to address broadband to the extent evident internationally. Though the initiative has since changed course, in 2009, Australia announced plans to spend AUD$31 billion on a National Broadband Network. In 2013, France pledged €20 billion for superfast broadband. In the US, of 48 reporting states, 25 have established a broadband office.

The impact of this lack of policy is evident in the OECD statistics charted in Figure 29 on the next page – the latest statistics available.[81] As of early 2016, Canada ranked 14th in terms of average available download bandwidth, 18th in terms of cost, and 23rd in terms of fibre penetration. Whereas in Korea, the average download bit rate of 23.6 Mb/s is available for $ 1.77/mo. (13.3 Mb/s/$), in Canada, one can only expect 9.7 Mb/s for $8.00/mo. (1.21 Mb/s/$). Fibre penetration in Korea is 69.39% compared to 5.32% in Canada.

Though not shown, but perhaps more telling is a comparison between Internet service availability here and in, say, Västerås, Sweden. Whereas at most locations in Canada you may have the option of two wireline providers (TELUS and Shaw in Western Canada), in Västerås, there are over 30. At least part of the issue is the Federal government's belief in facilities-based competition – versus the services-based regime in Sweden. By restricting service provisioning to those which can afford to deploy a network, the number of providers is necessarily small. When services can be provided over an open network provided on a utility basis, many can.



[81] http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm#map

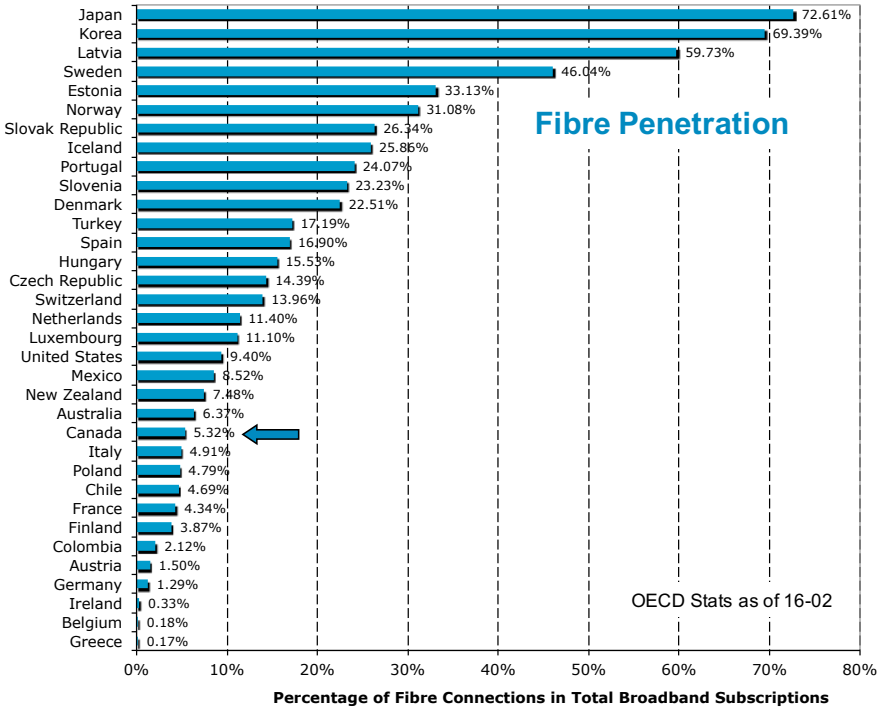


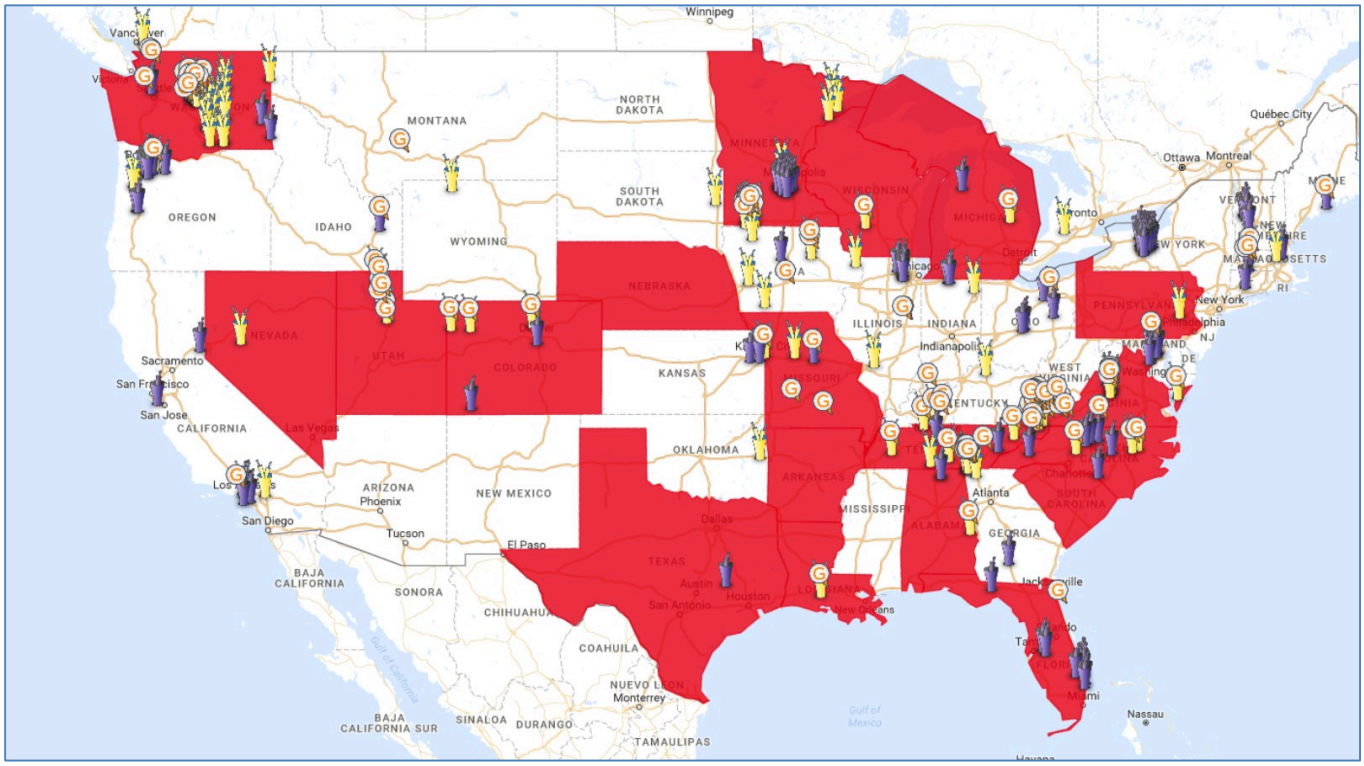
Figure 29 – International Internet service levels and pricing comparison.

An overview of the key models with which municipal and regional networks are becoming available internationally appears in Appendix 13.8.

Thanks to the initial Google Fibre Competition close to a decade ago, the value of broadband networks to both economic development and quality of life within communities, became self-evident to the more than a thousand initial applicants and, since then, community networks in the US have flourished. In addition to the over 200 networks shown in Figure 30, for example, 77 communities have publicly-owned cable networks and over 185 serve at least some portions of their community with fibre[82] – and this is in-spite of the fact that many US states actively inhibit (due to incumbent lobbying efforts) such approaches. Competition for talent amongst these '*gig*' communities is intense – see for example, the ads in Figure 31.

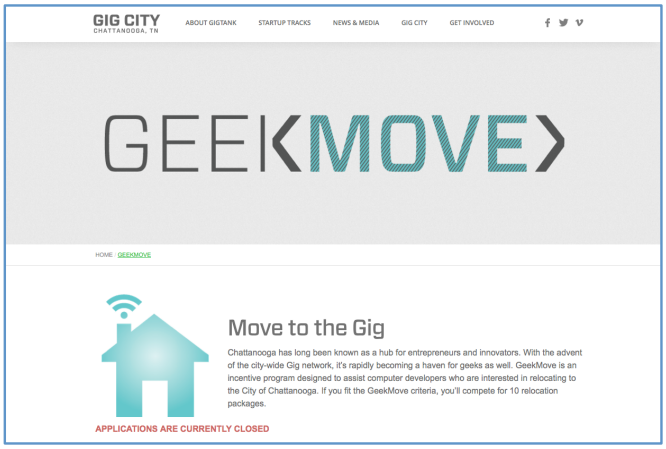
The business model options each community favours results from considerations ranging from size to risk, to priorities, complexity, and vision. What would seem to make the most sense to communities in northern Alberta would be a lit open-access utility-based model which can then leverage local ISP capabilities and resources and promote market-based competition on the services side. Personnel from Big Lakes County recently visited three public utility districts in the northwest US – specifically those in Grant, Chelan, and Douglas counties. All three operate open-access utility fibre networks for the benefit of all ISPs in their respective counties. All three are willing to share their learnings and expertise with municipalities in northern Alberta.

[82] https://muninetworks.org/communitymap

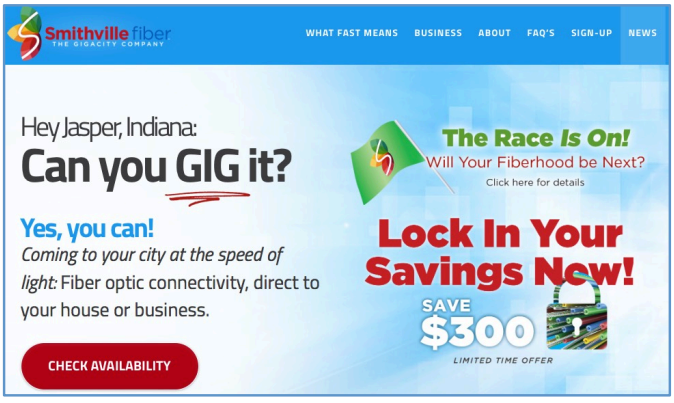


	95 Communities with a publicly owned FTTP network reaching most or all of the community.		Over 110 communities in 24 states with a publicly owned network offering at least 1 Gb/s services
	Over 130 communities with publicly owned dark fibre available.		19 states have barriers in place that discourage or prevent local communities from deciding locally if such an investment is a wise decision.

Figure 30 – Municipal fibre networks in the United States (updated to May, 2017).



Chattanooga, TN



Smithville, TN

Figure 31 – Talent competition among United States '*Gig*' communities.

8.2 Municipal Networks in Canada

8.2.1 Overview

As shown in Figure 32, Alberta ranks 11th out of 13 provinces and territories based on download speed – and Alberta has the SuperNet. Even Alberta's two largest cities do not fair well – Calgary and Edmonton are respectively ranked 11th and 21st out of 25.

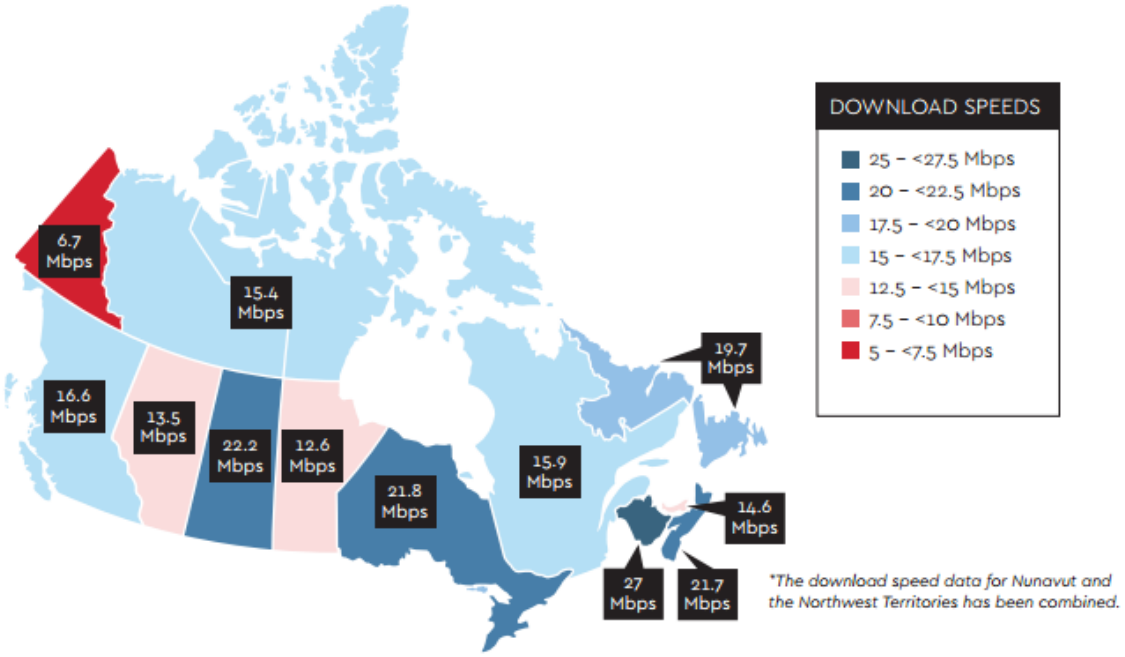


Figure 32 – Comparative Internet speeds across Canada.[83]

Whereas there are over 110 communities in 24 US states with publicly owned networks offering 1 Gb/s services, in Canada, there is only one – that in Olds, Alberta. Given the many initiatives currently underway, this may change. Some key initiatives in Alberta are outlined below.

8.2.2 Alberta SouthWest

The Alberta SouthWest Regional Alliance initiated the first regional broadband strategy encompassing the member municipal districts of Pincher Creek, Cardston, Willow Creek, Crowsnest Pass, Ranchland, and Waterton together with the towns of Claresholm, Fort Macleod, Granum, Nanton, Pincher Creek, and Stavely, and the villages of Cowley, Glenwood, and Hill Spring. The initial work focused on community engagement, education, and strategy. Once completed, the focus shifted to individual community support. Once completed, the final phase was to refine the regional strategy and facilitate implementation. While well-intended, an unintended consequence of their focus on helping individual members move forward, was that some of their larger members then did so – on their own – to some extent stranding both the smaller members and inhibiting a more regional approach. Axia's concurrent offer of '*free and hassle-free fibre*' to communities in the Region that could show 30% of their addressable premises interested in Axia services simply compounded the problem. With the defacto foreclosure of a more regional approach, the regional level work did not proceed to implementation.

[83] CIRA; *Canada's Internet Performance: National Provincial and Municipal Analysis*; 2016-04.

Of the communities moving ahead on their own, the current success story is Waterton. Leveraging a Shared Services Canada project to upgrade water facilities throughout the Waterton townsite, the town moved to deploy fibre to every premise in Waterton and now provides a rich set of both fibre and WiFi based Internet services throughout the town and campground. Now that the TELUS backhaul links have been upgraded to 1 Gb/s, O-Net will begin providing a full triple-play (Internet, telephone, and television) portfolio to residential clients when the tourist season begins to wind down this fall.

Perhaps partially in light of their experience, there is a growing recognition of the importance of multi-community scale. Indeed, the sharing of resources and expertise from dense to less dense areas enables a broader deployment of fibre in the areas to be served. In early 2016, the Alberta Government introduced a grants program aimed at facilitating regional scale planning-level broadband studies. Under the program, matching grants of up to $20 000 are made available to interested REDAs. Under the Community and Regional Economic Support (CARES) program, an additional allotment of up to $100,000 per REDA/yr for two years became available in 2017.

8.2.3 City of Calgary

In September, 2015, the City of Calgary adopted a dark fibre strategy based on the argument that facilitating Internet-based services is only one of six networks requiring connectivity[84] in the City and that providing the required connectivity for all networks is the City's responsibility, particularly as space in their rights of way is limited and the City does not wish to have their streets continually dug up – see Figure 33.

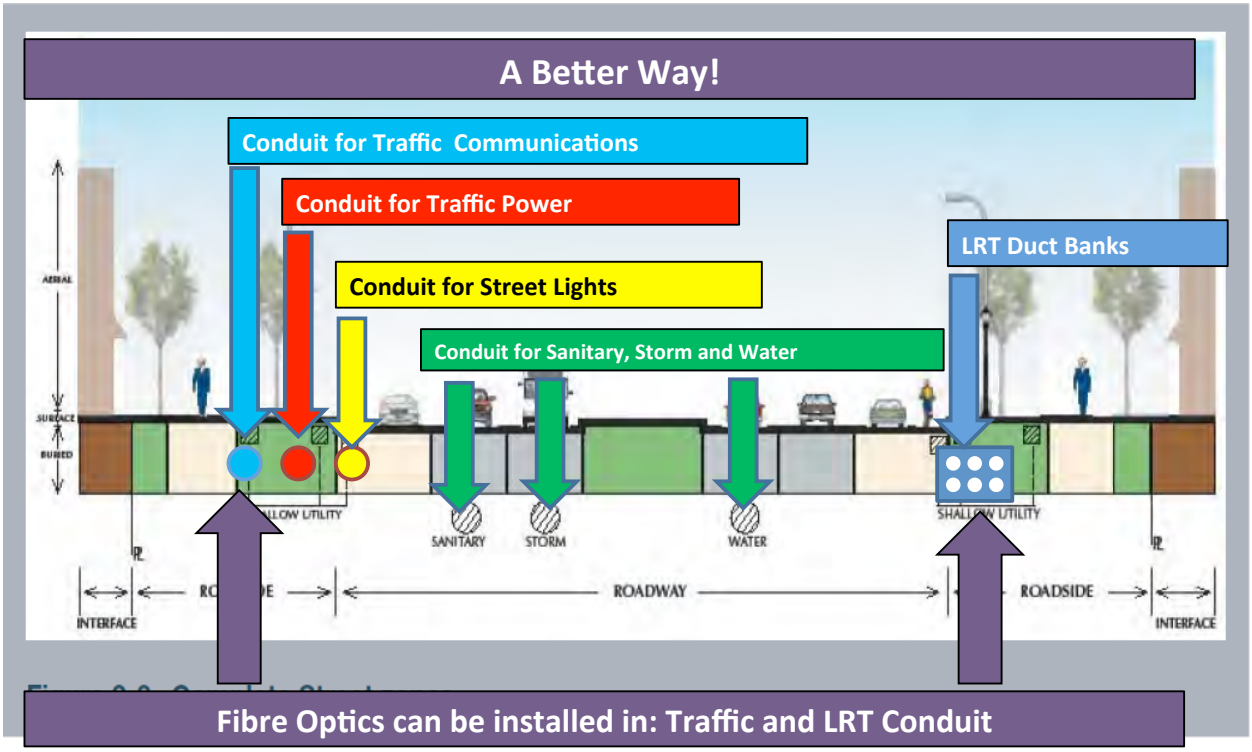


Figure 33 – City of Calgary – rights of way issues.

[84] Disaster recovery, critical infrastructure, law enforcement, asset management, citizen services, & public safety.

From the City's perspective, connectivity to some 230 remote offices, 450 traffic controllers, dozens of lift stations, and a multitude of transit and bus stations, traffic and security cameras, and so on is required.[85] Upon review, the City of Calgary found their four biggest challenges to be:[86]

- Managing the rights of way (RoW) – challenging now and will only get worse as duplicate infrastructure accelerates.
- Cost effective Connectivity for the City – Internet of Things (IoT) and Smart City Trends are drivers.
- Protecting City's ability to self-provision services – relies on infrastructure and access to ROW's.
- Community inequities are inevitable – What's the plan?

Their solution was to adopt a city-wide dark fibre strategy based on rich connectivity. Approved last September, the strategy aims to enable the connectivity required to create a healthy digital ecosystem and minimize disruption due to the civic construction required to provide it. The City will deploy dark fibre infrastructure and any others needing access to it will be able to.

The network will be run on an equitable, open-access basis and will connect all communities in Calgary. The City will not be entering the retail telecommunication services arena, nor providing fibre to the home. Competitive providers will be able to extend the City fibre to the business for those purposes and the City will buy the last mile fibre back over time, so that all fibre will remain the property of the City and the City can therefore retain control of what it sees as critical civic infrastructure. A presentation outlining the City of Calgary's approach can be viewed at:

https://youtu.be/dQMzkz6oaqg

Though the approach makes sense for larger centres and there are now three such efforts underway in Canada – Coquitlam, New Westminster, and most recently Campbell River. It is less applicable to smaller centres as those markets are not likely large enough to support more than one provider lighting up the network – in which case the '*first provider in'* gains a de facto monopoly.

8.2.4 Kainaiwa

As exemplified by the initiative undertaken by the Kainai Nation in southern Alberta, communities undertaking a do-it-yourself approach directly benefit from both the alignment between their broadband objectives and the interests of their communities as well as from the financial benefits that no longer flow to the shareholders of the incumbent service organizations. With respect to the Kainaiwa Fibre Network, the Blood Tribe claims to have repaid deployment expenses in five years and reduced their telecom expenditures from $50k to $7k per month – an annual savings of $516k that can be reinvested into the community.

8.2.5 Olds, Alberta

In the early 2000's, the Town of Olds, The Olds Chamber of Commerce, The Olds Agricultural Society, and Olds College partnered to establish a non-profit community development organization, the Olds Institute for Community and Regional Development (OICRD). The brilliance of the OICRD is that by combining the expertise from the public and private sectors, its activities became inclusive, could be more broadly supported and, without the encumbrances of local election cycles, were better able to take on longer-term projects. Over time, a dozen committees were formed under the auspices of the OICRD, each

[85] A video presentation on their strategy is available at: https://youtu.be/dQMzkz6oaqg

[86] Basto, David; *Building the Business Case for a Connected City*; City of Calgary; 16-03-10.

focused on a different aspect of community development – from community engagement, to business retention, to, well, technology.

Shortly after its inception, the Technology Committee, chaired by Joe Gustafson, settled on the notion of enabling superior broadband throughout the region via the deployment of fibre optic cabling. The idea was that if the OICRD got the fibre in the ground, they could then connect it to the newly created Alberta SuperNet and things would take-off from there. Reality struck quickly:

- Regional fibre estimates for Mountain View County came in shy of $100M. The focus then changed to Olds itself, with the regional option to be re-evaluated later.
- The SuperNet only provided backhaul connectivity (e.g., SuperNet could connect an Old's network to Calgary) but was not established to either light community fibre networks or to provide Internet services over them.

From the SuperNet, the Technology Committee then approached Shaw and TELUS. Shaw declined upfront, but TELUS indicated that should the network be deployed to their specifications, TELUS would consider lighting it and providing services. That did not materialize and they explored potential partnerships. In the end, the Technology Committee undertook to both deploy and light a state-of-the-art fibre network in Olds. When Bell Canada, Navigata Communications, MTS Allstream, and Rogers Communications then also declined to provide services, the OICRD established a wholly owned for-profit subsidiary to develop, provide, and operate a full set of triple-play (Internet, telephone, and television) services over the open, passive, OICRD network under the O-Net brand. In July, 2012, Olds became the first community in Canada with community-wide gigabit per second Internet.[87] O-Net became cashflow positive in the fall of 2015 and hasn't looked back since. Their Internet services table appears in Table 12.

Table 12 – Internet Services In Olds, Alberta

RUSH $90/MO†	ZOOM $100/MO†	GIG $120/MO†
50 Mbps Download†	**100Mbps Download†**	**1000Mbps Download†**
50 Mbps Upload†	**100Mbps Upload†**	**1000Mbps Upload†**
500GB Monthly Usage	**1TB Monthly Usage**	**2TB Monthly Usage**
Wi-Fi	Wi-Fi	Wi-Fi
2 Email Addresses	2 Email Addresses	2 Email Addresses
Local Support	Local Support	Local Support

The Olds' Connected Community Network (OCCN) illustrates by example how a small town community with a population of approximately 8,700 people can take ownership of ensuring its businesses and residents have access to global standard IT infrastructure and services as the foundation for their economic, social, cultural and environmental sustainability. It also demonstrates a potential path

[87] Chung, Emily. *Small Alberta Town Gets Massive 1,000 Mb/s Broadband Boost*. CBC News. 19 July 2013.

that Canada might take to regain its past position in the global telecom space. Modeled on the European services-based competition model, the Olds fibre network is separate from the services company.

Established as a largely social enterprise, O-Net is now available to provide similar services to any municipality that is able to deploy lit fibre optic network within their community. Further, those behind the Olds' fibre initiative are willing to share their learnings with any community that is interested – as outlined in the following video from the OICRD:

http://youtu.be/Uc_plnE3W5U

In it, Olds specifically offers to share their experience and expertise with any community interested in enabling state-of-the art fibre-based services within their communities.

It has been said that community fibre endeavours are likely 80% social and 20% technical and the Olds' experience supports this from several perspectives. First, the community-wide inclusive nature of the OICRD enabled coordinated long-term planning and broad-based support for projects like the OCCN. It enabled complementary support for key related initiatives such as community engagement. Being leading edge, mistakes were expected and no blame was attached. Issues from rights-of-way to financing were encountered and the cross-disciplinary nature of the OICRD enabled efficient resolution.

8.2.6 Parkland County

To enhance broadband services to the rural areas of Parkland County while preserving market forces amongst the wireless internet service providers (WISPs) in the area, Parkland deployed a number of fibre connected primary towers as well as a set of smaller secondary towers with wireless backhaul to the primary towers. WISPs, mobility providers, and first responders can rent space on these towers for their antennas. The idea was to bring the capital cost of serving remote areas down and help enable competitive broadband services to areas which might otherwise go unserved. The tower infrastructure was to be operated on a cost recovery basis.

To attract mobility and the Alberta First Responders Radio Communications System (AFRRCS) equipment onto the towers to help cashflow, robust (expensive) towers were constructed at sites which were a compromise amongst the requirements of the mobility, ISP, and AFRRCS providers. Few liked the locations, competition amongst the ISPs did not materialize, and the County is now struggling to find a way to make things work.

8.3 General Financial Considerations

8.3.1 Off-balance Sheet Considerations

Whereas traditional business case numbers only consider direct revenues generated by the provisioning of triple-play services in the community, when it comes to Council considerations, a municipality may wish to capture broader community (off-balance sheet) benefits such as positive impacts on the community's quality of life, youth retention, business attraction, and competitiveness. At the Council level, the debate as to whether this new infrastructure will focus largely on private benefits (broadband fibre as a market commodity) or public benefits (broadband fibre as a utility to achieve purposeful public benefits) will be decided. The results will help dictate who should own and control the fibre assets, should a community elect to go that way, and how well the assets will achieve broader public benefits.

In more rural settings, by quantifying and including broader public benefits, fibre can be justifiably deployed far deeper into rural areas than generally realized based on a simple '*internet-only*' case. As can be seen in Figure 34, the inclusion of tangible, public benefits into the broadband business case for a set

of First Nations communities in the Wood Buffalo area turned a marginal business case for fixed-wireless into a strong case for fibre.

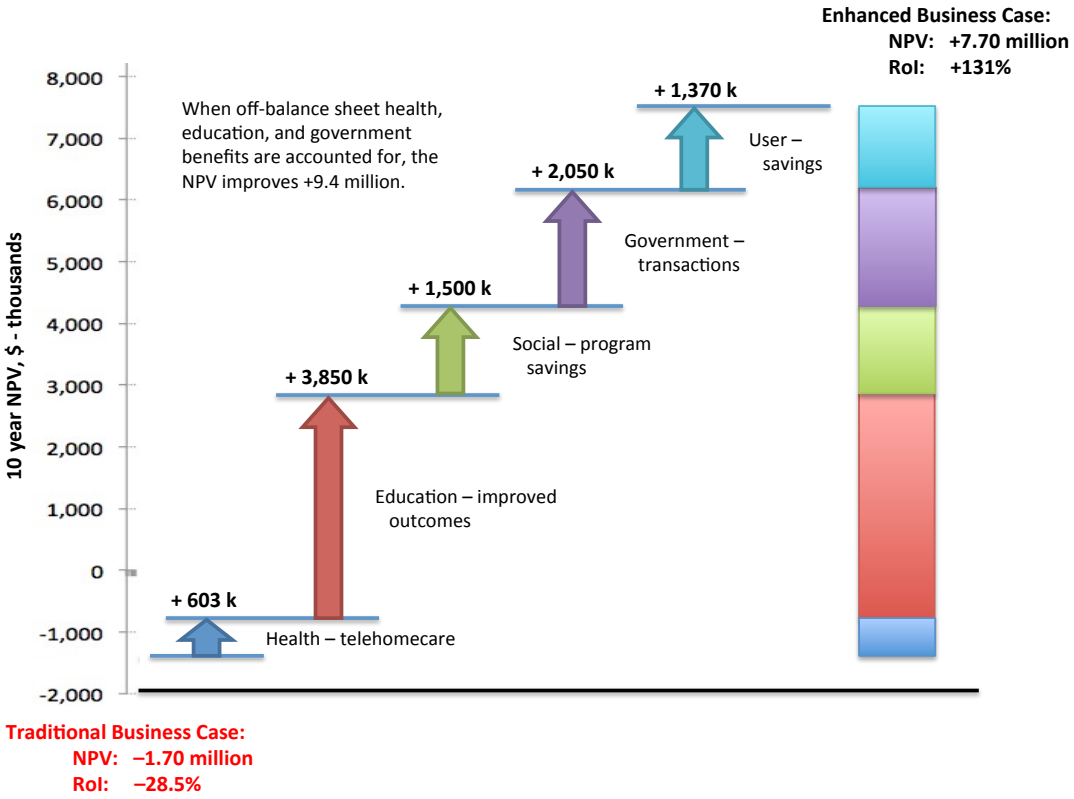


Figure 34 – Benefits assessment for RMWB First Nations.[88]

8.3.2 Wireless versus Wired

Though rural wireless solutions may initially be less expensive to deploy, they are both capitally and operationally more expensive over terms exceeding ten years. As home and business Internet usage tends to increase at rates exceeding 20%/yr, and has done so for over a decade, to meet this increasing demand, capacity must increase over five-fold per decade. Indeed, Neilson's Law suggests that this increase may be as high as 50%/yr for high-end users[89], – which implies that 1 Gb/s connections will need to be generally available by 2020. As scaling fixed wireless systems to keep pace with these demands becomes increasingly expensive, fibre/wireless cost comparisons should be done on a minimum ten-year total cost-of-ownership basis – in which case, fibre is generally found to be the least expensive technology to deploy.

In a sample design for a 200 square-mile rural area in Chamberlain, S.D., Vantage Point Consulting found that whereas the least expensive wireless deployment came in at $370 per Mb/s per client, fibre came in at $9. In this comparison, the wireless network was designed to support 4 Mb/s per client whereas the fibre network could support 1 Gb/s.[90]

[88] Dobson, C.; *The True Economics of Broadband*; OSLI; 2013-09-29.

[89] https://www.nngroup.com/articles/law-of-bandwidth/

[90] Thompson, L., et al. *Comparing Wired and Wireless Broadband.* Vantage Point. 6 May 2015.

There has recently been significant press regarding the development and potential rollout of 5G wireless technologies as early as 2020. With peak speeds of 10 Gb/s, the potential seems tremendous. The details, however, are not so encouraging:[91]

- While the 10 Gb/s rate is a theoretical maximum peak rate under ideal lab conditions, the specification of most interest to users is the actual throughput capacity of the network. Throughput capacity tends to run at about 15% of the peak rate and declines as the user moves away from the cell-tower.
- At 15%, the useable throughput of a 10 Gb/s system is 1.5 Gb/s and as this is shared amongst all users with the cell's range, the usable throughput to individual users is simply 1.5 Gb/s less the average throughput of each user times the number of concurrent users in the cell.
- To minimize capacity issues, 5G deployment scenarios assume cells with a 150m radius – or about 14 cells per square kilometre.
- As each cell must be fibre connected, in rural areas, fibre-to-the-farm will likely be a less expensive and certainly a more scalable solution than 5G.
- When operational costs and capital replacement costs are considered, the same conclusion holds for all but the larger, densest urban areas.

In community settings, wireless can be an inexpensive way to improve Internet services quickly. As the first step in a community fibre deployment program, WiFi access points can be rolled out with the initial feeder network. As fibre access in the community becomes more ubiquitous, the WiFi system migrates to an overlay that can be used when one is '*out and about*' in the community.

8.3.3 Aerial versus Buried Deployment

If a deployment area receives its power aerially – i.e., via power pole infrastructure – and the poles can take the additional weight and there is sufficient clearance, fibre can be provided aerially at about a third of the cost of a buried deployment. Though buried infrastructure is more secure on a long-term basis, if the lower cost of an aerial deployment can be realized, the reduced capital requirements may increase the possibly of attracting private equity. Aerial deployments can also be done quickly and during winter months. On the other hand, if the pole infrastructure must be upgraded, then the buried deployment may prove less expensive.

The issue many municipalities run into when considering an aerial deployment relates to the fact that pole attachment standards have changed since many of their poles were installed. As long as the poles remain '*untouched*', poles deployed prior to the standards changes are grandfathered and can be left as is. Unfortunately, though, as soon as a community wishes to place fibre on the poles, the poles will have to be upgraded to current standards prior to fibre being attached. Though credits are available to help offset the upgrade and/or pole replacement costs, the costs add up and may obviate the advantages of going to an aerial build.

8.3.4 Grant Funding

Grant funding or cash infusions to a broadband deployment project reduces the project's capitalization requirements and can thereby increase the affordability to smaller and more rural municipalities. As well, the subsequent reduction in principal and interest repayments improves the bottom-line margin and reduces operational risk. Municipalities still need sufficient scale, though, to achieve positive operational margin needed for sustainability.

[91] Thompson, L. & Vande Stradt, W.; *5G is Not the Answer for Rural Broadband;* Broadband Communities; 2017-03/04.

The revised CRTC universal services fund mentioned in Sec. 3.2.1 will grow to $750M within five years. The terms by which these funds will be made available are under development and will likely be vetted in 2018. The first disbursements are expected in early 2019.

While the federal CTI program mentioned in Sec. 3.2.2 has ended, staff have indicated that a follow-up program is likely within an 18-month timeframe. As these programs have historically favoured shovel-ready projects, interested municipalities would do well to use the interim period to develop suitable projects.

8.3.5 Don't Delay

Electing to establish a municipal or regional fibre program is often perceived as a complex undertaking and postponing related decisions is an enticing option. While there may be very legitimate reasons to do so – say, the local water-plant needs to be refurbished and current funds are limited – some are less so. Examples include:

- ***Current offerings are sufficient to meet current requirements –*** yes, but demand and usage is growing exponentially while infrastructure deployment is linear. In order to meet future demand, deployments will need to start soon.
- ***Wireless technology is improving and will provide an inexpensive alternative –*** as discussed in Sub-section 8.3.2 above, from a usability and cost perspective, wireless technologies will not meet rural requirements anytime soon.
- ***Fibre may be usurped by the next 'big' thing –*** though not economical for FTTP implementations, opto-electronic equipment designed for long-haul implementations currently supports 160 wavelengths (channels or data-streams) on each fibre. As each wavelength can support a 100 Gb/s data-stream, the usable aggregate capacity on one fibre is 16,000 Gb/s – or 16 Tb/s. As the theoretical capacity of fibre is much higher and as the primary cost of deploying fibre is civil construction, current fibre capabilities will likely be sufficient for at least the next 30 years – and the deployment costs are not likely to decrease significantly.

Other considerations include:

- If a community delays a deployment, they lose the benefits of broadband until either they do or a private provider does it for them.
- Over time, the best '*anchor tenants*', or key potential clients for the network (which would boost initial cashflow and reduce deployment risk may be lost due to either the client paying for a custom-build from an incumbent, or the key clients being successfully courted by the incumbents. The risk extends to the premises, businesses, and areas with the highest profit margin potential. Once these clients are unavailable to a public provider, the decreased revenue may limit deployments in less profitable areas (e.g., using revenues from the higher margin areas to support the more rural lower margin areas; and using revenues from a business district to help fund a residential deployment).

Given that a land-grab of sorts is underway and that outside the larger centres only one fibre network is likely to be deployed, communities interested in inclusive fibre as a fourth utility need to move prior to their business case becoming untenable.

8.3.6 Public versus Private Financing

In general, private enterprise, particularly small to medium-sized enterprises, cannot compete with municipalities when financing long-term infrastructure. To see this, consider a $1M fibre deployment project. With 25-year financing from the Alberta Capital Finance Authority (ACFA) at the mid-August, 2017 interest rate of 3.076%, municipality payments come in at $4,802/mo. – $9.60/subscriber/mo. with 500 subscribers. Private enterprise looking to finance this over 5 years at 2.023% would face payments of $17,608/mo. – $35.22/subscriber/mo. with 500 subscribers. Larger private providers able to attract

patient capital may look to 10 to 15-year payback periods to make their numbers work. Indeed, TELUS refers to fibre as a '*generational*' investment.

Exacerbating this issue, is that, whether large or small, private industry will be evaluating investments on a net-present-value (NPV) basis. This implies that they are looking for a return on their investment that exceeds the gain available via a risk-free bond investment. From a municipality perspective, as long as the program is intrinsically sustainable, many will be more motivated by off-balance sheet benefits and economic development potential than by the project's NPV.

8.4 Business Models

8.4.1 Structure

Referring to Figure 35, counties and municipalities have the option to design, finance, and deploy lit home-run fibre networks to facilitate enhanced broadband services to their business and residential communities. Once the Community-Net (C-Net) infrastructure is in place, the community has several options to obtain services such as Internet, telephone, and possibly television. They can connect directly to a local service provider if one is available (say, CCI or MCSNet) or they can arrange backhaul to an Internet Exchange (IX) facility and there either connect directly to the global internet or cross-connect to an ISP that has a presence at the exchange.

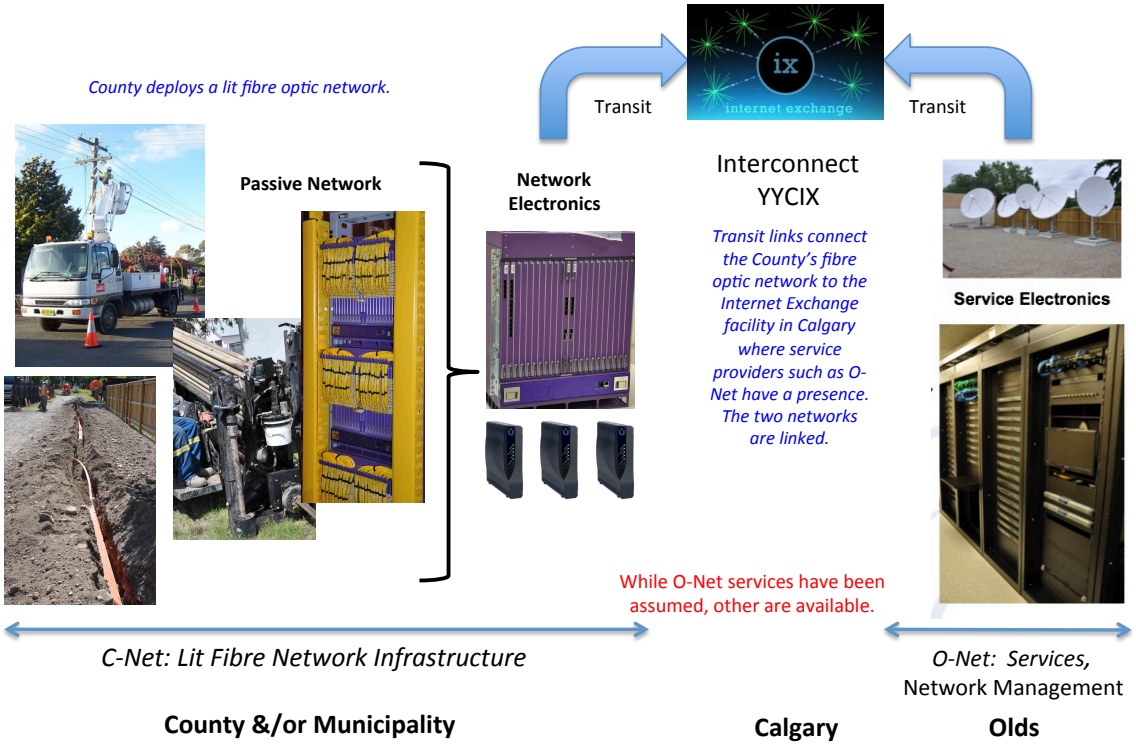


Figure 35 – Components of a telecommunications network.

In the figure, C-Net has arranged for a backhaul connection to the YYCIX Internet Exchange in Calgary and cross-connected to O-Net. With this arrangement, C-Net could contract O-Net to (1) manage their lit network and (2) at either the wholesale or retail level, be the service provider of choice, for at least the initial, say, five-year period.

Though the intent may be to establish C-Net on an open-access – level playing field – basis to all Internet, telephone, and television service providers interested in using the network to connect and

deliver broadband services throughout the community, the underlying services ecosystem needed to facilitate this in Alberta is not sufficiently developed. While several ISPs could provide Internet, and possibly voice, services, over the network, at present, O-Net is the only '*local*' provider that can provide the full suite of triple play services necessary to compete in an area currently serviced by TELUS and either Eastlink or Shaw. In the business cases financials to follow, O-Net services are assumed. Should the communities opt to pursue these options further, other options, as well as the trade-offs amongst them, would be evaluated.

To assist municipalities, O-Net can provide services on either a wholesale or retail basis, in which case a community could respectively approach a municipal fibre operation as a retail service or as a wholesale network operator. The differences are significant as in the retail arrangement, the community would need to establish local service operations, say CommNet, and assume the market risk associated with selling the services (Internet, telephony, and possibly television) and achieving sustainable revenue levels. In the wholesale case, as the service provider, it would be up to O-Net to establish local retail operations and assume the market risk associated with achieving revenue levels sufficient to cover both the costs of using C-Net as well as its operations in the community. With the retail option, O-Net receives regular monthly revenue based on the pricing levels of O-Net's wholesale services suites. In both cases, the network entity, C-Net, receives a regular income stream based on the cost of wholesale access to its network from the retail service provider – whether that be from a local ISP, CommNet, or O-Net.

Should the community choose the retail option, structurally, CommNet (service) and C-Net (network) operations could be one entity. Keeping them separate, however, leaves the door open to running C-Net as a local network utility on an open-access basis – in which case, CommNet may eventually be only one of multiple service providers on the network. Integrating them enables greater operational efficiency, but may inhibit open network operations down the road. In Olds, ISP operations are provided by O-Net and the network assets and operations are run by the Technology Committee of the OICRD.[92]

8.4.2 The Wholesale (Utility) Network Option – C-Net

A schematic showing service delivery and money-flows with the wholesale network option appears in Figure 36. Here, O-Net becomes the (initial) retail services operator and pays to use to C-Net to connect with and deliver their services to residential, commercial, and industrial clients in the community. For convenience, C-Net will outsource network operations to O-Net. Network operations includes arranging for client connections (client yard surveys, drops, and opto-electronics) to the network as well as network monitoring, operations, locating, and repair services. Contractor charges for drop installations and cable-cut repairs as well as costs for the optical network terminals (ONTs) required in client premises to connect to the fibre optic cable, including installation, will be billed back to C-Net. Monthly costs for the software required to maintain and operate the ONTs will be C-Net's responsibility as well.

As the ISP, all marketing, sales, home installations beyond the ONT, client support/help desk, services, and service delivery responsibilities reside with O-Net.

A variation on this is the dark fibre option in which the community deploys a dark fibre network and then leaves the network electronics to the ISP(s). While operationally simpler from both network and service provider perspectives, in smaller communities, once one service provider comes in, others may not.

[92] The Olds analogy is not exact as in Olds, O-Net actually owns the network electronics and the Technology Committee owns and controls a dark fibre network.

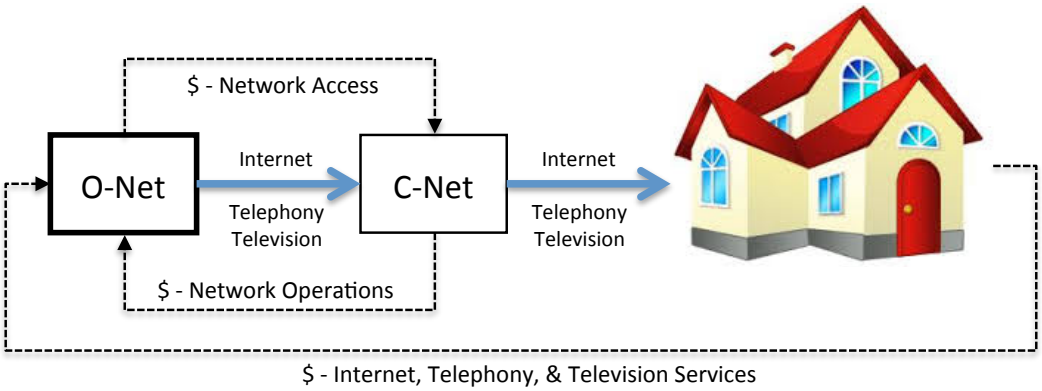


Figure 36 – A wholesale/utility network model.

8.4.3 The Retail Services Option – CommNet

To enable local retail options, O-Net offers an '*ISP-in-a-Box*' service wherein O-Net provides wholesale access to its triple play services portfolio together with all back-office billing, customer service, sales and marketing, and operations support tools a municipality needs to set up a local broadband services operation. The services could either be marketed under the O-Net brand or re-branded to, say, CommNet.

To utilize this offering, the community would need to establish a local services entity, i.e., open a sales office and either hire staff or contract for sales and marketing, accounting, installation, repair, and support operations. Structurally, options for the entity range from a non-profit to a small municipal services corporation.

A schematic showing service delivery and money-flows with the retail services option appears in Figure 37.

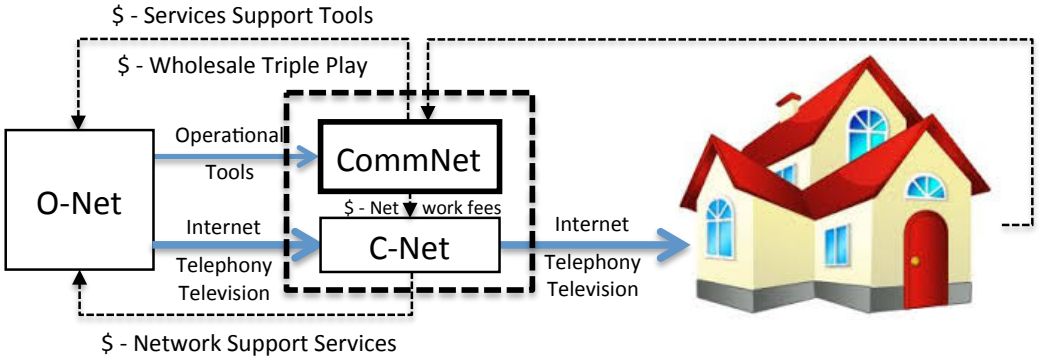


Figure 37 – A retail /ISP business model.

As the ISP, CommNet is responsible for sales and bills clients for services. Out of the ensuing revenue stream, CommNet would need to compensate:

- O-Net for the wholesale delivery of Internet, telephony, and television signals to C-Net, which delivers the signals (services) to the end customers,
- O-Net for access to the operational tools needed to run its network and services operations, and
- C-Net for use of its network.

For the numbers to work financially:

- The '*Network fees*' CommNet pays to C-Net for use of the network must cover both its operational expenses and any principal and interest payments associated with acquiring the capital used to finance the network deployment.
- At a minimum, CommNet's revenue must be sufficient to cover C-Net payments, the wholesale ISP-in-a Box payments to O-Net, and the costs of its own internal operations.

In summary, with this structure, the plan to enhance broadband connectivity and services throughout the community, would involve:

- deploying an operational (passive network plus network electronics) fibre network that passes every home and business in the community
- deploying the network and opto-electronics required to light the network
- connecting the network to the Internet Exchange facility in Calgary (YYCIX in the figure)
- interconnecting with O-Net at YYCIX to provide city-wide Internet, telephone, and television service – as well as back-office support, network monitoring, customer services, and billing
- establishing local operations, installation, maintenance, and marketing support to a competent provider and assuming the market risk associated with selling services

8.4.4 Financial Considerations

Business cases for fibre deployments tend to be interesting for two reasons. First, significant upfront capital is required to finance deployments and, second, the capital required increases with both the initial take-up rates (due to the costs to connect clients) and the intensity of the competition in the community (which decreases revenue). To offset these effects, initial deployments typically target more densely populated business districts to initiate revenue streams, then move on to the residential areas, and then to the outlying areas. Service uptake is typically higher for businesses, and margins on voice and Internet services are higher than those for television services. In essence, the strategy is to use cashflow from the more profitable areas to help finance deployments in the less profitable areas.

Strategies to reduce capital requirements include:

- Finance the project over as long a term as possible (e.g. a 30+ year fibre asset with a 30-year debt repayment term) to lower the monthly bill to customers;
- Use aerial deployment where pole infrastructure is satisfactory to reduce overall costs;
- Leverage planned civil works wherever possible (e.g., laying conduit whenever trenches and roadways are opened-up for repair or made available due to work on water, power, gas or telecom utilities in new development areas). In buried builds, civil works (i.e., trenching) account for approximately 70% of the deployment costs;
- Require conduit deployment and cat-5 wiring in all new developments;
- Leverage the additional cashflow available from the business, commercial, and greenfield areas (in some ways, the low-hanging fruit) to offset the less dense/lower revenue areas of the community or region;
- Allocate a portion of expected municipal operational savings to the project;
- Use a tax levy for, say, the drop portion of the build;
- In lower density areas, provide fibre-to-the-tower to enable higher bit rate, higher capacity wireless services to the surrounding area; and
- Go with WiFi first – build a community/customer base first.

Incredibly, some smaller communities cannot even raise the quarter million dollars an aerial deployment might cost them. As this is a trivial amount to larger communities with, say, a $15M build, larger communities might consider including the smaller communities in their plans. The additional scale their inclusion brings to the table, combined with the added municipal participation, can help leverage their operational costs, enhance grant applications, and enhance the sub-region's connectivity and capacity generally.

9 Utility Networks in REDI

9.1 Context

A map of REDI/MacKenzie County is shown in Figure 38. In the map, towns and villages are shown with orange pins and hamlets are shown with yellow. Fixed wireless towers are marked by green triangles. SuperNet fibre routes are shown in black, wireless ones are brown. SuperNet connection points are shown with yellow circles and text.

As can be seen, each of the communities in REDI has access to SuperNet and the existing fibre routes do pass close to a number of fixed wireless towers. Hence, should the communities be interested in establishing an open-access utility network operation to enhance Internet services in the County, they would be well advised to focus on FTTP solutions in the communities in combination with fibre to the key ISP towers to improve rural coverage.

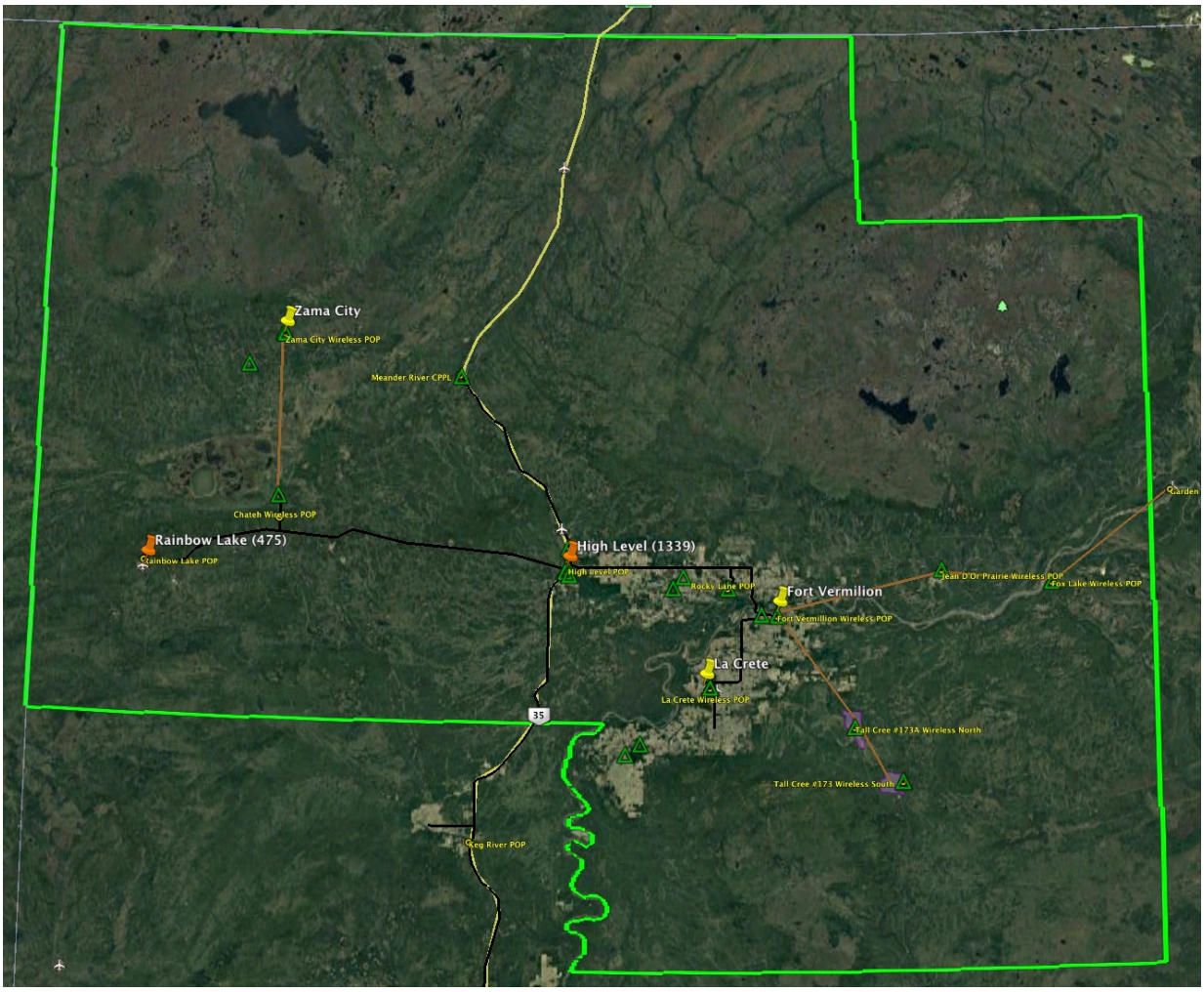


Figure 38 – McKenzie County.

As of this writing, the plans for SuperNet 2.0 had not been released so it will be assumed that the existing SuperNet connection sites will remain available and that the terms of their use will become more reasonable. With this approach, the more communities, hamlets, First Nations, and Métis Settlements involved, the better. As broadband needs increase and priorities evolve, this initial focus on the communities could move to a greater focus on the more rural areas. The high-level financials developed

below indicate that a multi-community-focused FTTP network would be financially sustainable, but only if all communities were involved.

This analysis is a subset of the larger set that has been completed for communities across northern Alberta. For guidance to the counties and municipalities throughout REDI, the available analyses are outlined in Table 13.

9.2 A Multi-Community FTTP Network

9.2.1 Business Structure

Assume that communities across MacKenzie County jointly deployed an open-access, lit fibre-optic network that will make world-class, fully scalable broadband infrastructure available to all local homes and businesses. Based on an assumed desire to leverage local ISP capabilities, the wholesale network option is selected, deployed on an open-access basis, and made available to all ISPs in the County. The business model assumed for the community network – Mac-Net – appears in Figure 39 below.

To keep things simple, assume that the communities will outsource management of its network to O-Net, simply because O-Net has in-house fibre/opto-electronics expertise. Network operations include arranging for client connections (client yard surveys, drops, and opto-electronics) to the network as well as network monitoring, operations, locating, and repair services. Contractor charges for drop installations and cable-cut repairs as well as costs for the optical network terminals (ONTs) required in client premises to connect to the fibre optic cable, including installation, will be billed back to Mac-Net. Monthly costs for the software required to maintain the network and premise gateways (ONTs) will be Mac-Net's responsibility as well.

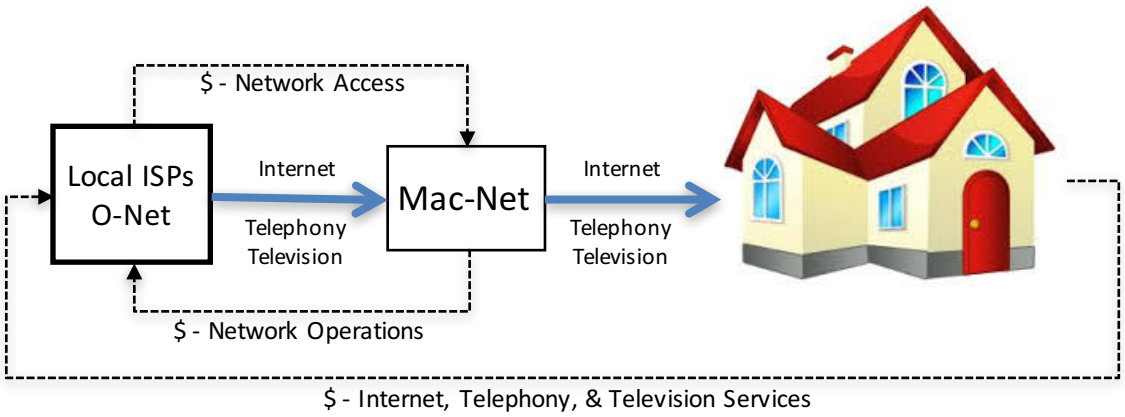


Figure 39 – Utility network model.

With this arrangement, providers such as the Arrow Technology Group (ATG), CCI, and others can each contract access to Mac-Net and utilize the network to deliver services over fibre to residents and businesses. This allows the ISPs to leverage their current service portfolio and support processes and increase their client base without a commensurate expenditure of capital. For this access, though, each ISP would compensate Mac-Net based on, say, the number of subscribers it served. Each connecting ISP would be responsible for all marketing, sales, home installations beyond the ONT, client support/help desk, and service delivery.

Table 13– Analyses Completed for Communities and Regions in Northern Alberta

Report*	**Category**	**County/Community** (Premise Counts)	**Comments**
Alberta HUB	Urban Centres	Bruderheim – 601	High level analysis. To increase operational scale and combined financials with Lamont are also provided.
	MDs, Counties	Lac La Biche	Detailed analysis including capital estimates for the hamlets of Lac La Biche, Plamondon, Beaver Lake, and Rich Lake.
		Vermilion River	Detailed analysis based on the study for the Vermilion River Regional Alliance. In addition to a county network, capital estimates are provided for the town of Vermilion, Dewberry, Kitscoty, Marwayne, Paradise Vallet, and Mannville.
GROWTH Alberta	Urban Centres	Whitecourt – 4,250 Barrhead – 2,000 Swan Hills – 725	Provides an interesting comparative view of the impact of operational scale as community size decreases.
	MDs, Counties	Woodlands	Provides capital estimates to connect several urban centres and ISP towers.
LSLEA	Urban Centres	High Prairie – 1,000	Detailed capital estimate and financials from the Big Lakes Study for the town of High Prairie.
	MDs, Counties	Big Lakes	See PREDA.
NADC	Urban Centres	Athabasca – 1341	Detailed capital and financial analysis for the Town of Athabasca.
	MDs, Counties	Athabasca	Including capital estimates for the Town of Athabasca and Boyle as well as for Athabasca County.
		Regional Municipality of Wood Buffalo	In fall, 2013, the now defunct Oil Sands Leadership initiative had Taylor Warwick complete a planning level conceptual review the options available to improve broadband services within Anzac, Conklin, Fort Chipewyan, Fort MacKay, Gregoire Lake Estates, and Janvier. The options included infrastructure to support mesh WiFi, hybrid fibre/WiFi, and full fibre/WiFi. The detailed study[93] is available on the NADC website.
PREDA	Urban Centres	High Prairie – 1,000	See LSLEA.
	MDs, Counties	Big Lakes	Detailed analysis based on the study for Big Lakes County. As the study is inclusive of the urban centres of High Prairie, Swan Hills, Enilda, Foust, Gift Lake, Grouard, Joussard, Kinuso, and area around Kinuso, capital estimates for each of these centre is provided.
		Smoky River	Detailed study Including capital estimates for Fahler, McLennan, and Donnelly.
REDI	Urban Centres	Mackenzie County	High level analysis Including High Level, Rainbow Lake, La Crete, Fort Vermilion, and Zama City.
The estimates provided are based on a common 'default' set of assumptions. Specifically, the assume a fully buried, air blown, home-run fibre network funded through a 25 year ACFA loan and operated on an open access basis as a utility. Depending on the choices made by individual communities and local conditions such as the availability of power poles, these numbers may change significantly. *All analyses appear in the NADC report. [94]			

[93] Dobson, C.; *Infrastructure Options for Rural Villages in the RMWB*; Oil Sands Leadership Initiative; 2013-09-14.

[94] Dobson, C.; *Northern Alberta Broadband Preparedness Project – NADC*; Taylor Warwick; 2017-09-15.

9.2.2 Deployment Capital

Assuming deployment conditions similar to those experienced in Olds, and a 25% premium due to the remoteness of MacKenzie County, a buried fibre deployment that passes every residence and business in Whitecourt would cost about $7.77M. In this context, access refers to laying fibre that passes every premise in a municipality. Later, when a premise orders service, a fibre drop connection from the premise to the fibre running past the premise will be needed.

Once the feeder and distribution networks are in place, additional capital costs will be incurred to deploy conduit and fibre from each premise ordering service to the distribution conduit running past the premise. The wiring within each premise may also have to be upgraded to enable service distribution to premise computers, phones, and televisions – but that falls to the ISP.

9.2.3 Deployment Schedule

The financials below assume that the network would be deployed throughout the communities over the spring, summer, and fall of 2018.

9.2.4 Opto-electronics and Backhaul

In addition to the deployments costs outlined above, capital is required for the opto-electronics and routing equipment required to '*light*' the fibre and establish a functional network, the electronics required in client premises, tools and test equipment, and so on. As the network is deployed incrementally over a number of years, to provide a breakdown of the overall capital expenditures a cumulative multi-year view is needed. Using the cumulative capital expenditures over the first five years of operation, a breakdown of the expenditures appears in the pie chart in Figure 40. Capital cost estimates over the first five years of operation for the proposed scenario come to $11.6M. In the chart, the $8.1M outside plant (OSP) deployment estimate (core and drops) includes the feeder and distribution plant required to pass every premise and provide drop connections to those premises that take service.

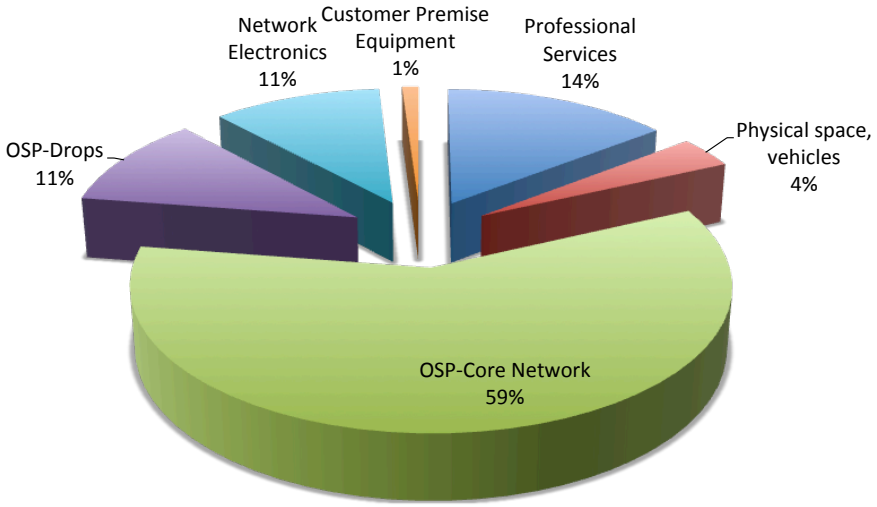


Figure 40– Cumulative capital expenditures from 2018 to 2022.

With long range optics, these electronics can support services to residents and businesses up to 35 km from the central office – which would enable the utility to extend services to residents and businesses in the surrounding county. To extend the range further additional opto-electronics can be placed up to 70 km away – which would then support services up to 105 km from the central office, and everything in-between (and so on).

The backbone connection from YYCIX to the community networks also needs to be sized appropriately. Should only Internet and phone services be offered, a single 1 G/s connection would initially suffice. To support television services, two 1 Gb/s connections would be needed. As the client base grows the required backbone capacity will increase.

9.2.5 Drop Capital

The drop cost parameters assumed in the financials are based on:

Drops			
	Brownfield	Inside unit fibre	Greenfield
Residential	1,100	550	250
Commercial	1,200	600	300

Inside copper wiring is simply reused.

Greenfield refers to drops in new suburban areas which leverage joint trench deployment. The '*Inside unit fibre'* is for deploying fibre within multi-dwelling units where reusing existing copper-based inside wiring is not possible.

9.2.6 Markets and Revenue

As retail service suites (Internet, telephone, and television) come from the ISPs using the network, Mac-Net revenues are based on the payments collected from the ISPs using the network. While there are various ways these payments can be structured, the financials presented below assume that each ISP pays a flat monthly fee to Mac-Net for each client they connect to. The fees assumed are:

	Residential	Commerical
Wholesale Network: $/mo	80.00	80.00

Revenue is thus determined by the penetration rates realized by the ISPs providing services. Assumed penetration rates are shown below.

Assumed Penetration Rates				
	Year 1	Year 2	Year 3	Year 4 on
	1	2	3	4
Residential penetration	20%	35%	45%	50%
Business penetration	30%	50%	65%	70%

Based on what O-Net has experience in Olds, these penetration rates are conservative, particularly as they would be the cumulative penetration amongst all providers using the network.

9.2.7 Operations

The operational costs for wholesale network operation are straightforward as most are handled via outsourced contracts. Once the network build is completed in 2018 and the target penetration rates are realized, operational costs stabilize and a view of those calculated for 2022 are shown in Figure 41. In the chart, Admin, ops, o-e, and mktng refer to administration, operations, opto-electronics, and marketing respectively. The numbers assume that the Town provides both equipment and storage space at no charge.

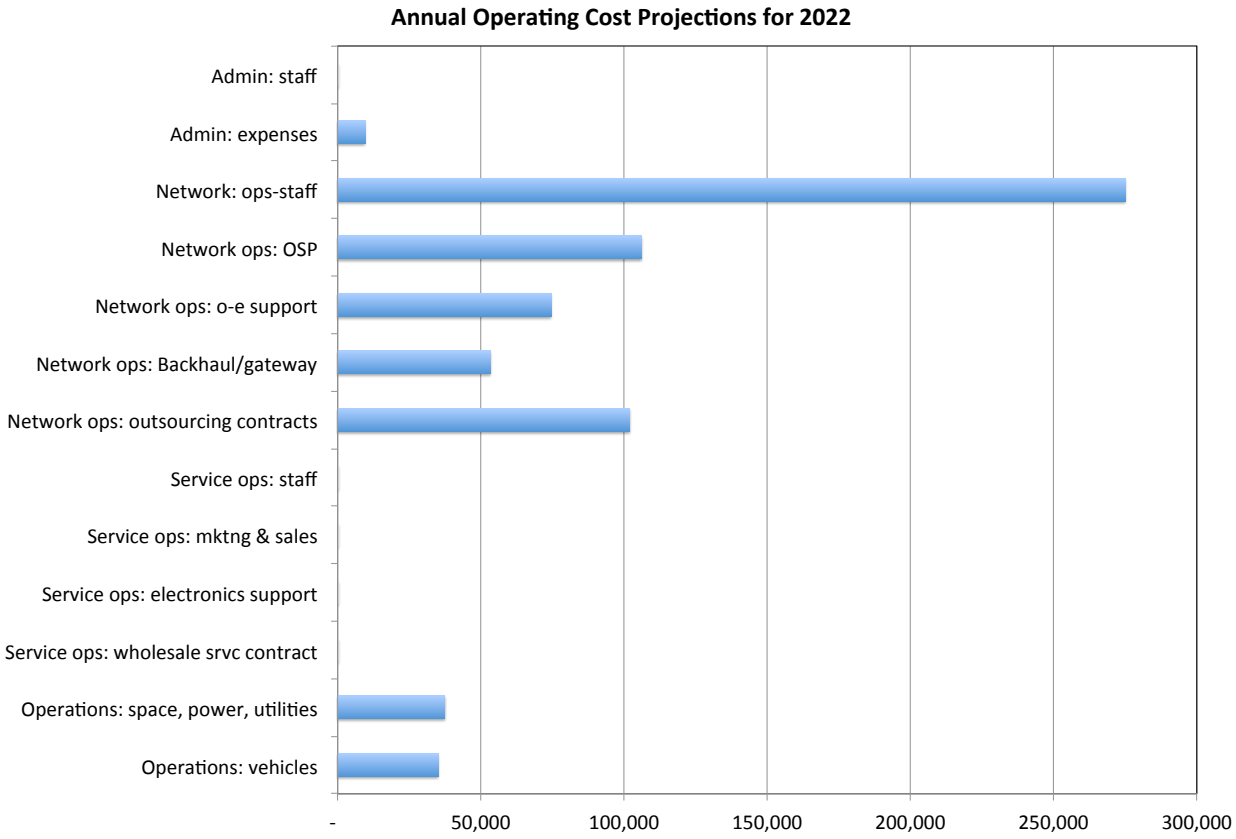


Figure 41 – Annual operational cost projections for the utility fibre network in 2022.

9.2.8 Financial Projections

To finance the deployment and establish operations as outlined above, the Town would secure two loans from the Alberta Capital Finance Authority (ACFA). As loan terms cannot exceed the useful life of the assets they cover, a shorter term, eight-year loan to cover the opto-electronics and a 25-year loan to cover the passive network and start-up costs. Whereas the opto-electronics will likely need to be upgraded every eight years or so, the passive network assets should last over 30. Interest rates are as per the published ACFA rates as of August 15, 2017 (25 years at 3.076% and 10 years at 2.430% – interest is not quoted for an 8-year term). Operating expenditures cover interest payments. Loan amounts must be sufficient to cover the deficits.

Model financial parameters assumed in the projections are detailed in the Table 14. Loan amounts are maximums only, the actual amounts required are drawn down in tranches once a year. Revenue and cost inflation are set to 1% and 2% respectively. The technology/bandwidth – Tech/BW – improvement factor accounts for the decreasing cost of electronics with time. In the model, network electronics are replaced every eight years. Contingencies and tax rates are set to zero.

Table 14 – Assumed Financial Parameters

General Parameters	
CDN$/US$	1.350
Inflation - revenue	1.00%
Inflation - cost	2.00%
Tech/BW improvement factor	15.00%

Grant Funding	
Grant funding	0

Contingencies	
OpEx contingency	0.00%
CapEx contingency	0.00%

Tax Considerations	
Include tax	No
Corp. tax rate - small bus	12.50%
Small bus limit	500,000
Corporate tax rate - bus	27.00%

Long Term Loan	
Loan Principal Limit	12,000,000
Term, yr	25
Interest rate	3.076%

Short Term Loan	
Loan Principal Limit	1,000,000
Term, yr	7
Interest rate	2.430%

Cashflow results for this scenario are summarized in Table 15. Though the operation goes cashflow positive in year 4 and, with debt servicing considered, the overall financials go cashflow positive in year 5. As the required capital must therefore be sufficient to cover the capital as well as a 4-year deficit, some $11.8M in capital will be required to fund the operation. By year 15, approximately $333,922 is being returned to the communities annually.

Table 15 – Utility Model Results Summary for REDI Communities

	Results
Years to positive cashflow	
Operating	3
With debt servicing (p&i)	4
Financing	
Start-up capital required	11,784,506
Net Cashflow - before debt servicing	
Profit - annual at 10 yr	524,905
Profit - annual at 15 yr	763,473
Net Cashflow - after debt servicing	
Profit - annual at 10 yr	138,429
Profit - annual at 15 yr	332,922

In graphical form, the non-discounted cashflow chart for the proposed utility appears in Figure 42. The capital (red) required to finance the project is shown to pretty much all be required upfront and the financing must be sufficient to maintain a net cashflow of at least zero. Operational sustainability is determined by the gap or difference between the revenue (blue) and operational expenditure (green) lines whereas overall sustainability, which includes principal repayment, is the difference between the revenue (blue) and the operational + principal repayment (dotted blue) lines. The bigger the gap, the better. The net overall cashflow line is the dotted orange line.

While technically these numbers work, operationally, the risk rather high due to the small margins together with the possibility of unexpected issues. Even with all the communities involved, the aggregate client base available in the area is small. As operational efficiency is a scale game, these initial results are typical for communities with populations less than around five thousand people.

Options to improve margins sufficiently that the communities might elect to pursue a deployment are many and varied. With only 900 premises, for example, Valleyview now has a model in which their numbers work. Options to be considered include:

- Assist your ISPs with marketing to increase penetration rates above 50/70%; support efforts to create a '*culture of use*' among REDI residents and businesses.
- Increase operational scale by servicing other communities. The impact of combining forces with both the County and neighbouring hamlets, First Nations, and Métis Settlements is discussed in the next section (9.3 – An Inclusive Regional Network).

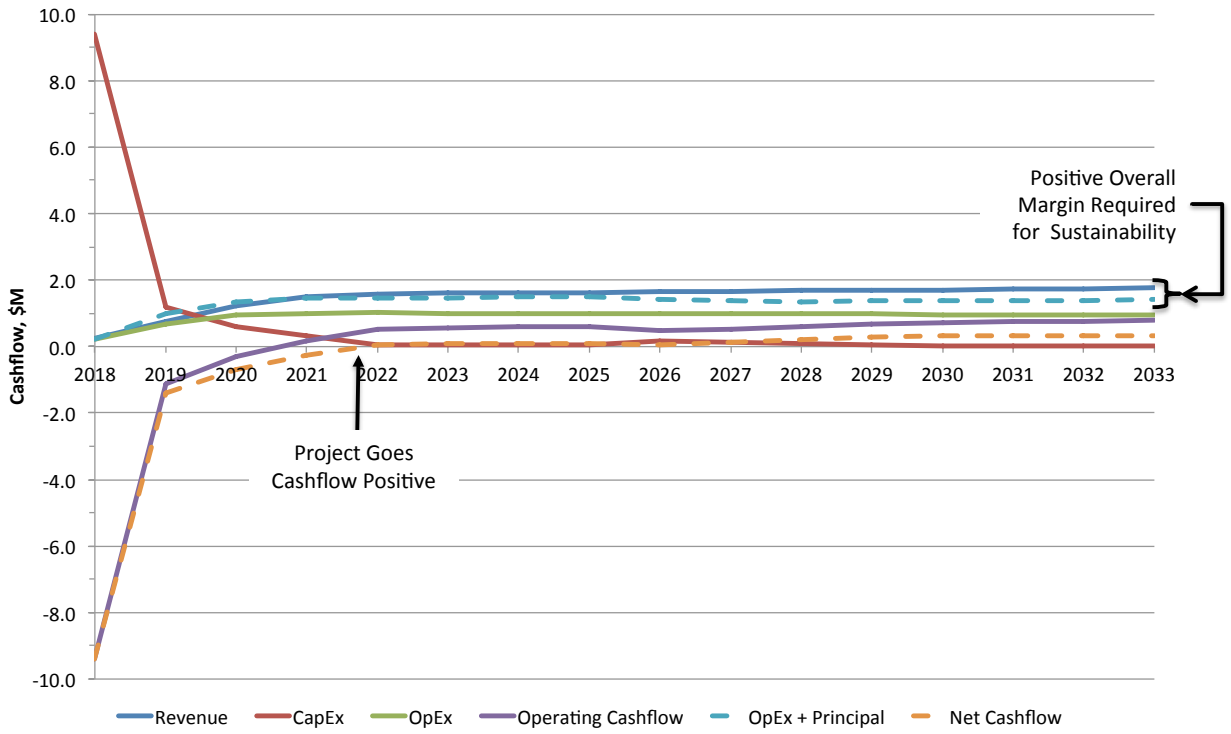


Figure 42 – Non-discounted cashflow projections for REDI.

- If the power poles in MacKenzie are in good order, an aerial deployment would reduce deployment costs by 40%, thus decreasing the required debt load and repayment schedule.
- Reduce the debt service payments by perhaps (1) obtaining grant funding, (2) attracting local capital, or (3) covering some of the build (say the drops) via the tax roll.
- The wholesale network access rate is set to $80/mo/subscriber. While this could be increased to $85 or $90/mo, the higher rates decrease service provider margins. Other charging arrangements are also possible. Mac-Net, for instance might charge a much lower rate, but on all serviceable premises, regardless of how many take service.
- Reduce operational costs by leveraging local resources and staff or outsourcing to a competent service provider.

The actions above provide proactive ways that the communities could manage financial risks and create a path toward financial sustainability of Mac-Net operations.

10 Next Steps

While regional and municipal options do involve more responsibilities and risks than simply transferring control to private enterprise, they come with significant advantages. As well, to manage the level of their involvement, close to turn-key options do exist and can be easily incorporated into regional, sub-regional, and community deployment programs – once the community has decided upon the business and governance structure, operational arrangements, and financing.

Whether or not MacKenzie County, and the towns, villages, First Nations, and Métis Settlements it encompasses, elect to move forward with broadband now or not, in order to position for future broadband planning and expansion, the following interim straightforward and inexpensive approaches to enabling significant future cost-savings should be considered:

Municipal Planning:

- Work with REDI to leverage planning/policy and financial resources;
- Develop a Broadband Services Strategic plan specific to your community;
- Embed fibre network requirements in internal IT planning processes; and
- Accelerate currently planned IT infrastructure deployment.

Leverage Planned Civil Works:

- Develop a policy for including installation of fibre conduit as part of applicable and appropriate town and county infrastructure projects, such as road (re)construction and water / wastewater projects.

Position for the future:

- Require that the inclusion of fibre conduit be a mandatory requirement in all applications for new residential and businesses development permits; and
- Adopt an inside wiring standard with Cat-5 wiring as the minimum standard.

11 Conclusions

Whereas wealth creation in the industrial era required significant physical resources, access to raw materials, manpower, and efficient transportation, wealth creation in knowledge-based economies is largely independent of place, local resources, and physical assets. In contrast, wealth now arises from human ingenuity, intellectual property, and novel business models. With growth and development timeframes in the new economy largely unconstrained by the building of physical infrastructure and the movement of goods and services, knowledge-based businesses often grow exponentially. As a foundational cornerstone of these emerging systems of wealth creation, access to information and communications technology has become critical to sustainable economic development in virtually every community and society on the planet.

Through this work the REDI is now in a better position to weigh their options and select those that best align with each's vision for the future of their area. Enhancing broadband has the potential to set the stage to dramatically and positively impact the fabric of life throughout the region by helping to enable exceptional network services; learn-in-place, work-in-place, and age-in-place opportunities for all generations; innovation and diversification in every economic sector; and positioning the region's brand as dynamic, progressive and relevant to the future.

To accommodate both present and future economic development needs, facilitate full citizen inclusion, and help eliminate any digital divides within the REDI region, regionally- or municipally-driven, utility-based, fibre-to-the-premise deployments capable of enabling symmetric access up to and beyond 1 Gb/s to all are recommended. The hybrid fibre wireless infrastructure suggested will cost-effectively

scale to meet all future bandwidth requirements, minimize cost to all potential clients, and enable the region to maintain control of critical civic infrastructure. Each of the three business cases developed suggests that each alternative evaluated has the potential to be run on a sustainable basis and, once cashflow positive, will remain so for the foreseeable future.

12 Acronyms

AAMDC	Alberta Association of Municipal Districts & Counties
ABF	air blown fibre
ACE	Alberta Central East
ACFA	Alberta Capital Finance Corporation
admin	administration
AESO	Alberta Electric System Operator
Alberta HUB	Northeast Alberta Information HUB Ltd.
AlbertaSW	Alberta SouthWest Regional Alliance
AMWWP	Alberta Municipal Water/Wastewater Partnership
APC	Alberta Community Partnership
Arrow	Arrow Technology Group
AUMA	Alberta Urban Municipalities Association
AWS	Amazon Web Services
Axia	AxiaConnect
BAN	base area network
Bell	Bell Canada
BRAED	Battle River Alliance for Economic Development
CAD$	Canadian dollars
CAEP	Central Alberta Economic Partnership
CAGR	compounded annual growth rate
CARES	Community and Regional Economic Support (program)
CCI	Corridor Communications Inc.
CIRA	Canadian Internet Registration Authority
CRP	Calgary Regional Partnership
CRTC	Canadian Radio-television and Telecommunications Commission
CTI	Connect to Innovate
CWWF	Clean Water and Wastewater Fund
DIY	do it yourself
DOCSIS	Data Over Coaxial Cable Interface Specification
DSL	digital subscriber line
DWDM	Dense Wavelength Division Multiplexing
EAN	extended area network
ED	emergency department
EDT	(Alberta) Economic Development and Trade
EDU	education
EMR	electronic medical record
EQAO	education quality and accountability office
FCM	Federation of Canadian Municipalities
FDH	fibre distribution hub

FN	First Nation
FTTP	fibre to the premise
GB	giga (10^9) bits
Gb/s	giga (10^9) – bits per second
Gb/s	giga (10^9) – bits per second
GDP	gross domestic product
GLHLM	GoA, Learning, Health, Library, and Municipality
GoA	Government of Alberta
GPON	gigabit passive optical network
GPS	global positioning system
GROWTH Alberta	Grizzly Regional Economic Alliance Society
HDD	horizontal directional drilling
ICMP	Inter-Municipal Collaborative Development Program
ICT	information and communications technology
ID 24	Improvement District No. 24
Infoway	Canada Health Infoway
IoT	internet of things
IRR	internal rate of return
ISED	Innovation, Science, and Economic Development (formerly Industry Canada)
ISP	internet service provider
IT	information technology
ITU	International Telecommunication Union
k	kilo (10^3) – thousand
K-12	kindergarten through 12th grade
kV	kilo-volt
LSLEA	Lesser Slave Lake Economic Alliance
LTE	long-term evolution
M	mega, million (10^6)
M2M	machine-to-machine
Mac-Net	Mackenzie County network entity
MARA	Mackenzie Applied Research Association
Mb/s	mega (10^6) - bits per second
MD	municipal district
MGA	Municipal Government Act
MGI	McKinsey Global Institute
MH	Medicine Hat
MHz	megahertz
mktng	marketing
MSI	Municipal Sustainability Initiative
na	not available

NADC	Northern Alberta Development Council
NAICS	North American Industry Classification System
NAIT	Northern Alberta Institute of Technology
NAP	network access point
NOC	Network Operations Centre
NorthwesTel	NorthwesTel Inc.
NPV	net present value
NTCA	National Telephone Co-operatives Association
o-e	opto-electronics
OICRD	Olds Institute for Community & Regional Development
ONT	optical network unit
ops	operations
OSB	oriented strand board
OSP	outside plant
PA	precision agriculture
PEP	Palliser Economic Partnership
p&i	principal and interest
PMP	point-to-multipoint
POP	point-of-presence
PREDA	Peace River Economic Development Alliance
PRiS	Peace River Internet Service Society
PTP	point-to-point
R2B2	Rural and Remote Broadband
REA	Rural Electrification Association
REDA	Regional Economic Development Alliance
REDI	Regional Economic Development Initiative for Northwest Alberta
RFP	request for proposal
RM	regional municipality
RMWB	Regional Municipality of Wood Buffalo
Rogers	Rogers Communications
RoI	return on investment
RoW	right of way
RPM	remote patient monitoring
Shaw	Shaw Communications
SLA	service level agreement
SMACi	social, mobile, analytics, cloud, IoT
SouthGrow	South Grow Regional Initiative
srvc	service
StatsCan	Statistics Canada
SU	Singularity University

SV	summer village
SWOT	strengths, weaknesses, opportunities, and threats
Taylor Warwick	Taylor Warwick Consulting Limited
TECH/BW	technology/bandwidth
TELUS	TELUS Corporation
TSAG	First Nations Technical Services Advisory Group
US	United States (of America)
UTN	Utility Communications Network
vLE	virtual learning environment
W4L	Water for Life
WILD	West Inter-Lake District Regional Water Services Commission
WISP	wireless internet service provider
XplorNet	XplorNet Communications
yr	year

13 Appendices

13.1 Use of Technology in Farming Operations

Country/ Province/ County/ MD / RM	Automated Animal Feeding	Automated Environmental Controls for Animal Housing	Automated Steering (auto-steer)	Computers/ Laptops for Farm Management	GIS Mapping (e.g., soil mapping)	GPS Tech -nology	Greenhouse Automation	Other Tech -nologies	Robotic Milking	Smartphones/ Tablets for Farm Management
Canada	9,405	8,695	39,708	108,655	15,801	58,166	1,579	1,185	1,063	83,071
Alberta	669	680	10,462	23,725	2,589	13,684	143	164	62	19,093
Athabasca	9	8	101	334	25	143	-	1	2	247
Barrhead	17	23	183	359	40	242	3	1	1	276
Big Lakes	1	-	52	135	16	63	-	1	-	113
Birch Hills	2	1	101	120	19	111	-	-	-	106
Bonnyville	4	1	83	290	17	133	2	2	-	221
Clear Hills	1	-	86	171	13	124	-	-	-	139
Fairview	3	4	79	114	24	96	1	-	-	104
Grande Prairie	3	6	255	612	40	308	1	4	-	488
Greenview	8	3	74	268	15	116	-	1	-	208
Lac La Biche	-	-	31	105	8	56	-	-	-	86
Lac Ste. Anne	5	1	61	393	14	117	5	5	-	292
Lamont	4	4	181	380	36	231	1	3	-	286
Lesser Slave Rive	-	-	9	54	2	20	-	-	-	46
Mackenzie	1	1	196	185	14	236	1	2	-	179
Minburn	3	4	246	349	57	277	1	2	-	304
Northern Lights	-	1	84	199	18	119	1	-	-	154
Northern Sunrise	2	3	60	88	15	67	-	1	-	74
Opportunity	-	-	-	-	-	-	-	-	-	-
Peace	-	1	40	81	4	59	-	-	-	59
Saddle Hills	-	-	87	207	13	111	-	-	-	159
Smoky Lake	1	3	94	206	22	130	1	1	-	179
Smoky River	3	3	201	216	38	218	-	7	-	190
Spirit River	-	1	45	60	9	56	-	-	-	56
St. Paul	5	3	120	336	19	176	1	1	-	260
Thorhild	5	5	68	204	13	97	1	2	-	159
Two Hills	7	9	149	250	35	188	-	4	-	218
Vermilion River	11	8	315	624	77	416	-	2	-	549
Westlock	14	15	239	437	62	306	1	6	3	353
Wood Buffalo	-	-	-	1	-	-	1	-	-	1
Woodlands	1	2	17	110	4	29	-	-	-	80
Study Area Total	**110**	**110**	**3,257**	**6,888**	**669**	**4,245**	**21**	**46**	**6**	**5,586**

Source: Statistic Canada, Census of Agriculture, farms reporting having technologies used on the operation in the year prior to the census (Table 004-0243).

13.2 Methodology

13.2.1 Current State

Developing the current state comprised data collection, mapping, and analysis on a community-by-community basis. Figure 43 shows the information and data being sought from each of the communities. The information and data was attained using primary and secondary research methods.

Various community statistics are needed for broadband business case inputs. Statistics Canada (StatsCan) population and dwelling data from the Census 2011 and 2016 (updated data when 2016 Census was issued in February 2017) was used to calculate five-year growth rates and compounded annual growth rates (CAGRs). The underlying data for the business counts was also from StatsCan. Since buried fibre deployments are significantly more expensive than aerial builds, it was necessary to assess how the community's utilities (e.g., power) are currently delivered. For this task, community Land Use maps were used to identify residential, commercial, and industrial areas. As well Google Maps and Google Earth was used – looking at street detail for the presence of poles and condition of road surfaces (gravel vs. paved).

Various methods were used to count dwellings. Site visits were made to five communities in the Alberta HUB region (Bruderheim, Lamont, Chipman, Hilliard, Mundare), where residential and commercial areas were observed, houses and multi-unit dwellings counted, and tall structures noted.

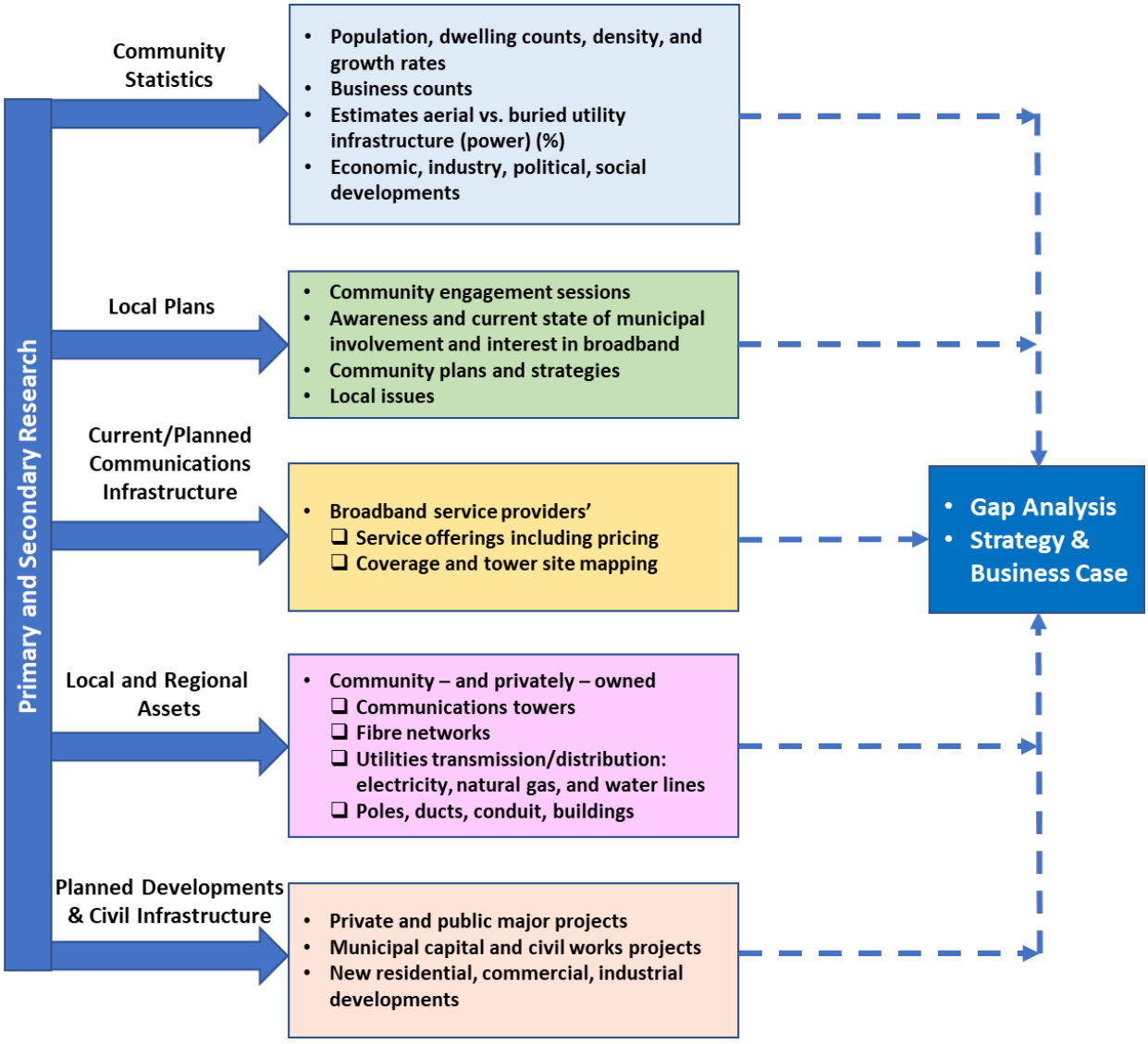


Figure 43 – Developing the current state.

To discover '*local plans*', the project team interacted directly with the communities through community engagement sessions; information and data requests; and telephone conversations (with communities, utility companies, ISPs and other community stakeholders). Extensive follow-up telephone calls were made by the report's author, the NADC, and the REDAs. The NADC created a video and Information bulletins to support the project. Alberta HUB and GROWTH Alberta conducted surveys with businesses located in their respective areas. The information attained was supplemented by document, website, and social media searches. Local and regional assets, both community- and privately-owned were inventoried and detailed insight about planned developments and civil infrastructure projects was attained.

Community contacts included Chief Administrative Officers and their staff as well as First Nation and Métis Settlement administrators and managers. Other groups or entities contacted during the study included ISPs, First Nations Technical Services Advisory Group (TSAG); electric and water utilities (e.g.,

Aquatera Utilities, NEW Water, Smoky River Regional Water Management Commission, ATCO Electric and Fortis Alberta).

Local ISPs were identified on a community-by-community basis and through conversations and website searches, their current and planned communications infrastructure, service offerings, and coverage were documented and tower sites mapped.

13.2.2 Desired State

Developing the desired state comprised data collection and analysis on a community-by-community basis. The information and data was attained using primary and secondary research methods.

To discover the '*future broadband visions and aspirations*' from the perspectives of the communities, the project team interacted directly with the communities through community engagement sessions, information and data requests, and telephone conversations. The information and data was evaluated and analysed to identify those communities, community partnerships, or regions that were most likely to develop and begin executing a broadband strategy in the near-term.

Community contacts included Chief Administrative Officers and their staff (information technology, planning and development, and economic development officers); elected officials; and First Nation and Métis Settlement administrators and managers.

The research for this phase of the project was conducted between January 2017 and May 2017. The reader is advised that the information and data found in this report is a '*snapshot*' in time. In other words, a variety of changes may have occurred since its collection (e.g., communities may have changed or evolved their broadband aspirations and visions, changes may have occurred in key staff who contributed to this report).

For the purposes of this phase of the project, broadband is defined a wide bandwidth data transmission with an ability to simultaneously transport multiple signals and traffic types. The medium can be twisted-pair copper wiring, optical fibre, coaxial cable, or radio. Broadband service is characterized as offering symmetric bandwidth between 50 Mb/s and 1 gigabit (Gb/s)/1,000 Mb/s and higher (really unlimited bit rates) (symmetric meaning the upload bit rate is as fast as the download bit rate).

13.3 Broadband Service Availability

To minimize provider costs, wireless services in rural areas are typically provided using point-to-multipoint (PMP) equipment. In this configuration, a 'host' tower transmits and receives signals to a specified geographic area. Each client has dedicated reception equipment that homes on the host tower. All users in the area share the host signal.

Higher-end business services may use dedicated point-to-point (PTP) systems that are typically engineered to deliver higher quality, higher bandwidth services. Pricing is installation specific and depends on the service parameters and equipment selected.

13.3.1 Regional Economic Development for Northwest Alberta (REDI)

13.3.1.1 Town of High Level

	Wireline Providers								
	TELUS (copper)			Northwestel (coaxial cable)			TekSavvy (copper)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
High Level									
Residential									
Option 1	63.00	up to 6	up to 1	39.95	up to 1	up to 0.25	29.99	up to 6	up to 1
Option 2	68.00	up to 15	up to 1	59.95	up to 8	up to 0.5	39.99	up to 15	up to 1
Option 3	73.00	up to 25	up to 5	79.95	up to 16	up to 0.77	44.99	up to 25	up to 5
Option 4				110.95	up to 50	up to 2			
Option 5									
Business									
Option 1	60.00	up to 15	up to 1	79.95	up to 5	up to 0.5	44.95	up to 6	up to 0.8
Option 2	85.00	up to 25	up to 5	109.95	up to 10	up to 0.77			
Option 3				129.95	up to 16	up to 1			
Option 4				149.95	up to 50	up to 2			
Option 5									

	Fixed Point-to-Multipoint Wireless								
	CCI (unlicensed)			Bell			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
Residential							KA2 Satellite		
Option 1	49.99	up to 2	up to 0.75	65.00	up to 5	up to 1	69.99	up to 5	up to 1
Option 2	74.99	up to 5	up to 1				79.99	up to 5	up to 1
Option 3	94.99	up to 10	up to 1						
Option 4									
Business							KA2 Satellite		
Option 1	200.00	up to 6	up to 2				69.99	up to 5	up to 1
Option 2	249.99	up to 7	up to 3				79.99	up to 5	up to 1
Option 3									
Option 4									

13.3.1.2 Town of Rainbow Lake

	Wireline Provider						Fixed Point-to-Multipoint Wirele		
	TELUS (copper)			Town - Rainbow Lake (coaxial)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
Rainbow Lake									
Residential							KA2 Satellite		
Option 1	63.00	up to 6	up to 1	49.07	0.5	0.05	69.99	up to 5	up to 1
Option 2	68.00	up to 15	up to 1				79.99	up to 5	up to 1
Option 3							Have stopped selling		
Business							KA2 Satellite		
Option 1	60.00	up to 15	up to 1	49.07	0.5	0.05	69.99	up to 5	up to 1
Option 2	85.00	up to 25	up to 5				79.99	up to 5	up to 1
Option 3							Have stopped selling		

13.3.1.3 Mackenzie County

	Wireline Provider			Fixed Point-to-Multipoint Wireless								
	TELUS (copper)			CCI (unlicensed)			Arrow (unlicensed)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
Fort Vermilion												
Residential										KA2 Satellite		
Option 1	63.00	up to 6	up to 1	49.99	up to 2	up to 0.75	65.00	up to 5	up to 1.5	69.99	up to 5	up to 1
Option 2	68.00	up to 15	up to 1	74.99	up to 5	up to 1				79.99	up to 5	up to 1
Option 3	73.00	up to 25	up to 5	94.99	up to 10	up to 1						
Option 4												
Business										KA2 Satellite		
Option 1	60.00	up to 9	up to 1	200.00	up to 6	up to 2	250.00	up to 1.5	up to 1	69.99	up to 5	up to 1
Option 2	85.00	up to 25	up to 5	249.99	up to 7	up to 3	500.00	up to 3	up to 1.5	79.99	up to 5	up to 1
Option 3												
Option 4												
Option 5												
La Crete												
Residential										KA2 Satellite		
Option 1	63.00	up to 6	up to 1	49.99	up to 2	up to 0.75	65.00	up to 5	up to 1.5	69.99	up to 5	up to 1
Option 2				74.99	up to 5	up to 1				79.99	up to 5	up to 1
Option 3				94.99	up to 10	up to 1						
Option 4												
Business										KA2 Satellite		
Option 1	60.00	up to 9	up to 1	200.00	up to 6	up to 2	250.00	up to 1.5	up to 1	69.99	up to 5	up to 1
Option 2				249.99	up to 7	up to 3	500.00	up to 3	up to 1.5	79.99	up to 5	up to 1
Option 3												
Option 4												
Option 5												

	Fixed Point-to-Multipoint Wireles		
	Arrow (unlicensed)		
	Cost	Bandwidth - Mb/s	
	$/mo	Down	Up
Zama City			
Residential			
Option 1	100.00	up to 5	up to 1.5
Option 2			
Option 3			
Business			
Option 1	250.00	up to 1.5	up to 1
Option 2	500.00	up to 3	up to 1.5
Option 3			

13.3.1.4 First Nations

	Fixed Point-to-Multipoint Wireless								
	Arrow (unlicensed)			CCI (unlicensed)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
Beaver First - Boyer & Child Lake									
Residential							KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	49.99	up to 2	up to 0.75	69.99	up to 5	up to 1
Option 2				74.99	up to 5	up to 1	79.99	up to 5	up to 1
Option 3				94.99	up to 10	up to 1			
Option 4									
Business							KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1	200.00	up to 6	up to 2	69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5	249.99	up to 7	up to 3	79.99	up to 5	up to 1
Option 3									

	Fixed Point-to-Multipoint Wireless								
	Arrow (unlicensed)			CCI (unlicensed)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
Dene Tha' - Bushe River									
Residential							KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	49.99	up to 2	up to 0.75	69.99	up to 5	up to 1
Option 2				74.99	up to 5	up to 1	79.99	up to 5	up to 1
Option 3				94.99	up to 10	up to 1			
Option 4									
Business							KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1	200.00	up to 6	up to 2	69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5	249.99	up to 7	up to 3	79.99	up to 5	up to 1
Option 3									

	Fixed Point-to-Multipoint Wireless					
	Arrow (unlicensed)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up
Dene Tha' - Hay Lake & Zama Lake (Amber River - recreation area only)						
Residential				KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	69.99	up to 5	up to 1
Option 2				79.99	up to 5	up to 1
Option 3						
Business				KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1	69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5	79.99	up to 5	up to 1
Option 3						

	Fixed Point-to-Multipoint Wireless					
	Arrow (unlicensed)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up
Dene Tha' - Upper Hay River						
Residential				KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	69.99	up to 5	up to 1
Option 2				79.99	up to 5	up to 1
Option 3						
Business				KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1	69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5	79.99	up to 5	up to 1
Option 3						

	Fixed Point-to-Multipoint Wireless								
	Arrow (unlicensed)			Little Red River First Nation			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
Little Red River Cree - Fox Lake									
Residential							TeleSat KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	0.00	up to 2	na	69.99	up to 5	up to 1
Option 2							79.99	up to 5	up to 1
Option 3							89.99	up to 6	up to 1
Option 4									
Business							TeleSat KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1				69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5				79.99	up to 5	up to 1
Option 3							89.99	up to 6	up to 1
Option 4									

	Fixed Point-to-Multipoint Wireless								
	Arrow (unlicensed)			Little Red River First Nation			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up	$/mo	Down	Up
Little Red River Cree - Garden River & John D'or Prairie									
Residential							KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	0.00	up to 2	na	69.99	up to 5	up to 1
Option 2							79.99	up to 5	up to 1
Option 3									
Business							KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1				69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5				79.99	up to 5	up to 1
Option 3									

	Fixed Point-to-Multipoint Wireless					
	Arrow (unlicensed)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up
Tallcree - North & South						
Residential				KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	69.99	up to 5	up to 1
Option 2				79.99	up to 5	up to 1
Option 3						
Business				KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1	69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5	79.99	up to 5	up to 1
Option 3						

13.3.1.5 Métis Settlement

	Fixed Point-to-Multipoint Wireless					
	Arrow (unlicensed)			XplorNet (licensed)		
	Cost	Bandwidth - Mb/s		Cost	Bandwidth - Mb/s	
	$/mo	Down	Up	$/mo	Down	Up
Paddle Prairie Métis Settlement						
Residential				KA2 Satellite		
Option 1	65.00	up to 5	up to 1.5	69.99	up to 5	up to 1
Option 2				79.99	up to 5	up to 1
Option 3						
Business				KA2 Satellite		
Option 1	250.00	up to 1.5	up to 1	69.99	up to 5	up to 1
Option 2	500.00	up to 3	up to 1.5	79.99	up to 5	up to 1
Option 3						

13.4 Mobility Providers

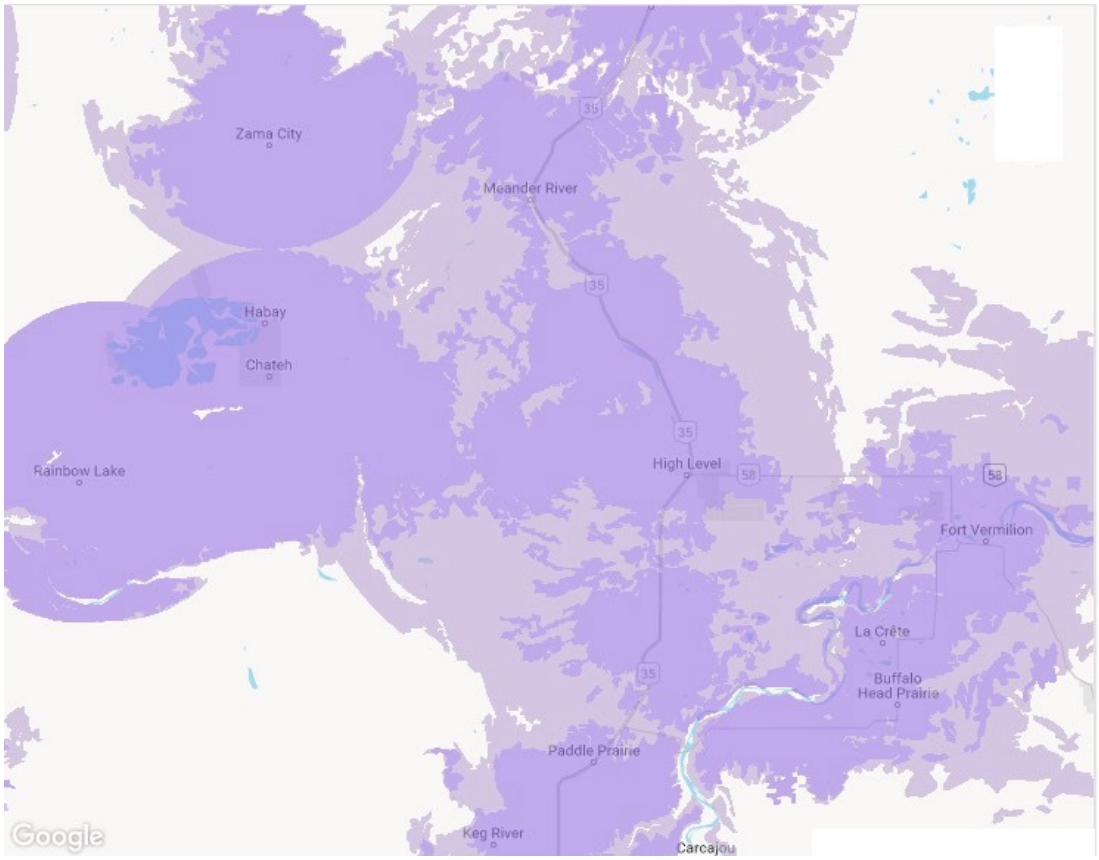


Figure 44 – Mobility coverage – TELUS/Bell.

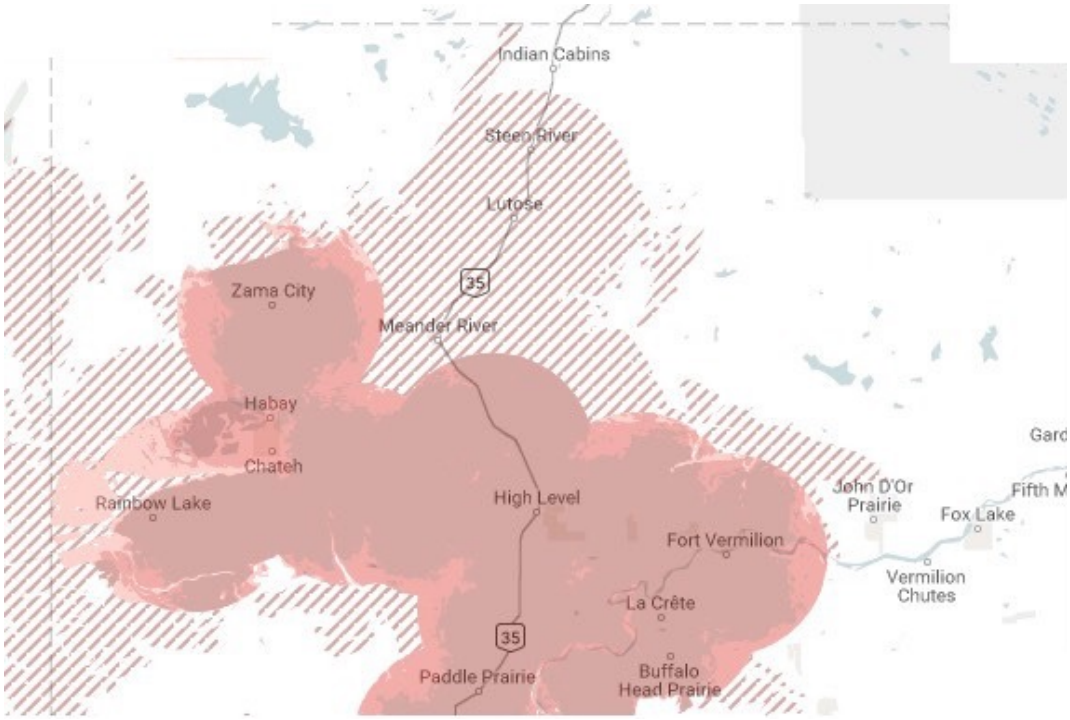


Figure 45 – Mobility coverage – Rogers Communications.

13.5 Alberta SuperNet

The Alberta *SuperNet* is a broadband superhighway, conceived by the Government of Alberta (GoA) in the early 2000's to connect public institutions, collectively termed the GLHLM (GoA, Learning, Health, Library, and Municipality) clients, to a broadband network for high-speed Internet access, video conferencing, and other services. The GLHLM component of the *SuperNet* links 4,200 GLHLM facilities in 429 communities. A second, wholesale backbone services, component enables rural ISPs to connect their access networks back to a peering point in Calgary and Edmonton. It is on this component that the discussion below is focused.

The Alberta *SuperNet* consists of the Bell-operated Base Area Network (BAN) serving 27 of the larger urban centres in the province and the Axia-operated Extended Area Network (EAN), covering the rest of the province. BAN communities in northern Alberta include Bonnyville, Cold Lake, Fort McMurray, Grande Prairie, Vegreville, Vermilion, and Whitecourt. While the *SuperNet* mostly consists of fibre-optic backbone facilities, wireless links are used to complete the network in the most rural areas.

As the *SuperNet* is operated on an '*open-access*' basis (its services are available to all service providers on a comparable basis), to preclude any conflicts of interest, neither Bell nor Axia can offer retail services such as Internet with in their *SuperNet* footprint. To date, Bell does not offer retail services within the province, but Axia NetMedia does provide retail services to corporate clients and, through AxiaConnect, provides retail Internet services in smaller communities (e.g., Town of Fairview).

Deploying fibre to smaller towns, villages, hamlets, small subdivisions, and other remote groups of premises need not be more expensive than deploying to neighbourhoods in urban areas, except for the following:

- A backhaul connection is needed to connect the community to the global network, and
- Operational costs could increase if the community is not near maintenance personnel.

The availability and monthly costs of the backhaul connections are therefore fundamental to enabling fibre deployment and sustainable operations in all of these communities. To enable triple play services in communities, a 1 Gb/s backhaul connection is the absolute minimum. The *SuperNet* operating requirement is to enable minimum 1 Gb/s (and preferably 5 or 10 Gb/s) connections between communities and a peering point in for example Edmonton at a low enough rate that these community operations are sustainable. Obviously, there are expenses other than debt service and backhaul, but those can be reduced by scale - either by outsourcing operations to a larger player or by partnering with other local communities to realize scale themselves.

Since its construction, there have been issues for users, ISPs, and municipalities with the SuperNet. Service Alberta summarized the current issues as follows:[95]

- Quality and cost of services;
- Uneven playing field between ISPs and the SuperNet operator;
- Poor contracts, which are difficult to manage; and
- From Service Alberta's perspective, escalating costs to the Government of Alberta.

The SuperNet operating contact will expire on June 18, 2018.

[95] Alberta. Bull, Stephen, Assistant Deputy Minister, Service Alberta, SuperNet Secretariat. *Alberta SuperNet 2.0*. Message to Doris Regula. 24 January 2017. E-mail.

13.6 ATCO's and Fortis Alberta's Service Areas

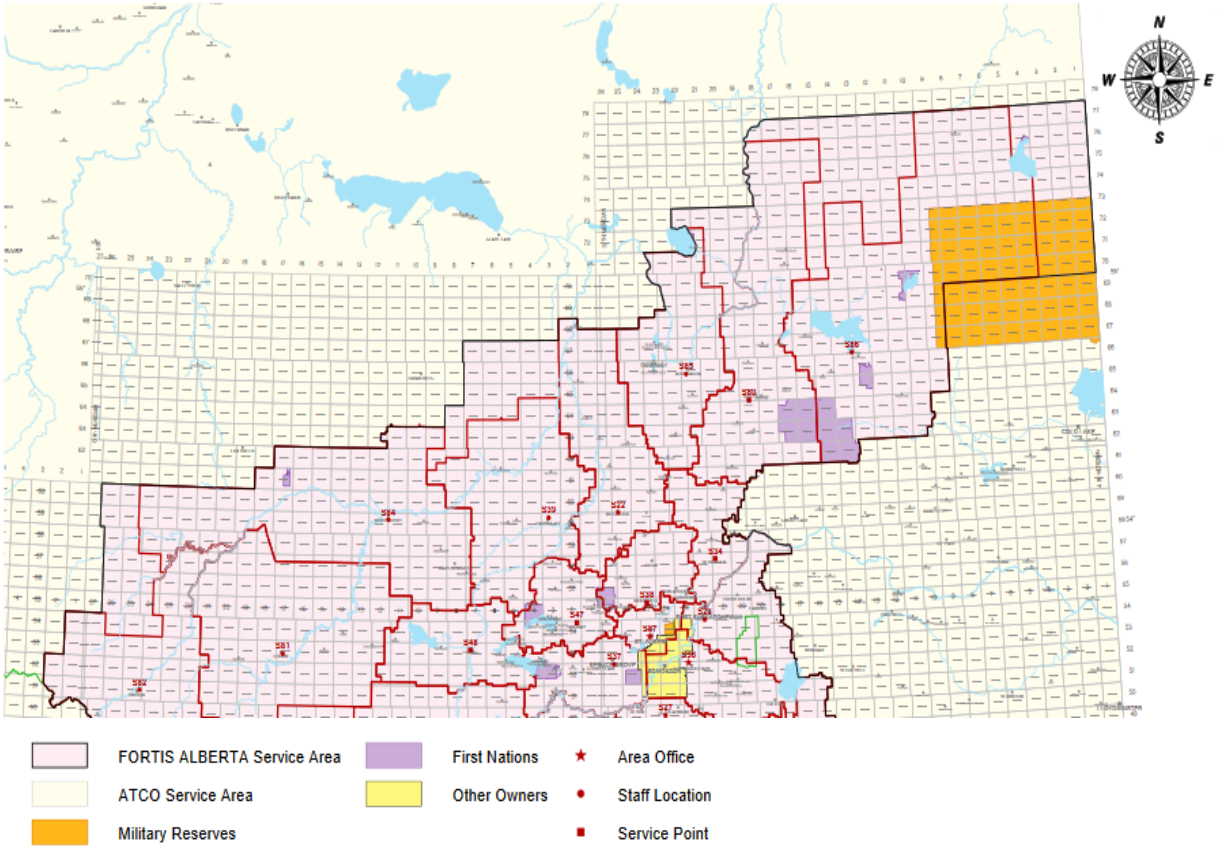


Figure 46 – ATCO Electric & Fortis Alberta service areas (northern Alberta).

13.7 Desired State

Table 16 – Community Broadband Plans and Visions

	Issues/Challenges Facing Community in Next 5 Years	Fibre /broadband on Agenda?	Factors impacting capability to pursue fibre/broadband	Broadband Next 3, 5, 10 Years
Towns				
High Level	• Ensuring residential and businesses are getting the advertised level of service and what they are paying for • Loss of industry – oil and gas, residents leaving • Attracting new businesses given remote location (need to be able to do business online)	On Council's radar	Cost and location	At the very least, citizens to receive the Internet service levels they pay for
Rainbow Lake	Remoteness	No	None provided	None provided
Counties				
Mackenzie	• Building the infrastructure needed for roads, water, and sewer • Improved cellular and Internet services coverage, reliability, and bandwidth • Remoteness	Has been a topic of discussion	Do not wish to compete with local communications companies and ISPs	Improved and enhanced broadband services (coverage, reliability and speed) offered by the existing ISPs and encouraged and supported by Mackenzie County Residents and businesses have access to the most current telecommunications technologies to permit them to participate in global opportunities[96]
First Nations				
Beaver First	Information was not available at the time this report was finalized			
Dene Tha'	• Housing shortage • Lack of employment (oil and gas decline) • Unstable and inconsistent Internet access	With the Chief	• Cost • Low density, particularly at Hay Lakes (also know as Chateh)	

[96] Mackenzie County. Mackenzie County, Sustainability Plan 2015 – January 2016, Approved January 12, 2017. 33.

	Issues/Challenges Facing Community in Next 5 Years	Fibre /broadband on Agenda?	Factors impacting capability to pursue fibre/broadband	Broadband Next 3, 5, 10 Years
Little Red River	• Fibre-based high-speed Internet services are a priority need • Remoteness and semi-remoteness affect the costs of goods and services because travel distances are significant on gravel roads (Fox Lake 162 access is ice bridge in winter and barge services in summer) • Cellular service is needed for the three First Nations communities, tourists, workers accessing the Wood Buffalo National Park, and goods and services providers • Reserve roads require designed/engineered modernization • Major housing shortage and overcrowding (i.e., need to address population growth and the addition of new families) • High unemployment • Economic opportunities and growth (Highway 58 connector to Fort Smith would improve opportunities) as well as regional work opportunities • Limited access to postsecondary educational opportunities •	Yes, high on Council's agenda[97]	Cost – would like to move away from fixed wireless to fibre-based Internet	Within 3 yrs. – envision community health centres, schools, college campuses, the First Nation's offices, and residents will have higher quality and affordable access to high-speed internet services (on par with other communities in the region that are served by the SuperNet). 5 yrs. – through the cooperative lobby efforts of the northern communities and the premises of the Broadband project, greatly improved access to educational and training opportunities for youth and others in developing skills, attaining a post secondary education, and improving the general capacity of the residents of the three Little Red River communities will become a reality. 10 yrs. – increased capacity of the communities drives economic growth and greater opportunities for the populace including having their own ISP or a continued partnership with Arrow.

[97] The Little Red River First Nation sees a role for broadband to play in addressing the issues and challenges facing their communities. Broadband would increase access to more online post secondary education for youth and its people as well as telehealth and other social services. Assistance with local improvements and the needs of the communities would benefit if communications and the sharing of information with the federal authorities were broader and more timely. As well the availability of broadband could encourage the creation of online business ventures.

	Issues/Challenges Facing Community in Next 5 Years	Fibre /broadband on Agenda?	Factors impacting capability to pursue fibre/broadband	Broadband Next 3, 5, 10 Years
Tallcree	• Housing (new, sustainable, maintenance, low income) • Employment • Infrastructure • Operational funding • Broadband bandwidth • Lack of cell phone coverage • Education	Yes	• Capacity • Lack of knowledge	3 yrs. – on par, in terms of bandwidth, with the Fort Vermilion School Division (50/50 Mb/s), reliable Internet 10 yrs. – being in a position to provide educational opportunities (access to training) and programming that would give their community a competitive edge in the job market

13.8 Business Model Options

Dark Fibre	Conduit	***E.g.,:*** Montreal ***Open access*** can be provided via conduit sharing or subducting, but is limited by the size of the existing conduit.
		Pro's: Simple operationally, can be handled by traditional utility departments. Takes 50-60% of the deployment expense off the table for service providers if well designed. ***Con's:*** Typically only includes feeder and some distribution routes; Limited breakout points; May restrict fibre architecture.
	Fibre	***E.g.,:*** Stokab in Stockholm, Qnet in Coquitlam, OICRD in Olds, Calgary ***Open access*** is typically provided via home-run architecture and by provisioning multiple fibres per premise. If fibre counts are limited, a community may opt for first-come, first-served arrangements.
		Pro's: Simple operationally, but considerably more helpful than a conduit-only play. Takes 50-75% of the deployment expense off the table for service providers. Reduces disruption due to civic construction. Enables efficient conduit/fibre design and can be optimized for connectivity. Over-provisioning is required to ensure sufficient fibre and space for multiple sets of network equipment. ***Con's:*** Potential service providers must also deploy network equipment to light the fibres they wish to lease prior to providing services. In large metropolitan areas, this works, but in smaller communities, it will limit the number of service providers available to you. O-Net, for instance, is not likely to play, and if one does come in, it's likely that no-one else will, due to the limited market – giving them a defacto monopoly.

Lit Fibre		***E.g.,:*** *SuperNet* in Alberta (backbone only). Common in Europe and would work well here. ***Open access*** can be provided via an independent network operator and a well-managed routing centre.
		Pro's: Facilitates unencumbered services-based competition amongst pure-play service providers and thus opens up services innovation to all players. ***Con's:*** Goes against long standing (if not antiquated) federal policy of facilities-based competition. A services-based eco-system has not yet developed in Canada and current incumbents will boycott your network.
Integrated		***E.g.,:*** Bell, Rogers, Shaw, TELUS; Traditional business model. All incumbents.
		Pro's: Good for single-purpose networks and universal service.

		Con's: Inhibits competition and innovation is only with permission from the network operators. Results in defacto monopoly control of critical civic infrastructure. Interests of the incumbent shareholders do not align with the needs of the communities they serve.