Edmonton Metropolitan Region Board

Broadband Situation Analysis

Final Report | August 2020

Regional Broadband

RSM

taylorwarwick CONSULTING LIMITED

Edmonton Metropolitan Region Board
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1. Executive Summary

The world is witnessing an economic revolution as the value of physical assets are being far exceeded by the value of knowledge and data. Access to information and communications technology (ICT) has become critical to sustainable global economic competitiveness and increased quality of life in virtually every society on the planet. Moving forward, the requirement for connected infrastructure is no longer about simply moving data around, it is essential to enabling the fundamental societal transformation that impacts all aspects of daily life.

In 2020, the imperative for ICT has become immensely relevant. As the world witnessed the coronavirus spread, public health measures were implemented, disrupting the function of business and entire societies. In response, ICT is playing a vital role in ensuring those practicing social distancing can still work, communicate with family members, gain education and health care access, and contribute to society. This pandemic has highlighted the importance ICT plays in enabling the continuity of governments and businesses, and the speed of future economic recovery efforts. Across the Edmonton Metropolitan Region, many businesses have chosen to close their physical offices and have employees work from home in an attempt to stop the spread of COVID-19. In these unprecedented times, ICT is integral to ensuring economic activity can still occur and communities are connected. It is in these challenging times that the need for digital connectivity and internet access couldn't be more important, no matter where you live in the Region.

This cannot be emphasised enough; the world is changing rapidly. Broadband connectivity is fundamental to economic transformation and plays a vital role in improving quality of life. Any globally competitive region needs a clear strategy and plan in place to ensure they are not left behind. Recognizing how fundamentally important connectivity is to the economic growth and prosperity of the Region, the Edmonton Metropolitan Region Board (EMRB) commissioned the development of this Broadband Situation Analysis to better understand the current state of broadband deployment in the Region, to inform future work, and to enhance the economic competitiveness.

Broadband is a critical horizontal enabler and catalyst essential for the Region to achieve the vision and outcomes of the Growth Plan. As the EMRB's Growth Plan sets the direction until 2044, ICT transforms every policy area within the Plan. For example, within the transportation policy area, autonomous vehicle technology is advancing rapidly and will require 5G connectivity (or beyond) to be fully utilized.[1] Regardless of current connectivity levels, the next generation of technology will require an even greater network and the Region needs to be prepared.

Figure 1. Broadband Enhanced EMRB Growth Plan Policy Framework

The Situation Analysis develops a common understanding of the opportunities that enhanced connectivity can create, provides an understanding of the gaps that exist in the Region today, and provides recommendations for the EMRB to consider for future work. The recommendations aim to close the identified gaps and prepare the Region to take full advantage of emerging technologies that drive new business models and cutting-edge industry

[1] 5G's Important Role in Autonomous Car Technology

technology across all economic sectors to ensure it remains globally, economically competitive. To do this, this report is broken into five overarching sections:

This report begins with a **Socioeconomic Impact Assessment** of the quantitative and qualitative impact enhancing broadband connectivity can have on the Region's GDP and quality of life.

After establishing the impact of enhancing broadband connectivity, a **Current State Analysis** of the Region's municipalities is provided identifying current service levels and assets, and the strategies that are in place to enhance them. In addition, this section of the report identifies ecosystem stakeholders that are involved in providing overarching strategy, funding, and advocacy.

To move forward from the current state and establish **the Desired Future State**, the historic and continual evolution of broadband technology is explored, and an international jurisdiction scan is provided. This section establishes what the future looks like, compares the Region and Canada to the rest of the world, and provides key insights and best practices to inform the Region.

In completing each of the above sections, key gaps are identified and summarized in the **Gap Analysis** section of the report. These identified and consolidated gaps provide direction for the recommendations of the report.

The Broadband Situation Analysis report concludes with a set of key **Recommendations for Consideration** to inform EMRB's next steps in enhancing broadband connectivity. Each recommendation has been developed in response to the identified gaps and provides an actionable path forward for enabling regional collaboration.

Figure 2. Final Broadband Situation Analysis Report

Socioeconomic Impact Assessment

Broadband connectivity is absolutely and fundamentally essential to the Region's long-term social and economic prosperity. Sustainable economic prosperity over the next several years is especially crucial for Alberta's economy in light of the current crisis.

The onset of the unprecedented COVID-19 pandemic has devastated the Canadian economy, which is expected to contract sharply in 2020. The Canadian economy shrank by 2.1% during the first three months of 2020 after expanding 0.1% in the previous quarter, as shown in the figure below[2]. It is the sharpest decline since Q1 2009, and it is expected that Canada will face a relatively longer recovery period.

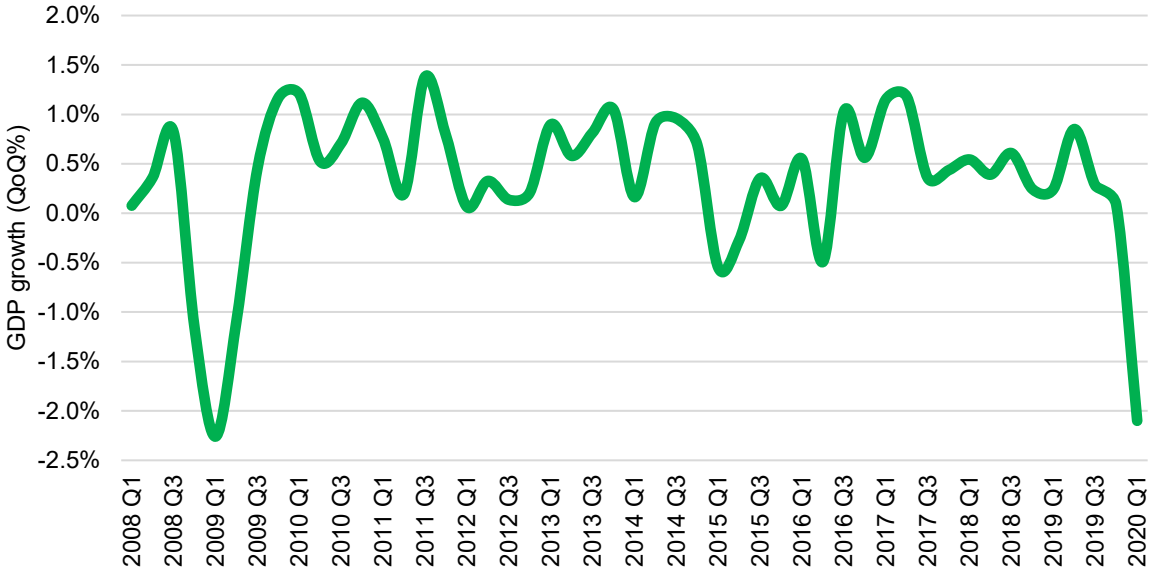

Figure 3. Quarterly historical and forecasted real GDP growth in Canada Q1 2008 – Q1 2020

Alberta's economy is likely to be hit harder due to low oil prices and Alberta's reliance on the oil and gas sector. Even prior to COVID-19, Alberta's economy has been in a downturn given low oil prices. Alberta's GDP dropped by 0.6% in 2019 from the previous year, compared to a national GDP growth of 1.6%[3]. Alberta's unemployment rate has been nearly two percentage points above the national average. The Edmonton Census Metropolitan Area had a GDP growth of approximately 0.5% in 2019[4].

As governments start to lift restrictions and focus on economic recovery post the global pandemic, it is expected that the Federal Government will announce a significant infrastructure stimulus program[5]. Evidence suggests that investing in broadband connectivity generates substantial economic and social impact[6]. Investment in broadband connectivity would not only address the significant service gaps in the Edmonton Metropolitan Region, it would also enable socioeconomic benefits. For example, benefits enabled through the development of a smart region consisting of sustainable communities and a focus on increasing healthcare efficiencies through digital technologies, creates opportunities for improved economic prosperity and quality of life.

[2] Scotiabank

[3] Alberta Government; Economic dashboard; https://economicdashboard.alberta.ca/GrossDomesticProduct

[4] Quarterly Economic Update February 2020; Economic Insights; The City of Edmonton

[5] Ottawa seeks 'shovel-ready' projects for post shutdown stimulus plan; The Globe and Mail; https://www.theglobeandmail.com/politics/article-mckenna-seeking-shovel-ready-projects-for-post-shutdown-stimulus/

[6] The socioeconomic impact of bandwidth; Analysys Mason limited & Tech4i2 Limited; 2013

Methodology

The approach undertaken to analyze the impact of broadband from a societal perspective involved leveraging a Socioeconomic Return on Investment (SROI) methodology as the overarching analytical framework to estimate the socioeconomic benefits, in dollars, associated with enhanced broadband connectivity in the Edmonton Metropolitan Region. The SROI framework has been used by various governmental agencies to allocate government funding and build consensus with stakeholders. This approach enables a more holistic understanding of the benefits attainable from the investment in terms of the economic, social, environmental, and health outcomes.

Figure 4. The SROI Framework

The SROI assessment of broadband connectivity is based on the following core principles:

- **Evidence based –** Quantification and monetization of socioeconomic impact requires a strong evidentiary basis and relevant data. The goal was to maximize credibility of the analysis. As such, the quantitative impacts analysis only includes socioeconomic impacts for which there was a strong evidentiary basis.
- **Conservatism –** When making assumptions the analysis followed the rule of conservatism and erred on the side of caution in an effort not to overstate benefits. Risk analysis tools such as Monte Carlo simulation supported this endeavour by enabling explicit consideration of uncertainties.
- **Quantitative verses qualitative –** Not all socioeconomic impacts can be quantified and/or monetized; these impacts are qualitatively assessed in the form of case studies as they relate to the Edmonton Metropolitan Region under the sub-section entitled "Qualitative social impacts".

Economic Impacts

Utilizing the methodology and assumptions outlined, improving broadband connectivity across the Edmonton Metropolitan Region could enable economic recovery and **increase GDP by up to $1 billion per year, approximately a 1% increase in the Region's GDP**. This $1 billion would be multi-sectoral, enabling economic diversification and providing benefits across the Region. Alberta's GDP contracted by 0.6% in 2019 and is projected to decline sharply in 2020. These results are conservative as the relationship between broadband connectivity and economic growth have strengthened over the last several years.

Moreover, risk analysis was used to account for the uncertainty in the underlying broadband data (see *Appendix A: SROI Methodology* for an explanation of the Monte Carlo risk analysis tool that was utilized).

The GDP impact is analyzed under three scenarios. The increase in GDP is relative to the estimated baseline value of $96 billion for the Edmonton Metropolitan Region (2020). The sub-section in the body of the report titled "Scenario Specific Results" provides the probability distribution of each scenario.

Table 1. Summary of the GDP impact from broadband connectivity by scenarios

Scenarios	GDP impact ($ millions)	Percentage GDP increase relative to baseline
Scenario 1: Average 50 Mbps download speed	**$144 - $412**	0.15% - 0.43%
Scenario 2: Average 75 Mbps download speed	**$274 - $736**	0.28% - 0.76%
Scenario 3: Average 100 Mbps download speed	**$358 - $954**	0.37% - 0.99%

Qualitative Social Impacts

Apart from the GDP growth resulting from improved broadband connectivity, there are numerous socioeconomic benefits from enhanced broadband that are not directly quantified in the analysis such as:

- **Community –** broadband plays a role in improving share of information within the local community (e.g., by providing local information and facilitating online social networking).
- **Emergency Response/Preparedness –** high-speed internet enables public service groups and first responders to receive and share text, pictures, and videos with colleagues and the broader public, enabling them to better prepare for emergency situations.
- **Education and Skills –** broadband improves education and skills through distance learning and access to online information with videoconference communication between teachers and students.
- **Environment and Climate –** broadband can improve environmental sustainability by reducing the need to travel/commute and improves environmental monitoring.
- **Equality and Inclusion –** broadband internet has the ability to connect isolated individuals and communities and thus, empower these communities by providing a platform.
- **Finance –** there is a benefit associated with access to online shopping for goods and services which provides individuals the opportunity to save money and access markets outside of their community.
- **Healthcare –** improved broadband connectivity reduces the cost of providing health and social care services and improves outcomes through remote diagnosis and monitoring. A crucial part of effective telehealth services is the transmission of high-definition medical images, possible only by high-speed internet.
- **Well-being –** the use of broadband plays a general role in improving individuals' quality of life and social well-being by facilitating social interactions with friends, family and others.

A deeper qualitative analysis of socioeconomic benefits from broadband connectivity was conducted as a part of this study to understand their implications on Alberta and/or the Edmonton Metropolitan Region. These are discussed further within the body of this report, alongside a more detailed analysis of the impacts to each of the Region's municipalities.

Current State Analysis

Municipalities in the Region (both EMRB Members and Non-Members) each have their own unique opportunities and challenges. In general, it has been observed that the broadband connectivity challenges and opportunities faced by municipalities align with the three policy tiers outlined by Edmonton Metropolitan Region Growth Plan; Metropolitan Core, Metropolitan Area, and Rural Area.

Figure 5. EMRB Policy Tiers (Edmonton Metropolitan Region Growth Plan)

While the Metropolitan Core and Metropolitan Area can experience relatively high levels of connectivity and interest from Internet Service Providers (ISP) to build infrastructure, the Rural Area finds connecting residents and businesses over low-density areas challenging as there is an imbalance of investment on behalf of the ISPs, driven by density. This requires that municipalities within the Rural Area develop detailed broadband strategies to bridge connectivity gaps the ISPs are not willing to fill, whereas urban municipalities can be challenged by the fact that critical broadband infrastructure is owned by a small number of ISPs. Despite these uniquely rural and urban challenges, the Region as a whole, has an opportunity to collaborate on a path forward, can mutually benefit from development of regional policies, and partner with regional ecosystem stakeholders in speaking with one voice.

In addition to the municipal findings of this study, an analysis of the larger broadband ecosystem was completed. It was found that the ecosystem focuses on two areas: strategy and funding, and advocacy.

Figure 6. Ecosystem Stakeholders

The Provincial Broadband Strategy has recently been reinvigorated and there are several broadband infrastructure funding options available from the Federal Government. However, access to these funds by EMRB municipalities may be difficult as the Region, according to the criteria (connectivity maps prepared by the Canadian Radio-television and Telecommunications Commission (CRTC)), largely meets current connectivity standards. This speed data, which is a collection of ISP advertised speeds, contrasts what was

heard during interviews conducted, where it was indicated that CRTC connectivity maps are not a true reflection of the speeds actually experienced by residents and businesses. This has been a core topic of advocacy efforts led by Alberta Urban Municipalities Association (AUMA) and the Rural Municipalities of Alberta (RMA), who work closely with all levels of government to ensure their members have fair and equitable access to funds and information. Other organizations such as Edmonton Global bring the needs of the business community forward, with advocacy efforts focused on ensuring broadband is seen as a critical piece of infrastructure that is a core driver of economic development, business retention, investment attraction, and quality of life to attract talent. In consideration of these challenges and opportunities faced by the Region, there are several emerging recommendations for the role EMRB may fill moving forward.

Regional Current State

The Region has two distinct levels of service depending on location within the Region. Interview findings suggest that this dichotomy is caused by two main factors: municipal administrative capacity to make broadband deployment a focus and population density which directs infrastructure development. Furthermore, this dichotomy is evidenced by the need for municipalities to have a dedicated broadband strategy. Of the seven municipalities identified as being a part of the Metropolitan Core and Metropolitan Area, only three have dedicated broadband strategies (43%), while five out of six municipalities in the Rural Area have dedicated broadband strategies (83%).

In the majority of areas with greater population density, ISPs (namely TELUS and Shaw) offer high-speed internet. Shaw appears to offer Gigabit per second (Gbps) services in more locations than TELUS, however, TELUS is growing their Gbps service offering. It is important to note that Shaw has recently increased speeds through upgrading their coaxial cable infrastructure while TELUS has been upgrading its fibre infrastructure and installing fibre to the premises. In the short-term, Shaw appears to be the leader, however, more dwellings and businesses are being connected via TELUS' fibre. In these municipalities, having world-class connectivity that enables the next generation of technology is top of mind and infrastructure ownership, along with lack of competition in the telecommunications industry become key considerations.

In rural areas, ISPs often do not have a compelling business case for building infrastructure and providing services, as the lack of population density makes connecting these areas less profitable. As such, these municipalities have realized there is a need to take action themselves to improve broadband connectivity. In doing so, they have two key advantages over private enterprise. Firstly, they can access long-term capital at low rates that do not require payback in a 3-5-year period. Secondly, should they approach it as a utility, they can pool their resources and build one capable network that all ISPs can use to compete on vs each ISP trying to secure the capital to build a separate network. Furthermore, remote areas cannot solely rely on a fibre network and require the use of point-to-multipoint fixed wireless access (FWA) technology, where wireless equipment on a tower can connect premises in a ~20 km radius around the tower. Though much less scalable and operationally more expensive than fibre infrastructure, the capital deployment costs are significantly less and enable a positive return-on-investment (ROI) in sparsely populated areas. Most towers are currently limited via a point-to-point wireless backhaul circuit and rural areas can benefit from enabling fibre to the tower and potentially increase the available bandwidth by a factor of ten.

Although this dichotomy exists between the Metropolitan and Rural Area and their approach to connecting their communities differ, there are a number of similarities that were observed across the Region, including:

- The majority of municipalities in the Region have had conversations with ISPs to understand their options for enhancing their connectivity, however, these conversations largely occur in silos and on an ad-hoc and individual basis;

- Municipalities generally lack awareness and understanding of the breadth of broadband deployment options available and the costs and benefits of each;
- Municipalities are not applying for federal funding as the majority of the Region is ineligible to access current funds and applications require significant technical expertise;
- In the vast majority of EMRB member municipalities, there is an absence of 'dig once' engineering and development guidelines that considers the deployment of fibre or fibre conduit when other infrastructure construction occurs;
- The majority of EMRB member municipalities own fibre-optic infrastructure themselves that connects municipal facilities. In this regard, EMRB municipalities have control of these critical pieces of infrastructure (refer to the figure below); and
- Municipalities are not aware of where current privately-owned fibre infrastructure is located and where new fibre infrastructure will be deployed within their own municipality, as ISPs are reluctant to provide this information.

These regional considerations are further explained in the Current State sections in this report and the table below provides an overview of the findings of the analysis:

Policy Tier	Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Metropolitan Core & Metropolitan Area	Beaumont	!	!	✗	✓
	Edmonton	✓	✗	✓	✓
	Fort Saskatchewan	!	✗	✓	!
	Leduc	!	!	✓	!
	St. Albert	✓	✓	✓	!
	Stony Plain	!	✗	✓	!
	Spruce Grove	✓	✓	!	!
Metropolitan & Rural Area	Leduc County	✓	✗	!	✗
	Parkland County	✓	!	!	✗
	Strathcona County	✓	!	✓	!
	Sturgeon County	✓	✗	!	✗
Rural Area	Devon	✗	✗	✗	!
	Morinville	✓	!	!	✗

Figure 7. EMRB Broadband Current State Summary

Broadband Ecosystem

From an ecosystem perspective, there are several players assisting with enhancing broadband from a strategic, funding, and advocacy perspective. Outside of the actions being taken by municipalities, the provincial and federal governments play key roles in directing strategy and providing access to funds. In general, the current economic state of Alberta has slowed progress towards creating a Provincial Broadband Strategy (although development has now been invigorated). In addition, many competing provinces do not have a fibre infrastructure backbone like Alberta (SuperNet) and perhaps have greater access to funds specifically targeted at enhancing backhaul infrastructure. Furthermore, connectivity maps prepared by the federal government and the CRTC show the Region is well served and largely meets the CRTC connectivity

target speeds of 50 download /10 upload Megabits per second (Mbps). However, the Current State Analysis has found this information may not be reflecting the current reality, as data collected by CRTC relies on the maximum speeds advertised by ISPs, which often significantly differs from what is experienced by residents and businesses. These speed differences can be the result of a number of factors such as: end-user hardware (e.g. Wi-Fi vs direct modem connection), internet traffic at the time of access, physical distance from internet gateways, and potential throttling of speeds by ISPs (additional information on factors affecting speed can be found in *Appendix D*: *Connectivity Technologies*).

From a federal perspective, there are several funding mechanisms that can be accessed, namely the CRTC Broadband Fund which is currently open for applications and the Universal Broadband Fund (UBF) which is managed by Innovation, Science, and Economic Development Canada (ISED) and opened in the Spring of 2020. Accessing the CRTC Broadband Fund is difficult as applications require significant technical work to be completed for submissions. The difficulty of accessing these funds was clearly seen during municipal workshops, as no EMRB member was planning to apply for funding. However, there may be business cases to access these funds within the Region, as the Federation to Enhance Rural Internet Committee (FERIC) is attempting to access the CRTC Broadband Fund to complete two broadband infrastructure pilot projects, one in southern Alberta near Warner and one in western Parkland County. FERIC is a committee that was brought together by the Federation of Alberta Gas Co-ops to attempt to utilize existing pipelines to deploy broadband infrastructure. The Committee was established in late 2018 and is still in the early stages of creating a governance structure and strategy.

From an advocacy perspective, the provincial and federal governments are hearing the voice of municipalities, as well as the business community through organizations such as the AUMA, RMA, and Edmonton Global. AUMA and RMA are focused on providing the voice of municipalities and work with the provincial and federal governments to ensure that strategies and funds consider their members needs and constraints, and do not create barriers for them to access funds. Through larger economic development advocacy efforts, Edmonton Global ensures the voice of the business community is heard. Their focus is to create and market an attractive investment environment, and a key component is to ensure businesses have access to the appropriate infrastructure that will allow them to excel in the current digital age. For business attraction, broadband infrastructure is seen as an essential and absolute fundamental component, it is "table stakes" that plays a significant role in attracting and retaining businesses.

Definition of the Desired Future State

The Socioeconomic Impact Assessment and the Current State Analysis have shown that there are significant benefits to be gained from the deployment of broadband technology across the Region and an urgent need to advocate for improvement is present. It's important to understand and explore the potential path forward and to set a goal for where the Region needs to be in order to realize the estimated socioeconomic benefits and remain globally competitive. To inform a way forward, analyzing the role ICT plays in enabling the transformation of world leading economies and lessons learned from these leading jurisdictions has informed the development of a Desired Future State for the Region.

Techno-Economic Revolutions

As a general-purpose technology, developments in ICT impact every sector of the economy and are transforming society at a fundamental level. Understanding these changes and their implications is key to developing a solid foundation on which a sound go-forward strategy can be developed.

Over the past three hundred years, the robust links between innovation, technical and institutional change, and economic development have played out in the first four techno-economic revolutions and are currently playing out in the fifth – the Age of Information Technology and Telecommunications.[7]

Table 2. Techno - Economic Revolutions

1771	The 'Industrial Revolution' (machines, factories, and canals)
1829	Age of Steam, Coal, Iron, and Railways
1875	Age of Steel and Heavy Engineering (electrical, chemical, civil, naval)
1908	Age of the Automobile, Oil, Petrochemicals, and Mass Production
1971	Age of Information and Communications Technology
20??	Age of Biotech, Bioelectronics, Nanotech, and new materials?

Each technological revolution lasts between 40 and 60 years and propagates through two strikingly different stages – the installation phase and the deployment phase. As illustrated in the figure below,[8] when a new technology is introduced during the installation phase, entrepreneurs move in to capitalize on it. They attract new investment capital away from existing businesses and based on market experiments, establish new types of business organizations to deal with it. The resulting maelstrom of activity eventually reaches a climax and ends in a stock market crash.

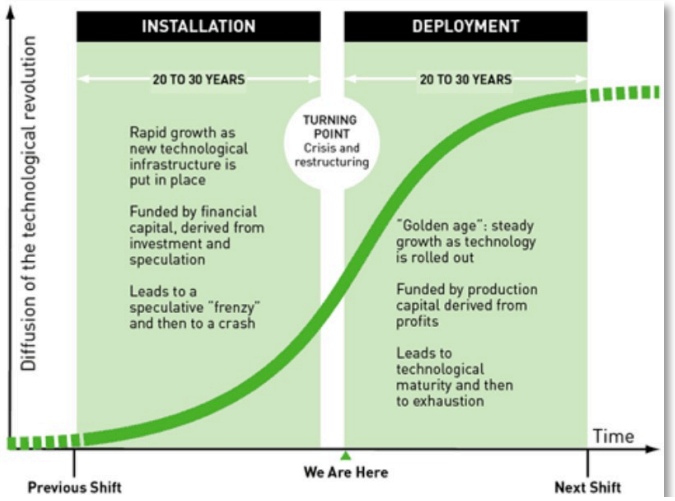

Figure 8. Phases of Each Socioeconomic Revolution

Industrial/production capital then comes to the table and finances the reasoned deployment of the underlying infrastructure required to enable the full economic and social potential of the new paradigm. In this second, deployment stage, innovation occurs across all economic sectors and the social benefits become widespread. As the commercial benefits take hold, the collective interests of the populace at large become part of the equation and state capital often comes to the table to help complete the deployment in commercially unattractive areas.

It is at this stage – this moment in time – that the debate as to whether this new technology 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. Ownership and control of fibre assets become a key factor in determining how well broader public benefits are achieved.

[7] Perez, Carlota; Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages; Edward Elgar Publications; 2003.

[8] Trends Magazine; *A New Golden Age… When People Least Expect It*; AudioTech Inc.; 2010-04.

The techno-economic revolution brought forth by development of ICT technology has shaped the globe. To understand what can be done by nations and regions to enhance their position in this current macroeconomic cycle, a Jurisdictional Scan of world-leading regions was completed.

Jurisdictional Scan

An initial list of international comparators and best practices was determined by identifying countries with the highest degree of FTTP (fibre-to-the-premise) deployment across the globe, as documented by the FTTH (Fibre-to-the-Home) Council and depicted in the figure below.

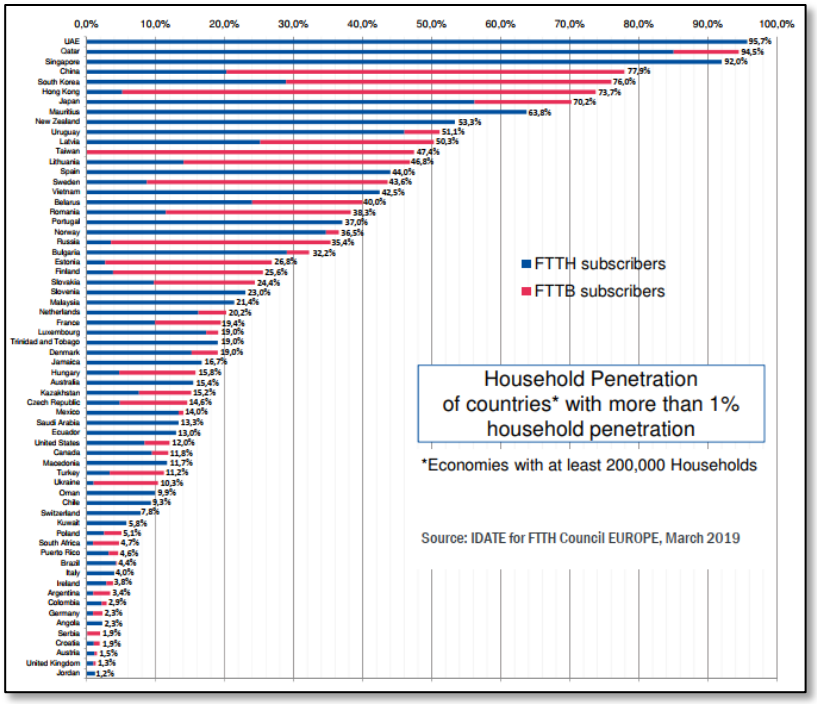

Figure 9. FTTP of Countries

According to the FTTH Council, Canada ranks 42nd of 64 countries. This provides 41 countries to gain lessons on how to further advance fibre deployment, countries were chosen according to the following approach:

1. **International Primary:** A selection of five countries was reviewed based on their percentage of FTTP, their political structure, and their land size. Of those countries with the highest FTTP percentage, Singapore, South Korea, and Japan, were comparators due to their advanced economies and relatively similar political structures (compared to countries such as the UAE, Qatar, and China), New Zealand was chosen due to its population density and political structure, while Australia was chosen due to its land mass, population density, and political structure.

2. **International Secondary:** In reviewing the larger list of countries, many nations within the European Union appear at the top. As such, a review of the European Union was completed, which, as a whole, has been guided by an overarching Digital Agenda for the Europe initiative. Finland and Sweden were included due to their similar population density to Canada.

3. **Continental:** The United States was reviewed to provide commentary on effective policies deployed in North America. Utilizing experience from past jurisdictional scans, a summary of identified States that have adopted unique and successful approaches for broadband deployment is provided.

4. **National and Provincial:** Finally, and through utilizing experience from past jurisdictional scans, a complete view of Canada and Alberta is provided to showcase the various models that have been adapted across the nation, which provides valuable lessons for the EMRB.

A full review and profile of each country is provided within the Jurisdictional Scan. Key findings of the international and national best practices include:

- Leading jurisdictions create **Governing Bodies** to understand broadband needs, provide guidance,, advocate for, facilitate, and help fund broadband development
- Many jurisdictions take it one step further and create **Crown Corporations** to execute broadband mandates and to develop and deploy broadband on large scale on behalf of governing bodies
- **Coordinated Long-term Regional Strategies** were key success factor. These strategies recognize broadband as a utility and consider both demand and supply side policy development, while also ensuring that all infrastructure projects consider broadband deployment, ultimately reducing costs
- World-leading broadband strategies and policies have a focus on **increasing competition** by ensuring monopolies do not develop and prices remain competitive through structural separation
- Where national and state/provincial funding is not readily available, leading jurisdictions develop **Municipally Owned Networks**, in particular in rural areas, that provide affordable connectivity to residents and increase competition
- Leading jurisdictions often **reduce legal and policy barriers** such as the number, complexity, and process time of permits, streamlining both permit submission and approval processes
- Additionally, **tax exemptions** are provided for landowners and developers when broadband infrastructure is developed on their land

These items are taken into consideration in development of the Desired Future State, Gap Analysis, and Recommendations to follow.

Desired Future State

In understanding the exponential nature of technology and considering the current state of broadband in the Region, it is clear the Region is falling behind. In consideration of the work undertaken and that remains ahead, the following Desired Future State was developed based on the findings embedded within:

Table 3. Desired Future State

By 2025, EMR municipal and ecosystem stakeholders will work in a collaborative and coordinated fashion to enable the deployment of broadband network infrastructure. This infrastructure will provide ubiquitous access and connectivity at rates up to and beyond 10 Gbps.
This coordinated and focused approach will be a catalyst for regional digital transformation, it will maximize socioeconomic benefits, and it will establish the EMR as a Smart Region.

The Desired Future State represents a path to developing world-leading broadband infrastructure and achieving the socioeconomic benefits. The Desire Future State takes into account the need for working in a

collaborative and coordinated approach which underpins the success of best practicecs, setting access and speed targets that are in-line with the ambitious goals of these leading jurisdictions.

Gap Analysis and Recommendations

To achieve the Desired Future State, there are a number of gaps identified in the Current State Analysis and the Jurisdictional Scan that should be addressed, informing key recommendations for consideration.

Table 4. Gap Analysis

Regional Gaps	
	**Regional Vision:** The Region lacks a unified and accepted future state vision for broadband.
	**Regional Strategy:** The Region lacks a unified strategy to enable the enhancement and deployment of broadband infrastructure.
	**Regional Advocacy:** Although several organizations advocate for enhancement of policy and funding frameworks, these efforts lack a singular voice.
	**Clear and Cohesive Policies and Guidelines:** The Region lacks broadband friendly policies and guidelines that ensure broadband infrastructure is deployed economically.
	**Education and Enablement of Municipalities:** There is no coordinated effort to educate the Region's municipalities on their broadband options and ability to receive funding.
	**Regional Collection of Data**: Although infrastructure and connectivity data are collected by municipalities, and the Provincial and the Federal governments, the Region does not have an aggregated data set to understand all broadband infrastructure and connectivity.

Three overarching key recommendations have been developed for consideration by the EMRB. These are for EMRB to: 1. **Develop a Regional Voice**, 2. **Create a Regional Strategy**, and 3. **Implement the Regional Strategy** in the long-term. An overview of these recommendations is detailed in the report.

Table 5. Develop a Regional Voice

1. Develop a Regional Voice	
	Coordinate regional advocacy efforts
	Educate and enable municipalities
	Build, monitor, and report on regional broadband data
	Set the foundation for a Regional Strategy

In the short-term and ongoing, the EMRB needs to focus on **Developing a Regional Voice**. Through these recommendations, EMRB will lay the foundation for enhancing broadband and will begin and establish itself as a key player in the broadband ecosystem. The recommendations are designed to build on the momentum that has been established through development of the Broadband Situation Analysis and will serve as a key indicator to the Region that the EMRB recognizes the gaps that exist and are leading to assist. Although these recommendations are meant to be actioned in the short-term, it is expected that the EMRB continue to play an ongoing lead role until responsibility is taken on by another entity.

Table 6. Create a Regional Strategy

2. Create a Regional Strategy	
	Integrate broadband into the Growth Plan as a critical enabler
	Integrate broadband considerations into EMRB initiatives
	Create a Regional Broadband Strategy

In the intermediate term, the EMRB should focus on **Creating a Regional Strategy**. These recommendations will solidify broadband as a key focus area for EMRB and are key in securing the Region's future growth and global economic competitiveness. The recommendations within are designed to weave broadband into the various strategies and initiatives that the EMRB undertakes and ultimately developing a true coordinated regional approach that addresses how broadband should and will be developed in the future. A 1-4 year timeline for developing and implementing these recommendations as extensive consultation will be required to meaningfully develop the appropriate approach.

Table 7. Implement the Regional Strategy

3. Implement the Regional Strategy	
	Implement the Regional Broadband Strategy to enable the deployment of broadband to achieve the Desired Future State and realize the socioeconomic benefits.

In the longer-term, the EMRB should **Implement the Regional Strategy**. The EMRB has myriad of options to choose from in the potential role it may choose to fill in enhancing connectivity in the Region, from continuing to coordinate advocacy efforts to directly enabling the deployment of broadband. It is important for the pros and cons of all options to be weighed appropriately against one another and that a coordinated and unified voice is achieved in order to ensure no regional member is left behind.

The above recommendations provided to EMRB for consideration represent key actions that need to be taken by the Region if the Desired Future State is to be achieved and the socioeconomic benefits of broadband are fully unlocked. In consideration of today's economic climate and the age of information and technology that we are currently in, it is imperative that meaningful action is taken to ensure the Region remains resilient into the future, unlocks new and innovative industries, and enhances the industries that continue to contribute to the Region's economic vitality.

2. Introduction

Background

Recognizing the fundamental importance of connectivity enabled by capable broadband infrastructure and its linkages to the Growth Plan, the EMRB commissioned the development of a Broadband Situation Analysis for the Edmonton Metropolitan Region (the Region) on behalf of its member municipalities and identified regional stakeholders. The objective of the Situation Analysis is to develop a common understanding of the opportunities that enhanced connectivity can create, provide an understanding of the gaps that exist in the regional current state, and outline recommendations that the EMRB should consider to close identified gaps and prepare the Region to take full advantage of emerging technologies that drive the creation of new business models and the adoption of cutting-edge industry technology.

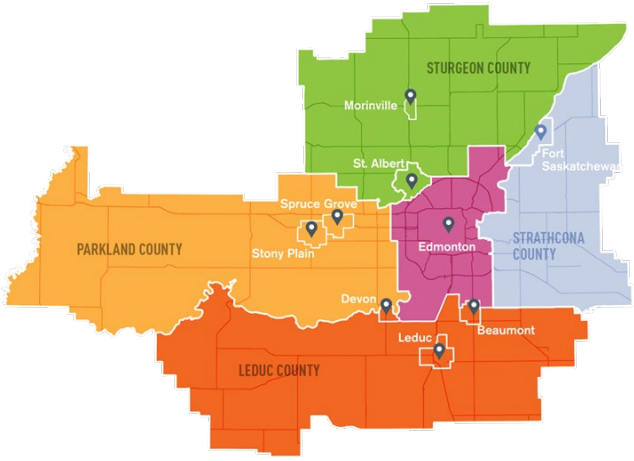

Figure 10. EMRB Member Municipalities

Growth Plan

Ultimately, EMRB is driven by the Edmonton Metropolitan Region Growth Plan (the Growth Plan or EMRGP) which outlines a roadmap for planning future growth across the Region in a responsible manner that sustains and advances regional prosperity and well-being. The Plan recognizes the Region's diverse rural and urban context, while focusing on the Region's collective strengths and competitive advantages. The Growth Plan places an emphasis on responsible growth through minimizing the expansion of the urban footprint; integrating land use and infrastructure decisions; building resilient, adaptable and complete communities; ensuring the Region's transportation systems are interconnected and enabling economic prosperity; protecting the environment and encouraging the growth of the agricultural sector.

Policy Framework

The Edmonton Metropolitan Regional Structure to 2044 provides a framework for enabling employment and population growth in the Region. The Regional Structure to 2044 consists of three policy tiers: the Rural Area, Metropolitan Area, and Metropolitan Core. These tiers reflect and respond to the diversity of communities within the Region and provide the framework for policies addressing unique growth opportunities. Broadband is a critical piece of enabling infrastructure that will support the outcomes of the Growth Plan's six interrelated policy areas:

1. Economic Competitiveness and Employment;
2. Natural Living Systems;
3. Communities and Housing;
4. Integration of Land Use and Infrastructure;
5. Transportation Systems; and
6. Agriculture.

Figure 11. EMRGP Integrated Policy Framework

Guiding Principles

The Growth Plan has seven guiding principles that shape the policy framework and policy areas. The EMRB Broadband Situation Analysis is consistent with and enables the guiding principles (including objectives and policies) in the Growth Plan:

1. Collaborate and coordinate as a Region to manage growth responsibly.
2. Promote global economic competitiveness and regional prosperity.
3. Recognize and celebrate the diversity of communities and promote an excellent quality of life across the Region.
4. Achieve compact growth that optimizes infrastructure investment.
5. Ensure effective regional mobility.
6. Ensure the wise management of prime agricultural resources.
7. Protect natural living systems and environmental assets.

EMRB Initiatives

Successful completion of the Broadband Situation Analysis should inform and enable other EMRB initiatives namely the Metropolitan Region Servicing Plan (MRSP), Integrated Regional Transportation Master Plan (IRTMP), Regional Agriculture Master Plan (RAMP), Shared Investment for Shared Benefit (SISB), and Edmonton Metropolitan Region Geographic Information Services (EMRGIS).

This study provides the EMRB with an understanding of the current broadband landscape in the Region and explores the desired future state of broadband technology and governance. The future direction identifies broadband opportunities that will enable the achievement of the Growth Plan's objectives and increase the economic competitiveness and quality of life for businesses and residents in the Region. Ultimately, this analysis identifies gaps and opportunities for enhancing broadband connectivity and provides actionable recommendations to address and inform a future regional broadband strategy.

Project Approach

To complete the Broadband Situation Analysis, EMRB engaged RSM and TaylorWarwick to compile the necessary evidence to build a compelling case to address connectivity gaps in regional broadband and identify opportunities to improve broadband capabilities across the Region. This document represents the compilation of all findings, analyses, and recommendations that have been developed in collaboration with regional stakeholders and EMRB. Key deliverables and sections of this report are defined below:

This report begins with a **Socioeconomic Impact Assessment** of the quantitative and qualitative impact that enhancing broadband connectivity has on the Region's GDP and quality of life.

After establishing the importance and impact of enhancing broadband connectivity, a **Current State Analysis** of the Region's municipalities is provided that identifies current service levels and assets, and the strategies that are in place to enhance them. In addition, this section of the report identifies ecosystem stakeholders that are involved in providing overarching strategy and funding, as well as those involved in advocating for enhanced broadband.

To move forward from the current state and establish a **Definition of the Desired Future State**, the historic and continual evolution of broadband technology is explored, and a national and international jurisdiction scan is provided. This section establishes what the future looks like, compares the Region and Canada to the rest of the world, and provides key insights on best practices for how the Region can move forward.

In completing each of the above sections, key gaps are brought to light that are summarized in the **Gap Analysis** section of the report. These identified and consolidated gaps provide direction for the key recommendations of the report.

The Broadband Situation Analysis report concludes with a set of key **Recommendations for consideration** to inform EMRB's next steps in enhancing broadband connectivity. Each recommendation has been developed in light of the gaps identified throughout this report and provides an actionable path forward for spurring regional collaboration.

Figure 12. Final Broadband Situation Analysis Report

3. The Socioeconomic Implications of Broadband

Context

Connectivity infrastructure, which together with the Internet and related technologies are collectively known as information and communications technology (ICT), are categorized as *general-purpose technologies* (GPTs). GPTs impact the entire economy and typically do so at both the national and global level. GPTs have the potential to drastically alter societies through their impact on pre-existing economic and social structures[9], as illustrated in the figure below.

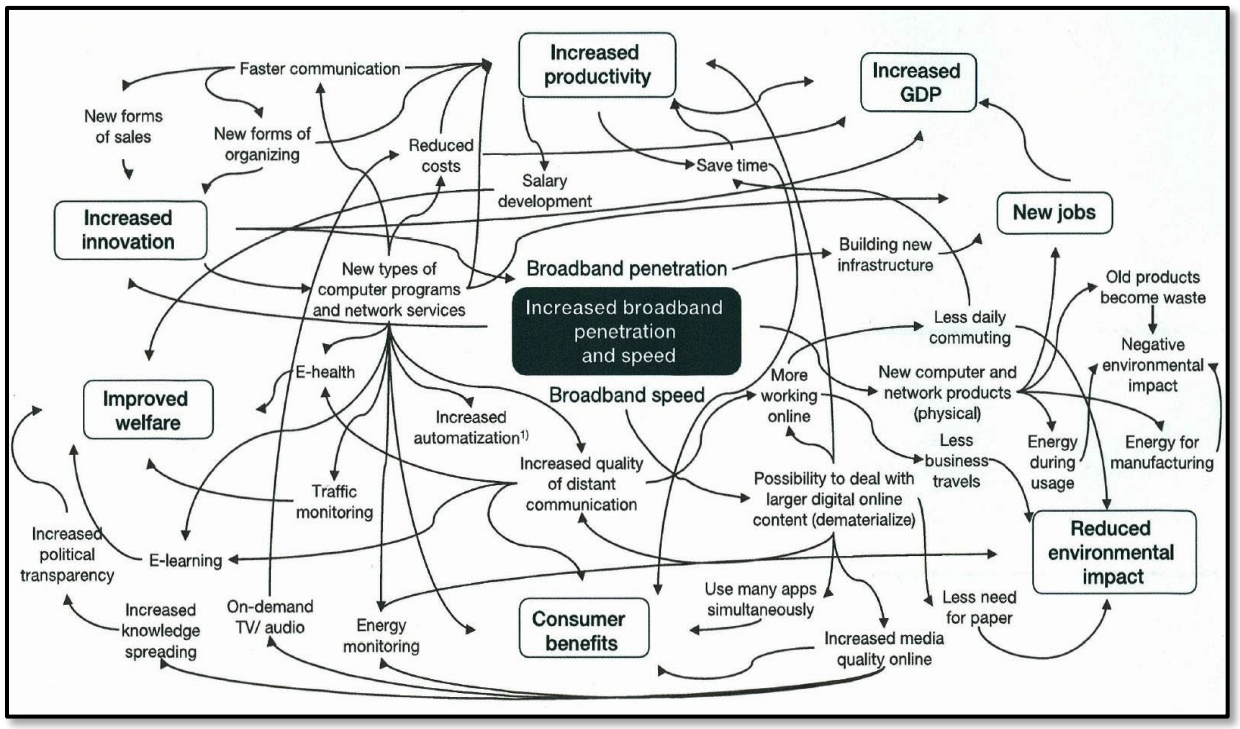

Figure 13. The Encompassing Impact of General-Purpose Technologies

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 directly increase the Region's contribution to the national gross domestic product (GDP). In the medium-term, higher broadband penetration and speed lead to indirect benefits such as cost savings, cost avoidance, productivity gains, increase jobs, and enhanced regional competitiveness. These benefits stimulate the economy and will also have an impact on the Region's contribution to GDP. Over the longer term, broadband connectivity plays a role in the development of *'induced effects.'* These include the transformative impacts on the economy, such as the introduction of new industries/industry clusters and new ways of working[10]. Indeed, the ultimate

[9] https://en.wikipedia.org/wiki/General_purpose_technology

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

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 [11].

The socioeconomic 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. Broadband connectivity is absolutely and fundamentally essential to the Region's long term social and economic prosperity. Sustainable economic prosperity over the next several years is especially crucial for Alberta's economy in light of the current crisis.

The onset of the unprecedented COVID-19 pandemic has devastated the Canadian economy, which is expected to contract sharply in 2020. The Canadian economy shrank by 2.1% on the first three months of 2020 after expanding 0.1% in the previous quarter, as shown in the figure below[12]. It is the sharpest decline since Q1 2009, and it is expected that Canada will face a relatively longer recovery period.

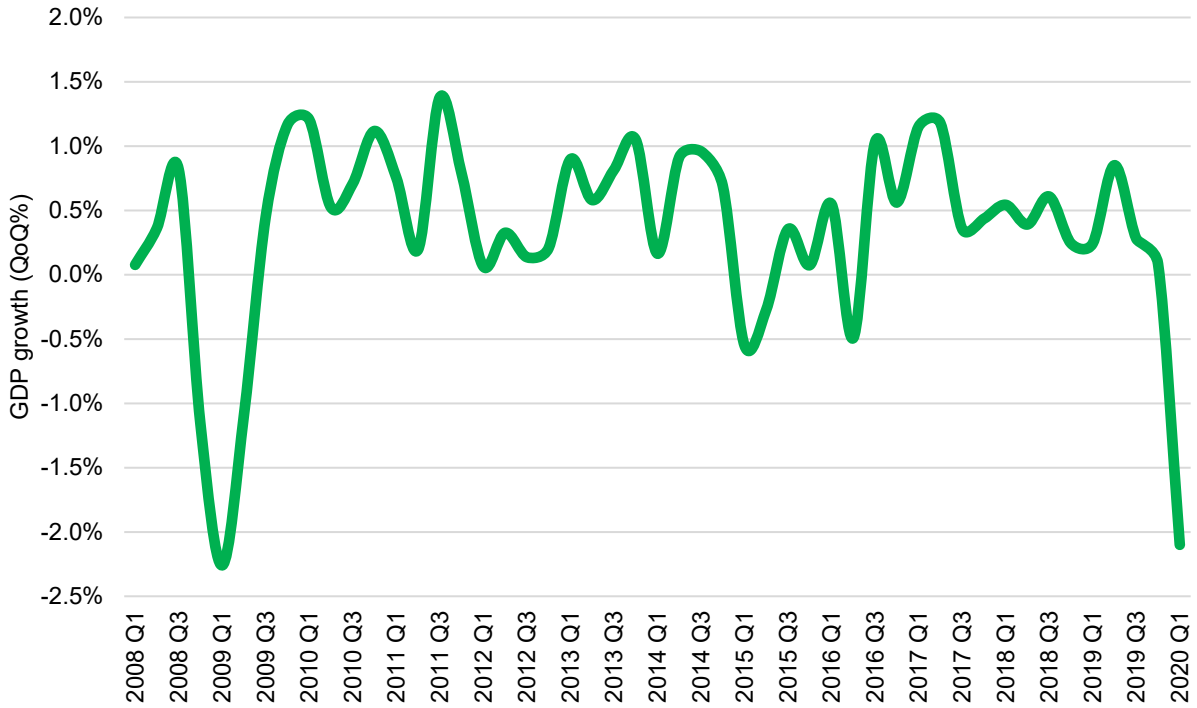

Figure 14. Quarterly Historical and Forecasted Real GDP Growth in Canada Q1 2008 – Q1 2020

Alberta's economy is likely to be hit harder due to low oil prices and Alberta's reliance on the oil and gas sector. Even prior to COVID-19, Alberta's economy has been in a downturn given low oil prices. Alberta's GDP dropped by 0.6% in 2019 from the previous year, compared to a national GDP growth of 1.6%[13].

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

[12] Scotiabank

[13] Alberta Government; Economic dashboard; https://economicdashboard.alberta.ca/GrossDomesticProduct

Alberta's unemployment rate has been nearly two percentage points above the national average. The Edmonton Census Metropolitan Area had a GDP growth of approximately 0.5% in 2019[14].

As governments start to lift restrictions and prepare measures to kick-start the economy, it is expected that the Federal Government will announce a significant infrastructure stimulus program[15]. Evidence suggests that investing in broadband connectivity generates substantial economic and social impact[16]. Investment in broadband connectivity would not only address the significant service gaps in the Edmonton Metropolitan Region, it would also enable unlocking socioeconomic benefits, for example, through development of smart cities and sustainable communities, and through digital health by driving healthcare efficiencies, improving access and better managing chronic diseases. This leads to improved economic prosperity and quality of life.

Moreover, broadband connectivity has the capability to transform the society's system of wealth. 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 an illustrative example of the differences these changes embody, consider the following:

- In 1996, Kodak had 140-thousand employees and was capitalized at US$28 billion. It filed for bankruptcy in January 2012.
- Three months later, on April 9, 2012, after 13 people worked for 18 months developing Instagram, they sold it to Facebook for one billion US dollars.

These key take-ways from this example of '*progress*' are:

- Whereas it took Kodak decades to develop and evolve its underlying (largely wet-chemical) infrastructure, Instagram was developed in 18 months. *Instagram could have been developed anywhere digital network infrastructure and talent were available.*
- As of 2012, digital technology had made photography essentially free and available to all. Relative to its peak in 1996, however, net employment at Kodak had decreased by 139,987 people. *Getting a job in the new environment is becoming more difficult.*

While there is more to the photography industry than these statements imply, the implications are supported by similar examples across many sectors – and serve to underline the critical importance of the underlying digital technologies. This is further evidenced by the market valuation of digital companies.

A study in 2012 began analyzing corporate valuations over time and found that current valuations very much depend on the business models employed[17]. Based on their research, new digital-based companies

[14] Quarterly Economic Update February 2020; Economic Insights; The City of Edmonton

[15] Ottawa seeks 'shovel-ready' projects for post shutdown stimulus plan; The Globe and Mail; https://www.theglobeandmail.com/politics/article-mckenna-seeking-shovel-ready-projects-for-post-shutdown-stimulus/

[16] The socioeconomic impact of bandwidth; Analysys Mason limited & Tech4i2 Limited; 2013

[17] The Great (Country) Race: Company Business Models and Country GDP – Opportunity or Threat?; Ribaudo, W.; SNS Special Letter; 2018-09-03.

– those above the digital divide in the figure below – have revenue multiplier valuations approximately 4 to 8 times those of more traditional (industrial age) companies below the divide. It should be noted that these multipliers are indeed changing very quickly. More interestingly, the data was then used to evaluate aggregated impacts on the host country's GDP and, perhaps not too surprisingly, found that those with a higher percentage of businesses above the divide, were growing faster than those below.

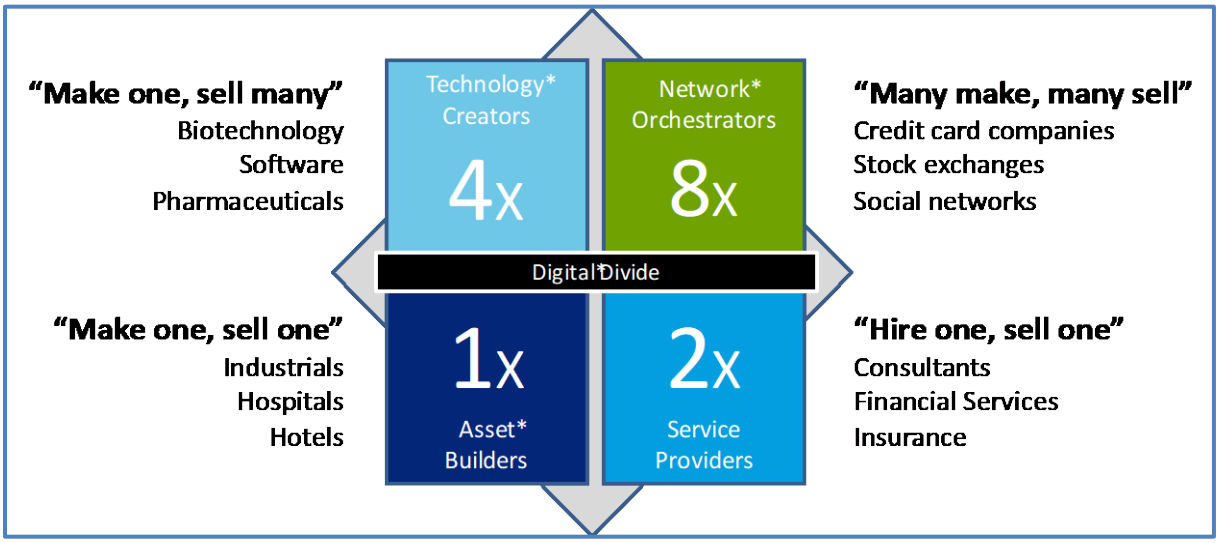

Figure 15. The Digital Divide in Wall Street Valuations

Largely enabled by developments in ICT, the overall technology landscape is evolving quickly and promises to significantly disrupt every aspect of society. A number of these technologies and the sectors they will impact are summarized in Figure 16.[18] In this, the key role that ICT plays in many of these is self-evident.

[18] Frank Dianna's Blog; https://frankdiana.net/2014/11/10/the-maker-economy/#more-1510 ; 14 11 10.

Figure 16. Disruptive Technologies and Their Impact Areas

Intelligent machines and robotics may render a significant portion of the workforce redundant, for example, while renewable energy sources and commercial space developments will provide humankind with solutions to a variety of existential threats, not the least of which are those associated with environmental collapse.[19]

Now more than ever, both public and private organizations are being forced to shift to digital meetings, remote work, and automation, connectivity is no longer a luxury but a necessity to remain relevant. As the digital economy has been growing 2.5 times faster than global GDP over the past 15-years[20], regional economic growth to a large extent depends on companies catching the digital wave and riding it. Those that do not, will be left behind and potentially become irrelevant.

The Region is well positioned to play a key role in furthering Alberta's innovation ecosystem. Innovation and entrepreneurship is becoming increasingly more important to local, provincial, and national economies, as well as the financial well-being of companies. It creates jobs, promotes healthy competition, and can open up brand new channels of commerce. The development of innovation ecosystems in urbanized regions is a leading indicator of future economic prosperity and success. Alberta has the building blocks in place to build a vibrant and strong innovation ecosystem. For example, despite some of the challenges Alberta's economy has faced over the past several years, a strong innovation ecosystem has emerged in the Calgary Region. High tech industries comprise 7.8 per cent of total employment in Calgary, which puts it ahead of Vancouver and on par with Ottawa[21]. High-speed broadband connectivity across the Edmonton

[19] Intergovernmental Panel on Climate Change (IPCC*); Special Report on Global Warning*; 2018-10-08

[20] Measuring the true impact of the digital economy; Huawei and Oxford Economics; https://www.huawei.com/minisite/gci/en/digital-spillover/files/gci_digital_spillover.pdf

[21] Trends in the Canadian Economy; The Real Economy Volume 1; 2019; RSM Canada; https://rsmcanada.com/content/dam/mcgladrey/en_CA/pdf_download/the-real-economy/canada-the-real-economy-q1-19.pdf

Metropolitan Regions could foster Alberta's innovative ecosystem leading to sustainable growth contributing to economic recovery and prosperity.

The onset of COVID-19 has further demonstrated the importance of high-speed broadband connectivity across all sectors of the economy. RSM and TaylorWarwick has conducted a Socioeconomic Impact Assessment aimed at providing further understanding of the socioeconomic implications of an investment in broadband connectivity for the Edmonton Metropolitan Region.

Approach

As a part of the Broadband Situation Analysis project, RSM and TaylorWarwick were engaged to conduct a high-level socioeconomic impact assessment of broadband connectivity with an objective to answer the following questions:

- What are some of the socioeconomic benefits of improved broadband connectivity?
- What does improving broadband connectivity mean for the Edmonton Metropolitan Region and communities that comprise the Region?

The approach undertaken to analyze the impact of broadband from a societal perspective involved leveraging a Socioeconomic Return on Investment (SROI) methodology as the overarching analytical framework to estimate the socioeconomic benefits, in dollars, associated with enhanced broadband connectivity in the Edmonton Metropolitan Region. The SROI framework has been used by various governmental agencies to allocate government funding and build consensus with stakeholders. This approach enables a more holistic understanding of the benefits attainable from the investment in terms of the economic, social, environmental and health outcomes.

Figure 17. The SROI Framework

The SROI assessment of broadband connectivity is based on the following core principles:

- **Evidence based –** Quantification and monetization of socioeconomic impact requires a strong evidentiary basis and relevant data. The goal was to maximize credibility of the analysis. As such,

the quantitative impacts analysis only includes socioeconomic impacts for which there was a strong evidentiary basis.

- **Conservatism –** When making assumptions the analysis followed the rule of conservatism and erred on the side of caution in an effort not to overstate benefits. Risk analysis tools such as Monte Carlo simulation supported this endeavour by enabling explicit consideration of uncertainties.
- **Quantitative verses qualitative –** Not all socioeconomic impacts can be quantified and/or monetized; these impacts are qualitatively assessed in this document in the form of case studies as they relate to the Edmonton Metropolitan Region under the sub-section entitled "Qualitative social impacts".

The scope of the analysis is limited to a high-level analysis of the socioeconomic impact of broadband connectivity in the Edmonton Metropolitan Region. The assumptions formed in this analysis relied upon several external data points including but not limited to: the Edmonton Metropolitan Regional household income, the GDP estimates from Statistics Canada, baseline broadband connectivity data from Canadian Internet Registration Authority (CIRA), and service providers in the Region, and data from peer reviewed literatures from credible sources, as referenced throughout the report. Based on these assumptions, the potential incremental economic growth to Edmonton Metropolitan Region from investment in broadband connectivity was estimated.

The assessment outlined in this documentation is based on RSM and TaylorWarwick's professional interpretation of the information obtained. The following sub-sections provide a detailed outline of the methodology employed, subsequent results including data sources used, any assumptions made and the qualitative implications of the study. It is important to note that this analysis is neither a comprehensive economic impact assessment for the Edmonton Metropolitan Region nor a feasibility study for broadband connectivity.

Ideally, this analysis will be updated throughout the project lifecycle, with increased complexity and refinement as the project progresses towards implementation. The framework below shows the lifecycle of a project and the type of socioeconomic analysis required at each stage.

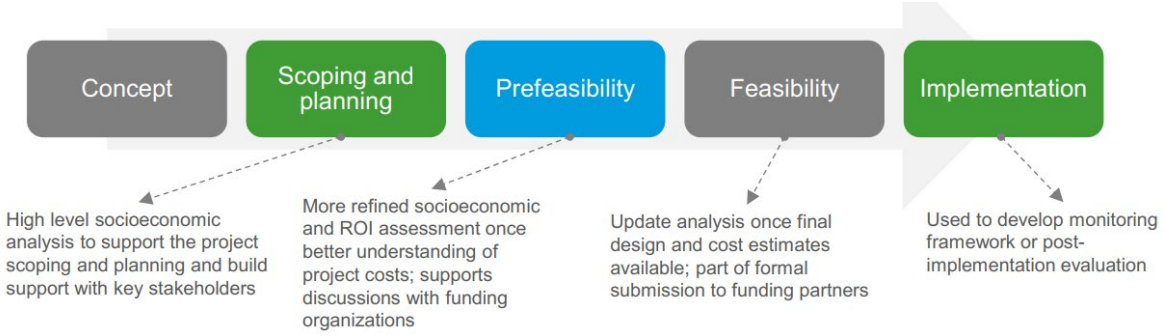

Figure 18. Lifecycle of a Socioeconomic Analysis

Methodology

Overview

As mentioned earlier, the SROI methodology was leveraged in order to assess the socioeconomic impact of broadband connectivity. A Monte Carlo simulation methodology was utilized to account for uncertainties and inherent risks associated with key data inputs. A description of SROI and Monte Carlo simulation is provided in *Appendix A: SROI Methodology*.

To estimate the social benefits associated with broadband connectivity, a literature review was conducted specifically to look at the relationship between broadband connectivity and economic growth using regression models that controlled for other factors known to impact economic outcomes. Broadband studies generally measure economic growth in terms of GDP growth and broadband connectivity in terms of broadband availability, broadband penetration and/or broadband speed defined as follows:

- **Broadband availability –** whether Internet Service Providers offers broadband services in a certain area;
- **Broadband penetration –** refers to the actual broadband subscriptions or use within a region; and
- **Broadband speed –** refers to the performance of an Internet connection, based on the number of bits per second transmitted or received.

In the regression models, the dependent variable is GDP (i.e., as a measure of economic growth) and the independent variable (i.e., the variable influencing GDP growth) is broadband availability, broadband penetration rate and/or speed (i.e., as a measure of broadband connectivity).

Based on the literature review, there exists a strong positive and causal relationship between broadband connectivity and GDP. An increase in broadband connectivity leads to an increase in GDP. This growth is observed due to the following reasons:

- Broadband infrastructure facilitates investment and job creation from broadband deployment services required;
- Improves opportunity and efficiency due to online businesses;
- Enables organizational change and coordination efforts for productivity gains;
- Enhances innovative ecosystem and distribution of ideas facilitated by greater access to information; and
- Fosters competition for and development of new products, processes and business models through better communication methods.

Given the strong evidentiary basis found on the relationship between broadband connectivity and economic growth, the socioeconomic impact model used for the assessment is based on the impact on economic growth in terms of GDP in each of the municipalities in the Edmonton Metropolitan Region.

It is important to note that the monetization estimates of the GDP impact from broadband connectivity also indirectly includes the impact of other socioeconomic factors, such as improved health outcomes associated with broadband connectivity. There is significant overlap between economic indicators and social impact, as illustrated in the Venn diagram below. It is difficult to disentangle the economic from the social impacts. Furthermore, there is limited literature available that causally links broadband connectivity to social benefits independent of the associated economic impacts.

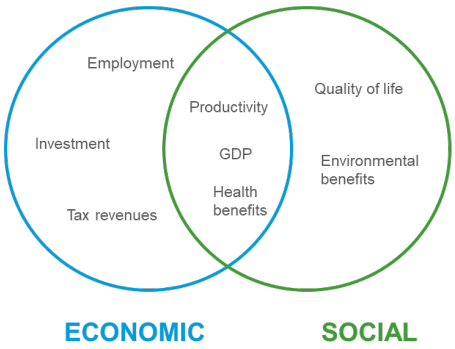

Figure 19. Relationship Between Economic and Social Benefits

Model specifications

Economic growth in the model is measured in terms of GDP through the value of all incomes generated in producing goods and services. The principal components of the income approach to estimating GDP are:

- Wages, salaries and other compensation of employees;
- Gross operating surpluses of businesses and corporations; and
- Taxes less subsidies on production, products and imports (i.e. payroll taxes, property taxes, GST).

In relation to broadband connectivity, broadband availability and speed in each municipality were considered and applied to an income elasticity factor (i.e., income growth factor).

The income elasticity factor used to estimate the impact on GDP is based on a study that measured the causal relationship between the increase in broadband download speed and the increase in GDP in several OECD countries[22]. To account for the uncertainty of this elasticity factor, this assumption is defined probabilistically in the Monte Carlo simulation by using the most likely occurring elasticity estimate of 0.3% as the minimum possible value[23]. The underlying rationale for this is that over the past decade since this estimate was developed, Internet use cases have moved from ones largely based on information retrieval to those of interactive application platforms and cloud-based services – and with these developments, the utility and impact of improved broadband on GDP can only have increased. That being said, the assumed impact of improved speeds was assumed greatest in areas with the lowest current service levels and smallest in those with the highest. In essence, the impact of going from 1 to 25 Mbps is much greater than that of going from 100 to 200 Mbps.

In order to determine an estimate of download speeds, data on the current download speeds in the Edmonton Metropolitan Region by each individual municipality was retrieved from two data sources:

- CIRA which uses data for download speeds from internet speed tests observed; and
- Available download speeds offered by service providers in each municipality.

The CIRA average speeds are generally much lower than the actual available speed that service providers offer in the Region, particularly in that of urban areas. Although the CIRA data provides a good estimate of the average speed actually observed, there is some uncertainty around the reliability of the data as results may be skewed to those with lower average download speeds, and thus present a higher likelihood to run the speed test. Similarly, the speed test data may also not be an exact representation of the Region's download speeds. As such, this assumption was also defined probabilistically in the model to account for the uncertainty in this aspect. Three scenarios were created based on reasonably achievable average download speeds for each municipality:

- **Scenario 1 –** 50 Mbps average download speed;
- **Scenario 2 –** 75 Mbps average download speed; and
- **Scenario 3 –** 100 Mbps average download speed.

[22] Broadband Infrastructure and Economic Growth; Czernich et al.; 2019; https://www.cesifo-group.de/DocDL/cesifo1_wp2861.pdf.

[23] Does broadband speed really matter for driving economic growth? Investing OECD countries; Rohman, Kholilul and Bohlin; 2012; https://www.econstor.eu/bitstream/10419/60385/1/72027561X.pdf

The download speed of 50 Mbps is the CRTC's aspirational goal that can be achieved with fixed wireless technology today, assuming the designs are appropriate for the capacity required and the terrain is at least reasonable. The municipalities could work with their service providers to achieve that for more than 90% of their areas. The 75 Mbps level is about the best that can be done with TELUS copper. The 100 Mbps is the point beyond which additional speed impacts are stable from a GDP perspective. As well, the 100 Mbps is the likely minimum that may be available from the CableCo's coax, TELUS or community fibre-plays.

As such, these levels were selected as the three scenarios for the analysis. Analysis of multiple scenarios outline how different future events, paradigms or policy regimes impact outcomes. With respect to broadband connectivity, the GDP growth is the main output. In this case, the scenario analysis assesses the potential impact on GDP growth from varying download speed targets. More specifically, it enabled comparison and analysis of the effectiveness of different speeds targetable by the Region. Based on the average download speed generated above for each simulation (in each municipality), the elasticity factor is applied against this figure up to the download speed of each of the scenarios defined above.

This gave a reasonable range estimate of the incremental impact on GDP for each municipality to upgrade the current average download speed up to the targeted average download speeds in the scenarios defined. The key model assumptions are summarized in the table below.

Table 8. Key Model Assumptions

Assumption	Units	Value
2019 Population growth rate	%	2.56
2020 Total Edmonton Metropolitan Region GDP	$ billions	96.68
GDP growth	%	2
Average download speeds for each municipality	Mbps	Blended average download speeds from CIRA and actual available speeds
Scenario 1 average download speed	Mbps	50
Scenario 2 average download speed	Mbps	75
Scenario 3 average download speed	Mbps	100
Percentage increase in GDP from doubling broadband download speed (broadband elasticity)	%	0.3
GDP corporate profits and government taxation - urban municipalities	%	35
GDP corporate profits and government taxation - rural municipalities	%	15

The next section outlines the results under each scenario. A few important points regarding the results should be noted:

- Data regarding baseline broadband connectivity conditions was assessed to be relatively low quality; further refinement is required as the initiative progresses;
- Some of the underlying literature leveraged was dated;

- Risk analysis is used to account for uncertainty in input assumptions and underlying data; and
- Based on the assumptions, the estimate of the economic benefits from broadband connectivity is likely a conservative estimate.

Economic Impact

Overview

Utilizing the methodology and assumptions outlined above, improving broadband connectivity across the Edmonton Metropolitan Region could **increase GDP by up to $1 billion per year**, which translates to, approximately, an incremental increase of 1%. This benefit would be multi-sectoral, enabling economic diversification and further shows that every EMRB municipality stands to benefit from this collective regional GDP increase. Recall that Alberta's GDP contracted by 0.6% in 2019 and is projected to decline sharply in 2020. Results are likely conservative as the relationship between broadband connectivity and economic growth has strengthened over the last several years. Moreover, risk analysis was used to account for the uncertainty in the underlying broadband connectivity data (see *Appendix A: SROI Methodology* for an explanation of the Monte Carlo risk analysis tool that was utilized).

The table below summarizes the GDP impact under each scenario analyzed. The increase in GDP is relative to the estimated baseline value of $96 billion for the entire Edmonton Metropolitan Region (2020). GDP was estimated on a regional basis. The sub-section below provides the probability distribution of each scenario.

Table 9. Summary of the GDP Impact from Broadband Connectivity by Scenarios

Scenarios	GDP impact ($ millions)	Percentage GDP increase relative to baseline
Scenario 1: Average 50 Mbps download speed	**$144 - $412**	0.15% - 0.43%
Scenario 2: Average 75 Mbps download speed	**$274 - $736**	0.28% - 0.76%
Scenario 3: Average 100 Mbps download speed	**$358 - $954**	0.37% - 0.99%

Scenario Specific Results

The figure below displays the distribution of the percentage GDP increase relative to the baseline under scenario 1, average download speed of 50 Mbps. The S-curve in the diagram shows the confidence interval of the impact given the distributional assumptions for the input variables. At any point along the curve, it shows the probability of not exceeding a specific value.

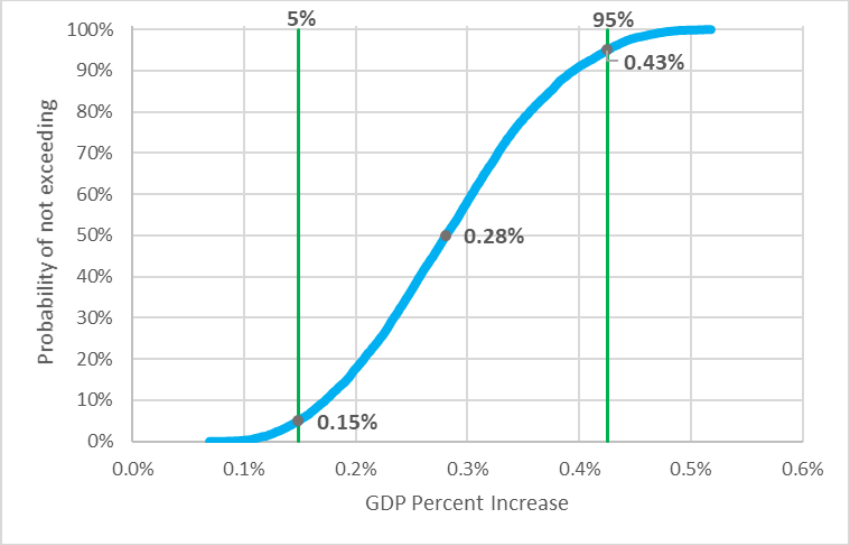

Figure 20. Distribution of Scenario 1 percentage GDP increase Relative to Baseline

The results are shown with a 90% confidence interval, which indicates that the range of values for the GDP impact can be expected with 90% certainty given the model specification and inputs. As shown in the figure, there is a 5% chance that the percentage GDP increase relative to the baseline will not exceed 0.15% and a 95% chance that it will not exceed 0.43% (there is a 90% chance of an impact within the noted range).

Under scenario 2, average download speed of 75 Mbps, there is a 5% chance that the percentage GDP increase relative to the baseline will not exceed 0.28% and a 95% chance that it will not exceed 0.76%.

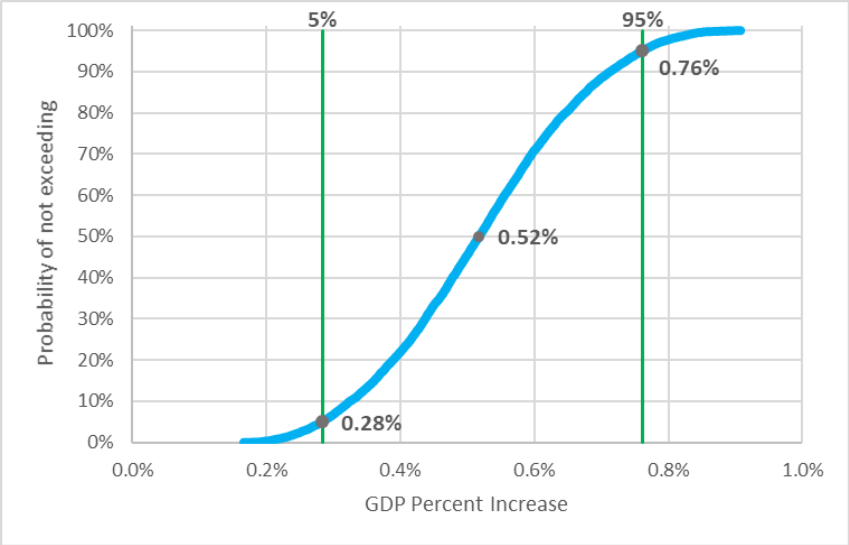

Figure 21. Distribution of Scenario 2 Percentage GDP Increase Relative to Baseline

Under scenario 3, average download speed of 100 Mbps, there is a 5% chance that the percentage GDP increase relative to the baseline will not exceed 0.37% and a 95% chance that it will not exceed 0.99%.

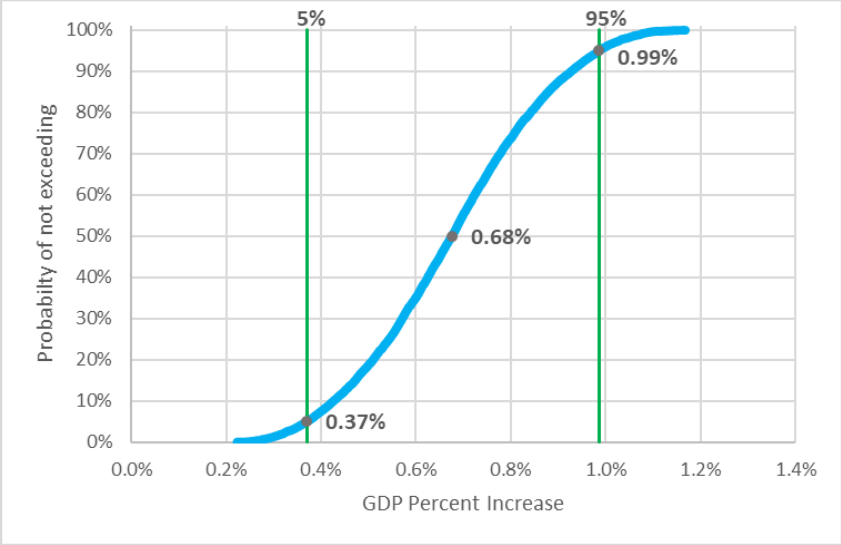

Figure 22. Distribution of Scenario 3 Percentage GDP Increase Relative to Baseline

Appendix A: SROI Methodology provides the same figures for the three scenarios showing the distribution in GDP dollar value.

Regional Results

The impact of broadband connectivity was also estimated on a regional basis. The figure below illustrates the percentage GDP increase relative to the baseline under each scenario broken down by municipality. Though communities with lower baseline broadband connectivity levels are estimated to benefit more, it is critical to underscore that every municipality in the Region will realize positive impacts and share in the benefit from the increased broadband connectivity. *Appendix A: SROI Methodology* provides the regional breakdown in GDP dollar value.

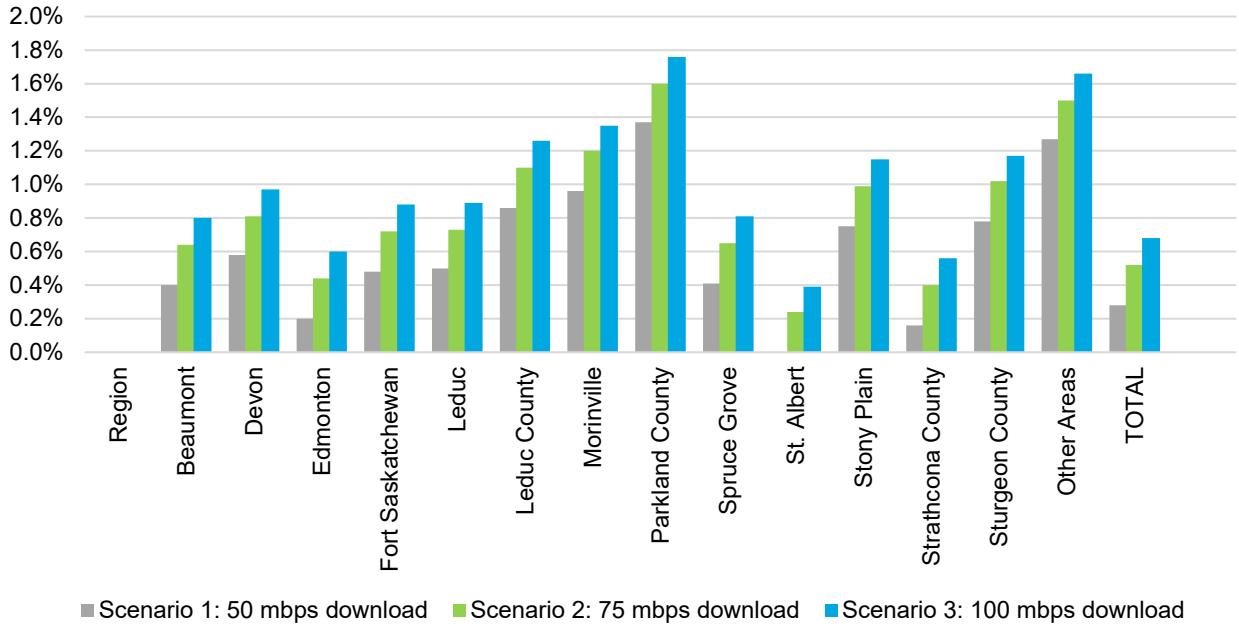

Figure 23. Percentage GDP Increase by Region Under Each Scenario

Based on the findings of this assessment, broadband connectivity and infdrastructure deployment could lead to an incremental GDP growth in the Edmonton Metropolitan Region between 0.15% and 0.99%, depending on the targeted average download speed scenario. Given the context of the current and expected future economic contraction and resulting recovery, even a move to Scenario 1 would be considered impactful.

The methodology used to quantify the GDP impact from broadband connectivity and the subsequent results and assumptions have been outlined thus far in this documentation. The next sub-section discusses a selection of qualitative impacts associated with broadband connectivity. Although not assessed quantitatively, these impacts could lead to induced economic benefits and add substantial value to the Edmonton Metropolitan Region.

Qualitative Social Impacts

Overview

Apart from the GDP growth resulting from improved broadband connectivity, there are numerous socioeconomic benefits from enhanced broadband that are not directly quantified in the analysis such as:

- **Community –** broadband plays a role in improving share of information within the local community (e.g., by providing local information and facilitating online social networking).
- **Emergency Response/Preparedness –** high-speed internet enables public service groups and first responders to receive and share text, pictures and videos with colleagues and the broader public, enabling them to better prepare for emergency situations.
- **Education and skills –** broadband improves education and skills through distance learning and access to online information. High-speed internet enables videoconference communication between teachers and students.
- **Environment and climate –** broadband can improve environmental sustainability by reducing the need to travel/commute and improves environmental monitoring.
- **Equality and inclusion –** broadband internet has the ability to connect isolated individuals and communities and thus, empower these communities by providing a platform.
- **Finance –** there is a benefit associated with access to online shopping for goods and services which provides individuals the opportunity to save money and access markets outside of their community.
- **Healthcare –** improved broadband connectivity reduces the cost of providing health and social care services and improves outcomes through remote diagnosis and monitoring. A crucial part of effective telehealth services is the transmission of high-definition medical images, possible by high-speed internet.
- **Well-being –** the use of broadband plays a general role in improving individuals' quality of life and social well-being by facilitating social interactions with friends, family and others.

A deeper qualitative analysis of socioeconomic benefits from broadband connectivity was conducted as a part of this study to understand their implications on Alberta and/or the Edmonton Metropolitan Region. These are discussed in the sub-sections below.

Improved Health Outcomes

With 3 out of 5 adult Canadians living with a chronic disease, the cost of chronic diseases to the Canadian economy is about $190 billion annually[24]. This represents about 67% of the healthcare costs in Canada. This cost may rise even further as the rate of chronic diseases increases by about 14% annually.

Improved broadband connectivity could be critical in enabling digital health solutions such as home monitoring and video visits to address this rising socioeconomic burden of chronic diseases. The current COVID-19 crisis in particular has demonstrated the importance of managing chronic diseases remotely as those with chronic diseases are particularly vulnerable to COVID-19. Digital health solutions enabled by high-speed broadband has been shown to improve health outcomes and decreased healthcare costs related to chronic disease. Widespread adoption of these techniques could result in access to better data for healthcare analytics, improved healthcare management, remote consultation, enable self-care management. It has the potential to increase patient quality of life through the following:

- Reduced or avoided travel and wait time;
- Avoiding delays in care (i.e. care outside of typical office hours); and
- Home based care and monitoring is by nature more proactive, which can in turn reduce the incidence of hospitalizations.

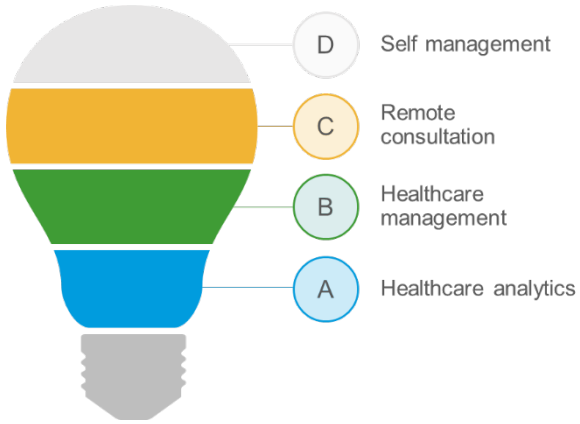

Figure 24. Opportunities from Widespread Adoption of Digital Health Solutions

The elderly, in particular, would benefit from remote monitoring and value the independence from remaining in their homes. Although representing a smaller proportion of the population, the elderly (65+) represents approximately 33% of the health care costs in Alberta[25]. In 2015, the cost of hospital and emergency room visits for the elderly population was about $2.7 billion[26].

Several studies found that the combination of home tele-monitoring, video visits and coordinated care results in substantial improvement in health outcomes. Based on a study measuring the impact of e-health on the health outcome of elderly veterans, it was estimated that such digital solutions could lead to a 63%

[24] Pre-budge submission to the House of Commons Standing Committee on Finance; Chronic disease prevention alliance of Canada; 2017

[25] Alberta Health Services; https://www.albertahealthservices.ca/about/Page13392.aspx

[26] Alberta Health Services; https://www.albertahealthservices.ca/about/Page13392.aspx

reduction in hospital admissions, a 60% reduction in length of stay and 40% reduction in emergency room visits by the elderly in Alberta (table below)[27].

Table 10. Estimate of The Impact Of E-Health Solution on Alberta's Healthcare for The Elderly

Among the elderly, home monitoring and video visits could reduce...	From	To	Reduction
Hospital admissions (number of patients)	121,281	44,874	**63%**
Lengths of stay in hospital (days)	1,466,065	586,426	**60%**
Emergency room visits (number of patients)	405,925	243,555	**40%**

Reduction in the number of hospital admissions and emergency room visits, particularly in the elderly population can have a material impact on Alberta's health care costs. As over half of the emergency room visits are non-emergencies, the use of e-health is applicable to the broader population as well. High-speed broadband connectivity could dramatically decrease these visits because of the use of tools to monitor patients remotely, increased collaboration between medical professionals, and increased transfer of medical data and images.

Greenhouse Gas Emissions Reduction

Greenhouse Gas (GHG) emissions in Alberta have increased substantially since 1990 relative to other provinces (see figure below[28]). Alberta is facing increased pressure to improve environmental outcomes and cut GHG emissions. In order to meet the 2030 reduction goals, Alberta would need an annual reduction of 12 million tonnes, which is about 40 tonnes of GHG from Alberta transportations annually[29].

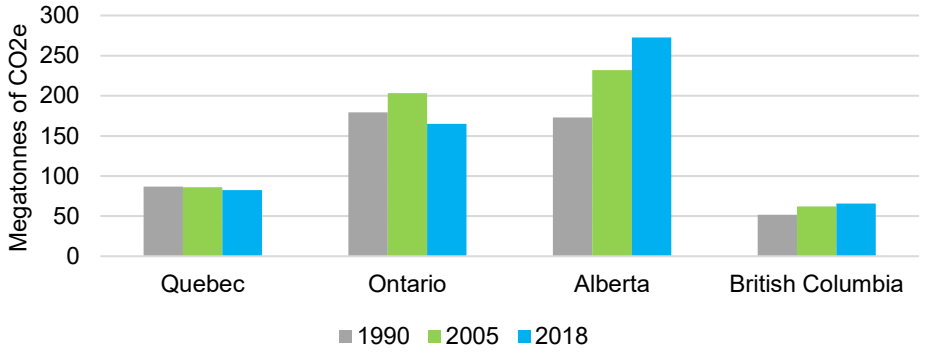

Figure 25. GHG Emissions (In Megatonnes Of CO2e) By Province 1990, 2005 And 2018

[27] Robert E. Litan; Vital signs via broadband: remote health monitoring transmits savings, enhances lives; 2008

[28] Greenhouse Gas emissions; Environment and Climate Change Canada; 2020

[29] Climate Change Alberta; https://www.alberta.ca/climate-change-alberta.aspx

Municipalities can have influence of over approximately 50% of GHG reductions in Canada[30]. The onset of COVID-19 has given a glimpse of a world of reduced GHG emissions. Studies have shown that in China alone, the slowdown as resulted in a 25% reduction in the country's total emissions[31].

Large scale telecommuting and congestion management could lead to a significant decline in GHG emissions. Increased telework through dependable, high-speed broadband access can dramatically reduce GHG emissions through:

- Decrease in commuting to work and gasoline burned;
- Reduction in electricity usage in office spaces by reduced demand from full time telework;
- Reduction in the construction of office space;
- Increase of fuel efficiency through reduction of vehicle idling due to congestion; and
- Reduction of air travel due to business.

Cars and trucks represent the largest sources of air pollution. Carbon dioxide represents the largest proportion of these emissions (approximately 70%)[32]. A typical passenger vehicle emits 4.6 tons of carbon dioxide per year[33]. The following table shows the projected potential emissions reduction in the Edmonton Metropolitan Region if there was a 10% reduction in passenger vehicle trips.

Table 11. GHG Emissions Reduction in Edmonton Metropolitan Region from A 10% Reduction in Passenger Vehicle

Emissions Information		
Carbon Dioxide production per passenger vehicle	4.60	tonnes
Total EMR Carbon Dioxide Produced per Passenger Vehicle	2,917,863	tonnes
10% Reduction in Passenger Vehicle	**291,786**	**tonnes**
Approximate Number of Cars Reduced	65,697	cars
Alberta Emissions Reduction Comparison		
Total Annual Reduction at 30% by 2030 for Transportation	12,015,000	tonnes
Proportion of Annual Target for Edmonton Metropolitan Region	**2.43**	**%**

A 10% reduction in passenger vehicles could decrease GHG emissions by nearly 300,000 metric tonnes in the Edmonton Metropolitan Region alone, annually this is 2.4% of Alberta's required target reduction for 2030.

Telecommunicating could relatively easily decrease vehicle trips by 10% with the supporting high-speed broadband connection to enable seamless access to conference call platforms, virtual private networks (VPNs) etc. COVID-19 has demonstrated that enhanced telecommuting is indeed possible. Some 40% of jobs in Canada are compatible to working from home or a remote office[34]. The underlying technology has

[30] Federation of Canadian Municipalities https://fcm.ca/en/programs/municipalities-climate-innovation-program/greenhouse-gas-reductions

[31] Fallout from coronavirus outbreak triggers 25% decrease in China's carbon emissions; CBC; 2020; https://www.cbc.ca/news/technology/covid-19-coronavirus-climate-carbon-emissions-china-economy-1.5477466

[32] Columbia Telecommunications Corporation; Benefits beyond the balance sheet: quantifying the business case for fibre-to-the-premises in Seattle; 2009

[33] United States Environmental protection agency; greenhouse gas emissions from a typical passenger vehicle

[34] Statistics Canada

improved significantly over the past several years to allow remote office for example through 5G technology.

Additionally, research suggests that implementing 5G technologies in smart traffic management can potentially reduce emissions through traffic congestion by at least 7%[35]. There is potential for higher reduction through improved environmental monitoring. The International Road Transport Union notes that free flowing traffic is a prerequisite for reducing carbon dioxide emissions. In the Edmonton Metropolitan Region, smart traffic management would decrease GHG emissions further by roughly 200,000 metric tonnes. Improved traffic flows would also reduce accidents and result in a substantial productivity improvement.

Increased Agricultural Productivity

Digital technology is already transforming the agricultural industry through smart irrigation, remote asset monitoring, remote soil quality monitoring, etc. Telematics is a technology that captures data from farm equipment operating in a field and transfers the data in real time. Through telematics, farmers can remotely track equipment, send information to and receive information from machines almost instantaneously.

Although big data is not new in agriculture, overtime, the agricultural sector has become increasingly data intensive. Agricultural equipment now provides real time raw data to cloud-based analytics services. Utilizing this data to make informed decisions and to control production costs and increase efficiencies is seen as being pivotal to a farm's ability to remain competitive and plan ahead, particularly with increasingly unpredictable climate changes resulting in narrower planting and harvesting windows. For instance, studies have shown that the planting window for corn and soybeans have shrunk by approximately half a day per week[36].

Many of these new technologies depend on cellular, satellite, or radio technologies to transfer data. Increased utilization of precision agriculture, which relies on high-speed connectivity, can significantly increase agricultural productivity. The current state of precision agriculture usually has a three-stage adoption process as outlined in the figure below. In order to achieve this three-stage adoption, broadband access is required to enable communication between transmitters and receivers, data transfer and automation of data transformation prior to data analysis.

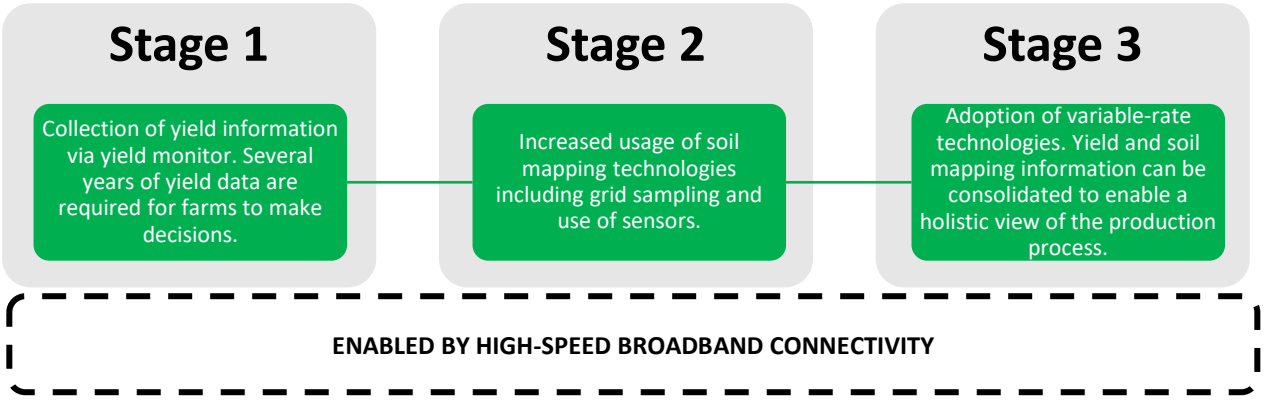

Figure 26. Stages of Precision Agricultural Adoption

[35] European Commission - Identification and Quantification of Key Socioeconomic Data to Support Strategic Planning for the Introduction of 5G in Europe

[36] Winsor, 2014

Broadband capacity is already lacking in rural areas. To make matters even more difficult, even if a farmer's house or county has wireless connectivity, this does not mean all the acres of farm production have access. Sufficient broadband connectivity is key as transferring this data manually from the equipment to the home office can be difficult and time consuming while increasing the likelihood of human error and data lost in migration.

With the added time pressures given the shortening of planting and harvesting windows due to climate change, advanced data analysis will be critical for medium to long-term sustainability. A study for the Southern Agricultural Economics Association's annual meeting in Atlanta, Georgia found that adoption of big data analytics associated with a nearly 10% increase mean farm incomes[37]. In Alberta, increased adoption of precision agriculture through improved broadband connectivity and use of big data analytics could increase Alberta's net farm income by nearly $225 million per year.

Another study by TaylorWarwick looked at the costs and benefits associated with Alberta's rural broadband deployment over a 20-year time horizon and found that Alberta could realize a net benefit of approximately $5 billion in farm income over the 20 years analyzed[38]. This benefit is realized through better access to weather and price information to drive management decisions.

Increased Household Benefits from Broadband Infrastructure

In 2009, CSMG completed a socioeconomic benefit analysis for Australia's National Broadband Network[39]. Using their methodology, and in support of a US FCC spectrum auction, Cartesian updated CSMG's estimates to reflect the landscape in 2019 as shown in CAD$ in the table below.

Table 12. Estimated Annual Benefit Per Household of Symmetric 25+ Mb/S Service

Use Case	Estimated Benefit $ / HH / yr.	Connectivity Needs	Sources of Benefit
Telecommuting	$350-$420	Efficient collaboration and low-latency video conferencing	Savings on fuel, vehicle and other transportation costs; reduced facilities costs
Remote Health & Learning	$70-$140	Videoconferencing with doctor/instructor, web-based tools and applications	Savings on transportation; reduced direct costs of doctor visits; reduced educational housing costs
E-Commerce	$140-$170	Research, comparison shopping and purchasing, including video reviews	Time and cost savings for purchasing decisions; reduced transportation costs

[37] Griffin, Mark and Whitacre for the Southern Agricultural Economics Association's annual meeting in Atlanta, Georgia; 2015

[38] TaylorWarwick; A cost-benefit analysis of Alberta Rural Broadband Deployment

[39] CSMG; National Broadband: Plan Policy Evaluation; 2009-11-02.

Streaming Video	$30-$70	Standard definition and 4k video streaming for entertainment	Reduced transportation costs; reduced direct spending on video entertainment
Cloud Storage & Computing	$30-$40	Storage, file syncing, and throughput for remote machine use	Reduced direct spending on computing capacity
Gaming & Social Media	$15-$30	Low-latency connection for responsiveness, including rich media and video interactions	Reduced transportation costs; reduced direct spending on interactive media and communication
Two-way Video Streaming	$210-$280	Low-latency video interaction	Reduced transportation costs for personal and family visits, etc.
Total Possible Benefit of High-speed Broadband	**$845 – $1,150**		

As these are benefits from deploying infrastructure that supports symmetric 25 Mb/s services minimum, they are incremental to benefits currently realized by existing broadband infrastructure in the Region. The estimates of the US FCC spectrum benefits were scaled to the likely deployment scenario per municipality within the EMRB. Assuming a 35% penetration rate, the potential gains for EMRB communities are provided in the table below. The methodology used to estimate the benefits are provided in *Appendix A: SROI Methodology*. From a use case perspective, deploying broadband infrastructure could generate approximately $188 million for Edmonton Metropolitan Region households.

Table 13. Estimated Household Benefits Per Year

Municipalities	Households	Benefits, $/year
Counties		
Leduc County	6,537	2,287,950
Parkland County	14,034	4,911,900
Strathcona County	37,559	13,145,650
Sturgeon County	7,830	2,740,500
Cities		
Beaumont	6,433	2,251,550
Edmonton	387,950	135,782,500
Fort Saskatchewan	10,675	3,736,250
Leduc	12,556	4,394,600
St. Albert	26,541	9,289,350
Spruce Grove	14,120	4,942,000
Towns		
Devon	2,622	917,700

Morinville	3,801	1,330,350
Stony Plain	7,149	2,502,150
	REGION TOTAL	**$188,232,450/year**

Many additional benefits have not been quantified in the estimate of household benefits, including:

- Consumer surplus from other broadband applications;
- Increased adoption of current generation applications;
- Innovation or productivity boost;
- Other environmental and mileage-driven benefits; and
- Economic stimulus.

Increased Value of Real Estate

Broadband connectivity has a positive impact on the real estate industry by playing a significant role in driving home buying decisions[40]. As shown in the figure below, access to high-speed broadband connectivity influences 86% of MDU/Condo purchase decision and 89% of single-family home purchase decision.

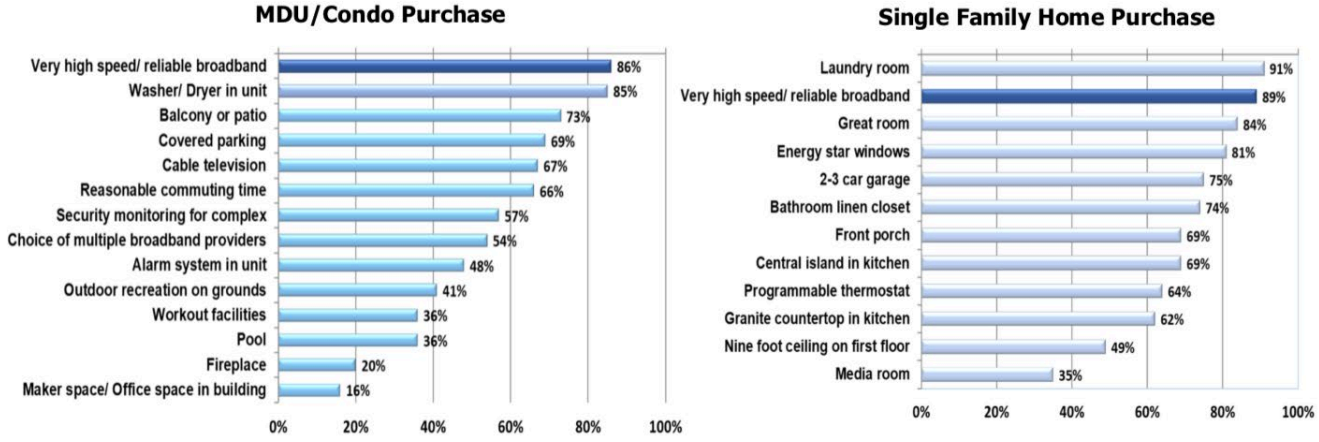

Figure 27. Percentage of Home Buying Decision Influenced by High-Speed Broadband

[40] RVA North American 2019 Advanced BB Report – 2019-12-17

Additionally, properties with high-speed broadband connection have a higher value in the real estate market. The figure below shows the discounts that would be needed to consider similar properties without broadband connectivity.

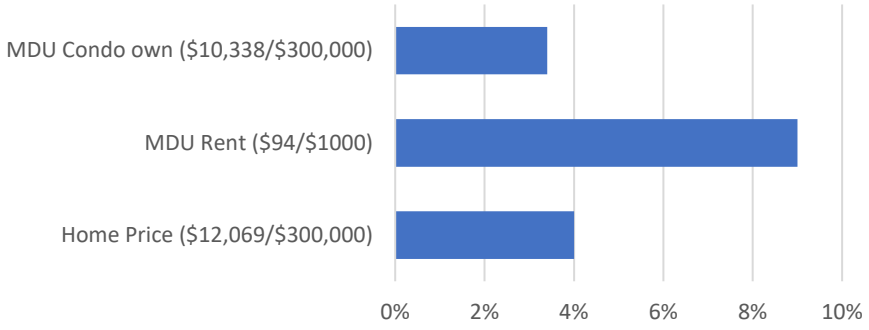

Figure 28. Fibre Broadband Drives Relocation Decisions

Assuming a 35% penetration rate and an average home price of $300K, the impact of a capable broadband connection would increase home valuations by $633 million.

Industry Sectors Improvement

A supply chain management analysis by Mckinsey calculated the uplift arising from industry sectors becoming more digitally intelligent over 10 years looking forward. The uplift in GDP was estimated by industry based on improvements in asset management, usage and labour productivity. Looking at the analysis, the impact of commercial/industrial enterprises in the Edmonton Metropolitan Region embracing digital technologies could lead to improvements in several industries. The figure below shows the percentage improvements and therefore benefits from improved connectivity.

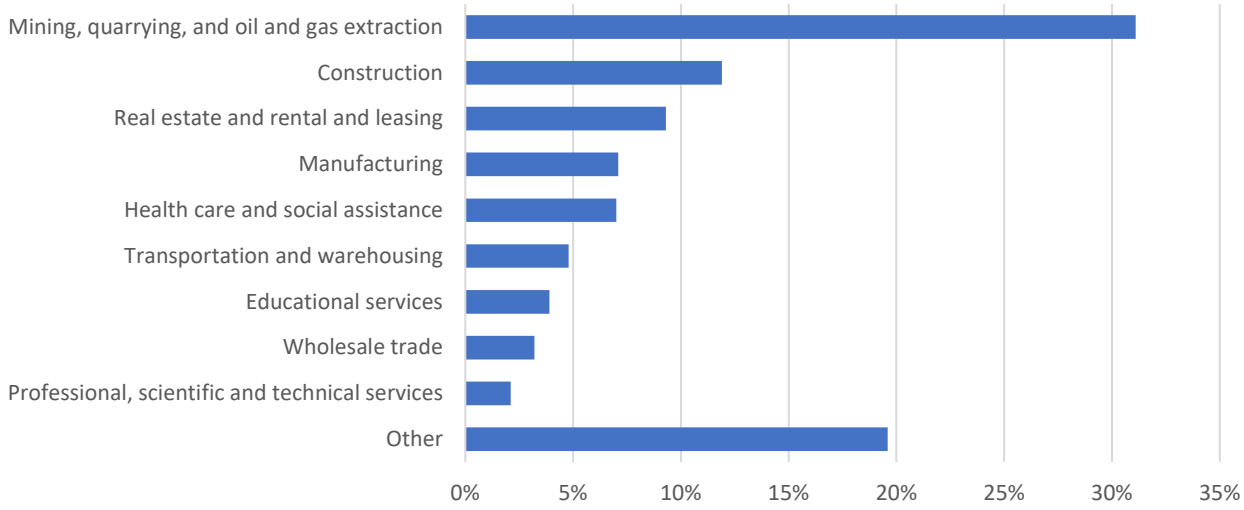

Figure 29. Percentage Improvement by Industry from Improved Broadband Connectivity

Overall, in addition to up to $1 billion incremental GDP impact from broadband connectivity in the Edmonton Metropolitan Region, the Region would substantially benefit from other socioeconomic benefits:

- Improved health outcomes from reduction in healthcare burden to the economy;
- Reduction in GHG emissions through telecommunication and smart traffic management;
- Increased agricultural productivity through increased adoption of precision agriculture;
- Increased household benefit to the Edmonton Metropolitan Region through broadband deployment;
- Increased value generated for the real estate industry; and
- Other industry sector improvements.

Industry Disruption

Of the many potentially disruptive technologies shown in Figure 7, the six technology enablers likely to make the biggest impact over the next decade are:[41]

- **3D Printing – Additive Manufacturing**
- **Networks and Sensors – The Internet of Everything**
- **Infinite Computing**
- **Artificial Intelligence**
- **Robotics**
- **Synthetic Biology**

Each is an exponentially driven digital-based technology with the potential, both individually and synergistically with others on the list, to truly disrupt the status quo across many sectors. With true broadband networks, these disruptions may be orchestrated from anywhere – that is, anywhere where the network capabilities exist. High-level examples of how industries are being transformed and disrupted are provided in the table below, and specific examples of disruption follow.

Table 14. Key Industries in the Region Impacted by Broadband Enhancements

Industry		Examples
	Agriculture	• Air and soil sensors for automated irrigation and fertilization • Automating harvest machinery with internet and GPS • Dashboards illustrating yield, crop health, and other critical metrics • Operational processes for value-added agricultural manufacturing
	Education	• Use of digital engagement tools to interact within and outside of brick and mortar classrooms, including the enablement of distance learning • Use of VR and AR technology to create immersive learning • AI to generate customized learning material
	Health	• MyHealth portfolio, dashboard, and virtual consultations • Cloud-based systems to improve patient care through big data analysis • Digital pre-symptomatic health tracking applications • Reduction of social isolationism through use of video conferencing and participation in online communities
	Manufacturing	• Full operations lifecycle tracking (Business to business/consumer) • Operational process management (bottleneck identification, lead times) • Facilitate automation and consequential process optimization
	Transportation	• Driverless vehicles and autopilot functionality • Automating detailed emergency response (Ambulance, police, fire) • Smart traffic management applications for optimized traffic flow

[41] Diamandis, P., and Kotler, S; Bold: How to go Big, Create Wealth, and Impact the World; Simon & Schuster; 2015.

	Energy	• Community-driven micro-grids (energy sharing) • Consumer facing smart grid (real-time energy consumption) • Solar-based connection points

Together with 3D printing, for example, ICT and the knowledge economy are rendering the traditional Daimler-Chrysler model for automotive manufacturing obsolete and opening up the very real possibility of a competitive manufacturing facility in, say, the Town of Stony Plain. The potential has spawned the so-called 'maker' movement.

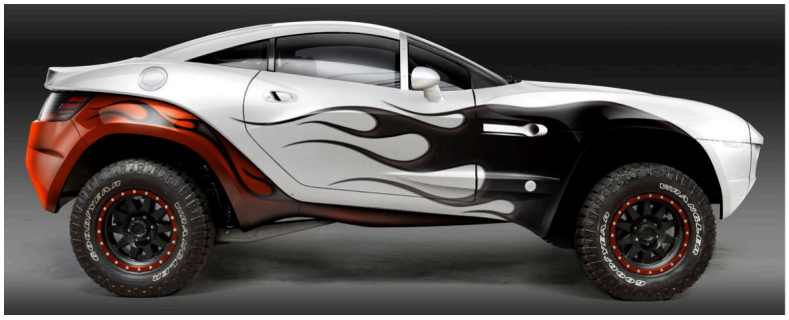

Figure 30. The Rally Fighter - Community Designed Vehicle

The poster child for 3D printing might be Local Motors. In a manner analogous to the open-sourced software model in which a large group of disparate individuals with a common interest collaborate to produce great work like Linux and Apache, Local Motors[42] has created an open-sourced platform linking 30,000 individuals with an interest in designing and building things that move – cars, bikes, trucks, and so on. Their platform is called '*The Forge*' and several years ago, a group of individual widely dispersed car enthusiasts used it to design the first community designed vehicle – The Rally Fighter – an off-road, street ready powerhouse. They then designed a combat vehicle for DARPA and were introduced to President Obama. Development time was five times faster and one hundred times less expensive than traditional defence development cycles. In both cases, the resulting vehicles were then manufactured in a micro-factory – the first of which was constructed in a refurbished 40,000 square foot building in Chandler, AZ for US$300,000. The development economics are such that Local Motors breaks-even on production runs of less than 200 vehicles.

Recent developments in additive manufacturing are now even rendering the 40,000 square foot factory redundant – indeed, a home garage with a broadband connection to download design files will suffice. On Sept. 14th, 2014 at the International Manufacturing Technology Show in Chicago, Local Motors 3D-printed a functional vehicle, the 'Strati' in front of a live audience. Once printed, their CEO, Jay Rodgers, took it for a spin. Change the files, and you end up with a boat, or farm implements, or, whatever.

Figure 31. Local Motors 3D Printed Vehicle

[42] http://www.localmotors.com/

Turning to the second item on the list, consider the Internet of Everything (IoE). According to the Cisco Visual Networking Forecast, the number of networked devices in Canada increased from 167 to 313 million over the 2013 to 2018 period.[43] The 313 million device estimate above translates to over eight networked devices per person in Canada and partially results from the proliferation of sensors and the linking of the Internet to the physical environment for purposes of monitoring, automation, and intelligence. Together these trends are leading to the development of the so-called Internet of Things or the Internet of Everything.[44]

Figure 32. The Internet of Things

The IoT not only enables disruption in the Smart Grid, Smart Home, Smart Cities, and Smart Regions areas, but also in enabling the connected car, next generation automation, and connected healthcare, including

[43] Cisco; *Cisco Visual Networking Index: Forecast and Methodology*, 2013-2017; Cisco; 2014

[44] Gartner Group poster: *The Intelligent City of the Future*.

personalized medicine and the quantified self. Further out, it will enable the energy and logistics Internet, and with contributions from artificial intelligence (AI), autonomous vehicles.

According to Cisco, some 50 billion smart objects will be connected globally by 2020 and enable everything from smart power, transportation, water, and so on. Of these, 601 M will be personal wearable devices, for which the compound annual growth rate (CAGR) is expected to be 44%.[45]

Infinite computing is becoming available via the 'Cloud'. Cloud computing is the delivery of computing resources as a service, whereby processing power, software, storage, information, and related services are provided over a network by a third-party utility service provider similar to the way in which power is delivered over the electrical grid.[46]

Figure 33. The Connected Home

In this real and quickly evolving context, it is not surprising that annual Internet and mobile traffic is growing at compound annual rates of 21% and 69% respectively. The message here is that the rate of growth in what will be needed for digital connectivity even five or ten years from today is going to be orders of magnitude greater than what we have experienced to date. That level of connectivity and capacity requires a fibre-based infrastructure whether constructed on a private, public/private partnership, or on a public fibre utility basis. Either way, the existing copper/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 result.

[45] Cisco; *The Zettabyte Era: Trends and Analysis*; Cisco; 2015.

[46] http://en.wikipedia.org/wiki/Cloud_computing

4. Current State Analysis

Approach

This section delves into the detailed current state of the Region's municipalities and the ecosystem that supports the development of broadband (note that information provided within was collected from interviews between January – March 2020, and the current state remains dynamyic and continues to shift). A summary of the information collected, and the approach taken is further outlined below:

A comprehensive understanding of current broadband and digital connectivity in the Region was developed through extensive engagement with regional stakeholders and research of existing broadband plans, initiatives, and studies completed by thirteen EMRB member municipalities[47], six non-EMRB member municipalities[48], and seven identified ecosystem stakeholders[49]. Research was then supplemented with interviews to collect missing information and spark regional conversation.

An inventory of all publicly available broadband assets in the Region has been collected and has been compiled into a visual representation of the current state of broadband, internet, and digital connectivity (including publicly and privately-owned infrastructure). RSM and TaylorWarwick utilized information gathered through engagements with Internet Service Providers (ISPs) and through broadband workshops to compile the inventory of assets which has been visualized through ArcGIS.

Regional broadband service levels were identified and mapped, highlighting internet coverage and speed analysis, and other parameters to understand access and capacity. RSM and TaylorWarwick analyzed regional ISP service offerings and CRTC internet coverage data to develop a comprehensive understanding of service levels in the Region.

This section is organized to reflect the approach above, and the current state summary of each municipality is split into two sections: Service Levels and Assets, and Broadband Strategy and Deployment. Furthermore, the Municipal Current State section of this document is divided into three overarching sections based on common findings and aimed to align with the existing EMRGP Metropolitan Region Structure to 2044 as closely as possible, which is defined as follows:

- **Metropolitan Core:** defined as the contiguous developed area within the City of Edmonton with the highest density development served by higher order transit and the highest concentration of regionally significant amenities and services, including downtown Edmonton.
- **Metropolitan Area:** defined as the area surrounding the metropolitan core, including portions of county lands, urban communities, major and local employment areas, and intervening undeveloped areas that are socioeconomically tied and that share industry, housing and infrastructure.

[47] The 13 EMRB member municipalities include: Beaumont, Devon, Edmonton, Fort Saskatchewan, Leduc, Leduc County, Morinville, Parkland County, St. Albert, Spruce Grove, Stony Plain, Strathcona County, and Sturgeon County.

[48] The 6 non-EMRB member municipalities interviewed include: Bon Accord, Calmar, Gibbons, Legal, Redwater, and Warburg.

[49] The 7 ecosystem stakeholders interviewed include: AUMA, Edmonton Global, FERIC, ISED, RMA, Service Alberta, and WD.

- **Rural Area:** defined as the lands outside the metropolitan area within the wider Edmonton Metropolitan Region, consisting of rural working landscapes with agricultural lands, major employment areas and local employment areas, natural living systems, recreation areas and resource extraction areas, counties, towns, villages, incorporated hamlets and country residential development with some local levels of service and community amenities.

Figure 34. EMRB Policy Tiers (EMRGP)

After establishing the municipal current state, the roles of the seven ecosystem stakeholders are then discussed in detail. These roles include: Strategy and Funding, and Advocacy.

Table 15. Broadband Ecosystem Stakeholders

EMRB Member Current State

Overview

The EMRB Member Current State was developed through extensive engagement with 28 stakeholders from the thirteen EMRB member municipalities[50]. In addition, extensive research was conducted on each municipality's corporate, economic, and IT plans to develop a detailed understanding of the emphasis placed on broadband enhancement. In completing this research, there were six key regional insights that were gained, which are as follows:

Municipalities approach network development on an ad-hoc and individual basis, often in silos
In most cases, each EMRB member municipality works to develop their own network in a silo and no intermunicipal collaboration mechanism (ICF, IDP, etc.) has been created that considers broadband needs. As such, each network is developed without consideration for overarching economies of scale and each municipality is negotiating with ISPs separately, which may result in a loss of buying power.

Municipalities are generally unaware of the breadth of deployment options available
Many municipalities are unaware of the vast range of options available when considering deploying broadband, and of those that are aware, few have a strong grasp of the costs and benefits of each approach[51]. This was apparent in workshops, as RSM and TaylorWarwick offered to go over the various deployment models if there was interest. In most cases, municipalities were keen to hear and understand the pros and cons of the various models.

Municipalities are not applying for federal funding
It was noted in interviews and verified through research that the majority of the Region is ineligible for current federal funds as they are reserved for areas within Canada that do not have access to broadband speeds of 50/10 Mbps.[52] However, in EMRB member municipalities where there are small pockets of eligible areas, municipalities noted that applying for funding was difficult due to technical application requirements. As such, EMRB member municipalities often leave broadband infrastructure development to the incumbents, who may themselves apply for federal funding with letters of endorsement from municipalities.

Municipalities in the Region lack broadband engineering and development guidelines
In all but two municipalities, guidelines do not exist that mandate fibre or other broadband infrastructure be deployed in new developments or when construction of roads or other infrastructure occurs. In many cases, it was cited that there was a concern around mandating such guidelines, as this would increase development costs and therefore detract developers from investing in municipalities. However, findings suggest, a dig once approach of integrating fibre infrastructure into other infrastructure corridors (roads, pipelines, etc.) could save millions of dollars and optimize infrastructure investment.

SuperNet is utilized for public buildings, however, municipal operation buildings are connected with municipal-owned fibre
SuperNet was often noted as being cost prohibitive for municipalities to connect their facilities to, and therefore, many of the Region's municipalities have chosen to build their own fibre infrastructure and connect through other backhaul providers.

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[50] A full listing of stakeholders can be found in *Appendix C: List of Stakeholders Interviews*

[51] Deployment options are described in *Appendix A: Telecommunications Technology – Evolution and Implications*

[52] CRTC Fixed Internet Access and Transport Maps

ISPs do not share their infrastructure plans

Across the Region, municipalities do not have a detailed understanding of where private broadband infrastructure has been deployed. It was noted that incumbents may be holding onto this information as it provides them with a critical competitive advantage. In addition, from a historical perspective, there may be a number of reasons for why this information is not available, including the dissolution of organizations that had previously developed the infrastructure and municipal permitting guidelines not requiring these details to be recorded.

The details from which these six insights were developed are provided in municipal current state summaries within this section. In addition, the table and figure below provide a high-level overview of each current sate summary. Feedback gathered on service levels was augmented by in depth research and internet speed research for each municipality.

Table 16. EMRB Broadband Current State Summary

Policy Tier	Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Metropolitan Core & Metropolitan Area	Beaumont	!	!	✗	✓
	Edmonton	✓	✗	✓	✓
	Fort Saskatchewan	!	✗	✓	!
	Leduc	!	!	✓	!
	St. Albert	✓	✓	✓	!
	Stony Plain	!	✗	✓	!
	Spruce Grove	✓	✓	!	!
Metropolitan & Rural Area	Leduc County	✓	✗	!	✗
	Parkland County	✓	!	!	✗
	Strathcona County	✓	!	✓	!
	Sturgeon County	✓	✗	!	✗
Rural Area	Devon	✗	✗	✗	!
	Morinville	✓	!	!	✗

Legend	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Level
✓	Dedicated broadband/connectivity strategy in place or is currently being developed	Guidelines are formal and followed by all developers/engineers	Majority of municipal buildings are connected via fibre-optic infrastructure	CRTC standards met across the board
!	Broadband/connectivity is referenced in strategy documents but no dedicated strategy is in place	Guidelines are informal and/or the municipality is considering putting guidelines in place	There is currently limited fibre-optic infrastructure connecting municipal buildings	CRTC standards met in all but one area and/or speeds do not exceed CRTC standards in multiple areas
✗	Broadband/connectivity is not referenced in any strategy document	There are no guidelines in place and no guidance is given	There is no municipal owned fibre-optic infrastructure	CRTC standards not met in two or more areas

Metropolitan Core & Metropolitan Area Tier Municipalities

At the Metropolitan Core & Metropolitan Area tier level, there are two overarching insights that were synthesized:

- These municipalities have the greatest interest from ISPs and municipal strategies focus on developing these partnerships; and
- Service levels are robust and Gbps service levels are highly prevalent within these municipalities. As such, most municipalities have begun to think about and prepare for 5G connectivity.

The basis of these insights is provided in the detailed current state summaries below.

Beaumont

Recently incorporated as a city, the City of Beaumont boasts a population of over 19,000. The City is home to over 170 storefront and 320 home-based businesses and continues to grow, stating in their 2016-2021 Strategic Plan that they aim to achieve higher growth in the commercial and light industrial sector. In addition, they are a member of the Leduc-Nisku Economic Development Association which provides the City with many opportunities for business.

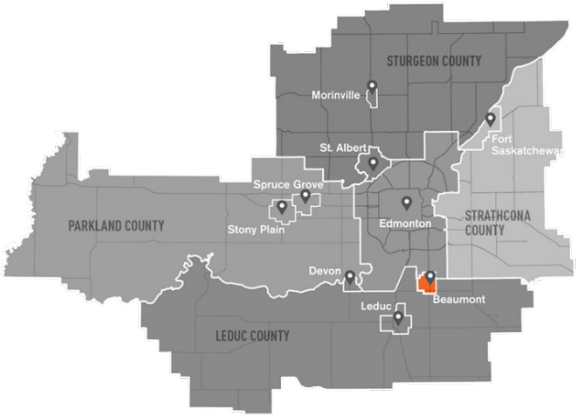

Figure 35. EMRB Member - Beaumont

Table 17. Beaumont Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Beaumont	!	!	✗	✓

Current Service Levels and Assets

Beaumont's broadband connectivity is primarily provided by Shaw and TELUS, with the majority of the City connected through Shaw. Data collected during this study indicates that Shaw is able to provide speeds of up to 600/20 Mbps in most areas, and 1000/125 Mbps in select business areas, while TELUS's speeds vary from 25/5 Mbps to 940/940 Mbps. Consequently, the City experiences varied speeds but is often above the minimum CRTC standards. It was noted in discussion with Beaumont that they experience two distinct connectivity gaps; one between their developed and undeveloped areas, while the other is between new and old developments.

To connect Beaumont's municipal buildings, the City utilizes wireless point-to-point bridges that connect to an antenna at their firehall, which is connected to SuperNet. Despite this connection, the City experiences bandwidth issues when a large number of users are utilizing the internet at once. Furthermore, there is a lack of fibre connecting any municipal facility, which is evidenced through Beaumont's online "Locate Key Infrastructure" tool.

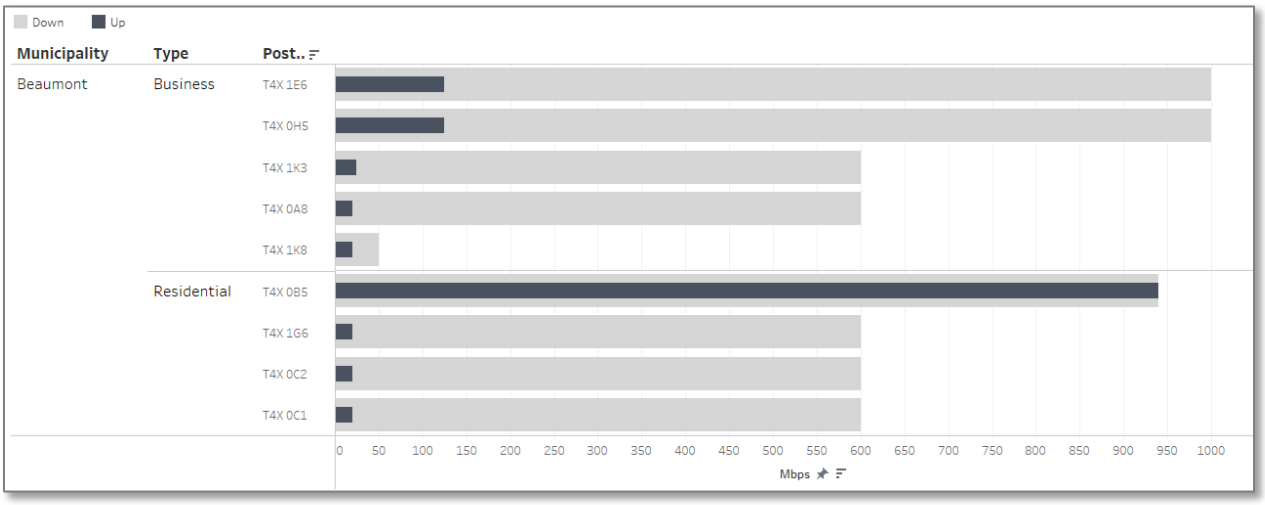

Figure 36. Beaumont - Maximum Advertised Speeds

Broadband Strategy and Deployment

Until 2018, broadband had not been a primary focus for the City of Beaumont. However, wide-spread residential demand for enhanced broadband connectivity across the City and connectivity issues within and between municipal buildings has realigned Council's priorities for broadband enhancements. As such, the City is looking to enhance broadband connectivity through a strategic emphasis on innovation. Strategies for current broadband enhancements are a subset of the 2017-2021 Municipal Strategic Plan, with a $500K fibre optic implementation to municipal buildings being planned over the medium-term. Beaumont's Council has emphasized the need to be forward thinking; by embracing innovation, technology, and versatility, broadband enhancements support Beaumont's strategic goals of "Livability" and "Connecting with Citizens" and can position the City for a "leapfrog moment to be a leader in Alberta."

The City has investigated an "open utility approach" to broadband development, where either ISPs or the City deploy fibre conduits during developments, such as water and sewage lines. Ideally, Beaumont wants to gain control over its broadband assets, but the City is open to sharing this responsibility with ISPs and other municipalities. As such, the City expressed an interest in investing in regional partnerships to advance broadband capabilities, not only in Beaumont, but in all neighbouring municipalities.

Edmonton

Edmonton is the Capital of Alberta and the second largest city in the province with a population of just under 1 million people and a land area of 684 km^2. In addition to a focus on the petrochemical, manufacturing, and transportation and logistics industries, the Government of Alberta and the City of Edmonton are major employers of residents. As the City continues to grow and modernize, technology industries such as artificial intelligence and machine learning, propelled by post-secondary institutions, are becoming more prominent in the City. Large telecom companies, real estate companies, and banks are also headquartered in Edmonton.

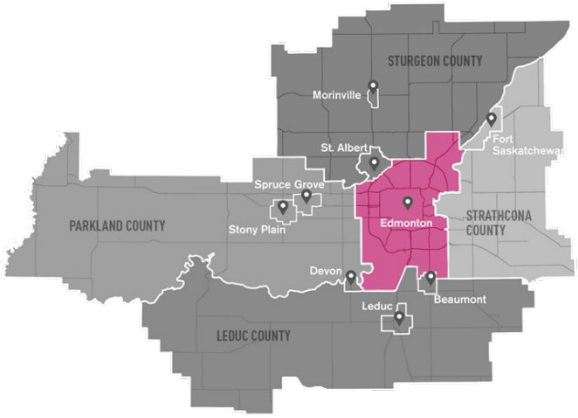

Figure 37. EMRB Member - Edmonton

Table 18. Edmonton Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Edmonton	✓	✗	✓	✓

Current Service Levels and Assets

The City of Edmonton is the most well-connected municipality in the Region. Citizens are able to access the internet through several service providers, with TELUS and Shaw offering the fastest speeds through fibre and coaxial cable connections. Through data collected within this study, it was observed that Shaw is able to offer speeds of up to 600/20 Mbps in all areas of the City, and 1000/125 Mbps in select locations. TELUS's services vary to a greater degree across the City, with offerings from 25/5 Mbps up to 940/940 Mbps where fibre upgrades have been made. Regardless, is appears that connectivity for businesses and residents is adequate. The City also has a wireless broadband infrastructure with six (6) radio towers operating with licensed and unlicensed spectrum frequencies. This infrastructure provides connectivity to City facilities, traffic intersection signal controls, etc.

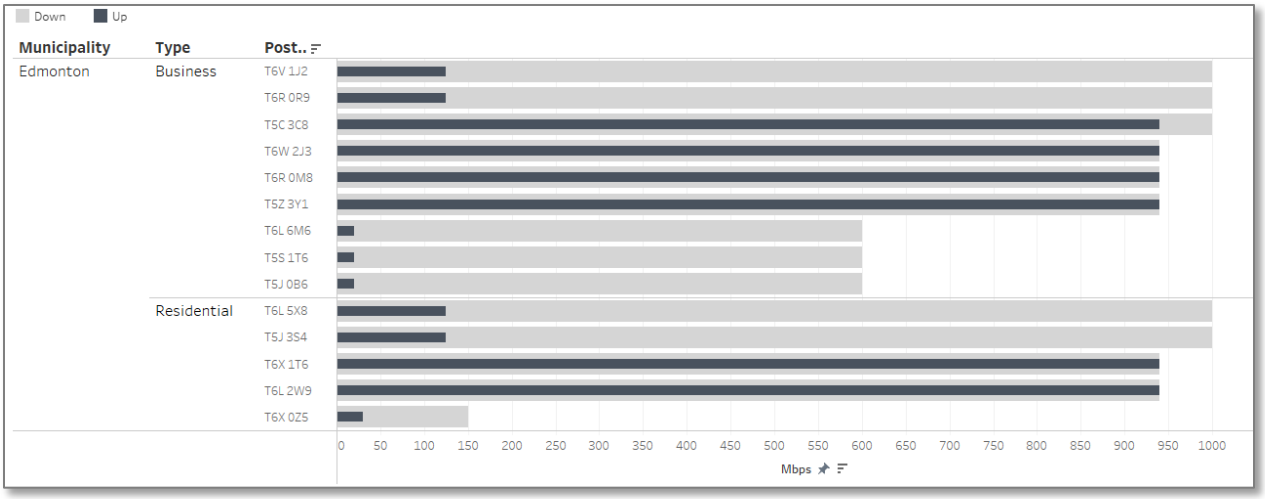

Figure 38. Edmonton - Maximum Advertised Speeds

In addition to the services that residents and businesses subscribe to, the City of Edmonton ensures that Open City Wi-Fi is available and accessible on 18 Capital and Metro Line LRT platform stations, and at 94 locations where the City of Edmonton operates. For municipal buildings, the City of Edmonton has a goal of ensuring high-speed connectivity to all City-owned facilities and has connected municipal facilities and post-secondary institutions through more than 200km of City-owned fibre assets (a portion of which were deployed in partnership with Cybera within the City's LRT system) and through leveraging existing EPCOR and SuperNet assets.

The image below is an excerpt from the City's "Digital Action Plan" which summarizes this progress:

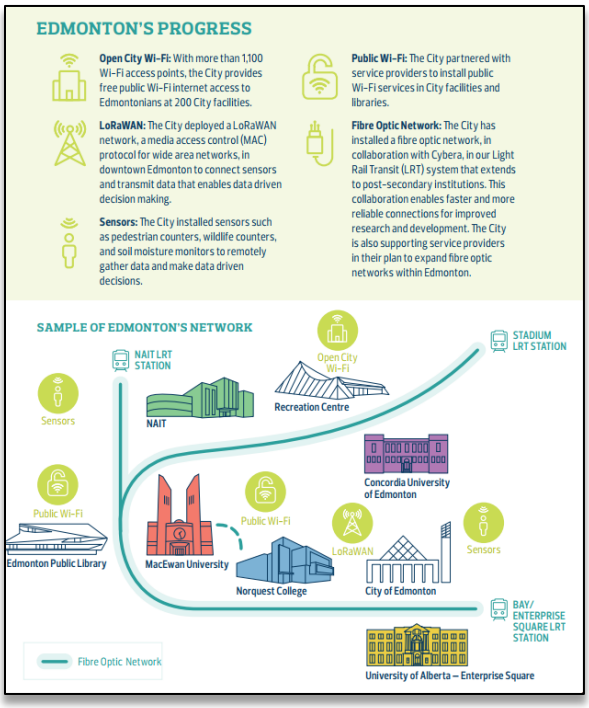

Figure 39. Edmonton's Digital Action Plan

Broadband Strategy and Deployment

With current broadband connectivity levels adequately supporting the majority of Edmonton residents, the City of Edmonton has set high-level broadband strategic direction in their "Smart City Strategy" and a further detailed strategy in their "Digital Action Plan." The Smart City Strategy outlines high-level objectives for enhancing broadband connectivity in the City, and the Digital Action Plan builds upon this, with a specific focus on bridging the digital divide and enabling mobile broadband networks (5G) to support the next generation of connected devices.

Within Edmonton's Smart City Strategy, three overarching goals are identified that aim to increase the City's Resiliency, Livability, and Workability. Within the goal of Workability, infrastructure is a focus area with specific actions outlined to "upgrade [Edmonton's] infrastructure to ensure high speed connectivity." One of the City's three guiding principles regarding this action item is to "enable broadband services through partnerships." This is highlighted by TELUS' $1 billion commitment to expand their fibre optic network across the City, the first phase of which delivered fibre connections to more than 25,000 premises in four Edmonton neighbourhoods. In addition, the Strategy outlines the following two guiding principles:

- The City of Edmonton will take an inclusive approach, working with providers and jurisdictions that are interested in collaborating with Edmonton
- The City of Edmonton will partner on innovative opportunities to make broadband and data networks more accessible for Edmontonians

The Digital Action Plan builds upon the Smart City Strategy and outlines detailed goals to bridge the digital divide and ensure the City is an innovator and early adopter in the deployment of the next generation of wireless technologies. Ultimately, this commitment to deploying next generation wireless systems can enable new possibilities for economic development, environmental sustainability, quality of life, and innovation. As such, the Digital Action Plan outlined the following goals:

1. Bridge the digital divide and continue to build a connected community and region
    - Enhance resident experiences using connected and digital technologies
    - Edmonton and its regional partners will improve access to broadband and wireless networks for residents of the region
    - The City of Edmonton will improve digital literacy and digital rights for Edmontonians

2. Demonstrate thought leadership in Smart City implementation by leading the deployment of next generation wireless networks.
    - The City will be a thought leader in next generation wireless technology and smart city deployments
    - The City will collaborate with regional partners to promote economic development in the Edmonton Metropolitan Region and attract new investments
    - The City of will work to remove municipal regulatory barriers pertaining to wireless network developments.

Through these two overarching strategies, the City of Edmonton has laid the foundations for enhancing connectivity within the municipality and Region.

Fort Saskatchewan

The City of Fort Saskatchewan is a 48 square kilometre city with a population of nearly 27,000, bordered by Edmonton, Strathcona County, and Sturgeon County. Fort Saskatchewan is a part of Alberta's Industrial Heartland, and as such, many Fort Saskatchewan residents are employed by the nearby petrochemical facilities. In addition to heavy industry, the commercial service sector in the City has grown in recent years, with international companies such as Wal-Mart and The Home Depot employing a large number of residents as well.

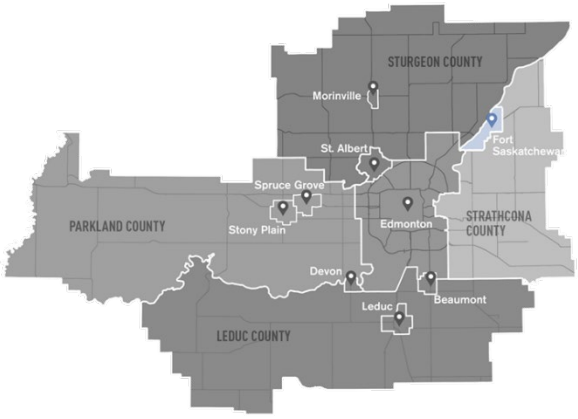

Figure 40. EMRB Member - Fort Saskatchewan

Table 19. Fort Saskatchewan Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Fort Saskatchewan	!	✗	✓	!

Current Service Levels and Assets

As Fort Saskatchewan is a municipal partner of Alberta's Industrial Heartland, broadband connectivity for these companies, and for the City as a whole, is crucial. The main providers of broadband connectivity in Fort Saskatchewan are TELUS and Shaw, along with SuperNet for schools and hospitals and Syban and Xplornet for connectivity in undeveloped areas. Shaw is able to offer speeds up to 600/20 Mbps in most areas, with a select few areas receiving 1000/125 Mbps and TELUS is able to provide between 15/1 Mbps to 940/940 Mbps throughout the City. In areas where Shaw and TELUS do not provide services, Syban provides wireless broadband connectivity at 50/20 Mbps and Xplornet provides broadband connectivity via satellite at 25/5 Mbps.

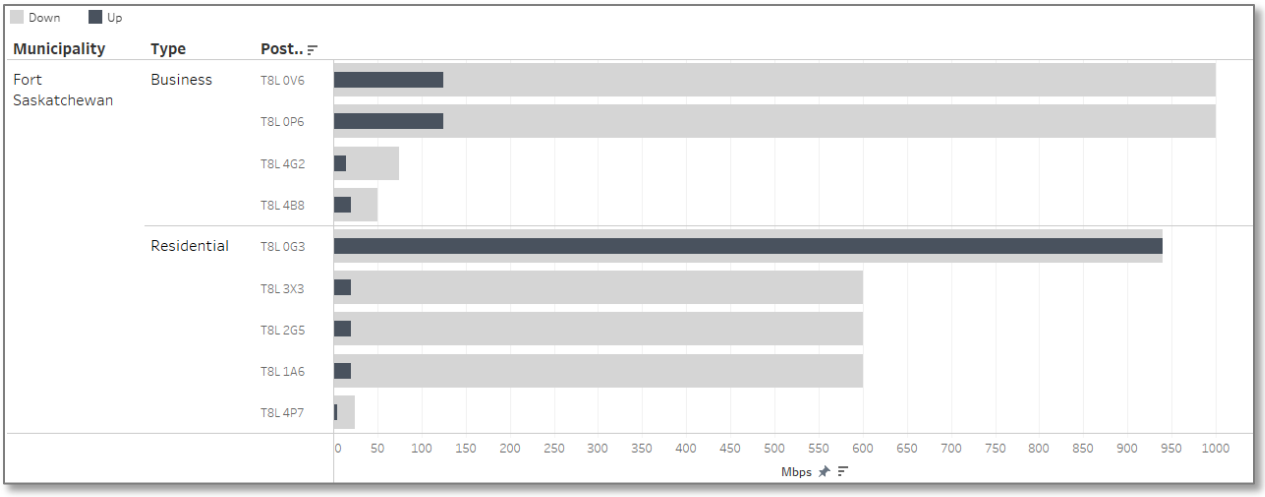

Figure 41. Fort Saskatchewan - Maximum Advertised Speeds

The City has fibre infrastructure along the main highway and conduit on major City streets but has primarily copper cable through its downtown core. This has allowed the City to evolve from point-to-point wireless connections to connecting all major City buildings with fibre. However, their City buildings are not located near major businesses and the fibre conduits were placed without a focus on these businesses; this makes it very difficult to connect to existing fibre infrastructure. Despite the disparity in connectivity and the lack of residential and business fibre deployment, it was noted in interviews that connection in Fort Saskatchewan is satisfying residents and businesses. As such, there has not been wide-spread concern of losing businesses due to connectivity/speeds, but the City recognizes that companies may not be choosing Fort Saskatchewan as a result.

Broadband Strategy and Deployment

Due to a perceived overall satisfaction with broadband service levels, Fort Saskatchewan indicated enhancing connectivity is currently not a Council priority. However, there has been discussion to leverage the existing City-owned fibre infrastructure to further explore smart city applications (such as connected traffic signals), 5G technology, and explore options to enhance connectivity to key areas/businesses. In addition, there have been preliminary conversations with TELUS in 2018 but no action has come from conversations as of yet.

As broadband is not a high priority for the City's Council, there is currently no dedicated broadband strategy, but the City has demonstrated high-level strategy in the following areas:

- **Small Business Equipment and Technology Funding Program**: Encourages resident small business owners to invest in equipment and technology that will increase efficiency, productivity, and competitiveness for their business.

- **IT Department Plan 2019-2022**:
    - Initiative to deploy fibre optic connectivity to City facilities (2019-2020)
    - Upgrade network backbone from 1 Gb to 10 Gb or greater (2020)
    - Increase Internet bandwidth to support increasing bandwidth demands from applications and storage (2020-2021)

Although the City has these high-level strategies, the absence of a formal broadband strategy has prevented budget requests from being approved by Council. For example, in October of 2019 reallocated money set aside for a project to install fibre optic cable down Highway 21 in preparation for the proposed future Fire Hall and fibre-optic connection to the CN Station from the 2020 Budget.

Leduc

The City of Leduc is home to over 33,000 residents spanning an area of 42 km^2. It is also home to the Leduc Business Park, located within the City limits, consisting of over 1,400 businesses primarily in the oil and gas industry. The City is an integral part of the provinces economic region; conveniently located at the intersection of two railways and near the Edmonton International Airport, Leduc heavily supports the energy and petrochemical industry.

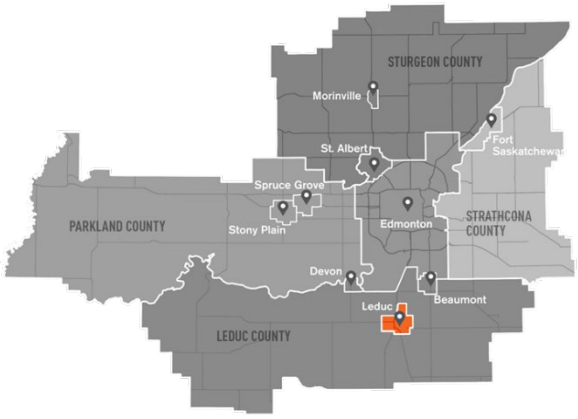

Figure 42. EMRB Member - Leduc

Table 20. Leduc Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Leduc	!	!	✓	!

Current Service Levels and Assets

The City of Leduc is primarily serviced by Shaw and TELUS, with Shaw offering speeds from 600/20 Mbps to 1000/125 Mbps, and TELUS offering speeds from 15/1 Mbps to 940/940 Mbps at the locations investigated in this study. Despite this range of offerings, it was indicated in interviews with Leduc that many businesses have experienced poor connectivity which has made them consider leaving the community if service levels are not enhanced. For residents, connectivity levels are generally adequate, and the City has not heard many complaints. However, it was indicated that service levels are generally much better in newly developed areas compared to older neighborhoods. From an infrastructure perspective, the City is aware of the general areas where private fibre exists and are working with ISPs to acquire a more detailed view. In addition, their municipal buildings are well connected with City-owned fibre infrastructure, with fire halls, operational buildings, and the City Hall connected through their network. For municipal buildings located a significant distance away from their current fibre build-out, they are relying on ISPs to provide connectivity.

Figure 43. Leduc - Maximum Advertised Speeds

Broadband Strategy and Deployment

Broadband enhancement was indicated as being a high council priority in interviews, which is exemplified by the City of Leduc's 2019-2022 Strategic Plan, and outlined in the following focus areas and strategies:

Table 21. Focus Areas of Leduc's 2019 - 2022 Strategic Plan

Focus Area	Strategies
A City with a Plan for the Future	• Ensure that the City of Leduc has clear plans and strategies, supported by enabling technologies, to guide future growth with a high quality of life. • Optimize the use of existing municipal infrastructure.
An Economically Prosperous City	• Encourage economic growth and diversification in Aerotropolis primary clusters.

As such, the City of Leduc is considering developing engineering and development guidelines to ensure deployment of fibre or fibre conduit in new developments and has been in advanced conversations with ISP's to further build-out infrastructure, with the goal of connecting all residents and businesses in the community over the next two years. In addition, they have been in discussion to build out a 5G network across the City to enable the internet-of-things and further their position as a smart city. However, they believe this is a longer-term play and are focused on first enhancing broadband connectivity. As conversations with ISPs continue, the City has also been considering the needs of Leduc County and their neighbouring municipalities. However, ISPs have been reluctant to connect the broader County, as population density in rural areas was noted as a hinderance to profitability and lack of clear fibre corridors restricts infrastructure development.

Furthermore, when discussing the role that EMRB can play in the ecosystem, the City noted that there is a need for a regional understanding of the corridors available for fibre deployment and a need to establish regional partnerships for the deployment of 5G, as it will require partnerships to be established with multiple private and public sector organizations.

St. Albert

St. Albert is a city of nearly 70,000 residents, spanning just over 48 km^2. Although the City's land use is primarily residential, the City is planning for commercial and industrial growth; there are 700 acres of land designated for commercial and industrial uses. St. Albert also has two industrial parks (with a third being built) which are home to light industrial, distribution, and small manufacturing companies. In addition, St. Albert has a major Smart City focus that drives Council priorities.

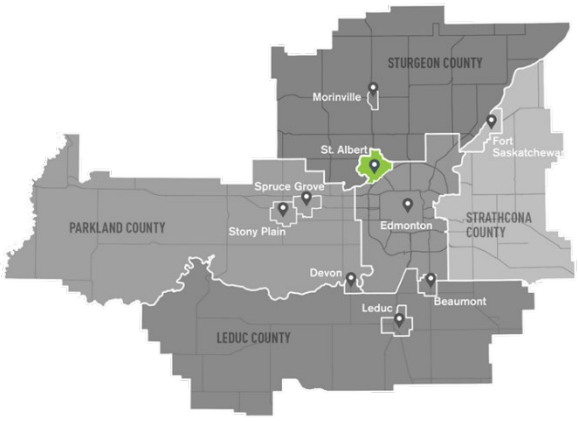

Figure 44. EMRB Member - St. Albert

Table 22. St. Albert Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
St. Albert	✓	✓	✓	!

Current Service Levels and Assets

Current broadband connectivity is provided primarily by TELUS and Shaw, with SuperNet connecting schools, libraries, and fire halls, and high speeds are offered to the majority of the City. Shaw is able to offer speeds between 600/20 Mbps and 1000/125 Mbps, whereas TELUS is offering 75/15 Mbps to 940/940 Mbps. Note that there are areas within City limits that do not currently have connectivity from the incumbents and are not meeting CRTC connectivity standards. Despite this, residential and business connectivity has largely been led by the incumbents, with TELUS commencing full-scale deployment of fibre in St. Albert in the summer of 2019, committing $100 million between St. Albert and the Sturgeon Valley in Surgeon County. In addition to TELUS, there are approximately 10 TELUS resellers, offering lower-cost options for internet-only services. Consequently, St. Albert is at the whim of TELUS and Shaw to deploy connectivity.

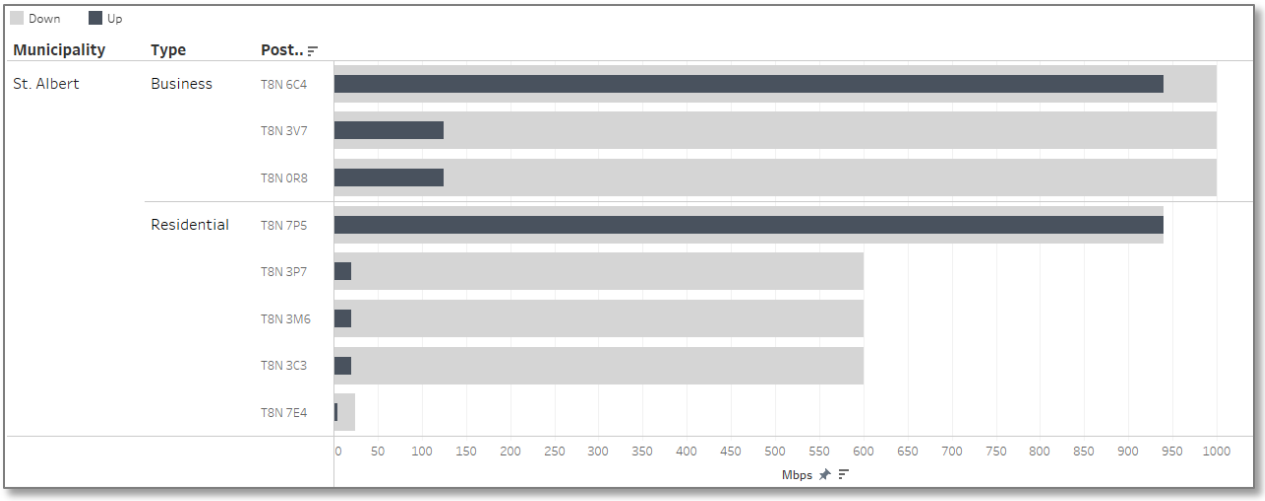

Figure 45. St. Albert - Maximum Advertised Speeds

Connectivity from SuperNet was indicated as a valuable asset to those directly connected but did not deliver to expectations the municipality had in leveraging it on a broader scale. In other words, SuperNet has been deployed to hospitals, fire stations, libraries, and schools, but does not have adequate last-mile connectivity. As such, the City has deployed its own fibre infrastructure that connects municipal facilities, utilities, and traffic signals, and plans on continuing to build out fibre infrastructure.

Broadband Strategy and Deployment

St. Albert administration has heavily advocated for broadband enhancement, with frequent council requests and specific attention given to broadband in their Smart City Master Plan which contained a number of proposed actions for enhancing broadband connectivity.

- A.1.1 - Accelerate the development of a municipal fibre-optic broadband network that will connect current and future facilities and other assets
- A.1.2 - Amend St. Albert's Community Design Principles and related policy to ensure that multi-chamber public conduit is installed in priority locations whenever municipal work provides the opportunity, and work with the development industry to install public conduit in growth areas
- A.2.1 - Inform, encourage, and facilitate if necessary, greater investment and faster speeds for residential Internet service delivery
- B.1.1 - Extend the City's municipal broadband network infrastructure into under-served local business areas
- B.1.2 - Position the City's broadband infrastructure as an open 'dark fibre' network that facilitates wholesale network access by Internet service providers, local public sector organizations, and other interested parties
- B.1.3 - Review the governance and administration of the City's broadband network infrastructure and solicit interest in innovative partnership or other service delivery options
- B.3.3 - Designate an area of St. Albert as a highly connected, technology enhanced 'innovation district' where complementary businesses and others may cluster and thrive

Through these proposed actions, the City has explored multiple deployment models, and ultimately ISP led deployment was selected for residential/business connectivity, and municipal-led deployment was selected

for municipal building connectivity. As such, the City has advocated to private industry and had conversations with the leadership of various ISPs, such as Shaw and TELUS, which may have been the catalyst that resulted in TELUS's commitment of $100 million to the City and caused Shaw to upgrade opto-electronics and increase speeds from 30 Mbps to 600 Mbps. In addition, the City has budgeted and secured $550,000 in 2020 to fund the expansion of its municipal owned network with similar amounts secured in each of the past few years. Furthermore, to future-proof the City, guidelines have been put in place to ensure that any new road upgrades and any new developments that include the build of an arterial road will consider fibre deployment.

Overall, the City has adequate connectivity, except in business parks where internet is limited. As such, St. Albert indicated that an opportunity exists to deploy wireless broadband through directional antennas in these underserved business parks. Regarding the rest of the City, there is a plan to deploy fibre at each traffic signal, where major arterial roads are being developed, and on the east side of the Henday (park-and-ride project). The City has considered leasing out spare capacity, but they do not have the resource capacity to be a responsive service provider.

Stony Plain

As one of the fastest growing communities in the Edmonton Metropolitan Region, the Town of Stony Plain has a population of approximately 18,000 residents over 36 km^2 of land. Over 800 businesses currently operate out of Stony Plain, with a number of business located between their North and South business parks which are zoned for commercial and light industrial use and suitable for all types of businesses. Stony Plain's industry is traditionally rooted in agriculture and economic development activity is currently focused on five sectors: business and professional services, energy and extraction, health care, food and food processing, and destination shopping, dining, arts, and culture.

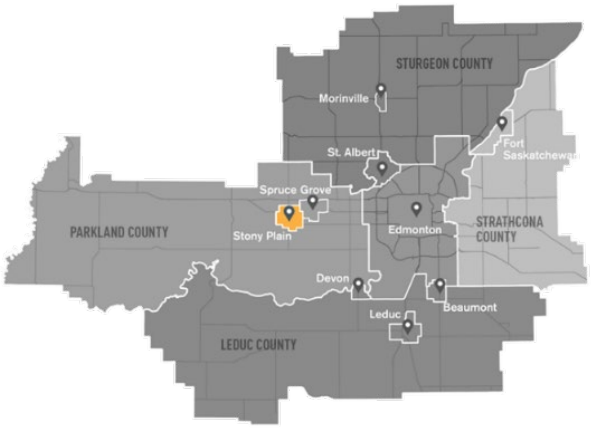

Figure 46. EMRB Member - Stony Plain

Table 23. Stony Plain Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Stony Plain	!	✗	✓	!

Current Service Levels and Assets

Shaw and TELUS are the current incumbents within Stony Plain, with Shaw offering speeds between 600/20 Mbps and 1000/125 Mbps and TELUS offering 15/1 Mbps to 940/940 Mbps. Despite a large majority of the Town having adequate connectivity and access to gigabit speeds, service levels are significantly lower in key areas such as the North Business Park (located north of highway 16A and east of highway 779) and south of the CN Rail Line that run through Stony Plain.

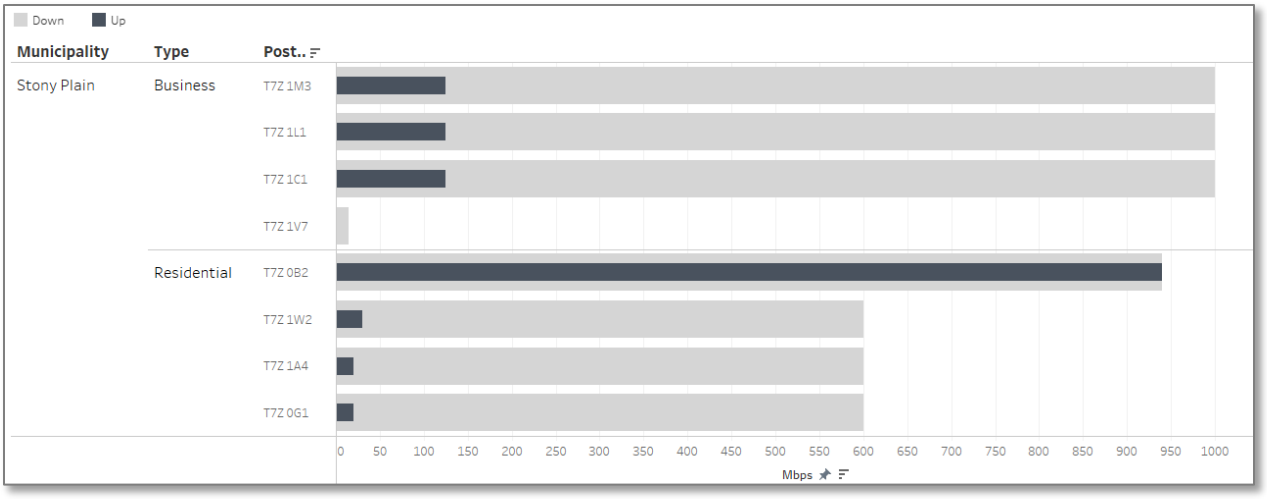

Figure 47. Stony Plain - Maximum Advertised Speeds

In addition, current providers service nine municipal facilities while Stony Plain has deployed and connected four municipal facilities with its own fibre-optic infrastructure. As such, the Town is currently satisfied with the service levels at its municipal buildings.

Broadband Strategy and Current State of Deployment

Stony Plain's Town Council has shown their commitment to enhancing broadband connectivity in the past, with $600,000 allocated towards the enhancement of the Town's municipal fibre-optic network, as detailed in their 2017 – 2019 Corporate Business Plan. However, this funding was re-allocated in 2019 towards the renewal of established critical aging infrastructure. As such, Stony Plain currently does not have a broadband strategy in place and noted that alignment across the Region is required to help set direction.

According to the Town, an opportunity exists to both heighten the awareness of current broadband conditions and leverage inter-municipal partnerships to define a regional broadband strategy. Furthermore, the Town is hesitant to enact any sweeping engineering or development guidelines, as they fear that posing these onto developers may cause their municipality to lose competitiveness. As such, they stated that region-wide guidelines would assist in ensuring that all municipalities across the Region remain competitive.

Barring a region-wide play, Stony Plain has been in conversation with major ISPs to understand their options for connecting businesses and residents. Incumbents have indicated that if Stony Plain invested in laying their own fibre infrastructure throughout the Town, they would not be willing to deliver services on it. Instead, Shaw has been investing to build out their own network further, and conversation is occurring with TELUS at the moment to do the same. However, TELUS has asked the Town to determine if 35% of residents and businesses are willing to connect through their services before deploying.

A number of options are available to the Town and there is recognition that broadband connectivity and enhancement is a necessity. However, the Town is unclear what the correct approach is and is continuing to determine the best path forward.

Spruce Grove

Spruce Grove is the ninth largest City in Alberta and continues to grow, with a population just over 35,000 and a land area of 32 km^2. As a home to over 250 companies located in industrial parks (over 1,300 total), Spruce Grove's economy focuses on the construction, transportation supply and logistics, manufacturing, fabrication and processing, and energy services industries. Many of these businesses are located south of the CN Rail Line, with opportunity for further business development in the area.

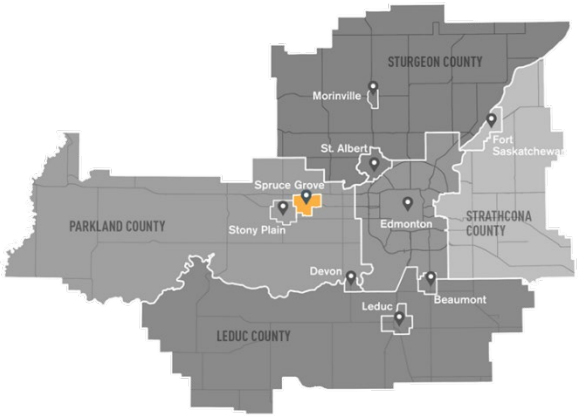

Figure 48. EMRB Member - Spruce Grove

Table 24. Spruce Grove Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Spruce Grove	✓	✓	!	!

Current Service Levels and Assets

The main ISPs in Spruce Grove are TELUS, Shaw, and Bell with SuperNet connecting schools. In general, the City has access to connection speeds between 600/20 Mbps and 1000/125 Mbps, offered by Shaw and 50/20 Mbps and 940/940, offered by TELUS. While residential connectivity may adequately support Spruce Grove residents (though mixed reviews), the current service levels and capacity in industrial and commercial areas were noted in interviews as being inadequate, specifically south of Highway 16A where local businesses have left as a result. Where higher business speeds exist, this is likely a results of fibre optic connections running to the business.

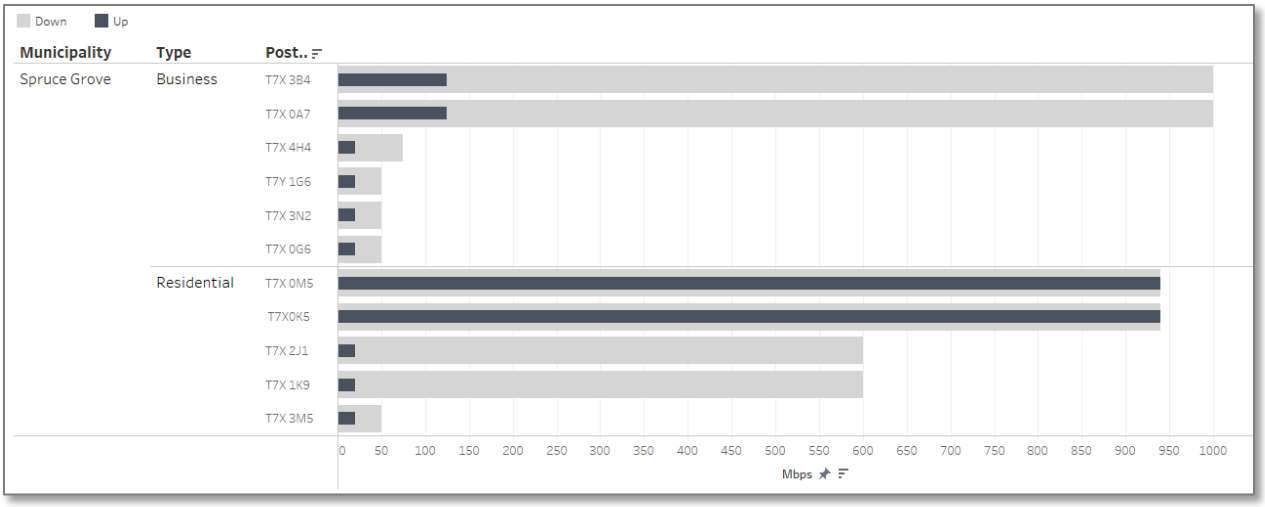

Figure 49. Spruce Grove - Maximum Advertised Speeds

Broadband Strategy and Current State of Deployment

Spruce Grove's City Council has made broadband a priority, as indicated and highlighted within the City's 2017-2022 Economic Development Strategy & Action Plan and further expanded upon in the City's Fibre-Optic Broadband Strategy. Within the Economic Development Strategy, the goal of "Building Our Community and Business Infrastructure" is defined, with a key objective being to "ensure that Spruce Grove's businesses have access to state-of-the-art broadband services at competitive rates." To achieve this, the Strategy set forth the following action items:

- Develop a next generation **broadband strategy** for Spruce Grove that provide options and recommendations on building out a fibre-optic network
- Prepare a recommended **implementation plan for a fibre-optic network** for consideration by City Council and incorporate into the Corporate Plan going forward
- Establish **engineering standards** that may require the installation of conduit in new subdivisions and road/utility rehabilitation projects
- Investigate the **cost and benefit of pursuing a "smart city"** standard in the utilization and availability of high capacity broadband

To date, the City has planned for the build out of a Fibre Ring in their Long-Term Capital Plan and further expanded upon each action item within their Fibre-Optic Broadband Strategy (completed in June of 2019 and approved by Council). The table below outlines the specific deployment recommendations from the Broadband Strategy and the current state of each recommendation:

Table 25. Spruce Grove Long-Term Capital Plan Broadband Deployment Recommendations

Deployment Recommendation	Current State
Advance negotiations with telecommunication carriers to confirm intentions for fibre optic investment and focus priorities on industrial and commercial areas that are underserved or where new lands are under development.	Conversations with telecommunication carriers are in preliminary stages. However, Spruce Grove noted that they do not have the ability to tell carriers "what to do and when to do it," especially

	when it comes to connecting non-residential service.
Update engineering standards to treat fibre-optic conduit systems as a municipal utility and include budgets in future roadway/utility construction projects to fund the deployment of these systems at the same time as other civil infrastructure work is undertaken.	The City has made significant progress towards this and guidelines exist to deploy fibre conduit during residential development. However, these guidelines have yet to extend to industrial/commercial development.
Reprioritize and advance the sequencing of the City's Municipal Fibre Ring Plan to construct the segments connecting the Public Works building to the Integrated RCMP facility and Campsite Transit Centre (using the Diamond Avenue alignment).	Funds have been allocated within the City's 2020-2022 Corporate Plan to complete the initial build out of the Fibre Ring ($692,801). The build-out is set to begin in 2021 and complete in 2028. However, note that funds have only been allocated for 2021 and 2022.
Consider Westwind Centre as an opportunity to extend fibre to these planned commercial lands as well as provide municipal infrastructure for commercial lands as well as potential municipal facilities.	In addition to the funds allocated for the Fibre Ring in the 2020-2022 Corporate Plan, $2,280,000 has been allocated to further expand the build-out of the Ring in accordance with Broadband Strategy recommendations. The build-out will begin in 2021 and is set to completed in 2024. However, note that funds have only been allocated for 2021 and 2022.
Develop a full engineering and business plan for the build-out of a fibre optic infrastructure network that integrates and takes advantage of the synergies between both municipal and business needs. The business plan should consider opportunities for some level of cost recovery.	Within the City's 2020-2020 Corporate Plan, $79,200 have been allocated towards the completion of a further detailed Business Plan for the Broadband Strategy recommendations (to be completed in 2020). It was noted that this Business Plan will help justify fibre installation throughout high priority industrial/commercial areas.
Utilize an implementation schedule to achieve the establishment of a fibre optic network within a 5-7-year timeframe including alternate connections into the Edmonton gateway.	This goal is inherently being achieved by the actions that are being taken above. In addition, it was noted in interviews that Spruce Grove needs desires to have a clear strategy on how to connect with other municipalities and build relationships. It was noted that inter-municipal collaboration could strengthen a regional business case for enhancing broadband services throughout the Region and an opportunity exists to enhance collective broadband advocacy.

Metropolitan & Rural Area Tier Municipalities

At the Metropolitan & Rural Area tier level, there are three overarching insights that were synthesized:

- These municipalities lack population density outside of their metropolitan centers and therefore ISPs lack interest in developing robust networks to connect those areas;
- As such, service levels are adequate in dense centers, however, rural areas struggle with connectivity; and
- These municipalities are most likely to build their own network infrastructure, and therefore require robust technical strategies.

The basis of these insights is provided in the detailed current state summaries below.

Leduc County

Leduc County, spanning over 2,600 km^2, is home to over 13,000 residents. The Edmonton International Ariport, located in Leduc County is an international hub. The area consists of a wide variety of businesses focusing on the agricultural, energy, manufacturing, and transportation industries, including Canada's largest developed energy services industrial park – the Niksu Industrial Park, where over 400 businesses employ more than 6000 people.

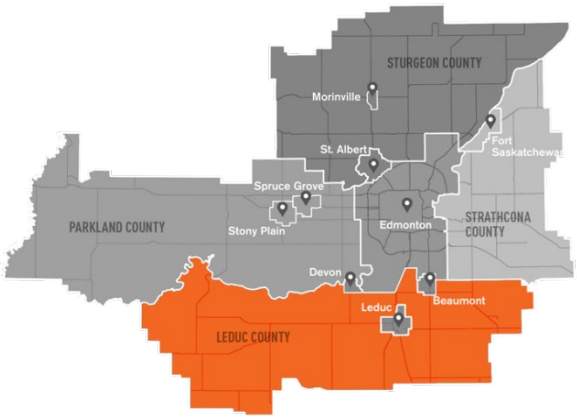

Figure 50. EMRB Member - Leduc County

Table 26. Leduc County Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Leduc County	✓	✗	!	✗

Current Service Levels and Assets

In Leduc County, Shaw, TELUS, and Bell all provide services; however, speeds rarely reach the 50 Mbps CRTC standard across the County. Overall, there is still a large need for better connectivity, speed, as well as fibre redundancy for the limited fibre that they have in their County Centre and firehall. With the increase in new, large businesses in the area such as Aurora Cannabis, as well as the existing players in Alberta's International Region, the demand for enhanced broadband connectivity is ever-growing. Nisku as a whole, which is home to over 400 businesses, was noted as being underserved which poses significant risks to the development of business in the area. From a municipal building perspective, the lack of broadband is limiting the County's ability to complete internal projects to improve operational efficiency and preventing them from adopting a fully cloud-based IT model.

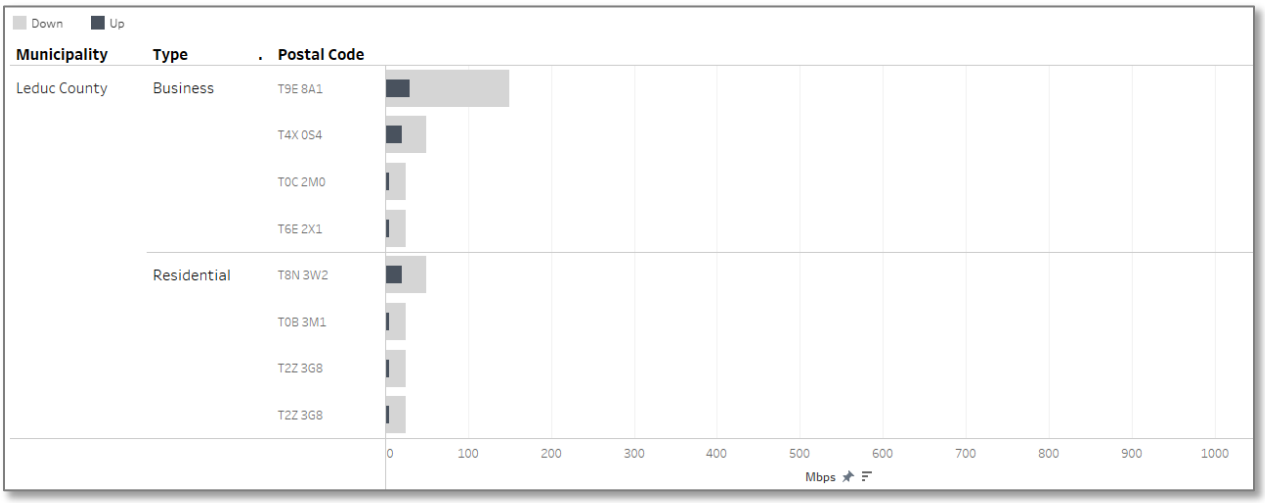

Figure 51. Leduc County - Maximum Advertised Speeds

Broadband Strategy and Current State of Deployment

In Leduc County, there is a clear emphasis on the need for broadband development. Their Council considers broadband a high priority when looking at it through an economic development lens, especially with regard to the agriculture industry. Leduc County envisions broadband being used to service a diversified agriculture industry which can act as the centre point for clusters of rural business developments. Their agriculture industry is following the 'smart' revolution which necessitates connectivity to facilitate everything from precision farming to advanced manufacturing to transportation logistics.

The Council's emphasis on broadband is detailed within Leduc County's 2018-2021 Strategic Plan, which highlights Economic Development as a strategic priority and the development of a broadband strategy as a key performance indicator. Furthermore, an RFP for the completion of a Regional Broadband Strategy was released in December of 2019 and development of the Strategy is currently underway. The Strategy will consider the needs of Leduc County, as well as the cities of Leduc and Beaumont, the towns of Calmar, Devon and Thorsby, and the village of Warburg. The Regional Broadband Strategy builds upon two studies completed in 2010 and 2011 that set broadband operational and network recommendations for the region as a whole and included a deep dive into the network requirements of the Nisku Business Park.

Parkland County

Parkland County, situated to the west of Edmonton, is home to over 32,000 people and spans nearly 2,400 km^2. Over 3000 businesses operate in Parkland County, with the majority of them situated in their six main industrial/business areas – the Acheson, Beacon Hill, Ellis, and Sherwin Industrial Parks, and the Parkland and Kalwin Business Parks. The largest and most prominent of the parks is the Acheson Industrial Area, which is the hub of their economic development and consists of over 200 businesses. These businesses are primary light industry and commercial.

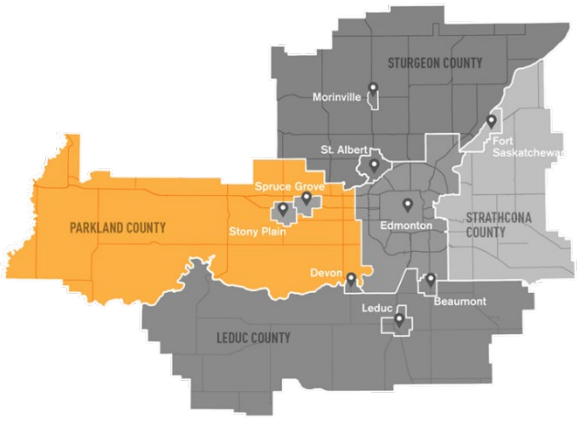

Figure 52. EMRB Member - Parkland County

Table 27. Parkland County Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Parkland County	✓	!	!	✗

Current Service Levels and Assets

Parkland County has invested nearly $9 million into advancing broadband programming and infrastructure in the County. Currently, Parkland County owns and operates 20 towers, some of which are co-located with multiple providers – namely Xplornet, TELUS, and Rogers – for which they spend an average of $1 million annually to support. Of these 20 towers, they estimate that seven or eight of them are at max capacity, with a few of them having some activity and one or two with no activity at all. Their biggest struggle with their towers occurs when providers on co-located towers oversubscribe them, which results in a lack of service between the peak hours of 5:00pm– 8:00pm when residents have come home and are accessing the Internet. This causes issues for the County, as citizens view it as the County's problem to solve. In addition, the County does not have significant fibre infrastructure connecting municipal buildings, however, a pilot project was recently completed that laid dark fibre in the Hamlet of Entwistle.

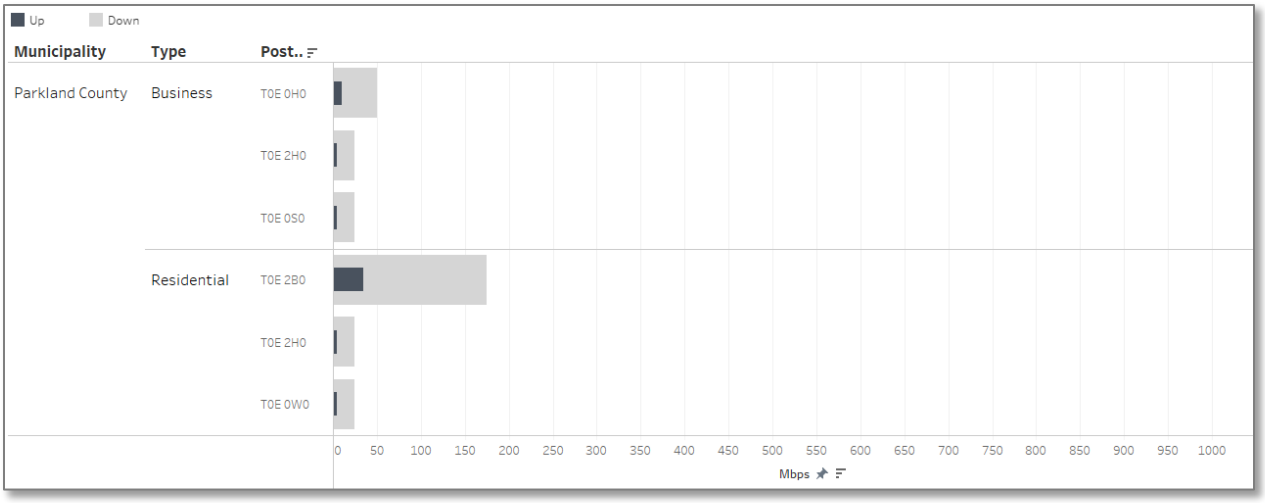

Figure 53. Parkland County - Maximum Advertised Speeds

Broadband Strategy and Current State of Deployment

Broadband connectivity has been a Council priority for some time, as indicated by their investment into building tower infrastructure. Recently, connectivity has been indicated as a priority within the following strategic documents and initiatives:

- Long-Term Strategic Plan (2015-2040):
  - Within the Strategic Plan's pillar of Complete Communities, a guiding principle is outlined which states that "we are a region of connected communities, through infrastructure, transit, recreation facilities, trails, and technology." Furthermore, this guiding principle outlines the following objectives related to broadband infrastructure:
    - Finalize a 25-year investment plan in infrastructure, facilities, services, and programs
    - Invest in, owning, and maintaining infrastructure that supports access to technology, improving quality of life and business viability
- Strategic Plan 2016-2020
  - Within the Plan's strategic priority areas of Economic Diversification, the following strategic goal is outlined:
    - Invest in and promote connectivity, supporting a knowledge workforce to enable the advancement of economic and community benefits
- Smart Parkland
  - A pillar of the Smart Parkland initiatives is Connectivity, which outlines the following:
    - Smart Parkland believes that broadband is the next essential utility, as vital to economic growth as clean water and good roads.
    - We continue to put in the infrastructure to help create an improved network for residents and businesses.

Furthermore, Parkland County released an RFP in November of 2019 to complete a Smart Parkland Feasibility Study, which is currently underway and set to complete in March of 2020. This study set out to conduct a feasibility study for technologies within Parkland County with a focus on towers and fibre optic networks, as well as infrastructure owned by the County. The project was initiated in part by Parkland's

strategic priority and in part by the result of the 2018 Entwistle Fibre Project, which was noted as losing its direction, resulting in unused dark fibre.

Ultimately, the priority of the County is to develop a sustainable business model for broadband development that considers its socioeconomic implications and provides reliable, reasonably priced, high speed Internet to 95% or more of its residents. In addition, the County indicated that the Region requires a multi-municipal plan to facilitate broadband development and recognized that they could play a key role in the development of a financially feasible business model for low-density areas.

Strathcona County

Strathcona County is the most populated county in Alberta, spanning 1,181 km^2, with more than half of their 98,000-person population residing in Sherwood Park. The County is a founding member of Alberta's Industrial Heartland, home to more than 40 petrochemical companies. As such, some of the largest industrial facilities in Western Canada are situated within the County in an area dubbed Refinery Row, where Imperil Oil and Suncor have their refineries.

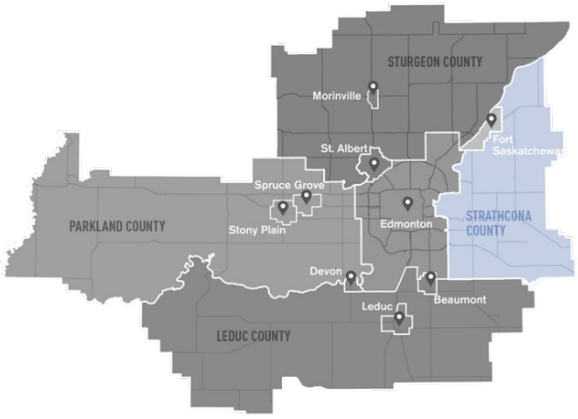

Figure 54. EMRB Member - Strathcona County

Table 28. Strathcona County Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Strathcona County	✓	!	✓	!

Current Service Levels and Assets

Based on a 2018 census, over half of the residents in the rural areas of the County were dissatisfied with internet services provided by the ISPs. The urban area of Sherwood Park is mostly serviced by Shaw and Telus. Most residents are receiving 600/20 Mbps from Shaw and 150/25 Mbps from Telus; however, business parks are considerably under-served.

The County's Rural Internet Access Program (RIAP), which ended in 2018, enhanced internet access in hard-to-reach areas by adding 27 new local internet towers, and upgraded many more towers to boost signal reach, which resulted in increased availability from about 40% to over 90%. Although RIAP improved internet access, the services provided are nowhere near the CRTC standards for speed.

As shown in in the CIRA performance benchmarks supported by mLAB, there are significant challenges with internet download and upload speeds, outside of major centres in Strathcona County.

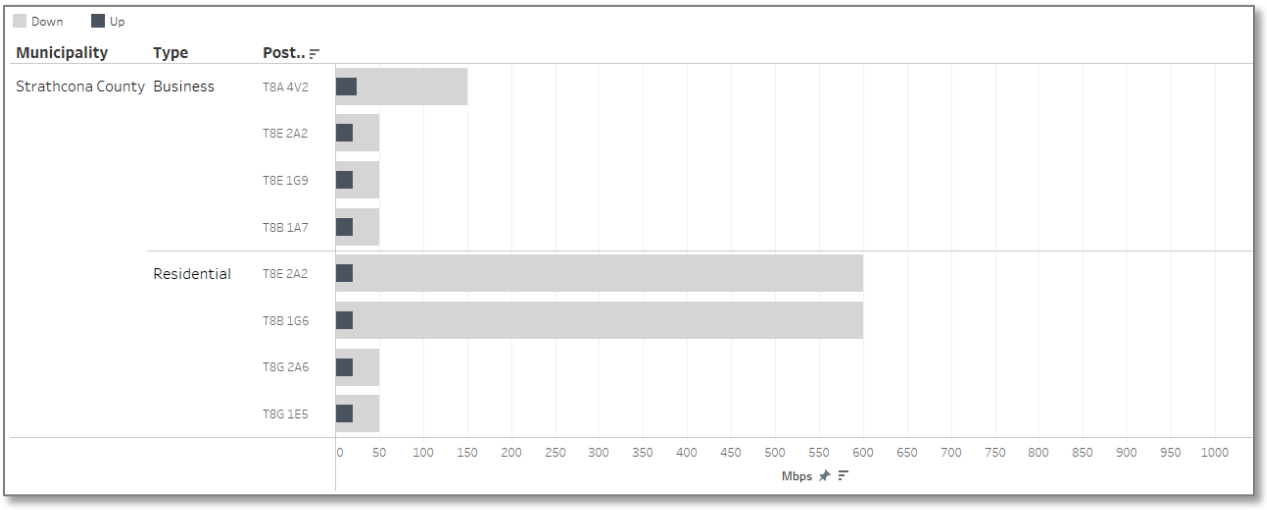

Figure 55. Strathcona County - Maximum Advertised Speeds

Broadband Strategy and Current State of Deployment

TaylorWarwick recently completed a broadband strategy for Strathcona County. This strategy explored options for the County to enhance connectivity through existing tower placement and explored other broadband deployment models. Notwithstanding the recent strategy, broadband has been a high Council priority in Strathcona County for some time. Between 2015 and 2018, the RIAP program incentivized ISPs to install smaller internet towers in areas where there were gaps in service, however, there is still a need to identify gaps in broadband capabilities. Therefore, the County is currently undertaking a future needs assessment to determine the appropriate strategy for developing broadband.

The County has identified that a regional broadband initiative could make use of existing infrastructure and identify what each member municipality needs to do in order to facilitate the development of mature broadband capabilities.

The County noted that EMRB could best assist by advocating on behalf its member municipalities and the government to catalyze broadband development. However, the County also expressed some reservations with government involvement without discussion with incumbents.

Sturgeon County

Sturgeon County is located immediately north of Edmonton with a land area of just over 2,000 km^2 and a population over 20,000. The County is a member of the Alberta Industrial Heartland and is home to over 700 businesses primarily in the hydrocarbon processing, advanced manufacturing, and agriculture industries. Included are hundreds of home businesses that are supported by Sturgeon County's Economic Development program, Start in Sturgeon.

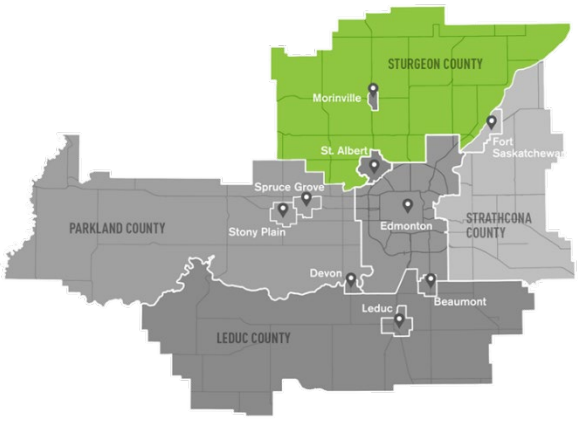

Figure 56. EMRB Member - Sturgeon County

Table 29. Sturgeon County Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Sturgeon County	✓	✗	!	✗

Current Service Levels and Assets

In Sturgeon County, the effects of limited broadband connectivity are being largely felt by businesses. The limited internet options within the County and the lack of high-speed connectivity is negatively impacting the competitiveness of businesses located within Sturgeon's industrial parks and agricultural areas. This is despite a number of carriers providing services within the County, such as TELUS, Shaw, TekSavvy, Distribute Tel, MSCNet, Albertacom, and Xplornet. Each provider is present in isolated pockets and other than the small area serviced by Telus, true high-speed broadband is not available. The County expressed that the ISPs exaggerated their capabilities and connectivity maps created by the CRTC do not show a true picture of service levels.

In terms of fibre optic infrastructure, the County has two municipal buildings located in Morinville that are connected by fibre, but that is the extent of their fibre connectivity.

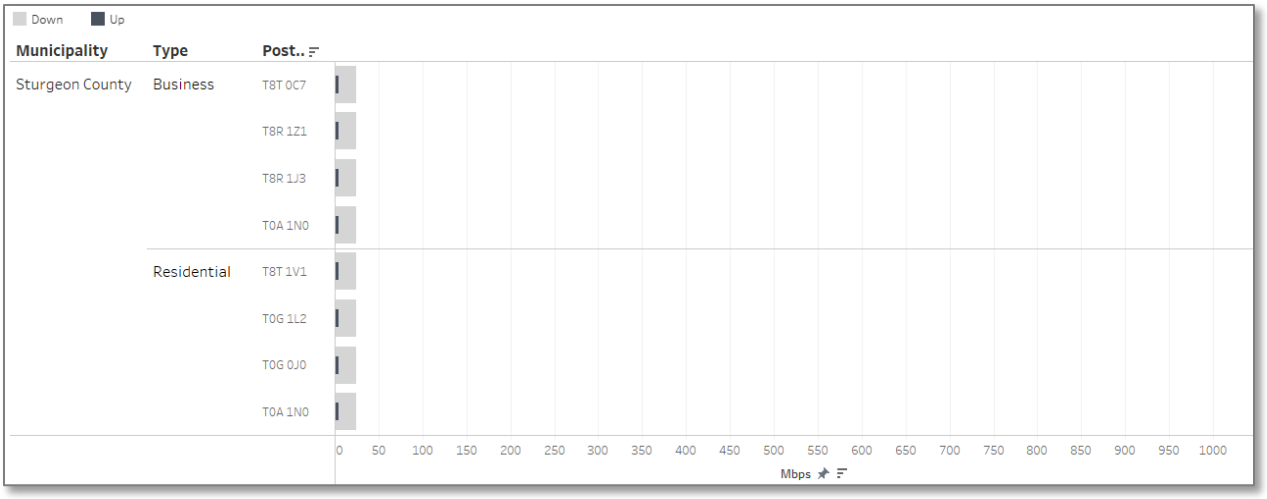

Figure 57. Sturgeon County - Maximum Advertised Speeds

Broadband Strategy and Current State of Deployment

Broadband connectivity has inconsistently been a Council priority. This is highlighted by their investment in a Sturgeon County and Morinville Broadband Analysis in 2018 that has yet to lead to major actions being taken to enhance broadband. However, the Analysis has been brought forward once again, and broadband is a strategic area of focus for the Council, as it was indicated by the County that it would be a topic of discussion at a Council strategic planning retreat in April 2020.

The renewed focus on the Broadband Analysis coincides with economic development activity that is focused on attracting energy, agricultural, and heavy industrial companies, with the latter noted as potentially having large opportunities in the short to medium term. As broadband is integral to any organization's operation, it is a key issue that needs to be resolved, in particular in Sturgeon County, where industrial parks are scattered and there is difficulty in connecting them through a single backhaul network. In addition, incumbents are not focused on these industrial areas, as indicated by TELUS' plan to spend $100 million on fibre connectivity in residential areas between St. Albert and the Sturgeon Valley.

In navigating the path forward, the County wishes to look to EMRB to help answer questions regarding what broadband service in the Region could look like for shared opportunities, coordinate intermunicipal sharing of learnings, and understand what would be required from the businesses and residents to facilitate the services.

In addition, the County's renewed focus on broadband has resulted in the development of an internal broadband working group that consists of representatives from the County's IT, Planning & Development, Intergovernmental Affairs, and Economic Development departments. This has also renewed their focus on actioning the findings of the Sturgeon County and Morinville Broadband Analysis, which is set to be refreshed during the summer of 2020.

Rural Area Tier Municipalities

At a Rural Area tier level, there are two overarching insights that were synthesized:

- These municipalities lack population density and therefore ISPs lack interest in developing robust networks; and
- As these municipalities have a relatively small tax-base, municipal revenue is not adequate for municipal-led network development.

The basis of these insights is provided in the detailed current state summaries below.

Devon

The Town of Devon was constructed by Imperial Oil as a residence for their workers shortly after one of the largest oil discoveries in the world in 1947 at Leduc No. 1 oil well. Since then, Devon has grown to over 6,500 residents in a 14 km^2 area. As a member of the Leduc-Nisku Economic Development Association, oil and manufacturing play a key role in its economy. In addition, the economy has diversified to include tourism to their Botanical Garden.

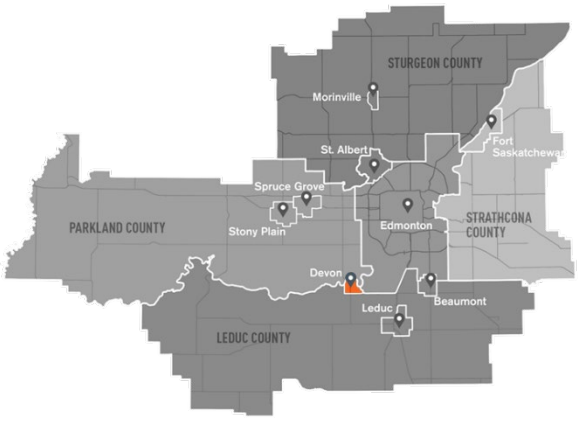

Figure 58. EMRB Member - Devon

Table 30. Devon Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Devon	✗	✗	✗	!

Current Service Levels and Assets

In Devon, Shaw is currently the major ISP with more services and conduit than TELUS, who is currently limited to residential areas. Analysis of broadband service levels indicated Shaw is providing speeds between 600/20 Mbps and 1000/125 Mbps, while TELUS is providing up to 150/25 Mbps. Furthermore, Shaw has indicated plans to invest in the installation of FibrePlus to connect buildings within the Town and increase their speeds up to 1 Gbps. In addition, the Town of Devon has indicated that the all municipal buildings will be connected via Shaw's network, using the TELUS network as a fall back. Despite the network that both Shaw and TELUS have built, service is not ubiquitous, with reported speeds of 50/20 Mbps existing throughout the Town.

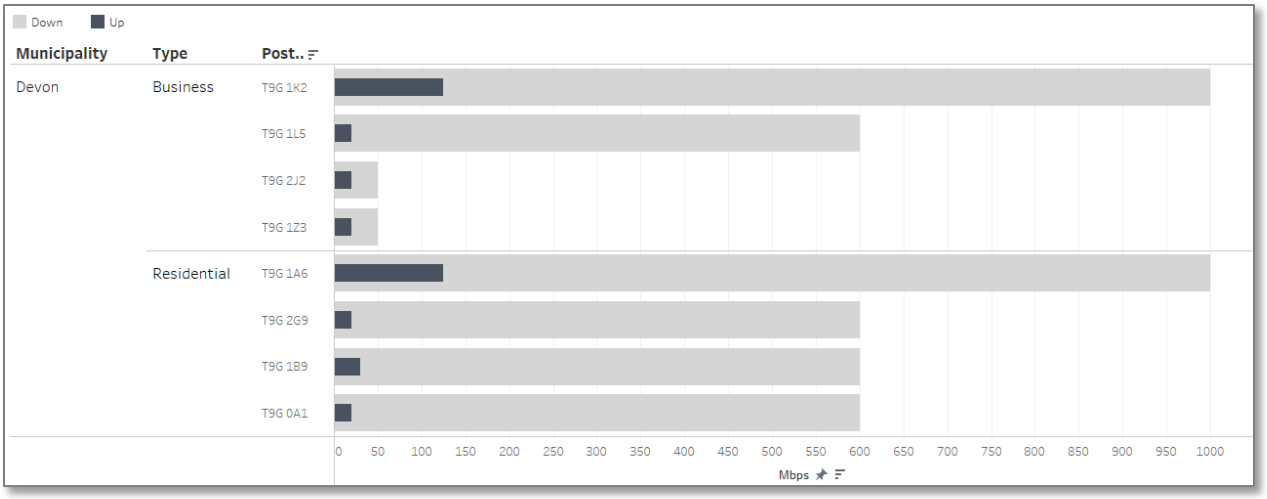

Figure 59. Devon - Maximum Advertised Speeds

Broadband Strategy and Current State of Deployment

Although Devon does not have a broadband strategy, there is recognition from Devon's Council that broadband is important, but a lack of budget for core infrastructure development has hindered any immediate deployment. As the Town continues to grow and expand, the expectation and need for better connectivity is also growing, specifically in the downtown core and in new developments. The Town realizes that a broadband strategy can be used to improve connectivity and/or to implement policies, procedures, and guidelines to have developers install conduits in greenfield developments. However, Council lacks the visibility into the requirements of the Town, and an analysis is required before determining whether a municipal-led or ISP-led deployment model is the path forward. Devon has considered a broadband utility model in the past, however, at the time it was seen as cost prohibitive and the return on investment depended too heavily on population growth.

In addition, and as indicated in the interview, the economy is currently suffering and making it difficult to attract investments in Devon, and as such, the Town does not want to place stringent development guidelines that includes broadband deployment in new development as there is concerns that it would make Devon less attractive for investment.

Morinville

Morinville is a town, with a land area of 11 km^2, located approximately 34 kilometers north of Edmonton and boasts a population of just over 9,800 residents. The business community, which spans outside of the Town and into Sturgeon County, is home to over 300 businesses in the manufacturing, light industrial, commercial and retail sectors. Many of Morinville's residents are employed by the nearby industrial parks throughout the County.

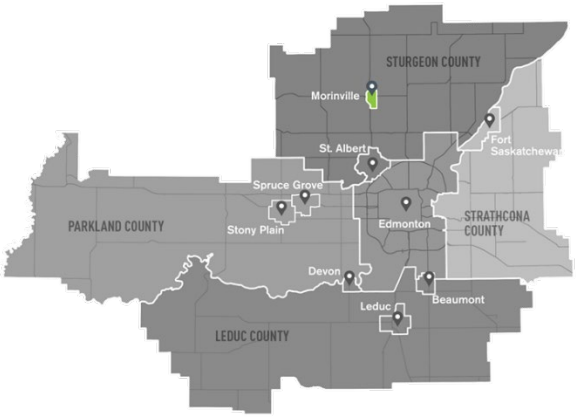

Figure 60. EMRB Member - Morinville

Table 31. Morinville Broadband Current State Summary

Municipality	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Levels
Morinville	✓	!	!	✗

Current Service Levels and Assets

In Morinville, ISPs are knocking at the door. The current main ISPs are Shaw and TELUS; however, TELUS's broadband services are generally very limited in availability unless businesses have made unique arrangements for DSL or fibre optic cabling. TELUS speeds range from 15/1 – 150/25 Mbps while Shaw is able to provide speeds up to 600/20 Mbps in most areas of the Town, with some business areas getting 1000/125 Mbps. Businesses, however, are suffering from the insufficient quality of legacy services and the high cost to upgrade to fibre optic technology, which have been quoted to be as much as $100,000 for a single business. Furthermore, businesses adjacent to those installing fibre are being quoted the same large construction costs which negates the ability for multiple adjacent businesses to benefit from economies of scale and bring their total costs down.

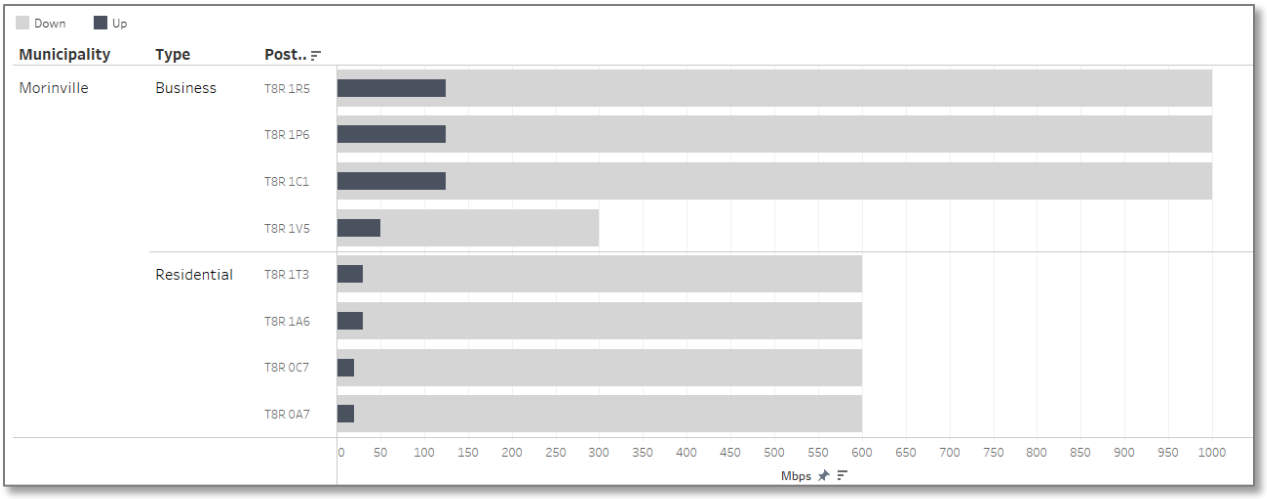

Figure 61. Morinville - Maximum Advertised Speeds

Broadband Strategy and Current State of Deployment

In 2018, Morinville and Sturgeon County commissioned a joint Broadband Analysis to assess the current state of the County's broadband. The result of this study were recommendations to improve broadband connectivity across the County and in Morinville using a collaborative approach. However, since then, there has not been much collaboration between the two municipalities, creating a disconnect between the Town and the County when looking at broadband development. The recommendations from the Analysis were as follows:

1. Monitor Federal Government (CRTC) grant programs
2. Contact the Canada Infrastructure Bank to understand project criteria and appropriate structure to be eligible
3. Engage the Alberta Government (SuperNet Secretariat) to understand the status of the SuperNet contract renewal
4. Review business park and wireless tower locations for pilot program opportunity
5. Additional public engagement
6. Complete a preliminary design and feasibility study to construct fibre-optic cable in pilot areas (Pro North Industrial Park and Villeneuve Airport Industrial Park)
7. Develop an RFP to solicit potential private sector partners to participate in the pilot projects
8. Select partners and confirm funding contributions

As such, Morinville's Council has identified a need for improved broadband connectivity to attract major businesses, such as cannabis facilities, to their industrial parks. The County's Analysis identified right of way opportunities for expansion of the Town's network through public roadway allowances, electric utility poles, and a limited number of pipelines and water utilities. However, constraints on infrastructure investments due to Provincial budget cuts and timelines to gain approval to use these rights of ways, such as the AB highway through the centre of Morinville, have prevented any major developments from occurring. Despite this, Morinville sees the need to develop policies and guidelines around developing fibre conduit in new developments and sees EMRB playing a role in encouraging these policies.

Non-EMRB Member Current State

In addition to the review of EMRB member municipalities, this study included interviews with six Non-EMRB member municipalities who fall within the broader Edmonton Metropolitan Region[53]. Analysis of these municipalities was limited to interview findings with seven stakeholders, as further detailed analysis was considered outside the scope of the Broadband Situation Analysis. A summary of those interviewed can be found below.

Calmar

The Town of Calmar has a population of over 2,000 and a land area of nearly 4.7 square kilometres. The Town is home to approximately 100 businesses that serve the community. The top industries in the Town are manufacturing, oil and gas, and retail trade.

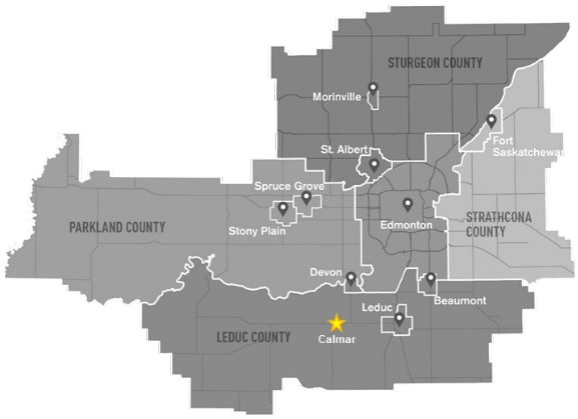

Figure 62. Non-EMRB Member - Calmar

Current Service Levels and Assets

The Town of Calmar does not have any wired connections, and this is creating issues within the Town. For the municipality, there is a risk of their operations being affected by the speed of their broadband which is provided by TELUS via satellites. In terms of industry, the current businesses in the Town are leaving industrial parks due to the lack of broadband and new businesses that are considering moving to Calmar are deterred by the lack of adequate broadband. There is a SuperNet backbone that runs down the highway next to the town with a POP in Town. Additionally, the lack of broadband infrastructure Is diminishing the Town's ability to attract and retain residents.

Broadband Strategy and Current State of Deployment

Although the Town does not have a broadband strategy, they are looking to create a broadband case in 2020 that lists viable options for development. In 2019, the Town was quoted a price of $4.5 million by TELUS to deploy fibre to upwards of 2,000 premises, Calmar would be interested in fronting the costs, but don't have the access to the necessary resources. It was noted that because conversations with ISPs happen in municipal silos, the progress of any broadband development has been slow, however, the Town is currently working with Big Wi-Fi to connect to the SuperNet and deploy within the town; this project is quoted at $100,000 and would provide them will speeds of up to 100 Mbps. Due to CRTC definition of accessibility, although the opportunity to access service exists through ISPs, it is not financially viable.

Broadband development is critical to the Town as more companies are inquiring about investing in Calmar due to their low cost per acre. In new development areas, the Town is exploring options to amend the development guidelines to include broadband infrastructure; however, there is reluctance given the price tag tied to offering this service in smaller communities.

[53] A full listing of stakeholders can be found in *Appendix C: List of Stakeholders Interviews*

Bon Accord

Bon Accord is a town located 40 km north of Edmonton with a population of just over 1,500 and a land area of just over 2 square kilometres. The Town is home to over 50 businesses operating in the agriculture, tourism, retail trade, and construction industries.

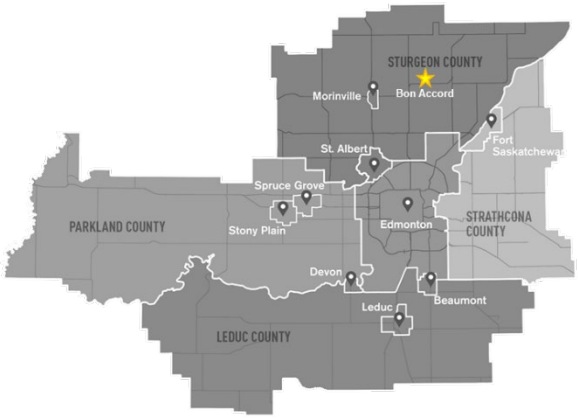

Figure 63. Non-EMRB Member - Bon Accord

Current Service Levels and Assets

Current services are provided mainly by Shaw and Telus, with residents noting that services are not adequate and there is downtime during peak hours. The Town does not know if businesses have left due to the current broadband capabilities. The only fibre infrastructure that Bon Accord has is SuperNet into their library but does not go into their municipal office.

Broadband Strategy and Current State of Deployment

Bon Accord's Council does not see broadband development as a priority, and they do not have a broadband strategy. Yet, there is a recognition that their broadband capabilities should be enhanced. As the average age of the residents in the town becomes younger and more businesses rely on technology, the lack of modernized broadband infrastructure could be a detriment to their economic growth.

Gibbons

Gibbons is a town of over 3,000 people spanning 7.5 km^2 and is located a short 5.6 km from the Alberta Heartland Industrial area, of which they are an associate member. The Town has many retail and professional service businesses and is focused on offering exceptional health care, education, and community and cultural services to its residents.

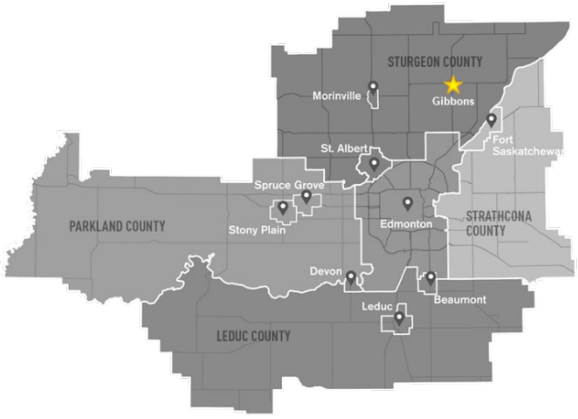

Figure 64. Non-EMRB Member - Gibbons

Current Service Levels and Assets

The current broadband capabilities in Gibbons are being provided primarily by Xplornet, TekSavvy, TELUS, and Shaw. It was noted that Shaw and TELUS are continuing to install fibre throughout the Town and that a 5G tower exists with the Town's boundaries. In addition, SuperNet is currently being utilized to provide connectivity to their municipal building including the library.

Broadband Strategy and Current State of Deployment

Although Gibbons does not currently have a broadband strategy, they are in the process of developing one that will be built off of the City of St. Albert's and the Town of Olds' strategies. In particular, Gibbons is interested in becoming their own ISP through developing and owning their own triple play service – providing broadband Internet access, television, and telephone service. They are currently researching and planning to develop this service and have been in conversation with the Town of Olds to understand how

they developed their community owned and operated Fibre-to-the-Premises (FTTP) network, called the O-Net. However, Gibbon's approach differs in that they plan to develop a fibre-connected standalone tower.

It was noted that being able to control their own broadband connectivity is important to the Town as it prevents ISPs from throttling bandwidth and enhances the Town's ability to support the growth of innovative companies in the area, such as tele-health innovation and 3D printing companies. In addition, their commitment is exemplified by the Town's development guidelines which requires fibre conduit to be run in all new subdivisions.

Legal

Legal is a French bilingual town of just over 1,300 people with a land area of just over 3 km^2. The Town is a small community surrounded by agricultural land that provides residents with the amenities they need and provides opportunities for retail businesses.

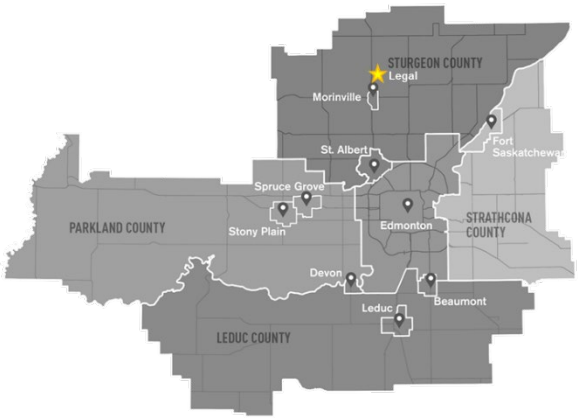

Figure 65. Non-EMRB Member - Legal

Current Service Levels and Assets

There are multiple broadband providers in Legal including MCSNet, Clearwave, Xplornet, and the SuperNet. Approximately five years ago, a mix of copper and fibre was installed from Morinville to Legal which enabled them to connect their municipal building and schools. However, issues with connectivity exist for businesses within the Town who complain that the internet lacks speed.

Broadband Strategy and Current State of Deployment

Legal does not have a broadband strategy and it is not a Council priority and there are no plans to expand the current broadband infrastructure in the Town. Although the newest subdivision within Legal has fibre, there have been no mandates to install conduits in new developments.

Redwater

Nearly 2,100 people live in the Town of Redwater, which spans 20 km^2. As a town that was developed around the discovery of oil, the oil and gas industry is predominant in the Town, with construction, manufacturing, industrial waste recycling, and retail services as other major industries. Redwater's industrial park is uniquely positioned five minutes away from Alberta's Industrial Heartland and has direct access to Fort McMurray through a heavy load corridor.

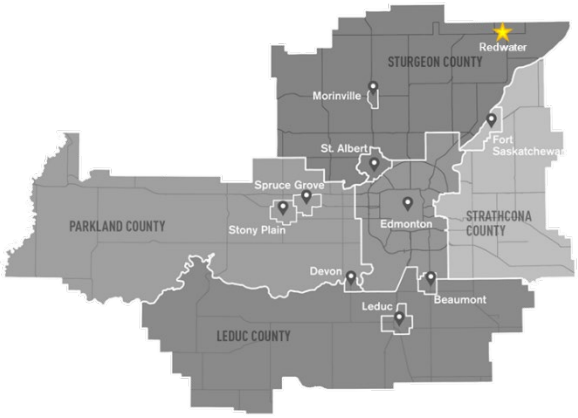

Figure 66. Non-EMRB Member - Redwater

Current Service Levels and Assets

Current services are provided mainly by Shaw and TELUS, with residents noting that services are not adequate and that they experience downtime during peak hours. However, despite the issues heard from residents, the business community has not notified the Town of any connectivity issues. Recently, Shaw has

upgraded its infrastructure and conversation had been occurring with Axia to enhance connectivity. However, conversations have not continued since the Bell takeover of Axia.

Broadband Strategy and Current State of Deployment

Redwater does not have a broadband strategy and their Council does not see broadband development as a priority. Despite this, they have expressed that creating broadband as a utility within the Town would be an attractive option if it was cost effective. Furthermore, it was expressed that creating engineering and development guidelines for deploying broadband infrastructure alongside planned construction of right of ways could potentially be an attractive business case. Moving forward, it was noted that the Town would look to the EMRB to assist with access to funds for completing feasibility studies that analyzed the Town's options for broadband development.

Warburg

The Village of Warburg is located 58 km west of the City of Leduc and boasts a population of over 750 people over a 2.7 square kilometre area. The Village is a member of the Leduc-Nisku Economic Development Association, as well as the 39/20 Alliance, a partnership between the Town of Calmar, and the Villages of Warburg, Thorsby and Breton. This alliance promotes municipal cooperation and economic development opportunities within the region to provide support to existing businesses and improve the quality of life of the region's residents.

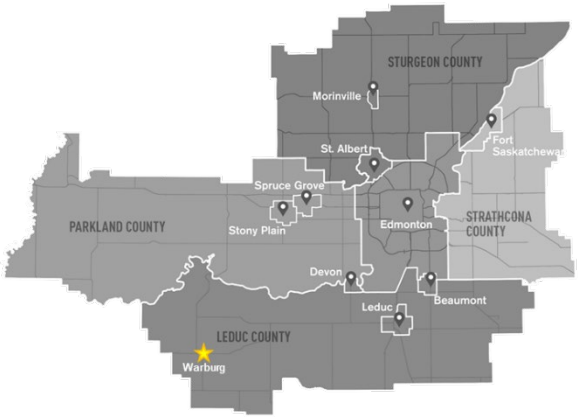

Figure 67. Non-EMRB Member - Warburg

Current Service Levels and Assets

In Warburg, the town was wired in by CCI Wireless with fibre connections to a TELUS point-of-presence (POP). Despite there not being many reported issues with broadband, the CRTC standard of 50/10 Mbps is not being achieved and businesses are leaving the Village. The only building in the Village connected to the SuperNet is the library, as connecting all other buildings was too cost prohibitive. Instead, Xplornet is used to connect all municipal buildings under a rental agreement that brings their cost near to $0; this agreement allows Xplornet infrastructure to exist on their municipal buildings. However, operations within the municipal buildings can still be difficult due to the quality of the broadband provided.

Broadband Strategy and Current State of Deployment

There is currently no Council broadband strategy for the Village, although there is an internal push to deploy fibre, especially in new developments. The lack of broadband development can be attributed to the struggle to obtain the necessary capital to deploy fibre. In order to facilitate new broadband developments, the Village is interested in partnering with Leduc County to develop a regional broadband solution, with a focus on deploying fibre to existing towers.

Ecosystem Current State

Ecosystem stakeholders play a significant role in ensuring the Region is connected. As such, workshops were held with thirteen stakeholders from seven ecosystem stakeholder organizations to understand the role that they play and will play into the future[54]:

Table 32. Broadband Ecosystem Stakeholders

This section provides an understanding of who these key stakeholders are and their role in the ecosystem.

Strategy and Funding

Innovation, Science, and Economic Development Canada (ISED)

ISED is a department of the Federal Government of Canada that works "to improve conditions for investment, enhance Canada's innovation performance, increase Canada's share of global trade and build a fair, efficient and competitive marketplace."[55] In recognition that broadband connectivity plays a vital role in achieving their goals, ISED developed the strategy document *High-Speed Access for All: Canada's Connectivity Strategy*. The strategy has an outlook to 2030 and has three overarching pillars, which are summarized below:

1. **High-Speed Access for All** – Further refines targets of 50 Mbps download / 10 Mbps upload and expanded mobile wireless; to reach 90% of all households by 2021, 95% by 2026, and 100% by 2030. Other important considerations include affordability, reliability, and scalability (ability to upgrade for faster speeds).
2. **Investing for Impact** – Specifies funds that are targeted where the private sector is not investing and that need to leverage other tools such as access to spectrum and existing infrastructure.

[54] A full listing of stakeholders can be found in *Appendix F: List of Stakeholders Interviewed*

[55] Government of Canada Website - ISED Homepage

3. **Partnering for Progress** – Ensures that new funding will be rolled out in coordination with existing programs, will consider the needs of all stakeholders, and that tools are made available that simplifies application development (such as enhanced data sets that can be used for planning and a new online portal (canada.ca/get-connected)).

High-Speed Access for All sets out clear goals as defined above, while **Investing for Impact** outlines the funds that will be made available and **Partnering for Progress** ensures that the voice of stakeholders is heard when developing criteria for application eligibility.

Within the pillar of **Investing for Impact,** $1.7 billion is committed in funding for new broadband infrastructure. This includes:

- $1 billion for ISED's Universal Broadband Fund (UBF)
- $600 million to secure capacity for Low Earth Orbit (LEO) satellites for the most remote areas
- $85 million top-up to the $500 million already committed to the Connect to Innovate (CTI) program to develop backbone networks where they do not exist

For the Edmonton Metropolitan Region, there is an opportunity to access ISED's $1 billion UBF, which has two phases of its release. In the first phase, which began in 2019 and will continue until the fund opens for application in 2020, ISED has been engaging with Canadian communities to gather feedback on eligibility requirements to ensure that funds will be distributed where they are needed. An action that has come from consultation is the development of the National Broadband Internet Service Availability Map, which will be used as a key criterion for determining eligibility. The Map was made in partnership with the CRTC in recognition that previous maps used for eligibility were not granular enough, as they divided the Country into 25 km^2 hexagons and if a single point within the hexagon had access to 50/10 Mbps speeds, then the entire hexagon was considered well served. The new National Broadband Internet Service Availability Map is considerably more granular and shows the connectivity along 250m road segments across Canada. Any areas that do not receive 50/10 Mbps (as advertised by ISPs) are eligible for the funds. An example of the two maps are provided below and detailed maps created by EMRB utilized CRTC and ISED data are provided in *Appendix I EMRB Broadband Maps*:

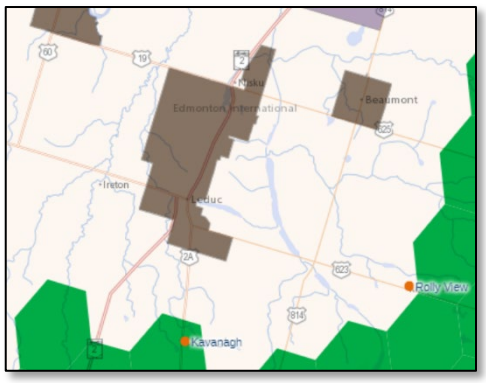

Figure 68. CRTC Fixed Broadband and Transport Map (25km^2 hexagons)

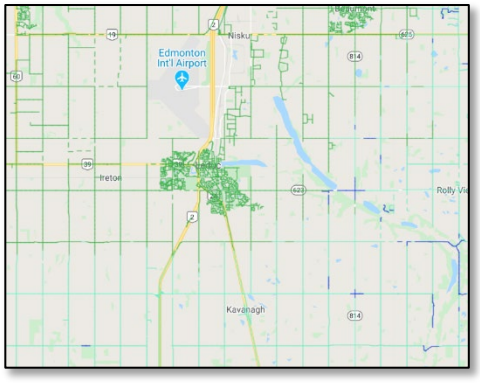

Figure 69. ISED National Broadband Internet Service Availability Map (250m roadway segments)

Phase 2 of the program, which marks the opening of the UBF for applications, is set to begin after the closure of the CRTC's $750 million Broadband Fund. The Broadband Fund was originally set to close on March 27, 2020 but has since been extended to April 30th, 2020. ISED has stated that they do not want to duplicate the work of applicants who have been applying for the CRTC Broadband Fund, and as such, application requirements will remain largely the same, and applicants will be eligible for funding from

both funds. In addition to coordinating efforts between the UBF and CRTC's Broadband Fund, ISED has been working with Infrastructure Canada (INFC)'s $2 billion Rural & Northern Communities Infrastructure Stream and Canada Infrastructure Bank (CIB), which is seeking to invest $1 billion over the next 10 years in infrastructure projects, including broadband infrastructure.

Federation to Enhance Rural Internet Committee (FERIC)

FERIC is a committee formed in the past year that aims to utilize existing gas and electrical infrastructure to enhance broadband connectivity in underserved areas of rural Alberta. The committee consists of the Federation of Alberta Gas Co-ops, the Alberta Federation of Rural Electrification Associations, CCI Wireless, O-NET, Foothills Natural Gas Co-op, West Parkland Gas Co-op, Service Alberta, AUMA, and RMA.

FERIC was initiated as there was a recognition that more can be done to service rural areas of Alberta, and that the various committee members had unique expertise in broadband deployment and infrastructure development. In addition, Committee recognized that there are nearly 9000km of abandoned pipeline that could be used to deploy fibre-optic cables. Although there is recognition that these organizations can come together to enhance rural connectivity, the Committee is still in its early stages of establishment and they are currently building a framework for collaboration and their future vision.

To test their initial model, FERIC is developing a funding application to access the CRTC's Universal Broadband Fund (due on March 27th, 2020) and are putting forward two pilot projects; one pilot project is located at the far south of the Province by Warner and the other proposed pilot project is on the western side of Parkland County. At the time of the workshop with FERIC, they were in the early stages of building out their application and further information could not be gathered.

Service Alberta

Service Alberta is a Government of Alberta ministry that is responsible for protecting and maintaining the government's IT infrastructure and leading the development of a provincial broadband strategy.

SuperNet

SuperNet has been a primary focus of Service Alberta since the early 2000's, building out one of the first broadband superhighways in Canada to connect public institutions (collectively termed GLHLM ([GoA, Learning, Health, Library, and Municipality]). The SuperNet links 4,200 GLHLM facilities in 429 communities and brings affordable high-speed network access options to nearly the entire Province. While it mostly consists of fibre-optic backbone facilities, wireless links are used to complete the network in the most rural areas. The vision of SuperNet remains to connect public buildings, and was originally created in a time where incumbent ISPs were not as large as they were now and building the provincial-led fibre-optic backbone was meant to build the scaffolding on which ISPs could build out their services (Service Alberta had never intended to become a service provider themselves).

Since construction began in 2001, the ownership of SuperNet has changed hands several times. Service Alberta originally built and owned SuperNet from 2001 to 2005, ownership was then transferred to Axia from 2005 to 2018, and ownership now resides with Bell Canada who purchased Axia in 2018. The transfer of the SuperNet contract from Axia to Bell Canada also included Service Alberta and was completed in 2019. Bell Canada now owns the entirety of the SuperNet, including points of presence (PoPs), which Service Alberta had owned under the previous contract with Axia.

As Service Alberta is responsible for IT infrastructure, they ensured appropriate contractual terms were built into the SuperNet operational contract that includes them in service model discussions over the next 20 years. This allows Service Alberta to ensure appropriate service model levers are built in that they consider the needs of rural and other communities where the business case for broadband deployment is less

financially attractive to ISPs. In addition, new contractual terms ensure that Bell offers wholesale rates to other ISPs that wish to leverage the assets already in place and ensures that this is equitable for both urban and rural communities and that pricing remains the same for both.

Since Bell assumed operational control of SuperNet, projects have been kicked off to upgrade infrastructure to "true carrier standards" and ensure security and speeds are in-line with new technology standards. In their first year of ownership, Bell completed full network and security studies to understand the gaps in service levels. They are now embarking on a two-year project to upgrade opto- and wireless electronics to meet appropriate service levels.

In addition, Bell is going to ensure that municipalities have a larger voice at the table. As such, Service Alberta discussed the possibility of a municipal symposium that is to happen in 2020 to ensure municipalities have a voice at the table with Bell.

Provincial Broadband Strategy

The Provincial Broadband Strategy has been a focus in recent years, however, funding for the Strategy has been limited due to the changing political and economic landscape in Alberta. Despite this, the Provincial Broadband Strategy has recently been brought back into focus and is under development. Currently, the Ministry is developing an action plan that is geared at reducing red tape for broadband deployment in transportation and crown right of ways, and they are compiling a Provincial view of the current state of connectivity.

The current state view being created by the Ministry includes a compilation of the various deployment strategies throughout the Province to identify synergies, as well as the development of GIS layers that depict all broadband infrastructure in the Province (both public and privately owned). However, Service Alberta has ran into issues and noted that ISPs are reluctant to provide location information of their broadband infrastructure. Despite the setbacks, they believe that a full GIS overlay of Alberta's broadband infrastructure will be gathered by the end of 2020.

In addition to the action plan, Service Alberta continues to assist applicants of the CRTC's Broadband Fund with letters of support.

Western Economic Diversification Canada (WD)

WD is federal institution who works to diversify the western economy while simultaneously improving the quality of life of western Canadians through innovation and community development. As such, WD developed a Western Canada Growth Strategy to position the west for success over the next ten years. By embracing enhanced digital access, the Grow West report outlined three goals centered around connectivity:

- **Improve Broadband**: Industry and governments need to work together to improve the availability of affordable, high-speed internet. Stronger connectivity will help all communities participate in the digital economy
- **Build Smart Communities**: Municipalities need effective and secure data collection to reduce waste and traffic congestion, while also improving public services and safety.
- **Deliver effective virtual services**: Governments should continue rolling out a full suite of digital services. Virtual access to business, education, and health care services reduces barriers faced by those in rural and remote communities.

Note, at the time of this study, WD has partnered with ISED to implement these goals relating to broadband strategy and are in the early stages of implementation.

In 2019, WD used the Grow West report as a mechanism to stimulate conversation around the ideas, concerns, and solutions to strengthening the Western Canadian economy. Consequently, WD received feedback from over 450 respondents regarding the future state of the Western Canadian economy. The question "What are the best ways to spur new growth in Western Canada?" revealed that digital infrastructure is a particular area of concern for participants, who pointed to broadband infrastructure gaps that disadvantage rural, remote, and Indigenous communities. The 2019 consultation generated the following insights:

- There is a lack of accessible high-quality broadband services which has created barriers to communities outside major urban centers including Indigenous communities;
- The Region has experienced limited economic growth with dampened business retention and attraction; and
- Poor/absent connectivity has created learning gaps with limited access to distance and online training.

With a focus on economic stimulation and diversity, WD also provides no interest loans to scale-up companies (over 3 to 5-year horizon). For example, an ISP platform software from Northern Alberta was given a no-interest loan to hire over 50 people across Canada and now provides software for IBM.

Advocacy

Alberta Urban Municipalities Association (AUMA)

AUMA works with elected and administrative leaders of Alberta's urban municipalities to help them build thriving communities. AUMA advocates for solutions to municipal issues and focuses on ensuring that their members have adequate support for funding applications to the appropriate funding bodies. As such, AUMA is in continuous contact with federal funding bodies such as ISED and maintains consistent discussion around the Universal Broadband Fund (UBF) and Investing in Canada Infrastructure program. AUMA's goal with these discussions is to provide input into these programs and discover accessible funding avenues where AUMA members can consistently meet funding requirements. For example, the Investing in Canada Infrastructure Fund is accessible to municipalities who are seeking funds for broadband enhancement, but municipalities are required to have obtained a portion of their funding from a provincial body. As such, AUMA discovered potential funding avenues through the Government of Alberta's Municipal Sustainability Initiative that can enable municipalities to access funds through Investing in Canada Infrastructure funds.

In addition to helping municipalities navigate through existing funding avenues, AUMA has also been a major advocate for changing the 60/40 UBF funding split. Currently, municipalities are required to input 40% of broadband enhancement funds to the UBF, with the federal government subsidizing the remaining 60%. AUMA members indicated that this funding split is not achievable and instead, should be closer to 90/10, whereby small communities will need to produce 10% of the funds with 90% coming from the federal government. With the interests of their members in mind, AUMA actively advocates that the UBF update the funding split but also increases the funding application intake model from once a year, to multiple times a year, allowing for greater flexibility with municipal funding applications.

In addition to advocating for broadband enhancement funding, AUMA often advocates for the current pain points of its members such as, insufficient SuperNet last-mile connectivity and business departure in Lamont and Sylvan Lake.

Edmonton Global

Edmonton Global is "the economic development organization for the Edmonton Metropolitan Region in Alberta, Canada." Their purpose is to promote the Region globally and attract and retain business investments and trade. As such, they engage with all levels of the government to drive change and enhance the economic competitiveness of the Region. To assist with building a narrative for these conversations, Edmonton Global has created "Going Global: A Guide to Competing in a Globalized Economy."

Within the document, four overarching goals are defined to enhance the Region's competitiveness; Adopt a Global Mindset, Create an Enabling Environment, Invest in a Globally Competitive Talent Pool, and Foster World Class Innovation. The goal of Creating an Enabling Environment further outlines three recommendations, two of which directly correspond with a need to enhance broadband infrastructure:

- "That the Government of Canada and Government of Alberta take a strategic approach to infrastructure planning with a coordinated 20-year economy- enabling infrastructure plan that includes a rolling list of high-priority, short-, medium-, and long-term infrastructure needs (including ongoing maintenance) put through a competitiveness filter to prioritize projects that will enhance our global competitiveness, productivity, and market access."
- "That the Government of Canada and Government of Alberta leverage public-private funding mechanisms to invest in the required infrastructure to achieve 100% internet coverage across the Edmonton Metropolitan Region by 2025 – with unlimited data and a minimum of 100 Mbps download speeds and 50 Mbps upload speeds."

In order to achieve the recommendations, set out in the "Going Global" report, Edmonton Global expressed a need to create a regional collaborative to remain competitive. Currently no form of regional collaboration exists, with many municipalities viewing collaboration as a one size fits all approach that will not address the unique requirements of their organization. Edmonton Global will instead, inform municipalities on what other regions are doing (global competitiveness and case for broadband enhancement), the level of investment required, and what is needed to meet the minimum connectivity requirements. Ultimately, the responsibility of enhancing broadband falls on the municipality, but Edmonton Global can provide expertise in broadband economics and advocate to all three levels of government for increased broadband investment.

From an economic development perspective, enhanced internet connectivity is not the first item that attracts businesses to the Region. Edmonton Global noted that connectivity is table stakes, it is something that is expected by businesses that are coming to the Region. Rather than an economic development attractor, it should be considered a business retention issue. For example, Edmonton Global had recent talks with a business and due to the poor connectivity in their business park, they weren't getting the bandwidth needed to do work and had to move elsewhere in the Region. As a first step, Edmonton Global indicated that defining the need and differentiation between residential and business connectivity is critical in making progress towards broadband enhancement. Thinking about broadband enhancements in this way can help establish mechanisms for resident cost recovery and ensure that business enhancements consider growth and economic development.

As such, Edmonton Global noted that broadband needs to be thought of as critical infrastructure and needs to be addressed when servicing land. Municipalities will not view broadband as infrastructure without having invested in it themselves. At a larger scale, this impedes economic competitiveness as Foreign Direct Investment (FDI) is attracted to areas where clusters of businesses are located, which is in part driven by a need for foundational technology. As such, businesses will continue to increasingly gravitate to areas where their broadband needs are met, and clusters of businesses reside. That leaves traditional industries such as agriculture in the rural areas, where a natural cluster for them exists. However, they will not be able to

remain competitive in the current technological environment that is driven by automation. There is recognition by Edmonton Global that the business case for deploying fibre is not there, and that creative solutions will need to be thought of, such as private-public-partnerships with ISPs to make the business case more attractive to them.

From a business attraction perspective, Edmonton Global is looking to attract high-tech organizations to the Region, as it was noted that intangible assets are far outstripping the value of tangible assets in today's economy. In general, however, the Edmonton Metropolitan Region is having difficulty retaining business, let alone attracting it.

Rural Municipalities of Alberta (RMA)

The Rural Municipalities of Alberta (RMA) is an independent association comprising of Alberta's 69 counties and municipal districts, which have large land masses and sparse population. As such, broadband connectivity is an issue for its members. RMA works to ensure that provincial and federal decision-makers, industry and other relevant stakeholders understand and incorporate rural Alberta's best interests in their policies. In the context of broadband, RMA focuses on helping current members obtain broadband funding by navigating through CRTC funding requirements, and UBF funding applications by providing their members with information that guides funding submissions. As such, information pertaining to broadband funding cycles and broadband success stories are shared by RMA through weekly newsletters to emphasize their role in connecting rural Alberta municipalities.

RMA is reinforcing their relationship with Cybera to enhance federal advocacy efforts but are limited from a resource capacity perspective. Nonetheless, broadband remains a major focus within RMA, with members consistently reinforcing the mantra that broadband is a necessity that can help enable their organization. RMA members indicated that current broadband awareness is largely dependent on what their neighbours are doing and broadband needs to be considered as a sustainability objective.

5. Definition of the Desired Future State

Through previous sections of this report, it is shown that there are significant benefits that can be gained from deploying broadband technology and that the current state of deployment within the Edmonton Metropolitan Region presents opportunities for improvement. As such, it is imperative to understand and explore what the path forward entails and to set a goal for where the Region needs to be in order to maximize socioeconomic benefits and remain globally competitive.

In exploring the path forward, this section first provides a historical and macroeconomic perspective on the current industrial or "techno-economic" revolution that has been underscored by the development of ICT technology. This provides context for our position in the overarching long-term revolutionary cycle that is transforming the globe and provides commentary on its trajectory moving forward.

Secondly, this section provides an overview of the current state of deployment in the world's leading jurisdictions and establishes the art of the possible through concrete examples. In this overview, a key focus is on providing strategy and policy information from which lessons can be gained and applied within the Edmonton Metropolitan Region.

Finally, through consideration of our macroeconomic and global position, the section is concluded with the definition of the Desired Future State for the Region. This aims to be achievable yet aggressive to ensure the Region establishes itself as a global leader.

ICT Technology – Evolution and Implications

Techno-Economic Revolutions[56]

As a general-purpose technology, developments in ICT impact every sector of the economy and are transforming society at a fundamental level. Understanding these changes and their implications is key to developing a solid foundation on which a sound go-forward strategy can be developed. These developments and their implications are outlined below.

Over the past three hundred years, the robust links between innovation, technical and institutional change, and economic development have played out in the first four techno-economic revolutions outlined in the table below and are currently playing out in the fifth – the Age of Information Technology and Telecommunications.[57]

Table 33. Techno - Economic Revolutions

1771	The 'Industrial Revolution' (machines, factories, and canals)
1829	Age of Steam, Coal, Iron, and Railways

[56] This section has been adapted from: Dobson, C.; *Regional Broadband Investigation – Needs, Opportunities, and Approaches at the Local Level and for the Calgary Region: Landscape Issues;* Taylor Warwick; 2016-09-28.

[57] Perez, Carlota; Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages; Edward Elgar Publications; 2003.

1875 Age of Steel and Heavy Engineering (electrical, chemical, civil, naval)

1908 Age of the Automobile, Oil, Petrochemicals, and Mass Production

1971 Age of Information and Communications Technology (ICT)

20?? Age of Biotech, Bioelectronics, Nanotech, and new materials?

Each technological revolution lasts between 40 and 60 years and propagates through two strikingly different stages – the installation, and the deployment phase. As illustrated in the figure below,[58] when a new technology is introduced during the installation phase, entrepreneurs move in to capitalize on it. They attract new investment capital away from existing businesses and, based on market experiments, establish new types of business organizations to deal with it. The resulting maelstrom of activity eventually reaches a climax and ends in a stock market crash.

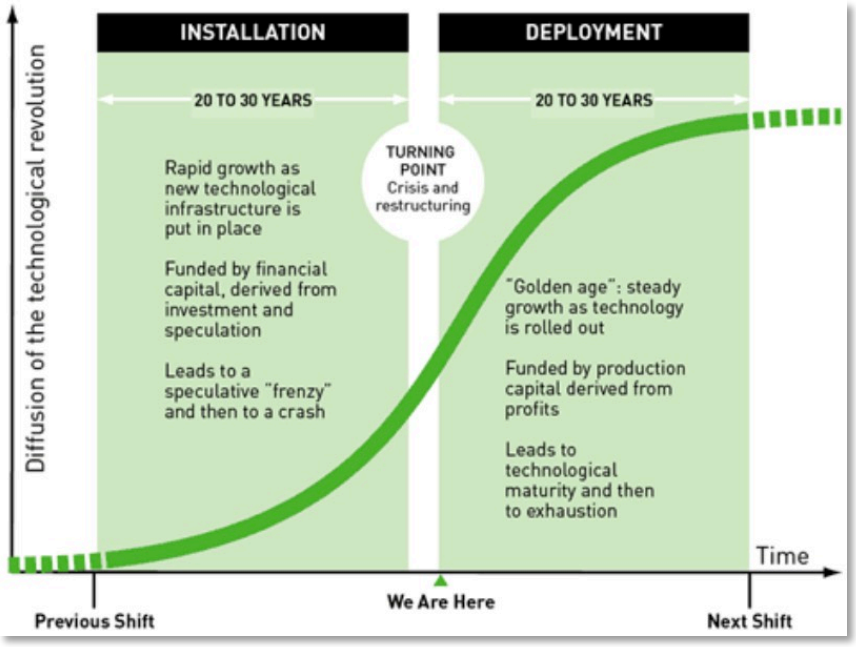

Figure 70. Phases of Each Socioeconomic Revolution

Industrial/production capital then comes to the table and finances the reasoned deployment of the underlying infrastructure required to enable the full economic and social potential of the new paradigm. In this second – deployment – stage, innovation occurs across all economic sectors and the social benefits become widespread. As the commercial benefits take hold, the collective interests of the populace at large become part of the equation and state capital often comes to the table to help complete the deployment in commercially unattractive areas.

From this perspective, the five techno-economic revolutions to date map out as shown in the figure below.[5] The displacement of the older established order as the new technology wave develops is not typically

[58] Trends Magazine; *A New Golden Age… When People Least Expect It*; AudioTech Inc.; 2010-04.

smooth. Compounding the impacts of both the Industrial and the current ICT revolutions is the fact that they ushered in a new system of wealth.

Technology is not kind…
It does not wait…
It does not say please…
It slams into existing systems…
And often destroys them…
While creating a new system.[59]

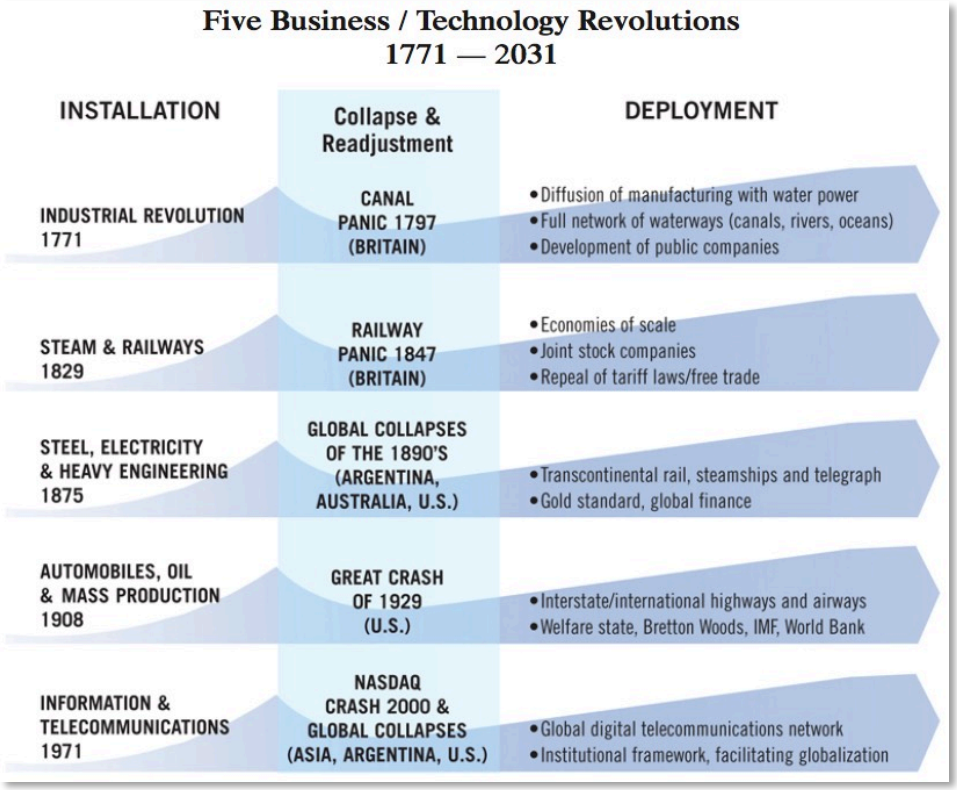

Figure 71. Five Business/Technology Revolutions

The congruency between the development of the Internet and the underlying enabling broadband infrastructure is striking. The dot com crash took place in 2001 and now, some 19 years later, the true benefits of the ICT revolution are impacting every sector of the economy. The positive externalities[60] are becoming self-evident and governments are stepping in to ensure near ubiquitous deployment (at least those outside North America, as discussed in the proceeding Jurisdictional Scan). Aligning these events with this timeline indicates that the ICT revolution is approximately 80% complete. As discussed in the following sections, developing technology, financial, economic, and policy objectives to maximize the benefits of the new paradigm as broadly as possible is an important challenge.

It is at this stage – this moment in time – that the debate as to whether this new technology 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. As such, ownership and control of fibre assets will be a key factor in determining how well broader public benefits are achieved.

[59] Enriquez, Juan; As the Future Catches You: How Genomics & Other Forces Are Changing Your Life, Work, Health & Wealth; Crown Business; 2005-10-25.

[60] Externalities relate to side effects or consequences of industrial or commercial activities that affect other parties without this being reflected in the prices or costs of the goods or services involved. [Wikipedia]

Despite the foundational nature of the required underlying connectivity infrastructure and its impact on economic development, neither Canada nor Alberta has yet developed a meaningful related technology policy. To date, the approach at both levels is to leave the deployment of the required ICT infrastructure to private industry and only intervene in areas where the projected return on investment (ROI) is insufficient to interest private providers – and the results are telling. Based on the Internet Development Index (IDI), Canada dropped two spots in 2016 and another three in 2017 and is now in 29th place globally.[61] The differences in approaches internationally to these issues are highlighted in the section on jurisdictional approaches later in this document.

Based on average urban and rural download speeds in Canada, Alberta ranks 10th out of 12 and rural speeds are under half those available in urban areas. This urban/rural divide is strikingly evident in the current state results presented herein for the Edmonton Metropolitan Region.

Network Evolution

Special Purpose to General Purpose

To meet the demands for telephony and cable television, two very different and highly specialized, single purpose networks developed:

- ***The telephone network:*** based on twisted pair copper wires and sophisticated highly centralized electronic switching equipment, the telephone network enabled the bidirectional transmission of low bandwidth voice signals between any two telephones anywhere on the planet.
- ***The cable television network:*** based on a coaxial cable distribution network, and no centralized electronics, the cable network could simultaneously transmit dozens (and later, hundreds) of high bandwidth television signals from a central location to thousands of endpoints (televisions) throughout the network's serving area. To watch a particular channel, each end user had to manually select the appropriate channel on their television set or cable television box. Unlike the telephone network, switching capability was non-existent and, as each cable distribution area independently focused on their own footprint, connections between distribution areas were non-existent.

Figure 72. Twisted Pair Copper Wire

Figure 73. Coaxial Cable

As building networks is an expensive undertaking and as only one of each type of network was needed in any area, competition not only made little sense economically, it inhibited ubiquitous deployment. Hence, a facilities-based regulatory environment developed to oversee the developing telephone and cable monopolies.

In the Age of ICT, demand for data connection services arose and to meet those requirements both the telephone and the cable networks evolved. Whereas the telephone networks evolved to support wider bandwidth connections, the cable networks evolved to both incorporate a bidirectional capability and

[61] CIRA; Factbook; Canada's Internet Factbook 2018

enable the routing of signals between any two particular endpoints. In both cases, the limiting factor was the final connection to the residential or business premises.

To increase the bandwidth on the telephone companies copper infrastructure, digital subscriber line (DSL) technology developed. Due to the physical limitations of transmission over copper lines, however, these technologies were fundamentally limited as supported bandwidths decline rapidly with distance. Beyond 2000m or so, data transmission rates drop significantly. As rural premises require transmission distances significantly beyond the 2000m limit, telco-based Internet services in rural areas are virtually non-existent.

In terms of access bandwidth, the cable industry was much better positioned as, being based on guided-wave transmission, coaxial cable could support Internet speeds exceeding many gigabits per second. Their issue, though, was that without switching technology, each cable had to carry all signals to every end-device connected and electronics were required at the endpoints to ensure that end users could only access their own data. Further, to support their traditional cable services, the bulk of the available bandwidth was reserved for the downstream delivery of television signals and only a small portion was earmarked for return Internet-related data. By reducing the number of cable channels delivered, more downstream Internet data could be accommodated. Increasing the upstream allotments was much more difficult, however, as the initial split-ratio selected was hard-coded into their equipment. While many cable companies now offer downstream Internet speeds of 600 Mbps, upstream speeds typically do not exceed 30 Mbps. With the availability of satellite-based television services, cable companies typically do not provide services in rural areas.

Faced with the physical limits of their copper technology, the telecommunication companies have been much more aggressive in upgrading their access infrastructure to support multi-gigabit per second services, than have the cable companies which, to date, have largely banked on the value of high bandwidth download capabilities.

More generally, network evolution on both the telco and cable fronts has been synergistic with three developments:

- **Digitization:** With the advances of Moore's Law, all signals, whether voice, data, or video, can now be economically converted to digital signals and transmitted as a data-stream. In essence, though the required transmission speeds vary, all signals have become one – if one can transmit an ultra-high definition television signal, one can transmit anything.
- **Fibre-optics:** The development of fibre-optic cables removed the bandwidth restrictions of both traditional copper and coaxial cable-based infrastructure. The theoretical bandwidth of current fibre optic cables is, for all practical purposes, unlimited.
- **Routing equipment:** Traditional narrow-bandwidth telephone switching equipment evolved to general purpose high-bandwidth routing technology that enabled virtual connections between any two endpoints, anywhere on the planet.

The bottom-line is that now, instead of the need for multiple special service-specific networks, only one network is required to support all telecommunication and broadcast television related services. Hence, the historic coupling of network and services, as evidenced by the vertical integration that typifies both the telco and cableco ecosystems in North America today, is, while perhaps operationally simpler, is no longer necessary.

The Nature of Competition

This logic suggests that our current facilities-based competition model with regulated monopolies based on historically provided service sets may no longer be optimal, particularly as all services can now be offered by both sets of monopolies. Indeed, perhaps it would more beneficial to split the industry into a commodity-based utility network ecosystem and an innovation-based services ecosystem. The significance of this revised industry structure cannot be understated:

- As deploying networks is expensive, facilities-based competition has limited deployments in semi-urban and rural areas. The rise of the general-purpose network means that only one network is now required. As deploying one, capable network is 3 – 4 times more capital efficient than deploying multiple networks, networks can be economically deployed much more deeply into rural areas and operated as a utility.
- As only one network in any area is now required, and as fibre-based infrastructure is a forty-plus year asset (as further explained in Appendix D: Connectivity Technologies), the entity in control of the new infrastructure is in a key and valuable position.
- Removing the need to build a network prior to competing on services significantly reduces the barriers to entry and would both increase services-based competition and facilitate the deployment of innovative service sets.

Unfortunately, however, removing the high barriers to entry facilities-based competition enables is not something current telecom and cable incumbents are likely to embrace. Having to compete in a truly competitive, over-the-top, services-only game is quite different than operating in the relatively secure traditional regulatory environment the incumbents are used to. For Canada's ranking in the international broadband space to improve, and for Canada to truly reap the economic benefits unfettered, truly capable ubiquitous networks enable, fundamental change may be necessary.

Jurisdictional Scan

Introduction

As outlined in the previous section, ICT infrastructure has rapidly evolved over the past 20-30 years, and it is at an inflection point, where its use has become widespread and it has become the backbone of the economy. As such, leading jurisdictions around the world have made significant and focused effort to meaningfully enable infrastructure deployment.

Through studying these world-leading jurisdictions, the EMR can gain valuable lessons on the various levers that the Region can use to efficiently and effectively develop broadband. As such, this section summarizes key policies, programs, and initiatives taken by countries around the world who are successfully developing broadband and providing high-speed connectivity to their citizens.

Approach

An initial list of international comparators was determined through identifying countries that had the highest degree of FTTP (fibre-to-the-premise) deployment across the globe, as documented by the FTTH (Fibre-to-the-Home) Council and depicted in the figure below.

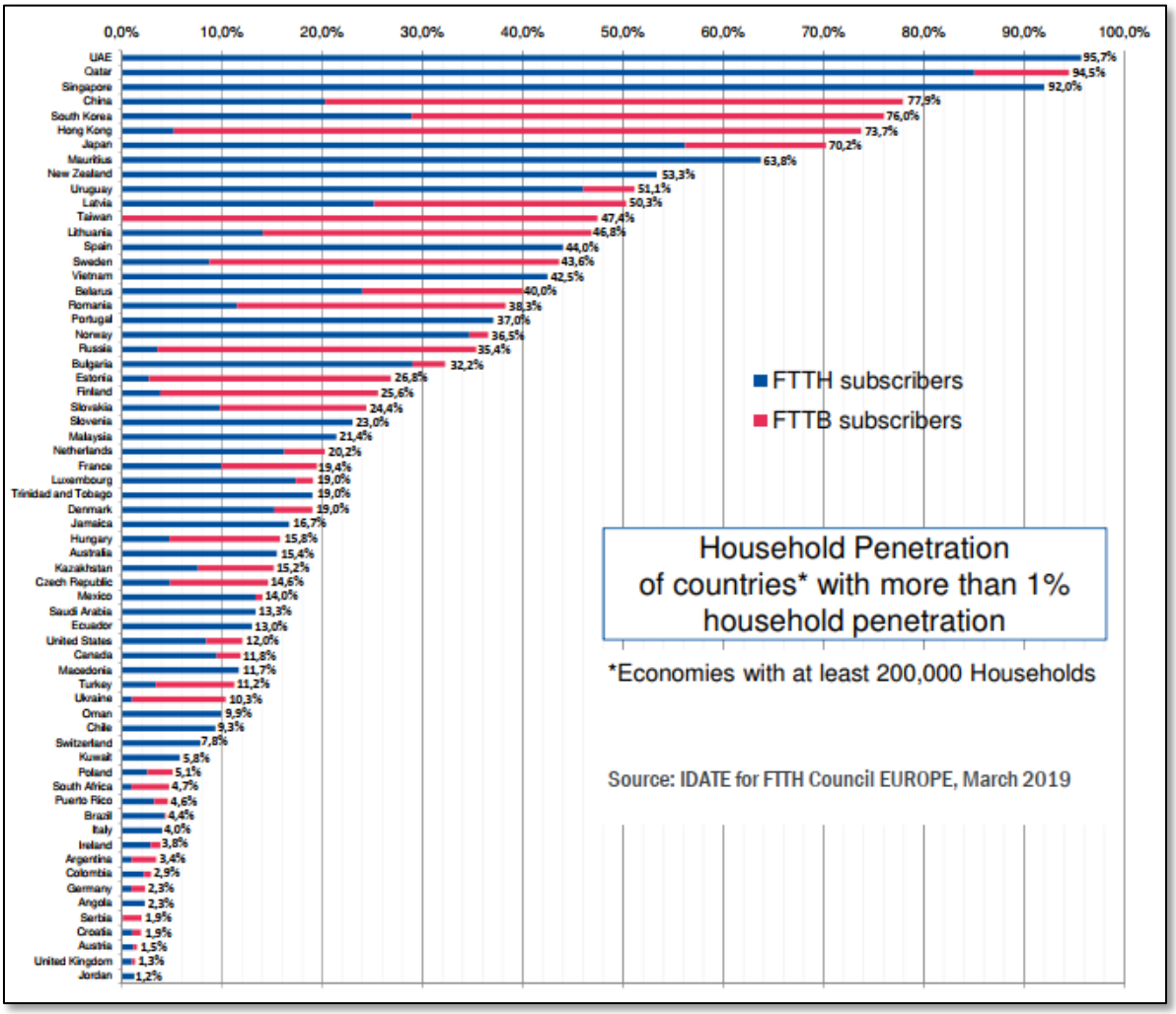

Figure 74. FTTP of Countries

According to the data gathered by the FTTH Council, Canada ranks 42nd in this list of 64 countries. This provides a list of 41 countries that can be reviewed to gain lessons on how to further advance fibre deployment. However, a complete international review falls outside of the scope of this study and the countries highlighted within this document were chosen according to the following approach:

1. **International Primary**: A selection of five countries was chosen for review based on their percentage of FTTP, their political structure, and their land size. Of those countries with the highest FTTP percentage, Singapore, South Korea, and Japan, were chosen as comparators due to their advanced economies and relatively similar political structures (compared to countries such as the UAE, Qatar, and China), New Zealand was chosen due to it's similarity of population density and political structure, and Australia was chosen due to its land mass, population density, and political structure.

2. **International Secondary**: In reviewing the larger list of countries, it was noted that many nations within the European Union appear at the top of the list. As such, a further review was completed on the European Union, which, as a whole, has been guided by an overarching Digital Agenda for Europe initiative. In this section, a review of Finland and Sweden are offered as they are European nations that are most similar in population density to Canada.

3. **Continental**: Additionally, the United States was reviewed to provide commentary on effective policies deployed in North America. Utilizing experience from past jurisdictional scans, the consulting team identified a number of States that have adopted unique approaches to broadband deployment that have proven successful.

4. **National and Provincial**: Finally, and through utilizing experience from past jurisdictional scans, the consulting team provides a complete view of Canada and Alberta to showcase the various models that have been adapted across the nation and provinces, which provides valuable lessons for the EMR.

Summary of Findings

When looking globally at successful broadband deployments, there are clear and key similarities in the approaches that are being taken. These underscore the need for the Region to work in a collaborative manner and can be summarized as follows:

- Leading jurisdictions create **Governing Bodies** to understand broadband needs, provide guidance, and advocate for, facilitate, and help fund broadband development
- Many jurisdictions take it one step further and create **Crown Corporations** to execute broadband mandates and to develop and deploy broadband on large scale on behalf of governing bodies
- **Coordinated Long-term Regional Strategies** were seen as a key success factor. These strategies recognize broadband as a utility and consider both demand and supply side policy development, while also ensuring that all infrastructure projects consider broadband deployment, ultimately reducing costs
- World-leading broadband strategies and policies have a focus on **increasing competition** through ensuring monopolies do not develop and ensuring prices remain competitive through structural separation

- Where national and state/provincial funding is not readily available, leading jurisdictions develop **Municipally Owned Networks**, in particular in rural areas, that provide affordable connectivity to residents and increase competition
- Leading jurisdictions often **reduce legal and policy barriers** such as the number, complexity, and process time of permits, streamlining both permit submission and approval processes
- Additionally, **tax exemptions** are provided for landowners and developers who have broadband infrastructure developed on their land and

These items are taken into consideration in development of the Gap Analysis and Recommendations, which are found in proceeding sections of this report.

International Primary

The importance of capable broadband infrastructure has been globally recognized and efforts to improve infrastructure and services are underway in many countries through a variety of approaches.

This section of the report explores international jurisdictions whose strategies and policies have made them achieve the highest levels of fibre deployment in the world, effectively establishing themselves as world leaders in broadband innovation. These countries include Singapore, South Korea, Japan, and New Zealand.

Additionally, Australia's network deployment efforts are explored in this section, as they serve as the closest international comparator to Canada from a land size, population density, and political structure perspective.

Singapore

Land Size: 721.5 km^2

Population Density: 7866:1 People to Square Kilometre

Political Structure: Parliamentary Representative Democratic Republic

FTTP: 92%

Strategic Focus: Structural separation of infrastructure, with private operational ownership

Singapore has been focused on developing its ICT sector since the early 1980s and has since developed a series of seven masterplans that have guided the sector's development. The sixth master plan, known as Intelligent Nation 2015 (iN2015), was created in 2006 by Singapore's Infocomm Development Authority (IDA) and had a 10-year vision to transform Singapore into a nation powered by telecom. One of the initiatives organized to achieve this was the Next Generation Nationwide Broadband Network (Next Gen NBN) project[62].

Many lessons can be learned from the successes of the Next Gen NBN project, which aimed to create a "fibre-to-anywhere" network that was well-run and efficient, and better able to deliver services at the lowest cost to consumers and businesses, while achieving speeds of 1 Gbps and more. This objective was achieved in 2013, ahead of their 2015 target which is shown today in Singapore reaching 92% FTTP penetration. To achieve this success, the IDA took a unique and innovative path.

[62] Towards a Next Generation Connected Nation – Infocomm Development Authority

As the IDA and Singapore embarked on their Next Gen NBN journey, a number of deployment models were considered, including government led development of broadband infrastructure, providing investment incentives to the private sector, and granting regulatory relief to incentivize existing operators to invest in the network. However, these approaches were rejected as the IDA's fundamental belief is that reliance on market forces ensures the best outcome for consumers and that private sector organizations are more capable of ensuring infrastructure is well-run and can deliver services at lower costs. Although the IDA was keen on relying on market forces, they wanted to ensure that the network was operated in an effective open access manner. As such, the IDA entered into a competitive dialogue and RFP process that was used to shape the industry structure and ensure the network was developed in collaboration with the private industry.

The competitive dialogue was a year-long process that included conversations with 12 pre-qualified consortia to solidify business and operation model considerations. Through these conversations, the IDA created a three-layer industry structure model that is depicted in the figure below:

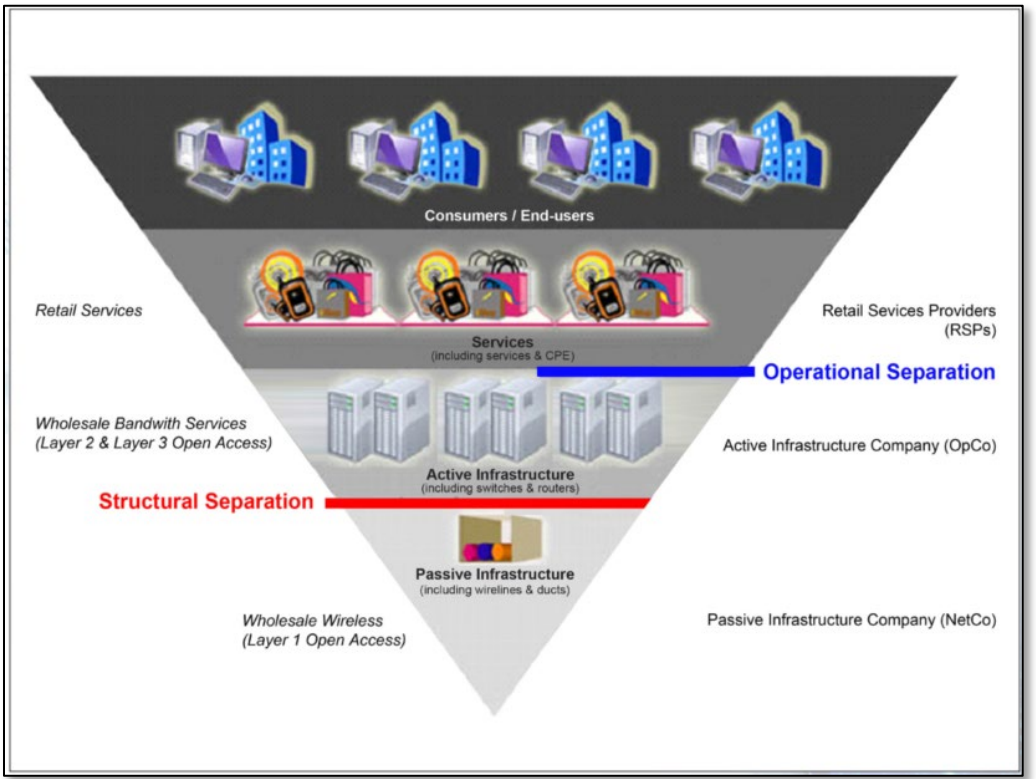

Figure 75 Singapore's Three-layer Industry Structure

The three-layer structure includes a separate Network Company (NetCo) and operationally separated Operating Company (OpCo). The NetCo is responsible for the design, build, and operation of the passive infrastructure (i.e. fibre optics) and the OpCo is responsible for the design, build, and operation of active infrastructure (i.e. routers, switches, and access network equipment). The OpCo is also responsible for providing wholesale broadband access and connectivity to Retail Service Providers (RSPs). Through creating this structure and then developing regulations on the ownership structure of the NetCo and OpCo, the IDA ensured fair and equitable access for providing services on the network.

Once this industry structure was developed, the pre-qualified candidates were allowed to create partnerships and reorganize their businesses in a manner that aligned with the structural separation

requirements of the RFP. In September 2008, the Government selected the OpenNet Consortium [63]as the NetCo, and in April 2009, selected Nucleus Connect as the OpCo. Deployment of the network then began in August of 2009 and completed in 2013, ahead of the 2015 scheduled completion date, as efficiencies were gained through deploying the network through existing ducts and manholes and avoiding civil construction where possible. To create the network, the Singapore Government offered up to CAD $725 million in grant funding. [64]

In addition, to the focus on ensuring sound broadband deployment strategy and policy was established, the IDA also ensured their approach focused on spurring demand for access to the network. This is outlined by the following three propositions made to end-users:

- The first is that OpenNet would waive all installation charges for home and building owners when the network first reached their area. This facilitated high take-up of Next Gen NBN by home and building owners.
- The second proposition was the concept of "Universal Service Obligation" or USO for fibre connectivity. This meant that the NetCo and the OpCo were required to meet any reasonable request for Next Generation services within stipulated service activation periods when the USO came into effect from 2013.
- The third was that besides connectivity to homes and businesses, IDA required OpenNet and Nucleus Connect to provide network connectivity to outdoor locations or what IDA terms as "Non-Building Address Points" or NBAPs for short.

The IDA's approach to developing this network is one that can be looked at as a success, as Singapore has developed a world-leading broadband network that can and is continually innovated upon and is highly competitive, with over 30 RSPs. Moving forward, the IDA (who has now transformed into the Infocomm Media Development Authority or IMDA) is guided by their Infocomm Media 2025 strategy, which is focused on furthering the bandwidth and resiliency of the Next Gen NGN and creating a Heterogeneous Network (HetNet), which "will allow devices to leapfrog seamlessly between the network that best suits their operating scenario."[65]

South Korea[66]

Land Size: 100,210 km^2

Population Density: 510:1 People to Square Kilometre

Political Structure: Presidential Representative Democratic Republic

FTTP: 76%

Strategic Focus: Public-private partnerships, with tax incentives and low interest loans

[63] It is interesting to note that the OpenNet Consortium was led by Axia NetMedia Corporation, which was also involved in the creation of Alberta's SuperNet.

[64] IMDA Nationwide Broadband Network

[65] Infocomm Media 2025 – Infocomm Media Development Authority

[66] e-Resilience: China, Japan, and the Republic of Korea

In the early 1990's. South Korea developed an agenda that put information and technology as one it's main national objectives. As such, the Government developed the Ministry of Information and Communication in 1994 to fulfill the following roles:

- Oversee competition policies for the telecommunications industry;
- Design national informatization policies;
- Broadband infrastructure planning;
- Fostering the ICT industry;
- Supporting technology development; and
- Developing skilled technical manpower.

In 1996, Shortly after the creation of the ministry, South Korea's first informatization master plan was created. The plan aimed at making South Korea a nation that embraced and utilized data and information to create an innovative and prosperous economy. The nation has since iterated upon their plan and are currently implementing their fifth informatization master plan, which focuses on the development of leading-edge innovative industries[67]. The journey that has brought them to this fifth plan has numerous takeaways.

Embracing their overarching informatization master plans has led to three major initiatives that have resulted in the development of South Korea's broadband infrastructure over the past 15 years. This includes the following:

Korea Information Infrastructure Initiative (KII), 1996 - 2000

- This was a key component of the nations first informatization master plan and was implemented from 1996-2000
- It focused on creating a backbone network to connect all public facilities, encouraging the rollout of a public network by granting tax incentives and low-rate loans to investors, and creating a testbed backbone network connecting the nation's research institutions

Broadband Convergence Network (BcN), 2004-2010

- This marked the beginning of South Korea's journey in achieving widespread FTTP deployment. The goal of the initiative was to provide speeds of 50-100 Mbps to 20 million subscribers by 2010. This aspirational goal was nearly achieved with 14.82 million subscribers as of December 2010; however, speed targets could only be achieved in urban areas. At 75% of those in rural areas could connect to 50 Mbps speeds.
- As such, the government launched the Rural BcN Project in 2010 and has successfully deployed the BcN at speeds of 100 Mbps via FTTH in 12,156 of the 13,217 villages, covering 92% per cent of the country. The project was completed in all rural areas across the country in 2017.
- The deployment of this network and services was largely completed by the private industry.

Ultra Broadband Convergence Network (UBcN), 2010-Ongoing

- After wide-spread deployment of the BcN, South Korea aimed to upgrade its infrastructure to achieve gigabit speeds. The nation's goal was to achieve 90% giga internet coverage by 2017, and

[67] Master Plan for an Intelligent Information Society

has since achieved this, with gigabit services now available to 93% of it's citizens. It now aims to provide 50% of its citizens with 10 Gbps speeds by as early as 2022. [68]

- Similar to the BcN Initiative, the Giga Internet Initiative focuses on eliciting investment from the private sector to build the network.

It is clear to see through these initiatives that South Korea has relied on public-private-partnerships to spur the development of broadband infrastructure in the nation. However, their policy on competition and collaboration has changed significantly over the years. South Korea first began to deregulate the industry in 1997, designating broadband as a "value-added" service which allowed new entrants to rent networks from other carriers without restriction. This changed in 2005 and broadband was reclassified as a facility-based service to increase requirements for new entrants to have licenses and a detailed description of their services. However, regulations are still in place that require open access to fibre networks once they become more than three years old.

In addition, South Korea has a unique funding model through the Information Promotion Fund which was setup in 1996 to re-invest profit from the ICT market back into the ICT sector. The primary objective of the Information Promotion Fund has been to support the rollout of broadband networks, E-Government, ICT education and ICT research and development. The figure below depicts the source and expenditure of these funds:

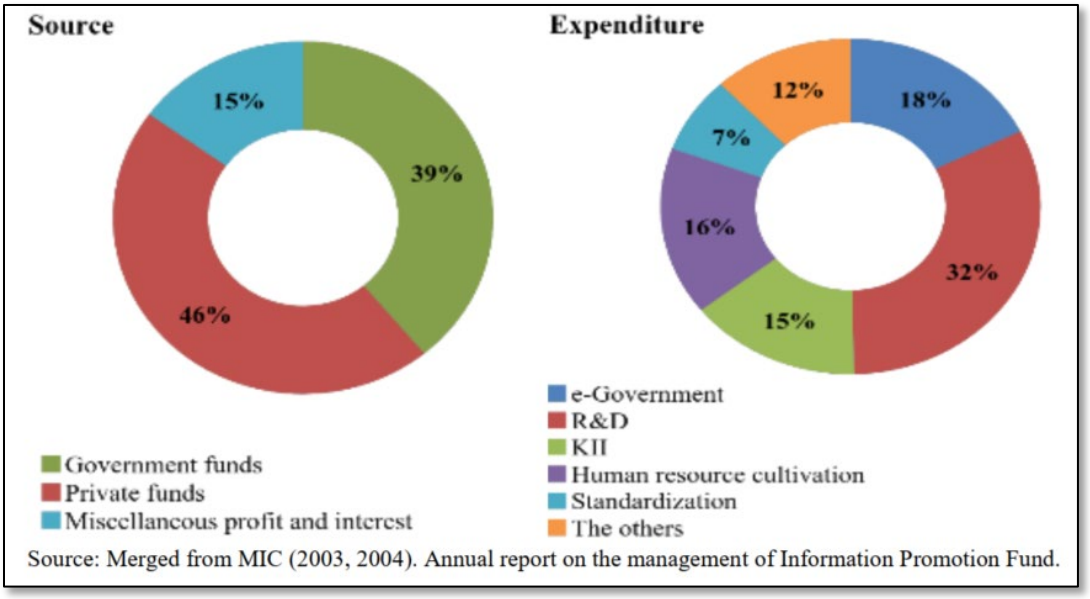

Figure 76 Information Promotion Fund

[68] South Korea getting 10 Gigabit per Second Internet

Japan[69]

Land Size: 377,915 km^2

Population Density: 347:1 People to Square Kilometre

Political Structure: Parliamentary Representative Democratic Constitutional Monarchy

FTTP: 70.2%

Strategic Focus: Government subsidization, tax incentives, and low to zero interest loans for the development of open access networks

Japan's journey in developing its ICT sector began in earnest in 2001 with the launch of the e-Japan Strategy. The focus of the strategy was to create an ICT oriented society and to do so through the deployment of broadband infrastructure. The goal of the strategy was to ensure that 30 million households were provided with speeds of 30-100 Mbps and an additional 30 million households being provided speeds of 2-10 Mbps by 2005, which represents the total number of households in Japan. Additionally, the strategy stated that citizens should receive these services at a reasonable price and that the infrastructure would be developed through competition. To achieve this, the Japanese government provided subsidies, tax incentives, and low or zero interest loans to the private sector, which ultimately spurred the market to meet these goals by 2003. As such, in 2003, Japan launched the e-Japan Strategy 2, which called for further advancement to the existing network and proliferation of its utilization across industries.

This was quickly followed by the launch of the u-Japan Strategy in December of 2004, which set a target of providing 90% of households with access to ultra-high-speed fibre networks by 2010. This created a paradigm shift towards advanced broadband technology and spurred research and development in the sector. This was followed by Japan's New IT Reform strategy in 2006, which aimed to create a new type of society where various social issues are resolved through the use of ICT. This solidified the importance of and the emphasis on the need for deploying an ultra-high-speed network. This led to the development of the Expert Committee on IT Strategy Evaluation, which set up an assessment system on priority policy issues and provided guidance on policy implementation to relevant ministries.

In 2009, the i-Japan Strategy 2015 was created to address issues affecting previous strategies. The focus of this strategy was on users, whereas previous strategies were focused on the perspective of carriers and manufacturers. It set a target of achieved speeds of 100 Mbps for mobile networks and 1 Gbps for fixed access by 2015 to ensure every citizen can easily, seamlessly, and safely exchange information at anytime and anywhere. The three priority areas of development were e-government, healthcare, and education/human resources, and cloud technology was encouraged to build-up these systems.

These goals were then further solidified in the release of Japan's IT Declaration in June of 2013, which announced a goal to be the "World's Most Advanced IT Nation." The pillars of this declaration were as follows: 1) achieve future growth through the use of ICT, 2) utilize ICT in households, workplace and towns, 3) improve safety and security of ICT services and 4) provide a one-stop access to public services through the use of ICT. It also highlights the need to use big data and to develop a response to the Internet of Things era. The result of these strategies has been that all households in Japan had broadband access by 2015,

[69] e-Resilience: China, Japan, and the Republic of Korea

with the 99% or greater having access to high-speed (greater than 30 Mbps speeds) services mainly through FTTH.

As deployment through these strategies was occurring, it was obvious that an urban-rural divide also existed in Japan and that special measures were needed to be taken to bridge the gap. As carriers did not often want to go to remote areas as the economics of deployment were not favorable, the Japanese government provided a tiered set of subsidies for local governments. In most rural areas, the Government provided a 1/3 subsidy for the construction of broadband infrastructure to local governments, if the capabilities of the local government were limited than a ½ subsidy was offered, and finally a 2/3 subsidy was offered for remote islands. Carriers were then encouraged to use the infrastructure through an indefeasible right of use scheme. This subsidization strategy was further encouraged through a 2008 government strategy aimed at bridging the digital divide, which was also achieved by 2015.

It is important to mention that the Japanese government placed emphasis on ensuring the broadband market provided equal opportunity and fair competition. As such, policies have been developed that ensure equal access to all facilities and ensure that there is open access to all facilities. New market entrants can enter with notification or registration, and then access existing infrastructure to deploy their services.

New Zealand

Land Size: 268,021 km^2

Population Density: 18:1 People to Square Kilometre

Political Structure: Unitary Parliamentary Representative Democracy

FTTP: 53.5%

Strategic Focus: Public-private partnerships, land subsidization, and development of open access networks

Recognizing the critical importance of ICT, the New Zealand Government committed to improve service performance and affordability with the release of the Digital Strategy in May 2005. The Broadband Challenge Fund and the Community Partnership Fund of combined over $40 million were launched to stimulate digital growth through open access fully unbundled fibre networks. Due to insufficient impact, New Zealand amended their Telecom Act in 2006. Competition was promoted as well as equal access to key wholesale services. This also allowed the Telecommunications Commissioner to effectively monitor industry development elements and regulatory compliance. Still not satisfied, the government drafted 'Digital Strategy 2.0' which built on the three pillars: connections, confidence, and content. The full non-facilities-based model has proven to be successful, and because of that, the government in New Zealand has mandated structural separation between the network and the services.

In addition, to facilitate the quicker and more efficient deployment of broadband infrastructure across the country, the government in New Zealand has implemented two policies:

1. The Amendment Act to their existing Land Access Regulatory Impact Statement "enables the use of existing infrastructure (such as electricity lines) for deploying fibre optic cable in rural areas," with subsidies being provided to the owners of the land where the right of entry exists to balance out the impact.[70]

[70] https://www.mbie.govt.nz/assets/64989c6218/ris-land-access-for-telecommunications-to-support-deployment-of-ufb.pdf

2. The National Environmental Standards for Telecommunications Facilities 2016 (NESTF), which replaced the previous 2008 regulations, enables telecommunication companies and local councils to save money and time when low impact broadband infrastructure, such as cabinets or poles, are being installed by removing the requirement for authorization to use natural and physical resources, called resource consents. This means that access to broadband for consumers can be sped up, while ensuring environmental effects are still minimised and properly managed.[71]

Currently, the government is funding two initiatives that will provide broadband connectivity to 99.8% of the population with a total NZ$1.5 billion invested. The two initiatives are the Ultra Fast Broadband Initiative (UBFI) and the Rural Broadband Initiative[72], which is in its second iteration called the RBI2, and are being implemented by the government created Crown Infrastructure Partners, which represents a public-private partnership. The UBFI initiative sets out to provide speeds of up to 1 Gbps to 87% of the population by the end of 2022, while the RBI2 project aims to bring rural households and businesses broadband speeds of at least 20 Mbps.[73]

Australia

Land Size: 7.692 million km^2

Population Density: 3:1 People to Square Kilometre

Political Structure: Parliamentary Democracy

FTTP: 15.5%

Strategic Focus: Public-private partnerships for the development of open access networks

With a land size of nearly 7.7 million square kilometres, a population density of 3 people per square kilometre, and a similar political structure, Australia is the closest comparator country to Canada from a population density, land mass, and political structure point of view. Along with their similar physical and political attributes, Australia is a country with a FTTP percentage only 3.5% higher than Canada's, which serves as a direct comparator for strategies.

The National Broadband Network (NBN) in Australia set out to provide fixed line access to nearly 92% of homes and businesses in the Country, fixed wireless to 5% and satellite connection to the last 3% with AUS$31billion in government funding. In 2009, the government of Australia created the NBN Co., a crown corporation tasked to design, build, and operate the NBN throughout the Country. Their Statement of Expectations was created to ensure that all Australians have access to peak wholesale download data speeds of at least 25 Mbps and at least 50 Mbps for 90 percent of fixed line premises.[74]

The NBN access network, when completed, will replace the existing copper networks and some of the existing hybrid fibre co-axial networks as well. As such, all homes and businesses currently being served by

[71] https://www.mbie.govt.nz/assets/eb46bb4e5c/resource-management-regulations-2016-draft-users-guide.pdf

[72] https://www.mbie.govt.nz/science-and-technology/it-communications-and-broadband/fast-broadband/policy-and-regulation/

[73] https://www.zdnet.com/article/new-zealand-invests-nz15m-into-rural-broadband-upgrades-for-covid-19-efforts/

[74] https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook44p/Broadband

these networks will be required to switch to the NBN in order to maintain service. In order to facilitate this transition and ultimately protect end users from the adverse impacts of this transition, the government of Australia, in conjunction with NBN Co, the local ISP Telstra, and the industry, developed the Migration Assurance Policy. This policy and its accompanying framework "establish assurance principles [...] to promote active involvement from industry to implement an effective end-to-end migration process." The main priority of the policy and framework is to support service continuity for end users as the NBN is rolled out and service is switched over to the new network, reducing the risk of interruption to their services.[75]

The National Broadband Network is still in development today, as increasing costs and political difficulties slowed progress, and increased total cost to ~AUS$51 billion. The newest projections for completing the project are for 2020.

International Secondary (European Union)

The European Union (EU) has spurred the development of the ICT sector in its region through a series of strategies beginning in 2001. The results of these strategies are shown through the large number of European countries that appear near the top of the FTTP subscription chart displayed as by the FTTP by Countries figure at the beginning of the Jurisdictional Scan section. As such, a brief understanding of the region is provided here before delving into specific deployment examples from the region.

In 2001, the European Union released the eEurope 2002 Action Plan which aimed at making the EU the world's most dynamic knowledge-based economy by 2010 through achieving the following three objectives:

- Create a cheaper, faster, and secure internet;
- Invest in people and skills; and
- Stimulate the use of the internet.

Of these, creating a cheaper, faster and secure internet is of key importance to infrastructure development as it set out a directive for Europe to increase competition through the unbundling of local loops. This opens access to existing infrastructure to multiple service providers and allows ease of entry into the market.

Following the release of the eEurope 2002 Action Plan, there have been a number of strategy documents released that have focused on providing strategic direction and funding for the development of the ICT sector, these include:

- eEurope 2005 Action Plan
- i2010 – A European Information Society for Growth and Employment
- Digital Agenda for Europe
- Connectivity for a European Gigabit Society

To understand the affects these strategies and plans have had on EU nations, this report further explores the developments in Finland and Sweden.

[75] https://www.nbnco.com.au/corporate-information/about-nbn-co/policies/telecommunications-policies

Finland

Land Size: 338,440 km^2

Population Density: 19:1 People to Square Kilometre

Political Structure: Parliamentary Representative Democracy

FTTP: 26.5%

Strategic Focus: Development of open access networks through policy creation and easing permitting processes

Finland was the first country in the world to declare broadband a human right, promising 1 Mbps to all citizens in 2010. Their revised plan is to provide a minimum of 100 Mbps connections to all households in Finland by 2025, with the possibility to increase the speed to 1 Gbps. Their broadband strategy, which was updated in 2012, targets having 99% of all homes and businesses located within two kilometres of a fibre optic or cable network to enable connection speeds of 100 Mbps.[76]

Finland has put certain policies, acts, and measures in place that have and will continue to increase the deployment and reduce the cost of broadband infrastructure deployment. These include significantly easing old policies and acts that require permits for telecommunication cable deployment. For the remaining permits that must be submitted, permits procedures are being developed to support the one-stop-shop principle, where a single electronic service may be used for all relevant permits.

In addition, efforts have been made to use collaborative efforts to decrease the cost of broadband development. Finland is exploring the development of broadband infrastructure networks with underground electricity cabling, which is currently prohibited by the Electricity Market Act, but could allow electricity companies to lease access to the networks, creating service competition. Another effort, the Verkkotietopiste.fi, is a service that collects information about projects suitable for co-construction for network operators. The enhancement of this service will increase the searchability of the service to enable more construction projects that will reduce costs and increase the pace of broadband development.[77]

Sweden

Land Size: 450,295 km^2

Population Density: 25:1 People to Square Kilometre

Political Structure: Parliamentary Representative Democratic Constitutional Monarchy

FTTP: 46.5%

Strategic Focus: Development of open access networks through policy creation and easing permitting processes

[76] https://www.lvm.fi/en/-/government-maintains-a-target-broadband-speed-of-one-hundred-megabits-per-second-789423

[77] http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/161434/LVM_7_19_Digital_Infrastructure_WEB.pdf?sequence=1&isAllowed=y

Sweden has some of the highest internet speeds in the world, and rightfully so, since they sit near the top of internet usage by percent of the population. Their government's philosophy is to provide broadband "utilization without experienced limitations." By the year 2025, their goal is to have 98% of homes and businesses in the country with access to internet speeds of 1 Gbps, with the remaining 1.9% and 0.1% at 100 Mbps and 30 Mbps, respectively.[78]

The government of Sweden has identified certain activities that they will take in order to reduce the cost, and in turn the time it takes, to deploy broadband infrastructure across the country in order to facilitate their broadband strategy goals. Namely, the government plans to make permitting processes more efficient, since they are currently complicated and time-consuming, affecting the willingness of telecommunication companies and municipalities to invest into the expansion of the broadband network.

In addition, Sweden has a planning and construction act that requires municipalities to include broadband infrastructure in their general and detailed plans, including the reservation of land for broadband development purposes. In 2017, Sweden's government appointed the National Board of Housing, Building and Planning to assist in increasing the competence of municipalities with respect to this act. In order to make these practices even more effective and streamline the pace at which municipalities develop broadband, the government of Sweden is planning to conduct a study into how this framework can be updated to meet the increasing demand for broadband infrastructure.[79]

[78] https://ec.europa.eu/digital-single-market/en/country-information-sweden

[79] https://www.government.se/496173/contentassets/afe9f1cfeaac4e39abcdd3b82d9bee5d/sweden-completely-connected-by-2025-eng.pdf

Continental (United States)

Land Size: 9.834 million km^2

Population Density: 36:1 People to Square Kilometre

Political Structure: Federal Constitutional Republic

FTTP: 12.0%

Strategic Focus: Streamlining permitting, leveraging federal assets, and providing gap funding

As our neighbours to the south, the United States (U.S.) offer a great comparison point for Canada since, to they are similar to Canada in terms of land size, population density, and political structure. Similar to Canada, the U.S. has a national broadband strategy called "Connecting America: The National Broadband Plan" which was created in 2010 by the Federal Communications Commission, who are responsible for broadband access, among other telecommunications related areas. The plan's main goal, among many, is to provide at least 100 million U.S. households with affordable access to 100 Mbps download and 50 Mbps upload speeds by 2020.[80] This effort would improve the connection speeds of households already connected to broadband, however, nearly one third of U.S. households don't have access to broadband connectivity.[81]

However, unlike Canada, the U.S has a federal group which was created for the sole purpose of advocating for broadband. The Broadband Interagency Working Group (BIWG), which was created in 2017 by the National Telecommunications and Information Administration (NTIA) and the Department of Rural Utilities Service (RUS), was created to work with other federal agencies to reduce the barriers to broadband deployment and increase awareness of the importance of broadband development at a federal level.

Understanding the criticality of broadband connectivity to the economy, in 2019, the U.S. government declared the expansion of national broadband a priority and created the American Broadband Initiative (ABI). This initiative involves over 20 federal agencies to streamline permitting, leverage Federal assets, and maximize the impact of Federal funding in order to provide high speed internet to tens of millions of Americans, primarily in rural areas.[82]

This initiative is set to build upon the Connecting America strategy, as well as the BIWG to encourage and expedite rural broadband development.[83]

However, political unease and growing demands for broadband have undoubtably undermined some of the nations' efforts to develop broadband across the country. This, in additional to the slow pace of broadband development at a federal level has resulted in states and municipalities taking connectivity into their own hands to address the poor connectivity in the country.

Broadband efforts in the U.S include the creation of dedicated state-level groups to support and advise on broadband, such as in Hawaii, and the creation of publicly owned networks, whether that be a state-wide

[80] https://transition.fcc.gov/national-broadband-plan/national-broadband-plan-executive-summary.pdf

[81] https://techcrunch.com/2019/07/25/nearly-a-third-of-u-s-households-dont-have-a-broadband-connection/

[82] https://www.ntia.doc.gov/blog/2019/american-broadband-initiative-expand-connectivity-all-americans

[83] https://www.engadget.com/2019-02-13-american-broadband-initiative-rural-internet-us-government.html

fibre backbone or sophisticated municipal networks created through co-ops or through a Crown Corporation, among other policies which reduce the barriers to broadband development.

The following are examples of some of these efforts throughout the U.S.

Broadband at the State Level

Hawaii

Hawaii is one of the top ranked states in the U.S. for broadband connectivity and internet speed, despite the nature of their geography and the various reliefs of the land. Hawaii is a collection of islands with a land area of 28,311 square kilometres and a population density of 86 people per square kilometre. Although their size and population density are not comparable to that of Canada's, their geography and terrain present some challenges that are similar to areas in Canada.

In 2007, Hawaii created the Hawaii Broadband Task Force "to remove the barriers to broadband access, identify opportunities for increased broadband development and adoption, and enable the creation and deployment of new advanced communication technologies in Hawaii". They recommended that Hawaii create a vision for making Hawaii globally competitive, stimulate the demand for broadband in the state, and create an authority to advance the development of broadband. In August 2011, their broadband strategy was announced and set out to connect the entire state with 1 Gbps connectivity by 2018. Currently, 97% of Hawaiians have access to broadband speeds of 100 Mbps or faster.[84]

In order to advise the state's broadband development and bring multiple stakeholders' perspectives into the planning and strategy process, Hawaii created the Broadband Assistance and Advisory Council (BAAC). Their role is to advise the director of the Department of Commerce and Consumer Affairs (DCCA), who was charged with carrying out broadband development, to increase the deployment of broadband services for all Hawaiians that are affordable and easily accessible.

North Dakota

One of the most comparable states to Canada, and Alberta for that matter, in terms of populations density, industry, and overall location, is North Dakota, which has the northernmost geographic center of the 48 contiguous states. The state, which is the 19th largest in the U.S. with a land area of 183,272 square kilometres, is also the 4th smallest in terms of population density at 3.7 people per km^2. The spread of population centres around the state and multiple rural communities is very similar to Canada and Alberta.

Despite this, North Dakota has one of the highest percentages of connectivity in the Midwest, and is in the top 20 most connected states, at 92.2% of the population connected to at least 25 Mbps speeds, with over 75% of North Dakotan's with gigabit speeds in more than 325 communities.

North Dakota has been promoting and developing broadband across the state for over 20 years. In 2009, they passed a legislation, SB 2040, that provides tax exemptions for properties used to deploy telecommunications services and broadband infrastructure, which has increased the amount of investments in broadband.[85]

The state's broadband model supports their statewide network known as the North Dakota Statewide Technology Access for Government and Education network, or STAGEnet, which focuses on providing

[84] https://cca.hawaii.gov/broadband/files/2015/01/Hawaii_Broadband_Strategic_Plan_Dec_2012.pdf

[85] https://www.nd.gov/itd/sites/itd/files/legacy/alliances/broadband/ND-Broadband-Plan-2019.pdf

broadband connectivity across the state, especially to local governments and educational institutions. By using an anchor tenant model, the state partners with local telecommunications providers to provide broadband services to rural and metro governments, who can then offer services to their communities.[86]

Broadband at the Municipal Level

With over 900 community fibre networks in the U.S., as seen in the figure below, Canada clearly lags behind, with only one community owned FTTP network offering 1 Gbps services in Olds and a handful of communities offering dark fibre such as Calgary, Coquitlam, New Westminster, and Campbell River.

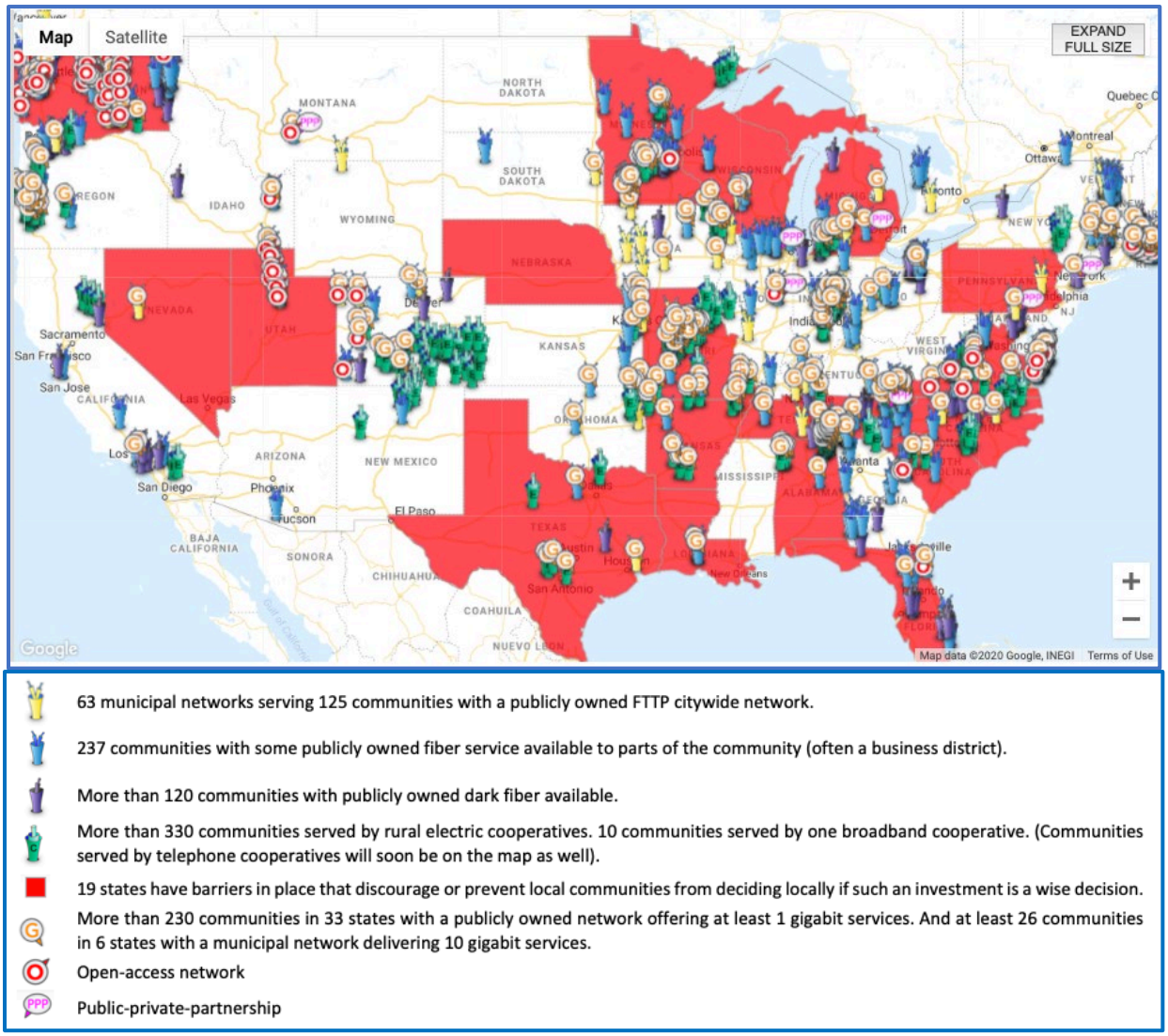

Figure 77. Municipal Networks in the U.S.

Over half of the states in the U.S. have at least one city with a publicly owned FTTH network that covers at least 80% of city residents and businesses, whether it was built through a co-op or a power-utility or some

[86] https://www.nd.gov/itd/statewide-alliances/stagenet/stagenet-strategic-goals-and-objectives

other city-owned means. These examples range from small rural municipalities to larger cities. Some the country's most sophisticated fibre networks are found in states with the worst ranked broadband connectivity and internet speeds. Below are two examples of such situations.

Ammon, Idaho

Idaho is ranked in the bottom 10 states for internet access rankings in the U.S.[87], however the small town of Ammon in Idaho is recognized as having one of the most sophisticated broadband networks in the U.S. Ammon is home to nearly 17,000 people and spans 19.3 square kilometres. They have a resident owned network with connection provided to them by local internet service providers (ISP). The technology director of Ammon attributes the success of their broadband network to treating it as a true utility, as if it were a road.[88]

In 2008, they adopted their broadband policy, which stated that broadband telecommunications are a basic, essential service. Following this, in 2011, they began development of their fibre optic network, called the Ammon Fiber Utility, which has yielded the following benefits:[89]

- The ability for the City to make changes and investments whenever they want without the permission of providers
- No risk of capital investment to extend the network since property owners finance the last mile of the connectivity
- Freedom of choice of service provider, chosen by the customers, and the freedom to change providers online anytime, without service interruption.
- Increased competition among ISPs and lower costs for residents

The City of Ammon was able to realize not only the potential financial benefits that would result directly from the investment into a truly city-owned broadband network, but they also recognized that benefits related to competition and innovations will naturally occur in the long-term, creating benefits for the community overall and building a sustainable city,

Chattanooga, Tennessee

Although Tennessee ranks in the lower half of states for internet access rankings in the U.S., [90] the City of Chattanooga boasts a sophisticated broadband network. With an estimated population of just over 180,000 people and a land area of nearly 400 square kilometres, Chattanooga is the 4th largest city in Tennessee. However, the sophistication of the Cities broadband was born out of necessity to expand the economy of the City.

Situated in the heart of Tornado Alley, Chattanooga is susceptible to power outages and loss of connectivity, which had high tech companies reluctant to invest in the area. In response, the Electric Power Board of Chattanooga (EPB), a municipally owned utility, decided to build a smart grid which would route power around any felled power line to maintain continuity of power. The implementation of this power grid

[87] https://www.usnews.com/news/best-states/rankings/infrastructure/internet-access

[88] https://www.fastcompany.com/90416863/the-city-with-the-best-fiber-optic-network-in-america-might-surprise-you

[89] https://sngroup.com/broadband-economic-case-ammon/

[90] https://www.usnews.com/news/best-states/rankings/infrastructure/internet-access

included the deployment of fibre lines which allowed the EPB to connect homes with 1 Gbps speeds relatively easily.[91]

Using the municipal utility, or Crown Corporation, model to deploy widespread broadband to its citizens created competition with the incumbent ISPs and has ignited a more competitive and innovative broadband market in Chattanooga. As a result, the advances in Chattanooga has led to advances in state policies. For example, Tennessee created the Tennessee Broadband Accessibility Act, which in 2017 created $45 million in broadband infrastructure and in 2018 was later amended to allow ISPs to utilize electrical utility infrastructure to provide internet services.[92]

Furthermore, within this Act, they have specified "State shot-clock for broadband-related permits" statute which requires the state to approve or reject all applications for broadband-related permits within 60 days of their submission.

This deployment model and associated policies have resulted in a significant increase in investment in Chattanooga due to the availability of gigabit services. The increase across various sectors is depicted in the figure below:

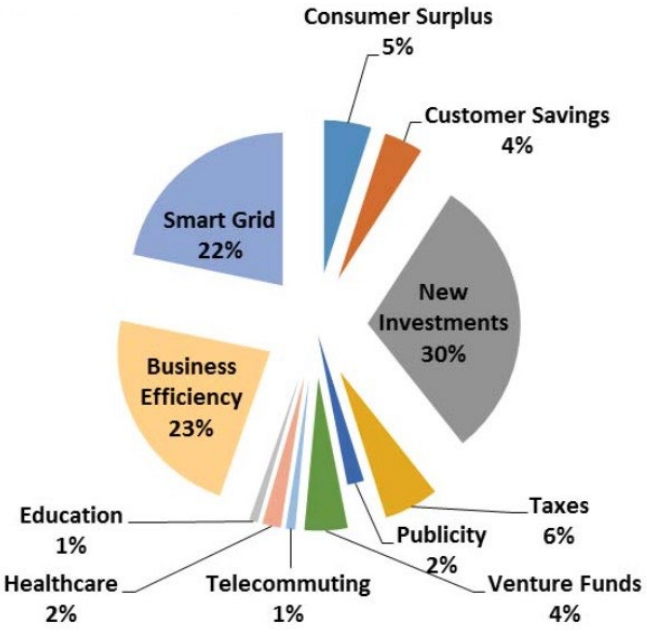

Figure 78. Increased Investment Due to Gbps Services

[91] https://www.thedailybeast.com/chattanooga-has-its-own-broadbandwhy-doesnt-every-city

[92] https://www.tennessean.com/story/news/local/2018/10/18/rural-broadband-internet-tennessee/1659004002/

National and Provincial

Land Size: 9.985 million km^2 (2nd Largest Country)

Population Density: 4:1 People to Square Kilometre (228th most densely populated country)

Political Structure: Parliamentary Democracy

FTTP: 12%

Strategic Focus: Providing gap funding for the development of broadband infrastructure

When analyzing Alberta, and Canada as a whole, it is easy to identify a common theme – efforts for broadband development and deployment are disjointed and scattered between municipal, provincial, and federal efforts. Although Canada provides funding for broadband development, there is no single source of governance for policies, initiatives, and planning across the country which results in provinces, regions, and municipalities taking measures into their own hands to address their gaps in connectivity.

In Alberta, this is apparent through the myriad initiatives, programs, reviews, and efforts taken by organizations, regions, and municipalities to address their connectivity gaps. Similarly, other provinces in Canada have also taken measures into their own hands to develop their broadband networks.

Although this method of developing broadband networks is effective at addressing the intricate needs of individual regions and municipalities, the lack of Canada-wide broadband governance creates inefficiencies. These inefficiencies are evident by our low FTTP and slower pace of deployment, especially in rural areas.

As mentioned in the Ecosystem Current State section of this report, in 2019, the Ministry of Rural Economic Development of Canada released a strategy called "High-Speed Access for All: Canada's Connectivity Strategy" which built upon their Connecting Canadians and Connect to Innovate programs. This strategy announced that through Budget 2019, up to $6 billion worth of government investment will be put towards universal connectivity in Canada. The Government of Canada plans to work with partners, such as the CRTC and private sector companies, to deliver 50 Mbps download and 10 Mbps upload speeds to 90% of Canadians by 2021, and the hardest-to-reach Canadians by 2030.[93]

Despite the country's efforts in broadband guidance and development, provinces across Canada have been and continue to address their gaps in connectivity, especially in rural areas, through regional and municipal initiatives due to the lack of clear broadband authority in the County.

Similar to Alberta, provinces have taken on initiatives to enhance broadband and have done so through various means such as the creation of Crown Corporations in Ontario and Nova Scotia, provincial funding for rural broadband development in Quebec, and the development of publicly owned broadband backbones in British Columbia and throughout Ontario to enhance their urban and rural broadband networks. The following provides further information about these initiatives across Canada.

[93] https://www.ic.gc.ca/eic/site/139.nsf/vwapj/ISEDC_19-170_Connectivity_Strategy_E_Web.pdf/$file/ISEDC_19-170_Connectivity_Strategy_E_Web.pdf

British Columbia

What sets British Columbia apart from the rest of Canada is that it has one of the country's few dark fibre utilities.

Coquitlam

The most prominent example is the Coquitlam Optical Network Corporation (QNet) in Coquitlam. Though initially deployed to control their traffic lights, in 2008 they created QNet, a corporation wholly owned by the City, to take advantage of the extra capacity of the City's fibre optic network. The network both provides highspeed access to schools, business, and residential complexes and makes dark fibre available for lease to service providers which can then add the opto-electronics and deliver their services. However, the corporation has since dissolved, and operations are being run internally by the City.[94] Following these efforts, similar networks have also become available in other parts of BC such as Campbell River and New Westminster.

The Strathcona Connected Coast Network (SCCN)[95]

The federal Connect to Innovate (CTI) program awarded $45.5 million (M) to the Strathcona Regional District (SRD) and CityWest Cable and Telephone (CityWest) to deploy a sub-sea backbone fibre-optic network that will provide backhaul connections to 154 rural and remote communities along the west coast of British Columbia (BC). The proposed routing is shown in the figure below. Of this, $32.97 M will go to SRD and provide service to 118 of these communities. SRD has established the Strathcona Connected Coast Network (SCCN) Corporation (SCCNC) to administer the program, hold the assets, and operate their portion of the network. The network is to be deployed over the 2020 to 2022 period.

Figure 79. Proposed SCCN Backhaul Network

Manitoba

Morden

In 2018, the City of Morden, Manitoba attempted to implement a municipal network called MoreNet which made news due it's intent to enable free Internet services throughout the City. [96] Morden's plans were at a

[94] https://www.tricitynews.com/news/coquitlam-winds-down-qnet-corp-but-retains-the-business-1.23955064

[95] https://srd.ca/projects/connected-coast/

[96] https://www.cbc.ca/news/canada/manitoba/morden-morenet-free-internet-1.4607183

larger scale and based on pre-5G fixed wireless equipment. Unfortunately, due to poor – and perhaps optimistic – planning, cost overruns forced the City to abandon the project in late October 2019.

Winnipeg

In 2020, Bell MTS announced that it plans to invest $400 million to bring "the fastest internet technology to Winnipeg," aiming to provide fibre connections to approximately 275,000 home and commercial locations.[97] This roll-out is a part of a large plan by Bell MTS to invest $1 billion in capital infrastructure in Manitoba. The project is estimated to created more than 1,100 direct and indirect jobs.

Winnipeg Metropolitan Region

Despite the interest from ISPs in Winnipeg, a number of other regional municipalities in the Winnipeg area have decided to take matters into their own hands. The Winnipeg Metropolitan Region (WMR), a regional growth board representing the municipalities of the region, took on the initiative of enhancing broadband connectivity. The WMR consists of 17 members, however, their broadband initiative only includes 12 of them. In order to deploy broadband in their region, the WMR created an organization called JohnQ, which is a municipal participation corporation. The organization was initially created with a flexible mandate to assist with public procurement and thereafter, JQconnect was developed with the specific goal of funding broadband projects. JQconnect represents a public-private partnership with a 50/50 partnership between a telecommunication partner and JohnQ. Ultimately, JQconnect is a for profit organization that is designed to do public good. Their goal is to initially create an open access network that provides an ROI that will allow them to continue to build additional infrastructure. Initial funding was gathered from shareholders (municipalities and the private sector), which allowed for additional borrowing from traditional lenders. They are now poised to begin their first development project.

Quebec

There are approximately 340,000 households in Quebec that do not have access to high-speed internet. In order to address this, $400 million has been allocated by the Quebec government to provide high-speed internet to unserved homes; this funding is part of a joint initiative with Ottawa called "Quebec Connected" which plans to provide service to Québécois People in multiple installments.

However, Quebec's Minister of Economic Development, Innovation and Export Trade, Pierre Fitzgibbon, announced in late 2019 that he would be taking $100 million of the $400 million allocated by Quebec to create another program called "Connected Regions" which would provide 50 Mbps speeds to 70,000 households and thousands of businesses that are underserved by current broadband infrastructure and not eligible for connection under the "Quebec Connected" program. Minster Fitzgibbon professed that this action was taken since he could not wait for the federal government to act, and if no action was taken it would be him to blame.[98]

Ontario

Ontario is the most populous province in the country with over 14 million people and a population density of 14 people per square kilometre. The majority of the province's population lives in urban areas, leaving approximately 14% of their population in rural areas. As such, Ontario has a multitude of independent projects that are occurring in order to provide better connectivity to their residents:

[97] Bell MTS Investing $400 Million to Connect Winnipeg

[98] https://globalnews.ca/news/6052008/quebec-high-speed-internet/

The Ontario Centre of Excellence in Next Generation Networks (CENGN)[99]

Funded by the Ontario government, two to three times a year, CENGN issues a challenge statement focused on different stumbling blocks to improved broadband services in rural communities in northern Ontario and invites both the communities and telecom providers to respond. The winning applications can receive up to $500,000 in grant funding to establish a 6-month trial to prove in their technology solution. Earlier this year, CENGN established a second fund focused on rural communities in the southern parts of the province.

Eastern Ontario Regional Network (EORN)

The EORN is a not-for-profit corporation that is owned by 13 municipalities in the Eastern Ontario Warden's Caucus.[100] Between 2010 and 2015, the EORN secured federal, provincial, municipal, and private sector funding to build a $175 million network to improve broadband services in Eastern Ontario, which was Phase 1 of their plan. In 2019, funding for Phase 2 upgrades and improvements was received by the Canadian, Ontario, and several municipal governments, with the rest coming from the private sector. Although the government owned 51% of the network after its completion, ownership has since been transferred to the ISPs.

WREPNet - Waterloo, Ontario

The Waterloo Region Education and Public Network (WREPNet) provides dedicated, highspeed fibre optic-based services to public sector and educational institutions in the region. The network is jointly owned by the partners which include the Region of Waterloo, the Cities of Kitchener, Waterloo, and Cambridge, and the local school boards. The network is governed by a set of committees, including a Steering Committee, a Business Planning Group, a Technical Team, and a Project Management Office who together facilitate the business and technical planning processes and ensure the WREPNet partners participate in the process to develop technical and business solutions.[101]

Peel Region– PSN

The Public Sector Network (PSN) is a dark fibre created through the partnership between the Region of Peel, the City of Mississauga, the City of Brampton, and the Town of Caledon. The network does not provide direct connectivity to residents, rather the network is leased out to ISPs and each municipality is responsible to connect their jurisdiction to the network.[102]

SWIFT

Southwestern Integrated Fibre Technology (SWIFT) is a municipally led broadband expansion project created to improve internet connectivity in underserved communities and rural areas across Southwestern Ontario. With a budget of over $200 million, they have installed 3,095 km of fibre to date. To support the sustainable, long-term development of broadband across the region, a board of advocates, known as the Western Ontario Wardens' Caucus, appoints one representative per county, for a total of 15 to liaise with the SWIFT board of directors. This ensures that the strategic direction taken by SWIFT is aligned with the strategic priorities of all stakeholders.[103]

Rhyzome Networks – Stratford, Ontario

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[99] https://www.cengn.ca

[100] https://www.eorn.ca/en/who-we-are/governance-and-accountability.aspx

[101] https://www.wrepnet.on.ca/about-us/

[102] https://pub-caledon.escribemeetings.com/filestream.ashx?DocumentId=5648

[103] https://swiftruralbroadband.ca/wp-content/uploads/2020/04/SWIFT-Governance-17-04-20.pdf

Rhyzome Networks, a Crown Corporation, was established as a data infrastructure utility wholly owned by the City of Stratford. Rhyzome provides both provides city-wide Wi-Fi services off of a mesh Wi-Fi and fibre system and wholesale access to both its Wi-Fi and fibre assets to other service providers.

Nova Scotia

The Province of Nova Scotia established Develop Nova Scotia (DNS) as a Crown Corporation '*responsible for developing and implementing a strategy to provide high-speed Internet access to unserved and underserved Nova Scotians. The Internet for Nova Scotia Initiative strategy will see high-speed Internet access available to more than 95% of Nova Scotia residences and businesses.*' [104] DNS was given the responsibility to manage a $193 million Internet funding trust to help connect communities, homes, and businesses across the province, and rural areas in particular.

A total of 15 pre-qualified organizations were selected by the DNS to execute their Internet for Nova Scotia Initiative which is set to begin projects in some communities in 2020, providing minimum speeds of 50 Mbps for wired connections and 25 Mbps for wireless connections.[105]

Alberta

Alberta has a number of unique initiatives that have been completed in recent years and this section provides a brief overview of each.

Regional Economic Development Authorities (REDAs)

Alberta SouthWest Regional Alliance (AlbertaSW)

Pre-dating the Community and Regional Economic Support (CARES) program, the Alberta SouthWest Regional Alliance was the first REDA to develop a regional broadband strategy encompassing member municipal districts and counties. Waterton National Park now has fibre-based wi-fi and triple-play services throughout the Waterton townsite and Cardston County is looking to be the first '*gig*' county in Canada. Cardston County is currently working with CCI Wireless, a local ISP. Other communities such as Fort Macleod, Nanton, Nobleford, Pincher Creek, Raymond, Stirling and others elected to go with Axia Connect and have since come under the TELUS umbrella.

Central Alberta Economic Partnership (CAEP) / Battle River Alliance for Economic Development (BRAED)

CAEP and BRAED joined forces to initiate engagement sessions focused on options to enhance broadband services throughout the region. This was followed by a set of community engagement sessions. Business Case development work for those communities most interested in moving forward concluded in early 2019.

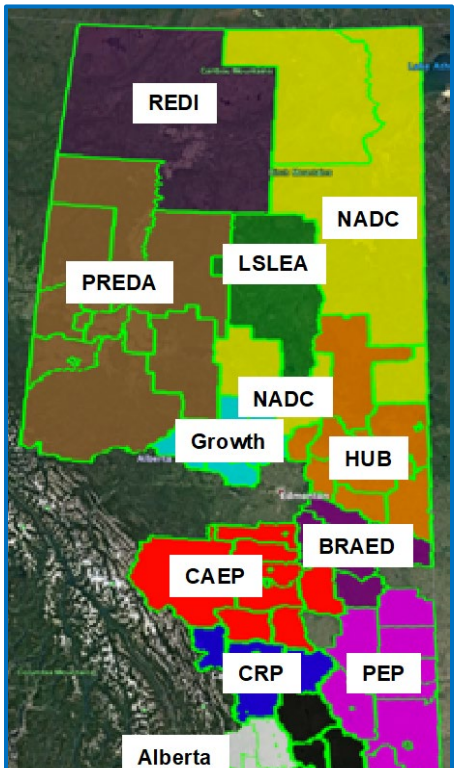


Figure 80. REDA Studies

[104] https://developns.ca

[105] https://developns.ca/projects/high-speed-internet/

Since then, Red Deer and Clearwater Counties are moving forward with a pilot fibre deployment.

Northern Alberta Broadband Preparedness Study

Including: Alberta HUB, Grizzly Regional Economic Alliance Society (GROWTH Alberta), Lesser Slave Lake Economic Alliance (LSLEA), Northern Alberta Development Committee (NADC), Peace Region Economic Development Alliance (PREDA), and Regional Economic Development Initiative (REDI) for Northwest Alberta

Covering half the Alberta landmass and easily the largest study of its kind in the province, the Northern Alberta Broadband Preparedness Study was jointly led by Alberta HUB and the NADC. The year and half study wrapped up in August 2018 and the results are available on the NADC website[106]. Since the study was completed, follow-up work has been undertaken by Big Lakes County and the Vermilion River Regional Association. Over the past few months, RFPs focussed on improving network services were issued by the County of Grande Prairie, Northern Sunrise County, the MD of Greenview, and the Regional Municipality of Wood Buffalo.

Palliser Economic Partnership (PEP)

After initially partnering with CRP, PEP established its own program to develop both a broadband strategy and business cases associated with potential deployments in each of its four sub-regions – Newell, Cypress, Forty Mile and Special Areas with Acadia. The work led to the development of a Southern Alberta Connectivity Initiative which has expanded beyond the region. The work should be completed by mid-2020.

SouthGrow Regional Initiative (SouthGrow)

Starting with an initial focus on developing an inventory of fibre assets in the region, SouthGrow followed up with community engagement sessions, and completed a review of the options available to enhance broadband services in the region in mid-2019.

More interestingly, SouthGrow then sponsored a cost/benefit study of the impact of broadband in rural Alberta. The study was done by the University of Lethbridge and the results were released in October 2019. According to the study, a high-speed Internet access in rural Alberta municipalities could pay back $3.50 for every dollar spent to deploy the network.[107]

Counties, MDs, and Special Areas

Big Lakes County – with Smoky River and Lesser Slave River

Since the completion of the Northern Alberta Broadband Preparedness study, Big Lakes has been working with High Prairie, Swan Hills, and its neighbours to complete a regional business case focused on deploying a utility-based fibre network and making it available to Internet service providers (ISPs) on an open-access basis. The studies are essentially complete, and the focus now is on developing two pilot projects, one in High Prairie and one in Joussard.

[106] http://nadc.ca/our-actions/initiatives/broadband-preparedness-project/

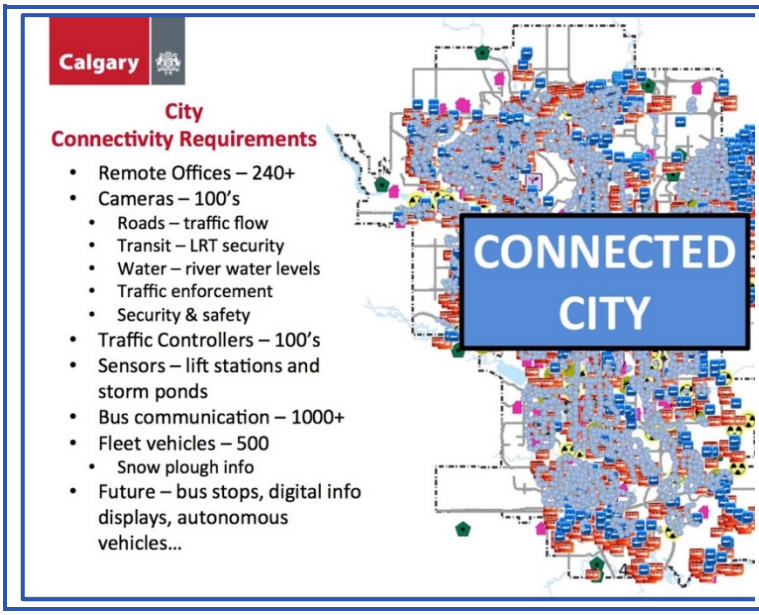
[107] Tran, K.C., et al; *A Cost-Benefit Analysis of Alberta Rural Broadband Deployment*; SouthGrow; 2019-10.

Municipalities

City of Calgary

Between 1997 and 2013, the City built and owned a private fibre network as a business unit (Envision) under its power corporation – Enmax. In 2013, the City sold this fibre network for $225.0M to Shaw.[108] Fortunately, not all the fibre assets came under Enmax control and those that did not were retained by the City for its internal use.

When the City of Calgary began evaluating its connectivity requirements, it found that thousands of connections would be needed. A summary of their requirements appears in the figure below.[109]



Business Unit	# CIRCUITS
Network Management	198
Calgary Transit	121
MPLS	88
Calgary Police Service	60
Traffic Management	101
ITS Storage Mgmt	29
Water Resources and Water Services	26
Public Safety Communications	9
Telecom Services	11
Calgary Parking Authority	17
Calgary Fire Department	21
Assessment Review Board	6
University of Calgary	5
Corporate Properties & Buildings	14
Election and Information Services	3
Tri-Services Building	1
City of Calgary Corporate Security	20
Recreation	5
Animal & Bylaw Services	6
Parks	7

Figure 81. The City of Calgary's Connectivity Requirements

They found their four biggest challenges to be managing right-of-ways, remaining cost effective, protecting the City's ability to self-provision services, and that community inequities were inevitable.

The solution space, they decided must involve:

- Ownership
- Protecting Rights-of-Way and Support Structures
- Fair and Equal Access
- Accessibility to all Communities
- Choice for the Community

The City then began developing an infrastructure strategy that involved:

- Accelerating fibre to stranded City facilities
- Proactive approach with greenfield

[108] https://www.enmax.com/news-events/news/shaw-to-acquire-enmax-envision

[109] Basto, D.; Fibre Strategy; City of Calgary; 2015-09.

- Develop a model for greenfield business parks – e.g. Aurora and Transit Oriented Developments
- License excess capacity to fund future fibre builds and cover operating expenses

When the City analyzed the cost to deploy 144-strand fibre cables to meet its internal needs, it realized it could up the count to 288-strands and make the additional fibre available to third-parties providers for an additional 6% – which could be covered by leasing fees.

In September 2016, the City adopted a fibre strategy[110] with which it planned to deploy sufficient fibre to meet all projected internal requirements as well as those of third-party providers which could lease the dark fibre on an as needed basis. In this way, it simplified management of its rights-of-way and minimized street furniture and construction related traffic disruptions.

Town of Olds

After a decade of work developing a full-service triple-play (voice, Internet, and television) fibre initiative to every home and business in Olds, over the summer of 2013 Olds became the first and only local community in Canada to provide Gb/s services.[111] The passive, dark network assets belong to the Olds Institute for Community & Regional Development (OICRD), a non-profit society founded on a partnership between the Town of Olds, Olds College, The Olds Chamber of Commerce, and the Olds' Exhibition society, and is charged with all aspects of economic development. To both light the network and provide triple-play services, the OICRD established a for-profit subsidiary, branded O-Net. O-Net is now available to provide services and back-office support to any community in Western Canada that deploys a local fibre network.

Figure 82. O-Net

Town of Vermilion

Over the past several years, the Town of Vermilion has been working diligently to improve broadband services within the footprint of the Vermilion River Regional Association (VRRA). Due largely to financial constraints, it's moved from an initial focus on fibre to a converged – hybrid fibre-wireless – network approach using the Infrastructure-as-a-Service (IaaS) model from Connect Mobility. At this point, though, the Town plans to have an initial pilot in its south industrial area up and running by summer 2020. If successful, the infrastructure will gradually be extended throughout the Town and then to other VRRA communities.

Village of Viking

Being frustrated with available service levels within their town, the Town of Viking decided to become their own wireless ISP and do so using FWA technology. To increase service levels, they arranged to mount an AP on the highest structure in town and point the antenna down to concentrate the coverage area on the town itself and thereby provide the strongest signal to their residential and business premises.

The configuration appears in the figure below The AP is mounted on the Providence grain elevator (under the red arrow) and connected via a point-to-point (PTP) wireless backhaul link (shown in red) to SuperNet fibre at the Town office. Subscriber flat panel antennas are required to receive service and the bi-directional white arrows in the figure illustrate typical subscriber links. Together with close to line-of-sight subscriber connections and a limited footprint, the Town is able to provide 50 by 50 Mb/s services throughout Viking

[110] Chief Financial Office – Information Technology; The City of Calgary Fibre Infrastructure Strategy; 2015-05-05.

[111] Chung, Emily; Small Alberta town gets massive 1,000 Mb/s broadband boost; CBC News; 130719.

and its environs.[112] Service management has been outsourced to Nutec Electro Tel and available service offerings are shown in comparison with those from MCSNet and TELUS in the figure below.

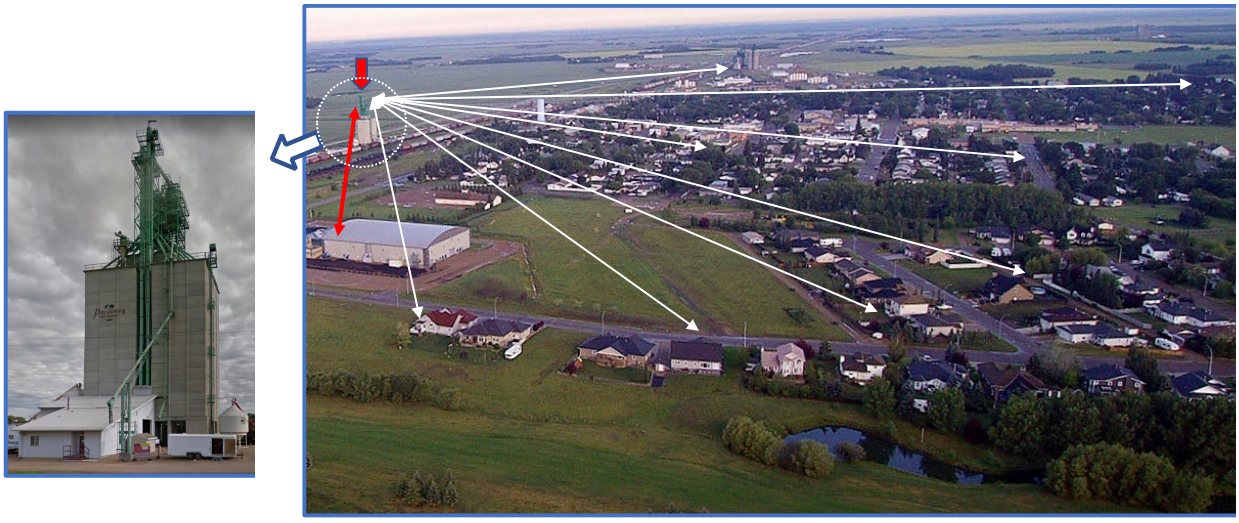


Figure 83. Fixed Wireless in Viking, Alberta

	Town of Viking			MCSNet			Telus	
							Internet 25	Internet 15
Download speed	50 Mbps			12 Mbps	20 Mbps	20 Mbps	25 Mbps	15 Mbps
Upload speed	50 Mbps			1.0 Mbps	2.0 Mbps	2.0 Mbps	5 Mbps	1 Mbps
Term:	36 Month Term			24 month Term plan			No Term	
Equipment Installation	$99.00			Free with Term plan			$100.00	
Data useage*	Basic*	Advanced*	Ultimate*	Ultra	Extreme	Extreme750	Internet 25	Internet 50
	250 GB**	500 GB**	750GB**	300 GB	500 GB	750 GB	300 GB	200 GB
Monthly Internet Fee:	$59.99	$89.99	$139.99	$79.95	$99.95	$149.95	$80	$75

Figure 84. Town of Viking Internet Service

[112] Harcourt, Patricia; *Viking offering high speed Internet to residents*; the Weekly Review; 2019-06-14.

Desired Future State

In understanding the exponential nature of technology and broadband development, and in understanding that the Edmonton Metropolitan Region is falling behind at both the international and national levels, the following Desired Future State represents an aspirational goal that was developed in collaboration with EMRB administration and represents an ideal future state in the context of broadband:

Table 34. EMRB 2025 Desired Future State

Desired Future State
By 2025, EMR municipal and ecosystem stakeholders will work in a collaborative and coordinated fashion to enable the deployment of broadband network infrastructure. This infrastructure will provide ubiquitous access and connectivity at rates up to and beyond 10 Gbps. *This coordinated and focused approach will be a catalyst for regional digital transformation, it will maximize socioeconomic benefits, and it will establish the EMR as a Smart Region.*

The Desired Future State represents a path to developing world-leading broadband infrastructure and realizing the associated socioeconomic benefits that will result. The aspiration is informed by lessons learned from best practices and takes into account the collaborative and coordinated approach world-leading jurisdictions take and sets access and speed targets that are in-line with their ambitious goals.

The 5-year time frame was created as many other regional approaches to broadband deployment in Canada took a similar length of time to coordinate. Moreover, broadband deployment and development is occurring in many other jurisdictions around the world at a rapid pace, and if swift and immediate action is not taken, then the Region and Canada will continue to fall behind.

Collaboration is another key component of this goal. Firstly, it falls in line with EMRB Growth Plan guidelines and secondly, Jurisdictional Scan findings show that successful deployment does not occur without collaboration across the ecosystem, and in most cases, does not occur without private sector expertise.

The 10 Gbps target was set as this represents the most ambitious goals from across the world. In consideration of investment attractiveness and readiness and in being able to harness the next generation of technology, it is not enough to simply close service gaps, it is imperative to go above and beyond as we move toward a digital world.

6. Gap Analysis and Recommendations

Gap Analysis

In order to achieve the Desired Future State, there are a number of gaps that need to be bridged. These have been brought to light through comparing the Desired Future State to the findings of the Current State Analysis and the Jurisdictional Scan. These are discussed in-length within each of the respective sections and are summarized here as they inform key recommendations:

Key Gaps Identified through the Current State Analysis:

- Municipalities approach network development on an ad-hoc and individual basis, often in silos
- Municipalities are generally unaware of the breadth of deployment options available
- Municipalities are not applying for federal funding
- Municipalities in the Region lack broadband engineering and development guidelines
- SuperNet is utilized for public buildings, however, municipal operation buildings are connected with municipal-owned fibre
- ISPs do not share their infrastructure plans

Key Gaps Identified through the Jurisdictional Scan:

In order to enhance their broadband connectivity and develop their broadband infrastructure, world-leading jurisdictions do the following:

- Create **Governing Bodies** to understand broadband needs, provide guidance, and advocate for, facilitate, and help fund broadband development
- They may also create **Crown Corporations** to execute broadband mandates and to develop and deploy broadband on large scale on behalf of governing bodies
- They have **Coordinated Long-Term Regional Strategies** that recognize broadband as a utility and consider both demand and supply side policy development, ensuring that their citizens are prepared and educated in how to utilize the internet and ensuring that connectivity is provided
- They develop broadband strategies and policies have a focus on **Increasing Competition** through ensuring monopolies do not develop and ensuring prices remain competitive through structural separation
- In rural areas, or where limited provincial/state and federal funding is available, they often develop **Municipally Owned Networks** that provide affordable connectivity to residents and increase competition
- They **Reduce Legal and Policy Barriers** such as the number, complexity, and process time of permits, streamlining both permit submission and approval processes
- They provide **Tax Exemptions** for landowners who have broadband infrastructure developed on their land and for developers

In synthesizing these overarching gaps and findings, the following Regional Gaps were developed:

Table 35 Regional Gap Analysis

Regional Gap Analysis	
	Regional Vision: The Region lacks a unified and accepted future state vision for broadband.
	Regional Strategy: The Region lacks a unified strategy to enable the enhancement and deployment of broadband infrastructure.
	Regional Advocacy: Although several organization advocate for enhancement of policy and funding frameworks, these efforts lack a singular voice.
	Clear and Cohesive Policies and Guidelines: The Region lacks broadband friendly policies and guidelines that ensure broadband infrastructure is deployed economically.
	Education and Enablement of Municipalities: There is no coordinated effort to educate the Region's municipalities on their broadband options and ability to receive funding.
	Regional Collection of Data: Although infrastructure and connectivity data is collected by individual municipalities and by the Provincial and Federal government, the Region does not have an aggregated data set to understand all broadband infrastructure and connectivity levels in the Region.

Through the extensive research completed for this report, the above gaps were identified as key items that need to be resolved in order to achieve the Desired Future State. Bridging these gaps ensures adequate supply of broadband connectivity is available to support a shifting economic landscape that requires diversification in order to remain resilient into the future.

Recommendations for Consideration

Three overarching key recommendations have been developed in light of the Gap Analysis for consideration by the EMRB. These are for EMRB to: 1. **Develop a Regional Voice (Ongoing)**, 2. **Create a Regional Strategy**, and to 3. **Implement the Regional Strategy**. An overview of these recommendations is provided below, with additional detail provided in the remainder of this section.

Table 36. 1. Develop a Regional Voice

1. Develop a Regional Voice	
	Coordinate regional advocacy efforts
	Educate and enable municipalities
	Build, monitor, and report on regional broadband data
	Set the foundation for a Regional Strategy

In the short-term and ongoing, the EMRB should focus on **Developing a Regional Voice**. Through these set of recommendations, EMRB will lay the foundations for enhancing broadband in the Region and will begin to establish itself as a key continuing player in the broadband ecosystem. The recommendations within are designed to continue the momentum that has been built through development of the Broadband Situation Analysis and will serve as a key indicator to the Region that the EMRB recognizes the gaps that exist and are willing to assist. Although these recommendations are meant to be actioned in the short-term, it is recommended that the EMRB continue to play an ongoing lead role until responsibility is taken on by another entity.

Table 37. 2. Create a Regional Strategy

2. Create a Regional Strategy	
	Integrate broadband into the Growth Plan as a critical enabler
	Integrate broadband considerations into EMRB initiatives
	Create a Regional Broadband Strategy

In the more intermediate term, the EMRB should focus on **Creating a Regional Strategy**. These recommendations will solidify broadband as a key focus area for EMRB and, as such, are key in securing the Region's future growth. The recommendations within are designed to weave broadband into the various strategies and initiatives that the EMRB develops and leads, and ultimately developing a true coordinated approach that addresses how broadband should and will be developed in the Region. A 1-4-year timeline is possible for developing and implementing these recommendations as extensive consultation will be required to meaningfully develop the appropriate approach.

Table 38. 3. Implement the Regional Strategy

3. Implement the Regional Strategy	
	Implement the Regional Broadband Strategy to enable the deployment of broadband, achieve the Desired Future State, and realize the socioeconomic benefits.

In the longer-term, the EMRB should **Implement the Regional Strategy**. The EMRB has myriad of options to choose from in the role it plays in enhancing connectivity in the Region, from continuing to coordinate advocacy efforts to directly enabling the deployment of broadband. It is important for the pros and cons of all options to be weighed appropriately against one another and it is important that a coordinated and unified voice is taken in order to ensure no regional member is left behind.

The following sub-sections delve into the details of each of the recommendations described above.

1. Develop a Regional Voice

To Develop a Regional Voice, there are four key recommendations: Coordinate Regional Advocacy Efforts, Collect and Monitor Data, Educate and Enable Municipalities, and Set the Foundation for a Regional Strategy.

Coordinate Regional Advocacy Efforts

EMRB should advocate for policy and funding frameworks that encourage and enable more capable broadband infrastructure to be deployed. In doing so, the following are key items for consideration:

- **Identify legislative and regulatory barriers:** Leverage the efforts of Edmonton Global, RMA, AUMA, FCM, and, more recently, FERIC and GERCC to promote the development and implementation of policies that encourage and enable more capable infrastructure to be deployed on a basis that encourages inclusion, economic development, services innovation, and entrepreneurship.
- **Advocate for funding and grants:** Leverage collaborative partnerships with ecosystem organizations to advocate for funding and apply for the various grants available through the Provincial and Federal Governments.
- **Advocate for increased competition through structural separation:** As structural separation is a key contributor to nations with the highest levels of broadband penetration and service-based competition, at the federal level, advocate for the abandonment of the Federal policy of facilities-based competition.
- **Advocate for exploring broadband networks as a utility:** Work to establish policy and financial frameworks to recognize and enable broadband networks to be provided on a (fourth) utility basis. At a minimum, funding and debt limit policies at the provincial and federal levels need to be updated to help enable municipalities to deploy the required infrastructure.

The above items were chosen as these were key items that bred success for world-leading jurisdictions.

Collect and Monitor Data

EMRB should continue to collect and monitor infrastructure and connectivity data, beyond the data included within this report, to track progress and enhance open-data policies to secure and capitalize on the data collected from deployed smart regional infrastructure.

- **Collaborate with Service Alberta, Regional Municipalities, and ISPs** to gather and collect regional infrastructure data. Service Alberta has already begun this initiative and collaboration and coordination with their efforts is paramount to ensuring a clear regional and Provincial picture is established.
- **Deploy a CIRA Speed Test** through a coordinated Regional effort to understand the discrepancy between advertised and actual speeds. Collecting this data provides greater clarity and insight of where problem areas may exist in the Region and can identify areas where additional infrastructure is needed.
- **Define measurements to track and measure success,** focusing on parameters of most interest to the EMRB. Potential key performance indicators might include percent inclusion, service take rates, diversity of institutions on the network, financial stability, new business creation and investment, mutually beneficial partnerships, and community engagement.

As the networks rollout, include smart region Internet of Things (IoT) devices that will enable public and private operational efficiencies and enhance quality of life throughout the region.

Educate and Enable Municipalities

Provide access to the resources, tools, and data regional municipalities require to understand and navigate the broadband space, community enablement, and digital transformation.

- **Utilize the Broadband Situation Analysis** to provide key information on the current state of broadband in the Region and in the world and provide information on key enabling broadband technologies and how they are evolving. Through tracking these developments, the EMRB can continue to update the Desired Future State and ensure the Region does not fall behind. Throughout the course of writing the Broadband Situation Analysis, the landscape has already changed and continues to evolve.
- **Continue to produce webinars** from the content within the report and through inviting ecosystem stakeholders and key national and international jurisdictions to provide updates and key learnings. In first instance, it is recommended that a webinar or presentation is coordinated with the Winnipeg Metropolitan Region, as their broadband efforts can shed light into how a Growth Management Board can manage and deploy this critical infrastructure.
- **Consider the need for enhancing digital literacy** among citizens, as this is a key factor in ensuring broadband and the internet are utilized to their full potential, and in ensuring the knowledge economy continues to grow. In analyzing strategies of world-leading jurisdictions, often supply and demand of broadband and the internet are mentioned. On the supply side of the equation is the development of broadband infrastructure that provides access to the internet and connectivity. On the demand side of the equation are the businesses and citizens that utilize the internet and educating them on how to utilize it to its full degree is key to ensuring economic benefits are realized.

Set the Foundation for a Regional Strategy

Bring the Region's municipalities and ecosystem stakeholders together to realize synergies between individual municipal broadband enhancement efforts and to inform Provincial and Federal strategy and funding efforts.

A potential forum or conference would serve as a conduit for short-term recommendations and would serve as an incubator of ideas that feed into medium and long-term recommendations. At a minimum, it is recommended that the ecosystem stakeholders identified through the Broadband Situation Analysis are invited, and consideration should be given to inviting key private sector organizations.

Figure 85. Regional Municipalities and Ecosystem Stakeholders

2. Create a Regional Strategy

Update the Growth Plan

As the Growth Plan is to be updated in the coming years, integrate the Desired Future State through regional policy. Officially recognize that digital infrastructure is a horizontal enabler of all six Policy Areas and critical to achieving the outcomes of the Growth Plan and realizing socioeconomic benefits outlined within this report.

Table 39. EMRB 2025 Desired Future State

Desired Future State
By 2025, EMR municipal and ecosystem stakeholders will work in a collaborative and coordinated fashion to enable the deployment of broadband network infrastructure. This infrastructure will provide ubiquitous access and connectivity at rates up to and beyond 10 Gbps. *This coordinated and focused approach will be a catalyst for regional digital transformation, it will maximize socioeconomic benefits, and it will establish the EMR as a Smart Region.*

As discussed at length throughout this report, broadband is critical to the Region's growth and its criticality will only grow into the future. As the EMRB Growth Plan sets objectives for the Regions growth to 2044, the EMRB is in a unique position to ensure a long-term strategy is established for enabling this critical economic catalyst.

Integrate Broadband within EMRB Initiatives

As broadband is a horizontal enabler of all Policy Areas within the Growth Plan, it also has many overlaps with EMRB's ongoing initiatives. Key consideration should be given to integrating broadband with these initiatives and below are high-level overlaps that exist:

MRSP: Broadband is a catalyst for enabling efficiencies through harnessing innovation across the focus service areas (Solid Waste, Storm Water, Fire/EMS, and Emergency Management). There is an opportunity that Broadband may be included as a service area through the creation of a regional collaborative. Regional broadband engineering policies and guidelines could be established and promoted.

IRTMP: The future of transport will be shaped by the development of smart and autonomous vehicles that rely on enhanced broadband and 5G connectivity. In addition, the development of transportation mobility networks creates an opportunity for broadband infrastructure deployment.

RAMP: The future of agriculture is being shaped by connected and precision farming. Ensuring capable broadband infrastructure is deployed in key agricultural and employment areas will enable this important industry, both from a production and value-added perspective.

SISB: Broadband infrastructure deployment is an initiative that can benefit the Region as a whole and, as such, may attract investment from many regional partners. Broadband infrastructure deployment may be a key pilot project for testing the SISB framework. SISB could be a catalyst for broadband deployment, making the Region investment ready.

Develop a Regional Strategy

A key gap seen in the Region was the lack of a coordinated longer-term strategy to deploy broadband. As such, a key recommendation for EMRB's consideration is to develop a longer-term strategy that identifies a framework to create and harness synergy amongst the many individual member broadband related initiatives and the various broadband stakeholders. This Strategy would encompass key aspects of recommendations provided and set the long-term direction for the governance and deployment of broadband infrastructure.

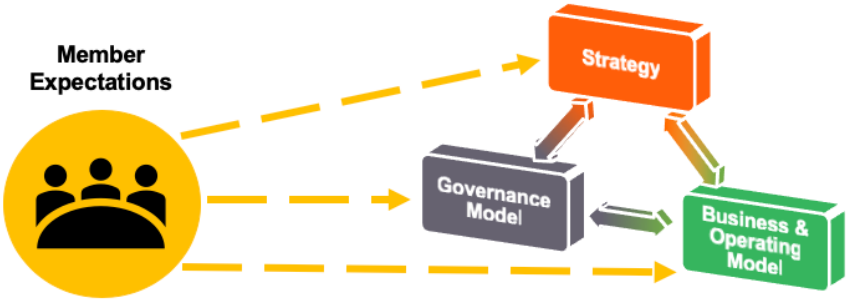


Figure 86. Key Components of a Regional Strategy and Action Plan

The first key consideration for EMRB is to decide whether or not, and to what extent they desire to be involved in broadband infrastructure deployment. If there is appetite to be directly involved in broadband deployment than EMRB should consider the spectrum of deployment options that are available. These are discussed in detail in *Appendix E: Business Models for Municipal Fibre Deployment* and Figure 87 provides a

depiction of the options and where they are currently being employed. Expectations will then drive the framework on which to move forward.

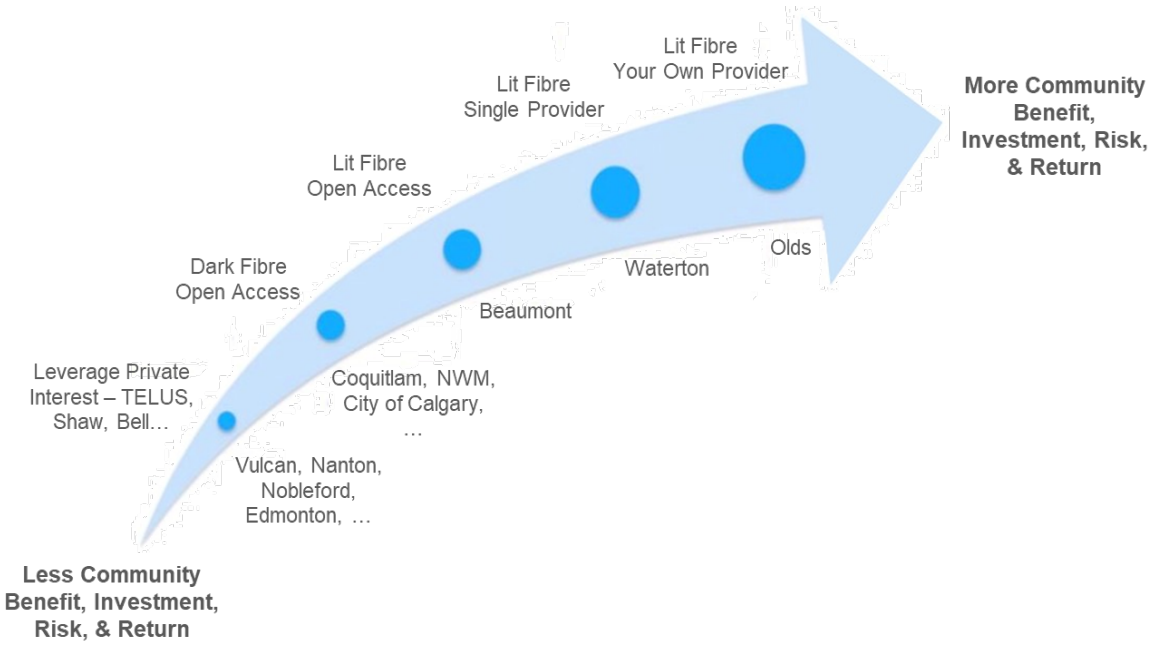


Figure 87. Business and Operating Model Options

If it is decided by EMRB that deployment will be left to status quo, then the Strategy can still address and build upon a number of the key recommendations provided within the overarching recommendation of Developing a Regional Voice.

3. Implement the Regional Strategy

Once the Regional Strategy is established, the natural next step is implementation. If the path forward for EMRB is to be involved in the deployment of broadband infrastructure, then the coordination and implementation of the Regional Broadband Strategy would explore options for the establishment of a collaborative framework. There are five high-level options for consideration and the choice depends on the design criteria the EMRB values most. The five options for consideration and exploration are described in the table below.

Table 40. Governance Model Options

Governance Model Options	Key Features
Growth Management Board	• All member municipalities enter into an inter-municipal agreement for the investment, development, and provision of the network and services. • This can serve as an incubator for the development of the additionally listed options
Regional Authority	• A selection of member municipalities enter into an inter-municipal agreement for the investment, development, and provision of the network and services.

	• An Oversight Committee is created but operates in an advisory role only. Accountability rests with municipal councils. • Owned and funded by member municipalities based on agreed upon funding, ownership, and financial management formula. • Requires a managing partner municipality to hold the assets.
Regional Commission	• Municipalities request the Minister of Municipal Affairs to establish a commission • Separate legal entity owned and funded by member municipalities. Can hold assets and borrow funds. • Board comprised of elected officials across member municipalities • Any financial surpluses may not be distributed back to member municipalities
Cooperative (ODC)	• The best option for a large group of stakeholders looking to collaboratively address their region's needs. • Three or more persons who desire to create a business organization who want to use services as a group, have an equal say in how the business is run, and share in any profits. • Provides services as a separate legal entity and can own assets, hire staff, and raise capital. • Overseen by a Board of Directors. • Flexible share structure.
Municipal Controlled Corporate	• Separate legal entity owned, funded, and controlled by one or more municipalities for the purposes of providing regional facilities or services. • Provides services as a separate legal entity and can own assets, hire staff, raise capital, and distribute profits. • Board of Directors can be mix of industry professional & elected officials. • Formation requires the approval of the Minister of Municipal Affairs.

In considering each of the options available for governing broadband deployment, the following matrix provides an evaluation of the pros and cons of each. This matrix is provided for consideration only, and it is recommended that each governance model option is explored further with appropriate legal counsel when/if it is appropriate to do so.

Table 41. Governance Model Option Comparison

Design Criteria	Growth Management Board	Authority	Commission	Cooperative	Corporation
Simplicity	High	High	Medium	Medium	Low
Flexibility	Low	High	Low	Medium	High
Municipal Control	High	High	Medium	Medium	Low
Funding Capacity	Low	Low	Low	Medium	High
Operational Depth	Low	Low	High	High	High
Expansion Ability	Low	Medium	Medium	High	High

Build Upon Momentum

The recommendations developed for EMRB's consideration represent key actions that need to be taken to resolve connectivity gaps in the Region and ensure its resiliency and socioeconomic growth in the long-term. The Broadband Situation Analysis has shown that there are significant benefits to enhancing connectivity in the Region, that service and strategy gaps exist, and that the leading jurisdictions in the world are significantly outpacing the EMR, Alberta, and Canada.

As such, it is imperative for EMRB to build upon the significant momentum that has been established through the regional conversations that have taken place over the course of the development of this Analysis. EMRB plays a unique role in bringing the Region together and in developing plans that ensure its growth over the long-term, irrespective of external factors. This unique position is one that makes EMRB well poised to tackle the enhancement of broadband connectivity and create a meaningful and lasting impact on the future prosperity and quality of life for all residents of the Region.

Appendices

Appendix A: SROI Methodology

Methodology

Social return on investment

Projects such as broadband connectivity upgrades have an impact on the economy beyond private sector considerations. SROI enables a wider set of considerations outside of solely financial costs and benefits. This is of significant importance in the evaluation of projects where the benefits are generally not just financial in nature. It enables the assessment of the social, environmental, health and economic outcomes.

SROI uses monetary values to represent the environmental and social values of the investment, which makes

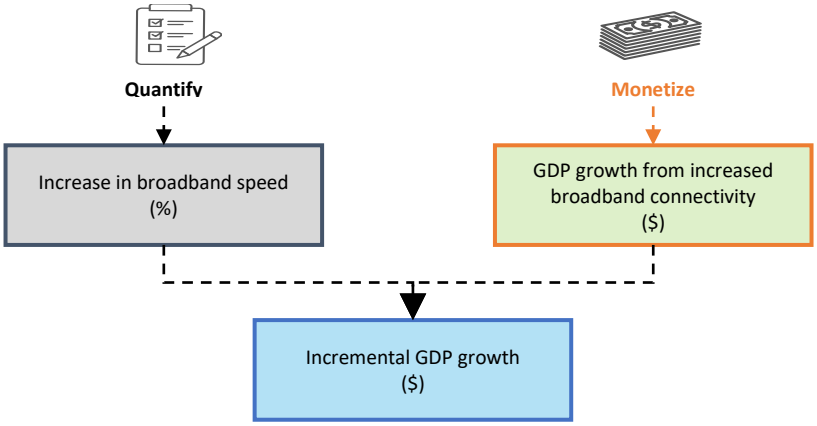


Figure 88. Monetizing Social Cost of An Investment

it comparable and additive to the project's financial impact. SROI monetizes – estimates a dollar value – for various environmental and social benefits and costs that would be relevant to the investment. The figure below depicts a simplified monetization process.

In order to monetize a specific social value, a strong evidentiary basis for monetization is required since the results of the analysis is directly impacted by these estimates. As such, ideally, analysis should only include social impacts that can be quantified or monetized credibly, backed by data and/or relevant literature.

Additionally, given the uncertainties associated with the social value estimates, it is essential to capture the inherent risk in the assessment. Taking into account the uncertainties in the underlying analysis provides a more comprehensive evaluation of the project.

Monte Carlo simulation

Monte Carlo simulation, a risk analysis tool, is used to account for the uncertainty in both input variables and outcomes. This method provides the opportunity to consider risk on a comprehensive basis by defining model inputs (i.e. assumptions) on a probabilistic as opposed to a deterministic basis. That is, based on the ranges of estimates, a Monte Carlo simulation provides the probability or likelihood of reaching various outcomes within the range, as illustrated in a schematic diagram below.

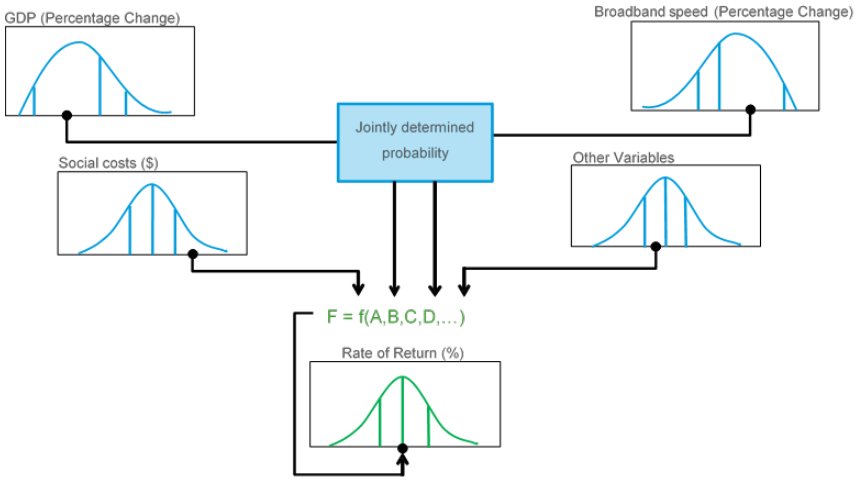


Figure 89. Illustrative Schematic Diagram of Monte Carlo Simulation Relationship Function and Variables

To account for inherent risks associated with the model used to estimate economic growth, a Monte Carlo simulation running 10,000 simulations to probabilistically define the income elasticity factor and the average download speed input was used for each Region. More specifically, a Pareto distribution was used that defines the minimum and maximum to get the range of possible values. This distribution has a long tail with a mean value closer to the minimum value of the range defined. Each simulation uses the distribution defined to randomly select an elasticity factor and an average download speed for each Region.

Increased household benefits methodology

The graphic below depicts the methodology used for calculating incremental household benefits of broadband infrastructure deployment.

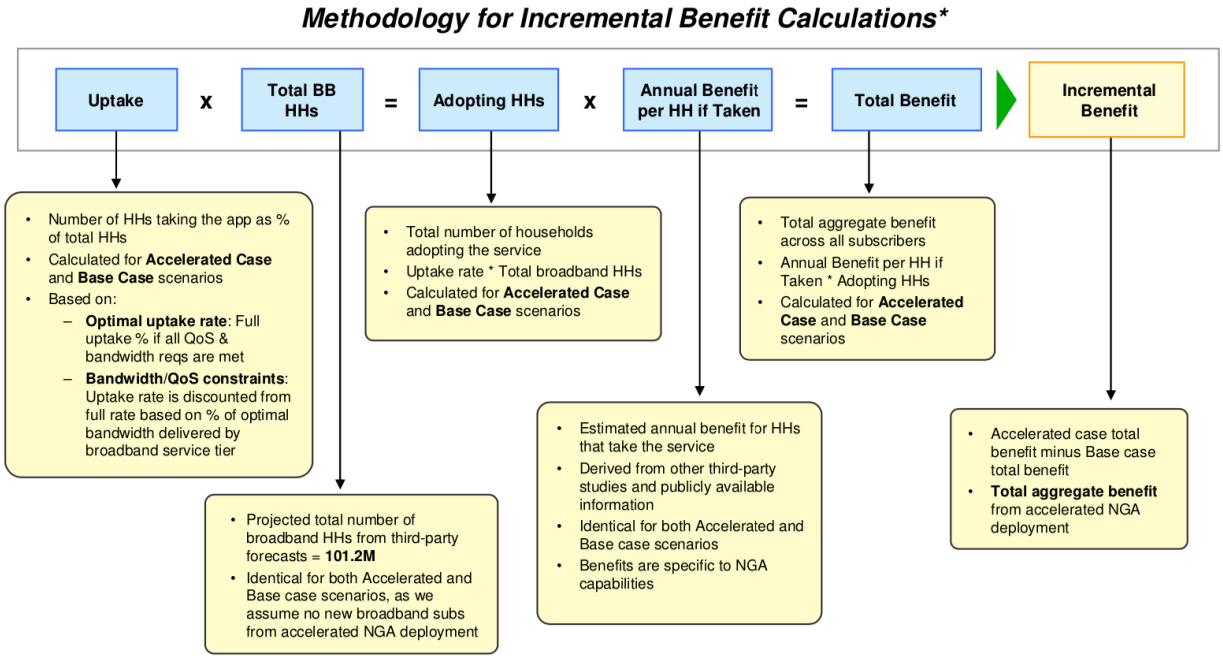


Figure 90. Methodology for Incremental Benefit Calculations

Economic impact of broadband connectivity under each scenario

Scenario 1 – Average 50 Mbps download speed

The figure below displays the distribution of the GDP impact under scenario 1, average download speed of 50 Mbps. The S-curve in the diagram shows the confidence interval of the impact given the distributional assumptions for the input variables. At any point along the curve, it shows the probability of not exceeding a specific value.

The results are shown with a 90% confidence interval, which indicates that the range of values for the GDP impact can be expected with a 90% certainty. This means that there is a 5% chance that the GDP impact will not exceed $144 million and a 95% chance that it will not exceed $412 million. The mean expected value of the GDP impact under scenario 1 is $271 million.

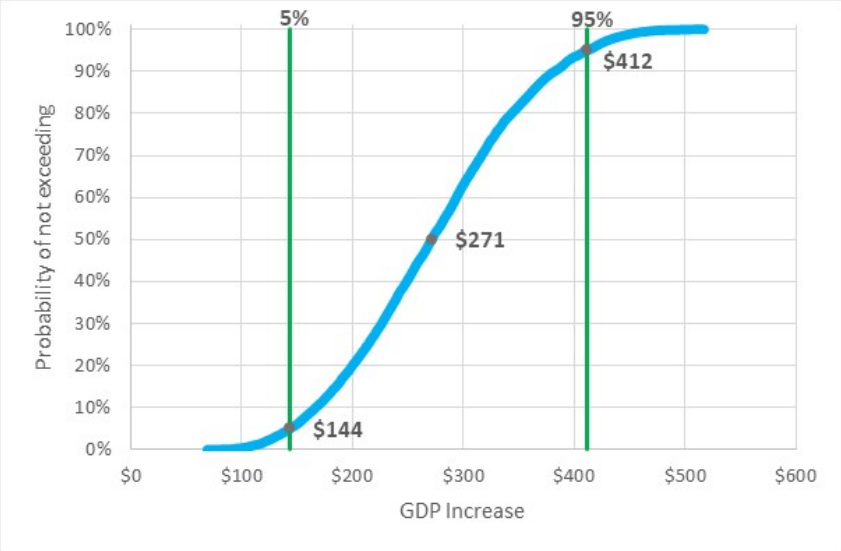


Figure 91. Distribution of Scenario 1 GDP impact ($ million)

Scenario 2 – Average 75 Mbps download speed

The figure below displays the distribution of the GDP impact under scenario 2, average download speed of 75 Mbps. There is a 5% chance that the GDP impact will not exceed $274 million and a 95% chance that it will not exceed $736 million. The mean expected value of the GDP impact under scenario 2 is $500 million.

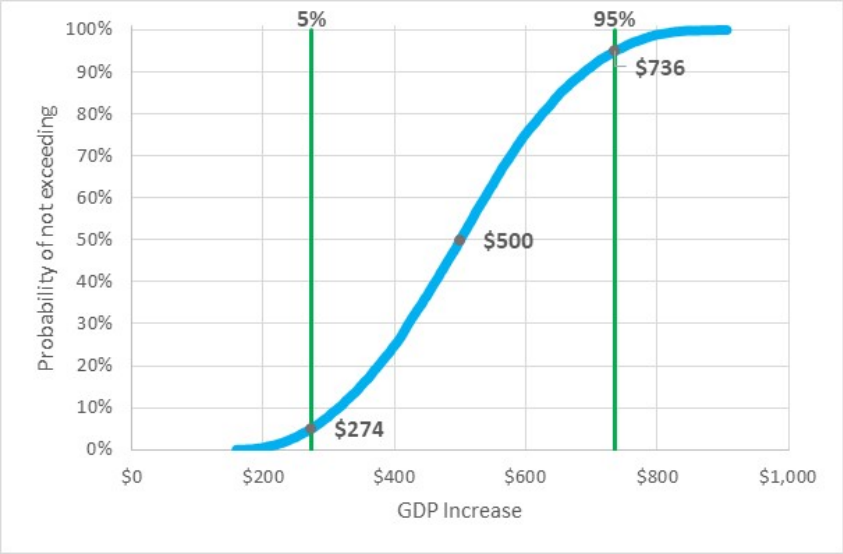


Figure 92. Distribution of Scenario 2 GDP Impact ($ million)

Scenario 3 – Average 100 Mbps download speed

The figure below displays the distribution of the GDP impact under scenario 3, average download speed of 100 Mbps. There is a 5% chance that the GDP impact will not exceed $358 million and a 95% chance that it will not exceed $954 million. The mean expected value of the GDP impact under scenario 3 is $652 million.

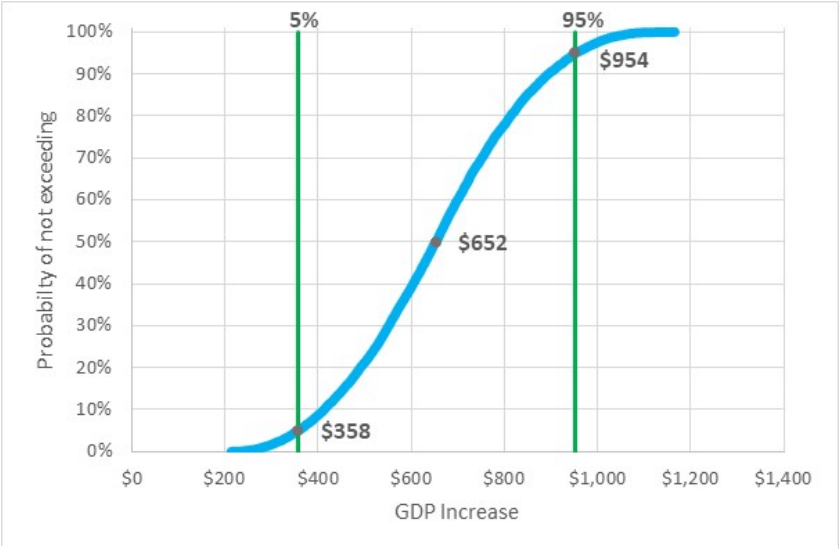


Figure 93. Distribution of Scenario 3 GDP Impact ($ million)

Regional economic impact

The table below outlines the percentage increase in GDP relative to the baseline and the GDP impact in dollar values under the three scenarios for each municipality in the Edmonton Metropolitan Region.

Table 42. Regional Economic Impact Under Each Scenario

Region	Scenario 1: 50 mbps download		Scenario 2: 75 mbps download		Scenario 3: 100 mbps download	
	Percent increase from baseline (%)	Dollar value increase from baseline ($ millions)	Percent increase from baseline (%)	Dollar value increase from baseline ($ millions)	Percent increase from baseline (%)	Dollar value increase from baseline ($ millions)
Edmonton	0.20%	132.59	0.44%	286.50	0.60%	389.10
Beaumont	0.40%	4.73	0.64%	7.49	0.80%	9.33
Devon	0.58%	2.21	0.81%	3.11	0.97%	3.71
Fort Saskatchewan	0.48%	8.05	0.72%	11.98	0.88%	14.61
Leduc	0.50%	10.59	0.73%	15.60	0.89%	18.94
Leduc County	0.86%	7.97	1.10%	10.15	1.26%	11.60
Morinville	0.96%	5.55	1.20%	6.91	1.35%	7.82
Parkland County	1.37%	38.24	1.60%	44.85	1.76%	49.25
Spruce Grove	0.41%	10.15	0.65%	15.96	0.81%	19.83
St. Albert	0.00%	0.00	0.24%	13.95	0.39%	23.25
Stony Plain	0.75%	7.73	0.99%	10.15	1.15%	11.77
Strathcona County	0.16%	15.72	0.40%	38.62	0.56%	53.89
Sturgeon County	0.78%	12.51	1.02%	16.29	1.17%	18.81
Other Areas	1.27%	14.23	1.50%	16.88	1.66%	18.65
Total	**0.28%**	**270.26**	**0.52%**	**498.44**	**0.68%**	**650.56**

Appendix B: Broadband Current State Legend

The legend below was utilized to create the Broadband Current State Summary graphic:

Table 43. Broadband Current State Legend

Legend	Broadband Strategy	Dev. / Eng. Guidelines	Municipal Owned Fibre	Service Level
	Dedicated broadband/connectivity strategy in place or is currently being developed	Guidelines are formal and followed by all developers/engineers	Majority of municipal buildings are connected via fibre-optic infrastructure	CRTC standards met across the board
	Broadband/connectivity is referenced in strategy documents but no dedicated strategy is in place	Guidelines are informal and/or the municipality is considering putting guidelines in place	There is currently limited fibre-optic infrastructure connecting municipal buildings	CRTC standards met in all but one area and/or speeds do not exceed CRTC standards in multiple areas
	Broadband/connectivity is not referenced in any strategy document	There are no guidelines in place and no guidance is given	There is no municipal owned fibre-optic infrastructure	CRTC standards not met in two or more areas

Appendix C: ISPs and Backhaul Providers

To access the Internet, municipalities, businesses, and residents require a subscription to an internet service provider. This section provides a listing of the various ISPs that serve EMRB members and a synopsis of their offerings.

Wireline-based ISPs

Axia

Service Alberta's operational contract for the Alberta SuperNet ended at mid-night, June 30, 2018 and was not renewed. Shortly after the announcement, Bell Canada announced that it would acquire all Axia NetMedia and Axia Connect assets. The deal closed on September 4, 2018.

ATCO

Since spring, 2018, ATCO has begun to aggressively evaluate options to deploy fibre both within and between communities. The initial draft plan is to deploy dark fibre within a community and provide access to it via a franchise-type agreement in which they both agree to service standards and pay the community a percentage of the community's revenue from ISPs using the fibre. In return, either the community or an approved entity would light the fibre, and potentially provide services over it. Out of these revenues, the community would compensate ATCO. Though many details have yet to be resolved, the plan is a promising one that could be quite beneficial to participating communities.

Bell Canada

Historically part of the SuperNet contract, in July 2018 Service Alberta awarded the contract to provide the government, learning, health, libraries, and municipalities (GLHLM) services to the Government of Alberta to Bell. As Bell Canada's Alberta operation is largely focused on providing managed lit services to the enterprise or large business market, it then sold Axia's rural Alberta consumer ISP operation, Axia Connect, to TELUS. The deal closed March 31, 2019.

Corridor Communications (CCI)

CCI is an internet service and home phone provider for rural and remote areas of Alberta, which is co-op owned. CCI Wired is a subsidiary of CCI Wireless and unlike their traditional wireless solutions, uses TELUS unbundled copper assets and digital subscriber line (DSL) technology in small towns to deliver Internet services. On March 31, 2020, an agreement was reached for TELUS to acquire the CCI Wired DSL (Digital Subscriber Line) assets. Currently CCI DSL is deployed at 18 Wired locations in Alberta with one village (Warburg) within the Edmonton Metropolitan Region.

Shaw

Shaw provides retail cable, telephone, and internet services to a large consumer base throughout Alberta. Shaw wholesale has been very aggressive/competitive with respect to providing backhaul services throughout the province and has recently embarked to enhance its services across the Region.

TELUS

Between 2000 and 2018, TELUS invested more than $45 billion in technology and operations in Alberta, and in September of 2019, TELUS announced that it would be investing $16 billion over the next five-years to

expand its broadband network infrastructure in Alberta.[113] The investment promises to bring Alberta the following:

- Better access to healthcare technology;
- Connect more homes, businesses, and schools to PureFibre;
- Support increased IoT capabilities and agriculture technology;
- Prepare the province for the introduction of 5G; and
- Fast track the latest technology and applications as they emerge.

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 a fibre drop directly to their premises.

Fixed Wireless ISPs

Corridor Communications (CCI)

CCI is an internet service and home phone provider for rural and remote areas of Alberta, which is co-op owned. CCI Wireless utilizes their wireless towers with radio equipment to deliver high speed internet connections to hard-to-reach areas of Alberta. CCI's purpose is to provide high quality, reliable internet service to the under-served communities without the benefit of wired infrastructure.

MCSNet

MSCNet has been providing wireless internet services to local Albertan communities since 1995. MSCNet is Alberta's largest fixed wireless ISP and is focused on servings rural Albertans. Currently, MSCNet covers most of central eastern Alberta and services Stony Plain with a wired DSL connection.

Syban

Syban is a wireless internet service provider that currently has over 50 towers servicing central Alberta. Syban is focused on connecting primarily on hamlets and small towns and is also focused on providing connectivity to Indigenous Communities.

Xplornet

Xplornet has been providing broadband solutions to rural customers for over a decade. Currently, Xplornet is exploring services to offer customers voice and data communication services through its unique wireless and satellite network. In 2019, Xplornet announced that it will invest $500 million over the next five years to deploy state-of-the-art hybrid fibre wireless and satellite technology in its facilities-based network in order to deliver broadband services to rural Canadians. Furthermore, in February of 2020, Xplornet announced that they had been acquired by Stonepeak Infrastructure Partners to execute on their expansion plans and strengthen its balance sheet.[114]

[113] TELUS Press Release

[114] Xplornet Communications Inc. Signs Agreement to Be Acquired by Stonepeak Infrastructure Partners

Backhaul Providers

Bell Canada / SuperNet

Once Axia NetMedia operations have been integrated into Bell, the wholesale service component of the SuperNet – that used to help service rural ISPs, will likely become part of the Bell wholesale services portfolio. To date, Axia NetMedia operations have not been integrated and the Next Generation Network pricing sheet used to supply wholesale services over SuperNet, are still in play.[22]

The extent of the SuperNet within the EMRB is shown in the figure below.

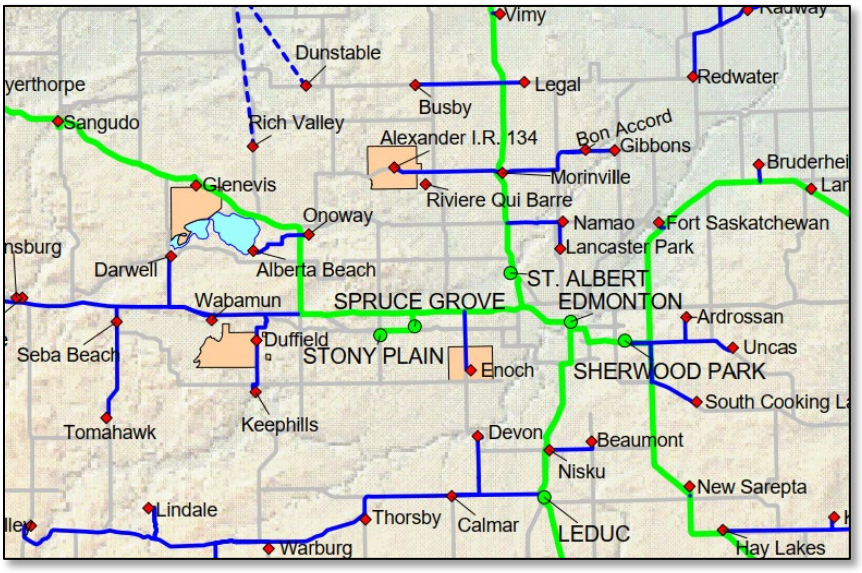


Figure 94. SuperNet Infrastructure

Shaw Wholesale

Alongside Shaw's residential and business offerings, Shaw provides fibre backhaul network access. The figure below displays Shaw's Western Canadian network infrastructure.

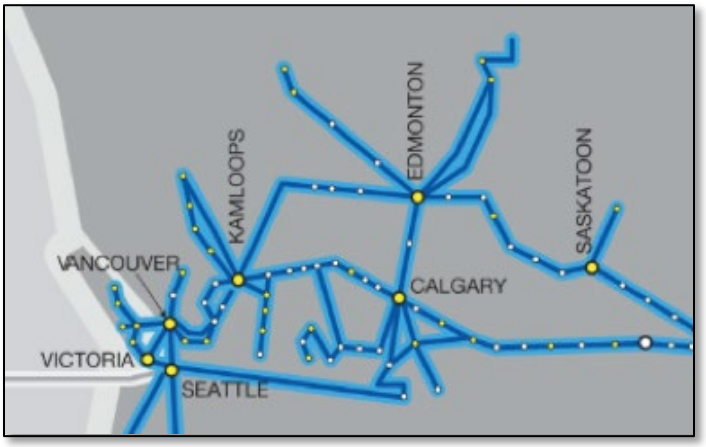


Figure 95. Shaw's Network

TELUS Wholesale

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

Zayo

Zayo provides both lit and dark fibre infrastructure in North America and Western Europe, providing connections in more than 400 markets. The figure below displays Zayo's Edmonton Metropolitan Region network infrastructure.

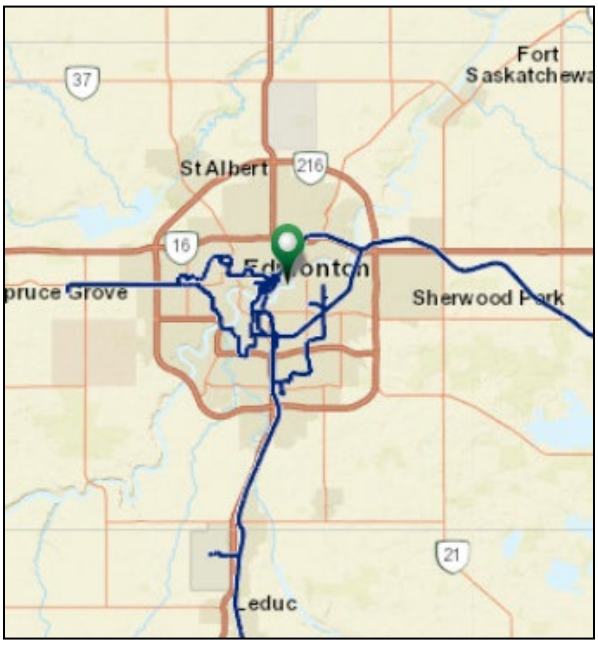


Figure 96. Zayo Backhaul Network

Appendix D: Connectivity Technologies

Access versus Backhaul

As shown in the figure below three components are required to establish a regional or sub-regional network:

- local, lit access network which provides premise access connections,
- backhaul/transit connection to connect the local network to an Internet Exchange, and
- Internet gateway at the exchange which connects the backhaul connection to the global Internet network.

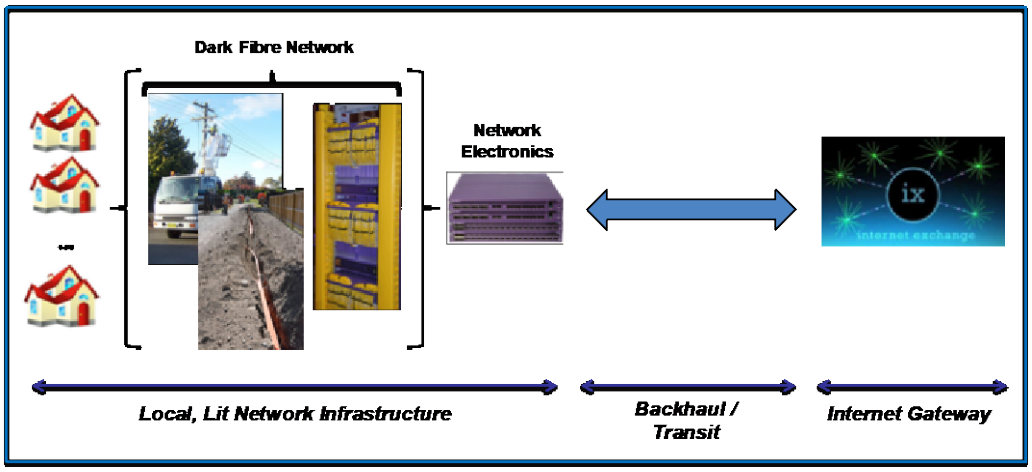
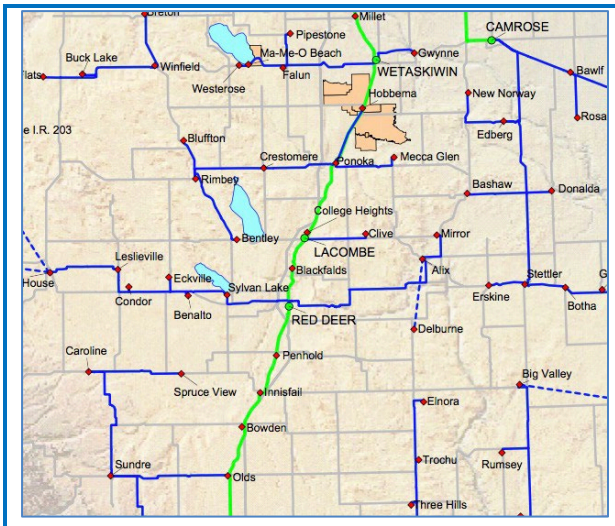
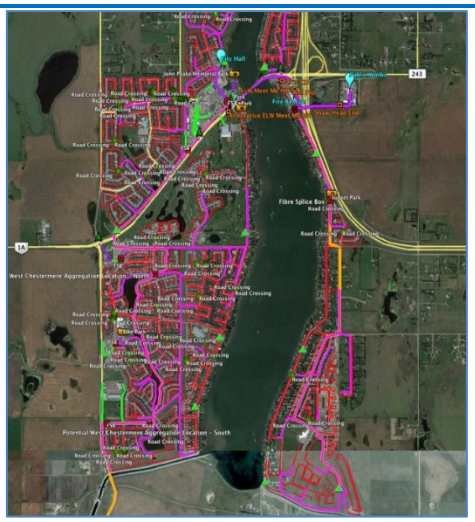


Figure 97. Local, Backhaul, and Gateway Components

An alternative view showing the differences between backhaul and access networks appears schematically in the figure below.



Backhaul: Inter-community connections with a connection to a peering point (e.g., YYCIX)



Access: Connections to residential, commercial, and industrial premises within a community

Figure 98. Backhaul Vs Access Networks – A Comparative View

An Access Technology Comparison

A visual comparison amongst the capabilities of the four major transmission technologies – wireless (tan), copper (tan), coaxial cable (yellow), and fibre (red) appears in the figure below. In the figure, unless otherwise specified, the numbers shown are in Mbps.

New fixed wireless systems will do up to 100 Mbps per antenna. This bandwidth is split amongst downstream (from the network to the client, like a Netflix stream) and upstream (from the client to the network, say for uploading photos or backing up data to the cloud) link requirements as needed and would typically be split into something like 75 Mbps down and 25 Mbps up. As the available bandwidth is then shared amongst all the homes taking service within the coverage area, if 50 homes took service and happened to be streaming media content concurrently, the maximum available to each would be 1.5 down by 0.5 Mbps up.

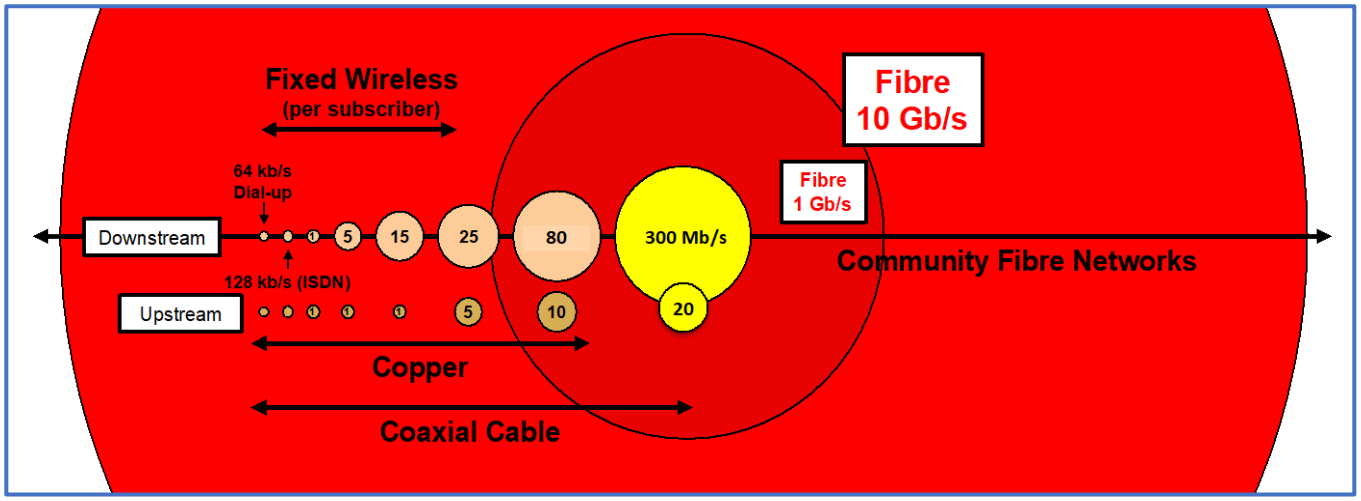


Figure 99. Connectivity Speed by Technology

Internet data services over the copper plant deployed by the telecommunication incumbents are provided via an evolving family of DSL technologies. Due to the attenuation of higher frequencies required to support broader bandwidth signals, the higher the supported bit rates, the shorter the possible serving distance between the incumbent equipment and the client's home or office. Whereas initial asymmetric DSL equipment supported 6 to 8 Mbps down and 0.512 Mbps up could be served from central offices within 4 km of the client, with fibre to every block, current equipment can provide services up to 80 by 10+ Mbps.

With more capable coaxial cable infrastructure, the current *data over cable service interface specification* (DOCSIS) and the current split ratio (5 – 42 MHz for upstream and 50 – 860 MHz for downstream) subscriber bit rates are typically limited to 600 Mbps down by 30 Mbps up. Changing that split to increase upstream bit rates requires changing every active component in the network, as well as the cable modem boxes.

By comparison, fibre used in community fibre deployments will theoretically support bit rates up to 2,800 Gbps,[115] its capacity is in essence, unlimited. Once deployed (buried civil works are ~70% of the cost), fibre network capacity can simply be increased by updating the opto-electronics at each end of the cables as

[115] Bandwidth estimate assumes 256 QAM at **λ** =1.55 µm

needed. Currently deployed opto-electronics provides for up to 8 concurrent 10 x 2.4 Gbps data streams, with each stream supporting 156 Mbps down by 37.5 Mbps services to each of 64 premises.

Backhaul Fibre Considerations

Opto-electronics used in long distance backhaul networks currently support 160 concurrent data streams at up to 100 Gbps each in one direction over single span distances in excess of 100 km. For bi-directional systems, two fibres are required.

Fibre Network Considerations

Optical Fibre

Fibre cables are comprised of many individual fibre strands. Cable sizes vary, but a single cable may contain hundreds of fibre strands, as displayed in the adjacent figure. As fibre strands are glass, the signals are transmitted by pulses of light. As different colours of light can be used on any fibre strand, a single fibre can support the concurrent transmission of multiple data streams.

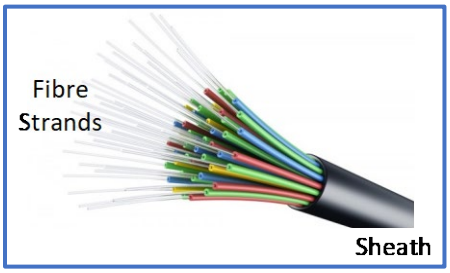


Figure 100. Fibre Cable

Fibre's advantages over copper and coaxial cable lines historically results from the physics of transmitting information using photons of light instead of electrons of electricity. In glass, optical attenuation is much less than the attenuation of electrical signals in copper or coaxial cable and much less dependent on signal frequency/wavelength. In terms of distance and bandwidth, fibre's capabilities are unparalleled. As fibre can theoretically support connection speeds up to 2,800 Gbps at 1.55 microns (µm) and current access systems operate at only 80 Gbps, deployed fibre capacity can be increased by 35-fold before its limits are reached. Though it is expensive to deploy due to the civil works involved, with essentially unlimited capacity, it can be considered to be a 40-year asset. To increase capacity, a community only needs to upgrade the opto-electronics at each end of the fibre.

Unlike copper wires that radiate signals capable of interfering with other electronic equipment (i.e. radio frequency interference or RFI), fibre is benign and neither radiates RFI nor is susceptible to it, making it immune to lightning strikes, safe when sharing a trench with gas-lines, and an excellent choice for secure communications (it cannot be tapped).

Deployment

Fibre infrastructure can be deployed either aerially, via the use of messenger cables in the communications space on power poles, or via burying conduit through which fibre cables can then be blown or pulled. Though aerial deployments are less expensive than buried ones, they are marginally less robust. Aerial deployments reduce deployment expenses by some 30% relative to the buried equivalent. Those estimates, though, assume that the power poles in those areas can be used to deploy fibre. Prior to proceeding with an aerial deployment, the poles will need to be evaluated. If many poles have to be replaced, then a fully buried deployment may be the least expensive option.

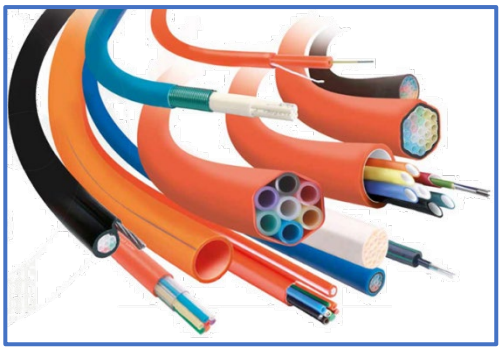


Figure 101. Flavours of Fibre Conduit

In buried deployments, costs vary with ground conditions – soft is better than hard or rock and gravel roads and alleys are less expensive than paved ones. Though fibre cable can be directly buried, for both flexibility and ease of maintenance, it is

often placed in conduit. Whereas fibre cable has traditionally been '*pulled*' into conduit, newer methods use compressed air. The latter, referred to as ABF or air-blown fibre, enables smaller conduit sizes (which saves cost) as well as significantly greater deployment distances. With ABF, the conduit can be deployed first and then the fibre only blown in when needed. Samples of ABF conduit appear in the adjacent figure.

Wireless Network Considerations

General Considerations

While progress in digital technologies is exponential and both wireless and wireline technologies are progressing rapidly, wireline technologies are currently 100-times more capable than wireless technologies and this lead is unlikely to diminish. Mobile, and especially 5G, technologies get more press, however, and with these rapid advances in, and hype around, wireless technologies, questions around whether wireless could make for a less expensive replacement to fibre often arise. The general answer is no, and reasons include:

- Wireless is typically an access technology only and fibre is generally required to connect wireless access nodes and establish a network. The capacity and quality of the wireless access system therefore depends on the quality of the network connections underlying it.
- Wireless and wireline technologies are complementary – wireless will never have the capacity of wireline for backhaul and wireline technology will never be mobile. Indeed, the '*ideal*' future-proof network will likely be one with a core fibre network connected to either 5G or Wi-Fi-6[116] at the edge. While fibre is, in essence, a medium independent of capacity (effectively unlimited), over time, the capacity of the 5G and Wi-Fi-6 networks will need to be upgraded as demands increase.

Figure 102. A Complementary Technology Set

- As a replacement for wireline technology, mobile wireless is less capital intensive, but operationally more expensive and less capable. There are, however, fixed wireless versions of the mobile (cellular) technologies becoming available that provide a good compromise in some access applications.

As access capacity in a wireless system is shared amongst all concurrent users of the system, the Internet speed or bitrate available to a user is inversely proportional to the number of users – the more users, the slower the available bitrate. In a fibre access system, beyond the split ratio mentioned earlier, no such sharing takes place. If a premise has a 1 Gbps access line, they should see a 1 Gbps service.

Lastly, unlike wireline systems, wireless performance is affected by weather, terrain, vegetation, and buildings along the line-of-sight between the user and the access point (AP) as well as by the distance between them. Wireline systems are essentially immune to these effects.

[116] Wi-Fi 6 is the rebranded IEEE 802.11ax standard and is the most recent standard governing wi-fi networks typically deployed in homes and businesses.

Scalability

A key difference between wireless and fibre-based access networks is scalability, where scalability refers to the ease and expense related to upgrading system capacity to enable higher bitrate services to end users. As end-user bitrate requirements increase annually, unless the system can be scaled, the provider will eventually run out of capacity. Similar issues arise when the provider's client-base and number of connected devices increases.

When wireless and wireline options are compared, the total costs with scaling, should be considered. Whereas fibre systems are initially more expensive, on a scaled basis, they may not be.

As fibre capacity with a home-run architecture is effectively unlimited, scaling fibre systems is accomplished by upgrading the opto-electronics (typically ~10% of the overall deployment cost). Upgrading wireless access systems is typically more expensive and limited. Options to scale wireless systems involve sectorizing the antennas, adding APs that operate at different frequencies or in a different band, and increasing the number of towers (densification). Furthermore, to enable 5G electronics, the radio equipment at every cell site – of which there will be many – will need to be upgraded.[117]

5G

Though 5G wireless technologies will be a significant complement to fibre access networks, they are not a replacement. While the technology is not yet mature, current hype indicates aggregate (shared) data speeds of up to 10 Gbps. These speeds, though, can only be realized under ideal conditions and for devices located near the radio AP. Including overhead, practical usable bit rates are typically only about 20% of the peak – or 2 Gbps per AP or cell site in this case. To achieve these rates, cell sites must be very small and this evolution to ever smaller cell sites is illustrated in the adjacent chart. Moving from 3G to 5G requires 400-times more cell sites and thus, 400-times the amount of fibre as these bandwidths can only be supported if the APs are fibre-connected. As each site will also need power and all will need to be replaced to upgrade the system, the capital considerations are significant.

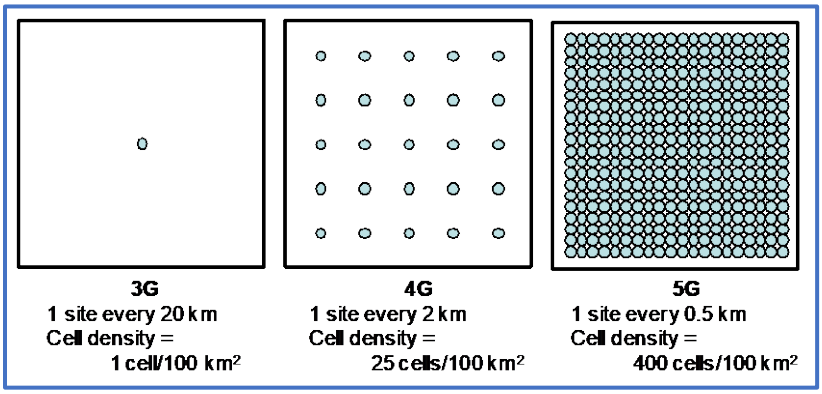


Figure 103. 5G Cell Tower Density Requirements

For example, in urban areas with premise densities of, 500 premises/km^2, at a 0.5 km spacing, each square-kilometer would be home to 4 APs. With each AP supporting 125 homes, if 40% or 50 homes were sharing the 2 Gbps capacity of the AP at any time, each premise would only see 40 Mbps. Increasing this requires even smaller cell sites and a commensurate increase in the number of APs. As 5G standards have yet to be finalized, true 5G services are not likely to be available for three to four-years. With fibre, 10 Gbps services

[117] The Cloud Radio Access Network (C-RAN) concept proposes to address this issue by centralizing the radios and only distributing the antennas.

are available today. As well, the premises equipment typically proposed for utility networks supports the new Wi-Fi-6 standard, thus enabling in-premise wireless connectivity speeds up to 6 Gbps, with no sharing.

Fixed Wireless

As advances in 5G will benefit the fixed-wireless and satellite markets and vice-versa, the capability-to-cost ratio with wireless equipment is improving rapidly. Fixed-wireless versions of 5G cellular systems are becoming available and some, such as that being developed by Starry[118] are being targeted as a replacement to last-mile fibre connections. A point-to-multipoint fixed-wireless system is illustrated in the figure below.

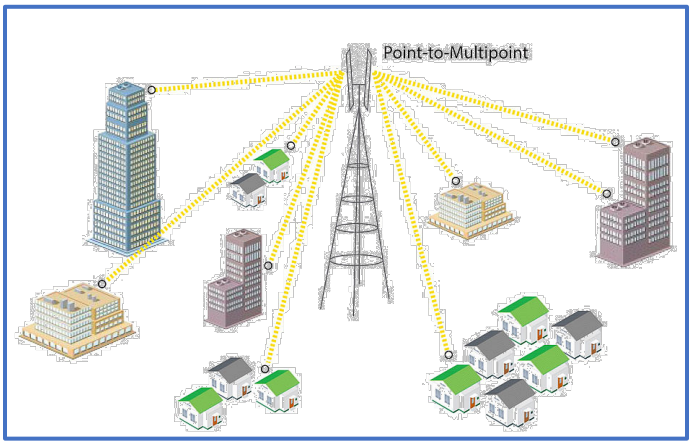


Figure 104. Point-To-Multipoint Fixed Wireless Networks

To achieve the aggressive capability targets set for 5G systems, all aspects of the radio technology are being exploited, from software-defined radio technology to more complex modulation, signal processing, and antenna (beamforming) technologies, among others. Of these, beamforming is especially key, as much for its capabilities as its price-tag. Beamforming refers to the ability of an antenna to generate multiple '*spot*' beams within its coverage area and coordinate the frequency re-use much more efficiently than that possible with fixed coverage antennas – together this increases the effective capacity of the system significantly. In effect, they create many mini-cells within the macro-cell associated with the fixed antenna equivalent – simultaneously increasing both signal strength and bandwidth.

A primary concern with technology development dependent on multi-dimensional improvements is that compromises are often required – leading to the analogy of the duck: while a duck can swim, walk, and fly, it doesn't do any of them overly well. It may take a while for 5G systems to truly reach their potential and deliver on the hype.

Satellite Technology

Traditional broadcast and communication satellites were positioned in geo-synchronous orbit, sometimes referred to as the Clarke Belt (Figure 105). Satellites in this orbit, which lies in the plane of the equator some 22,300 miles / 36,000 km above the earth's surface, appear to be stationary with respect to earth-bound observers. These large and expensive satellites tend to be capacity-limited from an internet perspective as each may have millions of devices within its footprint. There is also a delay problem – due to the round-trip time from the surface to the satellite and back, signals are delayed by a minimum of 240 ms, or about a quarter of a second. In broadcast applications this is irrelevant, but in two-way communication, it degrades services from a voice and video perspective, and renders the system unusable for games dependent on quick reaction times.

[118] https://starry.com

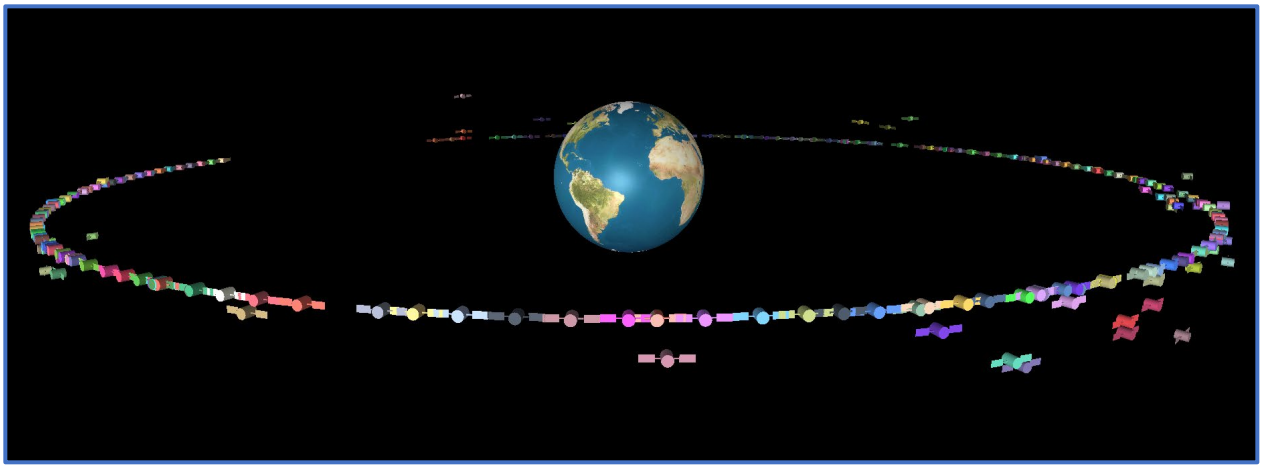


Figure 105. Geosynchronous Orbit

To get around both capacity and delay issues, current plans to provide space-based global internet services involve placing thousands of very small satellites in low earth orbit as illustrated in the figure below. Each would be much closer to the surface (500 – 1,200 km up, reducing latency) and have a much smaller footprint (less sharing so more capacity per user) than a satellite in geosynchronous orbit. The issue is that in these orbits, all the satellites would be moving with respect to the earth – making the network almost the reverse of the traditional terrestrial cellular system – but worse. In the latter case, the device may be in a car moving at 100 km/hr relative to nearby cell-towers while in low-earth orbit satellite (LEOS) systems, the ground-based device would appear to be stationary relative to the LEOS moving at speeds in excess of 28,000 km/hr.

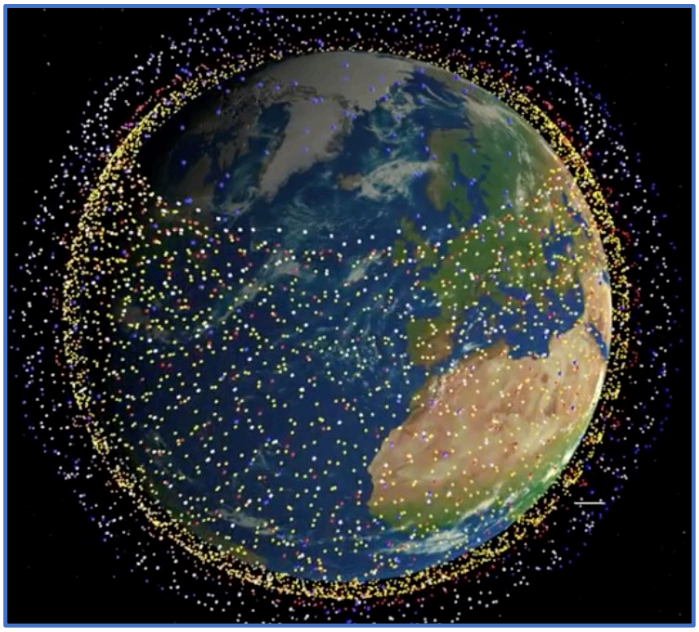


Figure 106. Proposed StarLink LEOS Constellation

Planning for at least five LEOS constellations is underway:

- Service commencement: 2020:

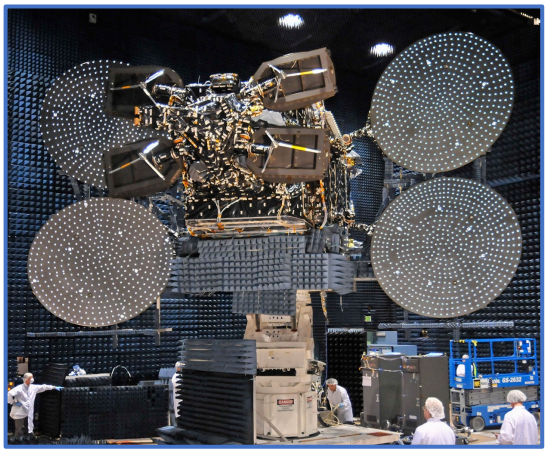
- OneWeb (Branson's, Softbank, Airbus) – has launched 74 of a planned 648-satellite constellations. A recent news release indicated that OneWeb may file for bankruptcy.
- StarLink (SpaceX) has launched 360 of a planned 12,000 – 42,000 satellite constellations. Pre-Covid-19 plans had commercial services planned for Canada this summer.

- Service commencement: 2022:
  - Telesat is planning a 300-satellite constellation
  - Project Kuiper (Amazon) – is planning a 3,236-satellite constellation
  - Hungyon Project (China) – is planning a 320-satellite constellation.

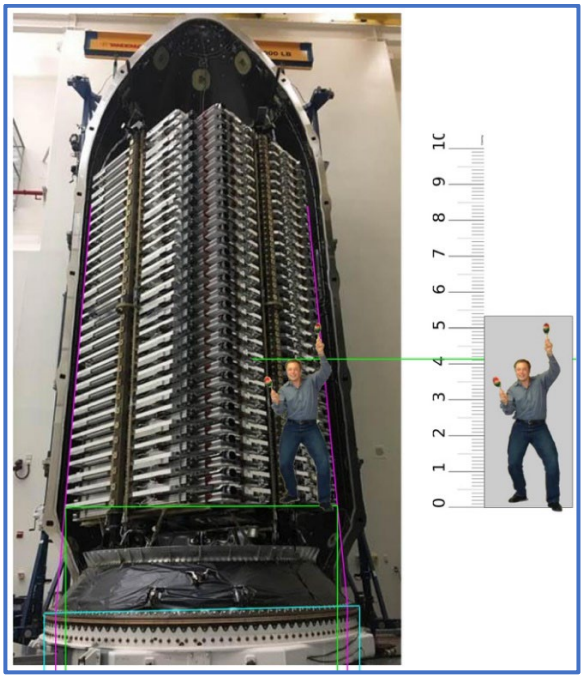
These are large numbers and, even with the much smaller and less expensive satellites planned (Figure below), will be expensive and take years to put in place. With OneWeb potentially going down, StarLink is the clear leader. According to Elon Musk's comments in May 2019, StarLink may cost more than $10 billion to deploy, but would likely bring in $30 billion to $50 billion per year when fully operational. Given StarLink has applied to license a million ground stations, it appears to be focused serving end-customers from day one.

In second place, is Telesat. Last August, the Canadian Government announced it would contribute $85 million to support research and development in support of Telesat's planned constellation of low-Earth orbit LEO satellites and another $600 million to subsidize Internet connectivity in rural Canada.

In contrast to StarLinks' plans, Telesat is focused generating revenue from below-market-rate sales to telephone companies and ISPs which, in turn, would provide services to end-users across Canada's north. Excess capacity would be sold to enterprises, governments, ships, and airlines. In return for the R&D contribution, Telesat has agreed to support approximately 500 professional jobs in Canada and invest $215 million in R&D.



Xplornet's 4G Geosynchronous Satellite



Ready for Launch – 2 stacks of 30 StarLink LEO Satellites (60 total)

Figure 107. The Evolution of Satellites

In contrast to these multi-billion-dollar plans is a small start-up called Clarke Belt 2.0 which proposes to place only a few small, highly capable satellites in polar orbit, focus on serving the underserved areas of the planet, and then scale as demand grows. If successful, perhaps they could help put Canada back in front in the commercial communication satellite space, a position it abandoned over a decade ago.

While the promise of these networks is real, and though advancing technology is increasing the odds of success, significant obstacles remain. To date, the three efforts in the late 1990s – Irridium, Teledesic, and Globalstar achieved only limited success. Of the new breed, LeoSat has already failed and it appears OneWeb's days are numbered. Should success be achieved, and betting against Musk is typically a bad idea, the cost of these services remains to be seen. Given the focus of all these efforts on remote areas and elite clients tends to indicate that they may not be competitive against terrestrial-based services in urban areas.

Appendix E: Business Models for Municipal Fibre Deployment

In deference to the traditional vertically integrated business model prevalent in Canada, municipalities can opt to design, finance, and deploy the connectivity infrastructure on a utility basis and then enable local service providers to provide competitive Internet, telephone, and television services over it. This network – services separation is illustrated in the figure below. As shown, with a network in place, local service providers can either connect directly to the network or come in via a backhaul connection from an Internet Exchange (IX) facility. With this arrangement, communities could, over time, make available world-class connectivity infrastructure to their residents and businesses and facilitate full competition in the services space. The fibre infrastructure will cost-effectively scale to meet all foreseeable bandwidth requirements, minimize cost to all potential clients, and enable a community to maintain control of critical civic infrastructure.

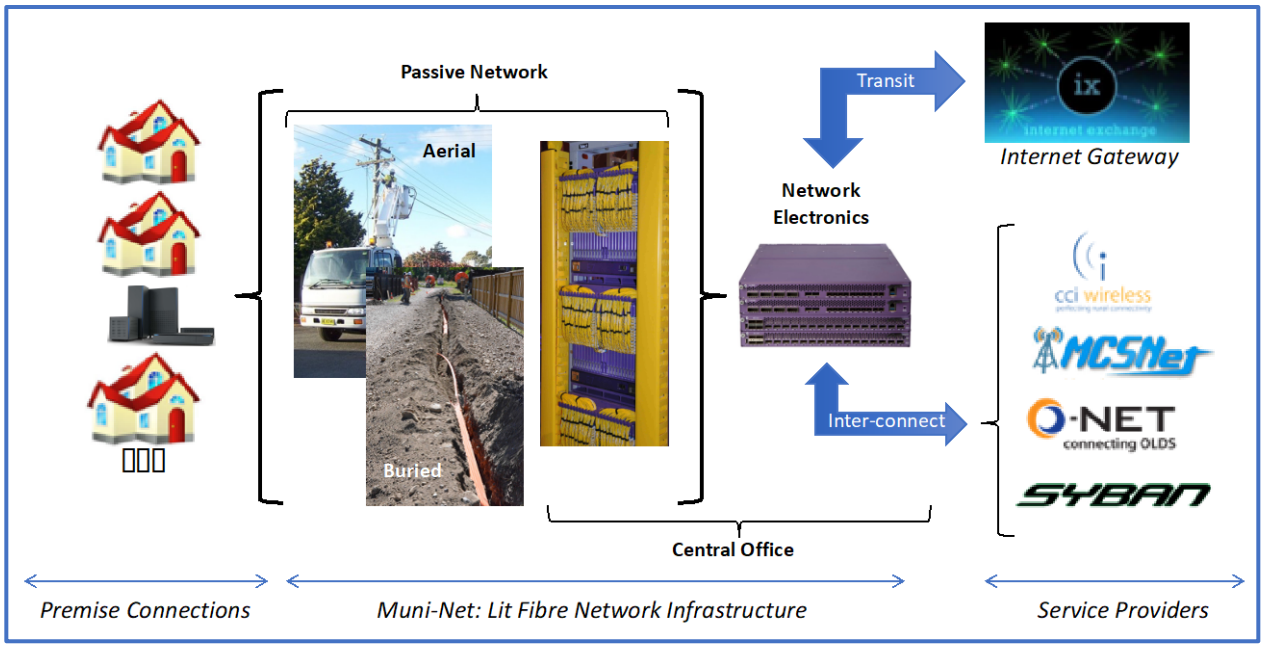


Figure 108. Facilities vs Non-Facilities -Based Business Models

Though the intent may be to establish the network 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 can 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 (Internet, telephone, and broadcast television) services.

A variation on this lit network utility model is a dark fibre option in which a 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. This could limit the opportunities for competitive services and pricing to customers. On the other hand, with sufficient fibre going in, in addition to a lit network access portfolio, a Muni-Net could also lease dark fibre to providers if it so choses.

Municipal Deployment Options

Municipalities play a key role in ensuring their residents and businesses have access to the internet through the various means described above and in *Appendix D: Connectivity Technologies*. This section builds upon the technical knowledge provided and offers a set of six options that municipalities have when considering their responsibility for broadband deployment.

Option 1 – Status Quo

The first option is to carry on with business as usual, i.e.: to leave Internet services to traditional incumbent wireline and wireless providers with no municipal involvement. Arguments for and against this approach are summarized below.

Table 44. Deployment Option 1 - Status Quo

Status Quo
Examples: Most Alberta communities have decided to leave broadband issues in the hands of the private sector.
Pros: No municipal money used and no project execution or operational risk. No perception of government competing in private industry.
Cons: Incumbent services focus on areas which make business sense. Service pricing depends on what can be competitively monetized versus enabling cost-based services that emphasize inclusion, affordability, and economic development. Little to no control over the infrastructure or service levels, either to meet municipal requirements or those of residents and businesses. Internet speeds and reliability are business as usual.
Risks: Internet service levels may lag residential and business requirements, potentially leading to declines in population, business activity, and municipal revenue. Given the pace of advancing technology, the projected impact of digital technologies on quality of life, entrepreneurship, and business growth, any mismatch between residential and commercial requirements and the availability of Internet services throughout the Region may negatively impact economic development. If service availability is not uniform, some municipalities may end up on the wrong side of the digital divide.
Risk Management: Turn municipal direction to other economic development initiatives.

Option 2 – Enhance Engineering and Construction Guidelines

The second option is to complete detailed engineering design guidelines and leave deployment to market forces and demand. Requirements on municipal access agreements and permitting might also be updated and increased to ensure all telecommunication infrastructure adheres to consistent engineering design guidelines. These would be in place to protect against interim builds that do not meet municipal requirements and prevent situations where municipalities may need to address issues or account for lower

quality infrastructure. These guidelines should be structured to support municipal participation in any of the options to follow.

Table 45. Deployment Option 2 - Enhance Engineering and Construction Guidelines

Enhance Engineering and Construction Guidelines
Examples: City of Calgary, Town of Olds.
Pros: No municipal money used for infrastructure build. No perception of government competing in private industry. Protects long-term interest in developing reliable Internet infrastructure by protecting right-of-way access from lower quality telecommunication builds. If at a future date, a municipality decides to build and/or operate a community broadband network, this would enable augmenting existing infrastructure with future infrastructure builds.
Cons: As this only impacts new infrastructure, if growth is slow or negative, the impact will be minimal. This approach does not address the current issues with inadequate Internet infrastructure or support. Little to no control over the infrastructure or service levels, either to meet municipal requirements or those of residents and businesses. Internet speeds and reliability are business as usual. Little to no control over the infrastructure or service levels, either to meet municipal requirements or those of residents and businesses.
Risks: Internet service levels may lag residential and business requirements, potentially leading to declines in population, business activity, and municipal revenue. Given the pace of advancing technology, the projected impact of digital technologies on quality of life, entrepreneurship, and business growth, any mismatch between residential and commercial requirements and the availability of Internet services throughout municipalities may negatively impact economic development. If service availability is not uniform, some municipalities may end up on the wrong side of the digital divide.
Risk Management: Focus regional direction on other economic development initiatives that will continue to attract investment.

Option 3 – Partner with ISPs

Augment Market Demand Incentives

Leverage the Region's telecom and cable providers to support their own builds in compliance with the Engineering Design guidelines. Offer municipal 'grant' dollars to encourage them to deploy their networks and services into areas the Region prioritizes. Arguments for and against this approach are summarized in Table 58.

Table 46. Deployment Option 3a - Augment Market Demand with Municipal Funding Programs

Augment Market Demand Incentives with Municipal Funding Programs
Examples: A popular approach. In years past, this was the model upon which Wildrose operated and deployed towers in a number of Counties. In the Regional Municipality of Wood Buffalo area, this approach was used to improve services in the Gregoire Lake Estates area. More recently, negotiations with private suppliers to improve services in select areas often result in the request for a cash infusion to make the providers' effort in particular areas worth their while.
Pros: The government is not competing with private industry. Protects long-term municipal interest in developing reliable Internet infrastructure by protecting right-of-way access from lower quality telecommunication builds. If at a future date a municipality decides to build and/or operate a community broadband system this would enable augmenting existing infrastructure with future infrastructure builds. Provides incentive to ISPs to build more infrastructure in priority areas.
Cons: Perception that municipalities are either picking a winner or subsidizing a local favorite. Given the high capital costs associated with infrastructure deployment, the cash infusions/grants/ subsidies may be significant. Despite of this: • All ownership and infrastructure control vests with the private providers. • No municipal access of flexibility to meet larger connectivity requirements. • No direct return on the municipal investment. Little to no control over the infrastructure or service levels, either to meet municipal requirements or those of residents and businesses.
Risks: While the one-time infusion may help put assets in place, area revenues may be insufficient to cover on-going operational and upgrade costs in some districts – as was the case with the Wildrose subsidies years ago. Over time, quality of service declines, and additional subsidies may be required.
Risk Management: Due diligence on the selected companies and their operations. Careful evaluation of the network's scalability requirements and operational costs. Longer term agreement with coverage, deployment timeframes, scalability requirements, service levels, and operational requirements built-in.

Establish a Public-Private-Partnership (PPP)

Public-private-partnerships provide a way to leverage the funding strength of municipalities with the operational and, perhaps, deployment expertise of private enterprise. In this way, the Region could seek to leverage suitable private providers – ISPs, telecom incumbents, utility companies – to support builds in priority areas in compliance with the Engineering Design guidelines. A PPP could be structured to support municipal participation in any of the options to follow. Summary arguments for this approach appear in Table 59.

Table 47. Deployment Option 3b - Establish a PPP

Establish a Public-Private-Partnership
Examples: While an increasingly popular approach in rural areas of the US, the PPP model for broadband has not yet been undertaken in Alberta, likely due to the time and legal expenses involved.
Pros: Would enable municipalities to leverage and balance their funding strength with the operational and, perhaps, deployment expertise of private enterprise. A utility-based private partner such as AltaLink may be able to leverage their utility assets to significantly reduce the costs of infrastructure deployment. • In the case of power transmission and distribution companies, it could provide access to significant infrastructure such as the optical ground wires atop high voltage transmission towers and low voltage phase conductors on distribution lines and thereby significantly reduce deployment expenses. • With gas and water co-operatives, it could enable access to rights-of-way and novel deployment techniques. Utility providers may have significant capital to invest and only require longer term, bond-type returns, in return. It could provide a way in which municipalities could achieve an open-access vision, retain some control over the infrastructure, and share both the risk and returns of the investment.
Cons: Depending on the scope and structure of the PPP, perception that municipalities are either picking a winner or subsidizing a local favorite. Depending on the infrastructure to be leveraged, municipal design guidelines may not be applicable. Private providers' requirements may not be acceptable to municipalities and they may only be interested in serving certain areas of the Region. PPP's can be complex and, due to legal requirements, can be expensive to establish.
Risks: Management may change and, with that, their return or control requirements.
Risk Management: Due diligence on the selected companies and their operations. Careful evaluation of the network's scalability requirements and operational costs. Longer term agreement with coverage, deployment timeframes, scalability requirements, service levels, and operational requirements built-in.

Option 4 – Dark Fibre Infrastructure

Municipal Facility Priority

Deploy fibre to connect municipal facilities and support operations. Whether or not additional capacity is included to accommodate other users could be reviewed prior to preliminary design. Summary arguments for this approach appear in Table 60.

Table 48. Deployment Option 4a - Municipal Fibre Networks

Municipal Fibre Networks
Examples: A popular approach. Fibre for municipal use, for instance, has already been deployed in the Region. Examples include Stony Plain, St. Albert, Strathcona County, and a number of others.
Pros: Improved municipal efficiency. No municipal money used, and the project execution or operational risk is minimal. No perception of government competing in private industry.
Cons: Should municipalities only deploy sufficient capacity to meet their internal needs, the ability to leverage the infrastructure for the benefit of the residents and businesses along the way is lost. City fibre may not service priority residential or business areas. Internet speeds and reliability are business as usual. Little to no control over the infrastructure or service levels, either to meet municipal requirements or those of residents and businesses.
Risks: Internet service levels may lag residential and business requirements, potentially leading to declines in population, business activity, and municipal revenue. Given the pace of advancing technology, the projected impact of digital technologies on quality of life, entrepreneurship, and business growth, any mismatch between residential and commercial requirements and the availability of Internet services throughout municipalities may negatively impact economic development. If service availability is not uniform, some municipalities may end up on the wrong side of the digital divide.
Risk Management: Turn municipal direction to other economic development initiatives. Public campaign to present the decision to delay spending municipal dollars on a major infrastructure build in favor of providing dollars to support infrastructure that will improve administration efficiencies, lower administrative expenses, and build economic efficiency.

Backhaul or Middle-Mile Infrastructure

As an increasingly critical asset, leverage new internal fibre deployments focused on enabling developing smart connectivity requirements to deploy sufficient fibre to enable a future move to a dark fibre-to-the-premise (FTTP) initiative, support Internet of Things (IoT) infrastructure, and meet the increasing needs of private industry – including enterprise clients and ISP requirements to support enhanced wireless deployments and improved rural connectivity. Summary arguments for this approach appear in Table 61.

Table 49. Deployment Option 4b - Backhaul or Middle-Mile Infrastructure

Backhaul or Middle-Mile Build
Examples: This approach has been evaluated in detail for the City of Calgary, the Counties of Clearwater, Cypress, Forty-mile, Newell, Red Deer, Strathcona, Acadia, and Special Areas 2, 3, and 4, among others.
Pros: Enables support for smart infrastructure and services as well as improved wireless and Internet speeds in the targeted areas throughout municipalities. In lieu of a direct subsidy, this may help to promote competition amongst ISPs. No perception of government competing in private industry.
Cons: Perception that the municipality is either picking a winner or subsidizing a local favorite. Should municipalities only deploy sufficient capacity to meet their needs, the ability to leverage the infrastructure for the benefit of the residents and businesses along the way is lost. Given the cost of this infrastructure, this loss is significant. No scale efficiency in operations.
Risks: Internet service levels may lag residential and business requirements, potentially leading to declines in population, business activity, and municipal revenue. Given the pace of advancing technology, the projected impact of digital technologies on quality of life, entrepreneurship, and business growth, any mismatch between residential and commercial requirements and the availability of Internet services throughout municipalities may negatively impact economic development. If service availability is not uniform, some municipalities may end up on the wrong side of the digital divide.
Risk Management: Turn municipal direction to other economic development initiatives. Public campaign to present the decision to delay spending municipal dollars on a major infrastructure build in favour of support to smaller backhaul projects that will spur on local economic development within the Internet services market.

Dark-Fibre-to-the-Premise (FTTP)

Deploy both backhaul, middle-mile, and distribution fibre throughout municipalities and make it available on an open- access, wholesale basis to telecom, cable, and wireless service providers as well as enterprise clients. To utilize the fibre assets, interested providers would have to light (add opto-electronics to) the fibre. Once lit, service providers could provide symmetric Internet services at rates up to 40 Gbps over the infrastructure. Mobility and fixed wireless providers could access the fibre to improve connections to their towers and leverage the capacity to improve cellular and fixed wireless services available off the towers. Larger enterprise clients may wish to use the dark fibre to establish secure, very high-speed links between their facilities. Summary arguments for this approach appear in Table 62.

Table 50. Deployment Option 4c - Dark-Fibre-to-the-Premise

Dark-Fibre-to-the-Premise
Examples: Large dark-fibre deployments are underway in Calgary and have been completed in Coquitlam, New Westminster, and Campbell River. On a smaller scale, the Olds Institute for Community and Regional Development (OICRD) established a dark-fibre network in Olds, Alberta.
Pros: Enhances economic development through improved residential and business attraction across municipalities. Helps prevent or eliminate downward trends in population and business activity. Scope and ubiquity are only limited by municipal priorities and financial capability. Solution is fully scalable to meet all future bandwidth requirements of municipalities and the residential and business communities. Less perception of government competing in private industry as the infrastructure will support local ISPs as well as the traditional incumbent providers. Minimizes operational issues, complexity, and risk as no opto-electronics are involved. Provides scale-efficiencies with respect to deployment and management of the dark-fibre assets. Provides attraction for local ISPs to invest in infrastructure – active network components. Enables ISPs to provide higher speeds and more reliable Internet services to many users, including businesses. Maximizes the opportunities for ISPs to competitively differentiate themselves. Potential for colocation revenue in the fibre centers established to support the dark-fibre infrastructure. Optimizes the potential for incumbent providers to use the network, whether to improve their mobility offerings, or to support 5G deployments. Municipalities can access the infrastructure to meet all its internal connectivity requirements. Enables large enterprise clients to deploy very high-speed links between local facilities.
Cons: Large capital cost to municipalities. Many local ISPs are not set up to light and run fibre networks. Though small relative to the dark-fibre investment, the required opto-electronics investment may be significant to smaller ISPs. Municipal control over service levels provided by the ISPs is limited. In larger centers, multiple providers imply multiple sets of active network electronics, resulting in capital inefficiency. Municipalities will not be able to leverage the multi-wavelength potential of current FTTP opto-electronic systems.
Risks: Based on the substantial investment required by the ISPs, municipalities could be in a situation where a substantial amount of dollars are spent and there are no actual ISP users.
Risk Management: Identify at least one ISP provider that is able to light the network and provide services prior commencing deployment.

Build Towers at Key Locations

In this case, instead of dark-fibre infrastructure, as part of a wireless plan, municipalities would build additional wireless towers at key locations throughout rural areas and make them available to local wireless ISPs. Summary arguments for this approach appear below.

Table 51. Deployment Option 4d - Augment Tower Infrastructure

Augment Tower Infrastructure
Examples: Parkland, Brazeau, and Lac Ste. Anne Counties, Special Areas and the RIAP program in Strathcona County.
Pros: Reduce the capital expenses required for a wireless ISP to serve rural areas sufficiently that they've business incentive to do so. In lieu of a direct subsidy, this helps promote competition amongst wireless ISPs. No perception that the municipality is picking winners. By building 'utility-grade' towers, municipalities could also attract Alberta First Responders Radio Communication System (AFRRCS) and cellular providers. Revenues from these clients can be used to reduce the costs to local wireless ISPs. Faster deployment and less expensive than a fibre build. Policies and procedures are available from other municipalities. (Parkland County is likely the most advanced.)
Cons: Over the last decade, due to increasingly expensive and more capable radios as well as increased competition from mobility providers leveraging their cellular assets (e.g., TELUS HUB), wireless ISPs have been consolidating. This reduces the number which are available to locate on a tower. Given the former point, once one provider is on a tower, others are less likely to locate there due to insufficient market. In many cases, a municipality may have trouble finding even one ISP to locate on their towers. The location requirements for AFRRCS, cellular, and fixed wireless towers differ, so finding a location that meets the needs of all three is difficult. Municipalities may find out after the fact that many of their towers may be in the wrong place. A 'utility-grade' tower with a concrete pad, perimeter fencing, equipment room with redundant power and fibre, and CSA approved may cost over a quarter million dollars. A typical wireless ISP tower can be deployed for under a third of that. Building towers without knowing in advance the radio equipment that will be placed on it requires that the tower be over-built, possibly leading to increased and possibly unnecessary expense. Wireless services in rural areas may not be sufficient to either meet the CRTC requirements or the requirements of local businesses. To meet these requirements, a fibre connection will likely be needed in a number of areas.
Risks: The towers are constructed in the wrong locations. No ISPs will locate on the towers. Service levels are insufficient to meet either the CRTC requirements or those of the business community. Fibre connections to the towers may still be required.

Risk Management: Due diligence to truly understand the challenges municipalities may have and are facing with their tower initiatives prior to deciding to move forward.

Option 5 – Establish a Network Utility

Of the options presented, the option to establish fibre or hybrid fibre/wireless networks in the areas of interest and make them available on an open-access, utility basis to all service providers has considerable merit. Summary arguments for this approach appear below.

Table 52. Deployment Option 5 - Network Utility: Lit Fibre-to-the-Premise

Network Utility: Lit Fibre-to-the-Premise
Examples: Lit, open-access, utility FTTP infrastructure is being actively pursued in the Counties of Clearwater and Big Lakes, the Towns of High Prairie, High River, and Vermilion, among others.
Pros: Enhances economic development through improved residential and business attraction across municipalities. Scope and ubiquity are only limited by municipal priorities and financial capability.
Solution is fully scalable to meet all future bandwidth requirements of municipalities and the residential and business communities.
Less perception of government competing in private industry as the infrastructure will support local ISPs as well as the traditional incumbent providers.
Provides municipalities with maximum control over the infrastructure and the services offered over it. Provides scale efficiencies with respect to deployment and management of the lit fibre assets.
Minimizes the investment and risk required by ISPs interested in providing services.
Enables ISPs to provide higher speed and more reliable Internet services to many users, including businesses.
Maximizes competition in the services space, leading to innovation and enhanced opportunities for entrepreneurial development in the services space.
Municipalities have full access to the infrastructure to meet all current and future internal connectivity requirements. Municipalities can fully leverage the multi-wavelength potential of current FTTH opto-electronic systems.
Even with the lit model, dark-fibre services can be provided to those suppliers requiring it.
Cons: A larger capital cost than that required for the dark-fibre network. The perception that municipalities are entering a private industry marketplace.
Minimizes the number of opportunities for the ISPs to competitively differentiate themselves.
Increased cost and operational complexity, both due to the management of the opto-electronics and to meeting the operational needs of the ISPs using the network.
Risks: The network requires the ISPs to provide retail services to users. Municipalities could be in a situation where a substantial amount of dollars are spent and there are no actual users.
Risk Management: Identify at least one ISP provider that agrees to provide retail services prior to commencing deployment.

Option 6 – Become a Retail Services Provider

Deploy both backhaul and access fibre throughout selected areas as in Option 4, light it as in Option 5, and then deploy a full-set of municipal-supported retail services (Internet, telephone, and television) to residents and businesses. All network operations and retail services operations could be outsourced. Summary arguments for this approach appear below.

Table 53. Deployment Option 6 - Become a Retail Services Provider

Become a Retail Services Provider
Examples: When Olds was unable to attract retail providers to supply services over its dark-fibre network, it established O-Net to both light and provide services over its network. An integrated fibre network and services solution was developed for the Town of Valleyview – but unfortunately interest waned. The Incumbents and wireless ISPs.
Pros: Full control over all aspects of network and service operations, including coverage, pricing, and quality. Reduces operational complexity associated with multiple providers using one network and improves operational efficiency. Increased overall profitability and margins. All proceeds from the operation would accrue to the municipality. Obviates the risk of not being able to attract a service provider.
Cons: The large capital cost and increased operational complexity. The perception that the municipality is entering a private industry marketplace and directly competing in both the network and services space. All technical, deployment, market, and operational risk resides with municipalities.
Risks: Poor execution could lead to cost over-runs and an operational model which is not sustainable.
Risk Management: Management and operational complexity can be minimized by outsourcing network and service operations to an experienced provider.

Appendix F: List of Stakeholders Interviewed

The list of stakeholders interviewed for the Broadband Current State Analysis is below:

Table 54. List of Stakeholders Interviewed

Category	Municipality / Organization	Interviewee Name	Interviewee Title
EMRB Member Municipality	Morinville	Brad White	Director, Planning and Economic Development
EMRB Member Municipality	Parkland County	Marc Ficht	Director, Strategic Initiatives
EMRB Member Municipality	Stony Plain	Shawn McCauley	Economic Development Officer
EMRB Member Municipality	Stony Plain	Adam Scharmann	Manager, Technical Services
EMRB Member Municipality	Stony Plain	Tanner Routh	Economic Development Specialist
EMRB Member Municipality	Sturgeon County	Rob Schneider	Manager, Information Services
EMRB Member Municipality	Sturgeon County	Ted Nestor	Senior Infrastructure Planner
EMRB Member Municipality	Spruce Grove	Dave Walker	Manager, Economic & Business Development
EMRB Member Municipality	Spruce Grove	Karla Gould	Economic Development Specialist
EMRB Member Municipality	Spruce Grove	Freddie Martinez	Director, Information Systems
EMRB Member Municipality	Edmonton	Daryl Croft	Branch Manager, Open City and Technology
EMRB Member Municipality	Leduc County	Mark Gallant	Economic Development Coordinator
EMRB Member Municipality	Leduc County	Kent Pudlowski	Manager, Information Management & Technology
EMRB Member Municipality	Leduc County	Des Mryglod	Director, Engineering & Utilities
EMRB Member Municipality	Leduc County	Jordan Evans	Manager, Long Range Planning
EMRB Member Municipality	Leduc	Bob Young	Mayor, City of Leduc
EMRB Member Municipality	Leduc	Shawn Olson	Director, Engineering
EMRB Member Municipality	Leduc	Joanne Graham	CIO, City of Leduc
EMRB Member Municipality	St. Albert	Gordon Coulman	Senior Manager, Information Technology

EMRB Member Municipality	St. Albert	Sharon Chapman	Director, Strategic Services and Information Technology
EMRB Member Municipality	Devon	Paresh Dhariya	Director, Planning & Infrastructure
EMRB Member Municipality	Devon	Manav Chadha	IT Coordinator
EMRB Member Municipality	Fort Saskatchewan	Trevor Harder	Director, Information Technology
EMRB Member Municipality	Fort Saskatchewan	Kevin Schmidt	Network Analyst
EMRB Member Municipality	Strathcona County	Chris Green	Manager, Infrastructure & Customer Support
EMRB Member Municipality	Strathcona County	Russ Avery	Director, Information Technology Services
EMRB Member Municipality	Strathcona County	Kathi Day	Regional Broadband Coordinator
EMRB Member Municipality	Beaumont	Rob Mackin	Director, Economic Development & Communications
Non-EMRB Municipalities	Warburg	Dwayne Mayr	Councillor, Town of Warburg
Non-EMRB Municipalities	Calmar	Michelle Levasseur	Economic Development Officer
Non-EMRB Municipalities	Redwater	Larry Davidson	Town Manager
Non-EMRB Municipalities	Redwater	Ann Hall	Economic Development Officer
Non-EMRB Municipalities	Gibbons	Farrell O'Malley	CAO
Non-EMRB Municipalities	Legal	Robert Proulx	CAO
Non-EMRB Municipalities	Bon Accord	Joyce Pierce	CAO
Ecosystem Stakeholder	ISED	Matthew Kellison	Senior Director, Connected Canada Branch
Ecosystem Stakeholder	ISED	Géraldine Devinat Pavon	Policy Analyst
Ecosystem Stakeholder	Western Economic Diversification Canada	Justin Riemer	Assistant Deputy Minister
Ecosystem Stakeholder	Western Economic Diversification Canada	Carolina Calderon	Director, Policy, Planning, and External Relations Alberta Region
Ecosystem Stakeholder	Western Economic Diversification Canada	Megan Jarosch	Senior Policy Analyst Alberta Region
Ecosystem Stakeholder	Western Economic Diversification Canada	Victoria Brown	Senior Advisor, Communities

Ecosystem Stakeholder	Service Alberta	Richard Bates	Provincial Telecommunications Business Analyst
Ecosystem Stakeholder	Service Alberta	Holly Saulou	Executive Director, Telecommunications & OCCIO
Ecosystem Stakeholder	AUMA	Clint Neufeld	Policy Analyst
Ecosystem Stakeholder	AUMA	Shaun Guthrie	Senior Director, Information Technology
Ecosystem Stakeholder	RMA	Warren Noga	Policy Analyst
Ecosystem Stakeholder	RMA	Tasha Blumenthal	Director, External Relations & Advocacy
Ecosystem Stakeholder	Edmonton Global	Lynette Tremblay	Vice President, Strategy & Innovation
External Jurisdiction	Eastern Ontario Regional Network (EORN)	David Fell	CEO
External Jurisdiction	Southwestern Integrated Fibre Technology Inc. (SWIFT)	Barry Field	Executive Director
External Counsel	DD West LLP	Orvel L. Currie	Managing Partner

Appendix G: Service Level Data

Data gathered for comparing service levels is provided in the excel document attached below:

Service Level Data

Appendix H: Glossary of Terms

In the context of telecommunications, there are many unique words and abbreviations that are used throughout this report. For clarity, CRTC's comprehensive telecommunication glossary of terms is provided, which can be accessed through https://crtc.gc.ca/eng/dcs/glossaryt.htm.

Appendix I: EMRB Broadband Maps

Through the data collected in this study, the following maps have been developed by EMRB:

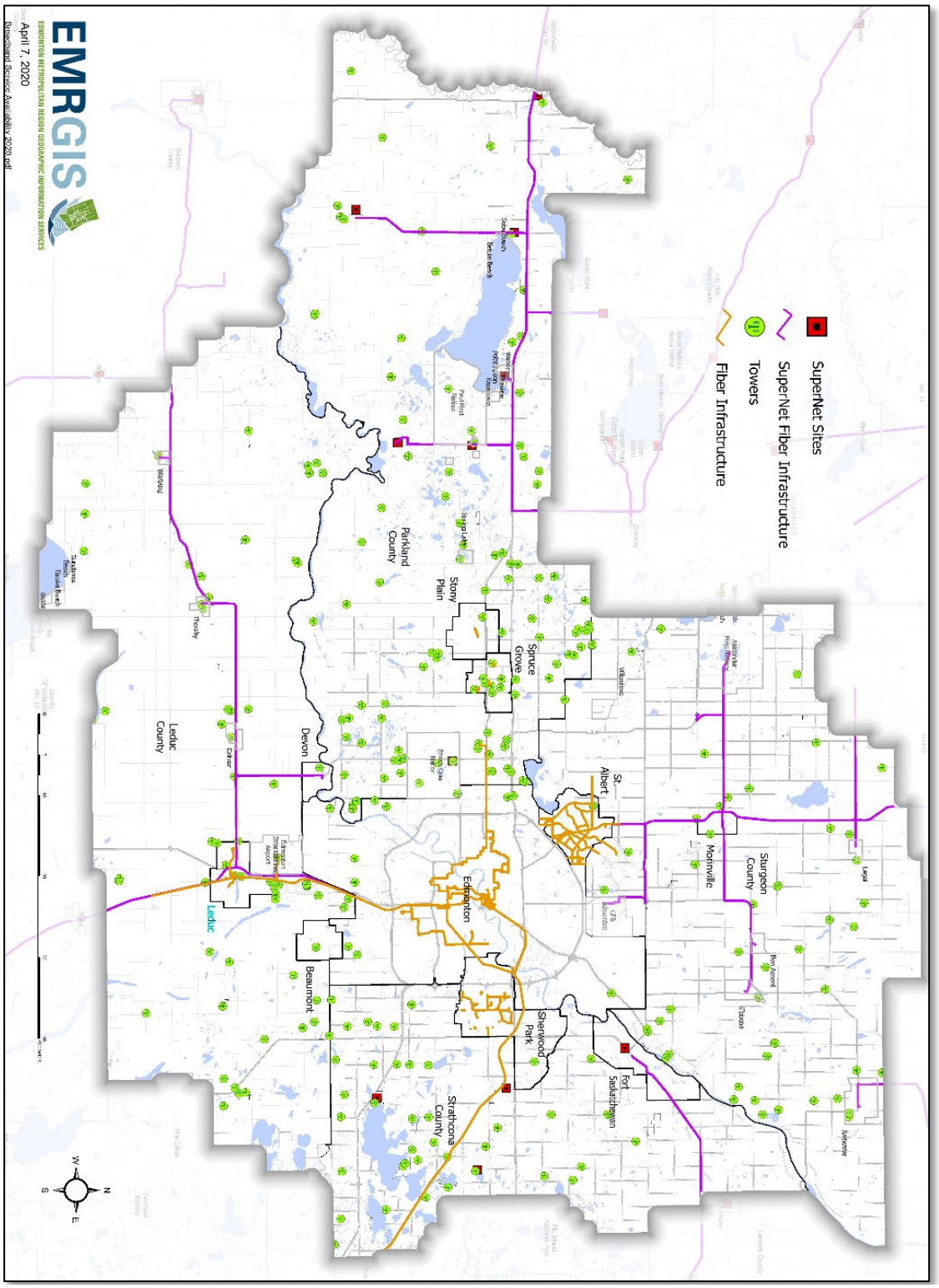


Figure 109. Broadband Infrastructure in the Region Map

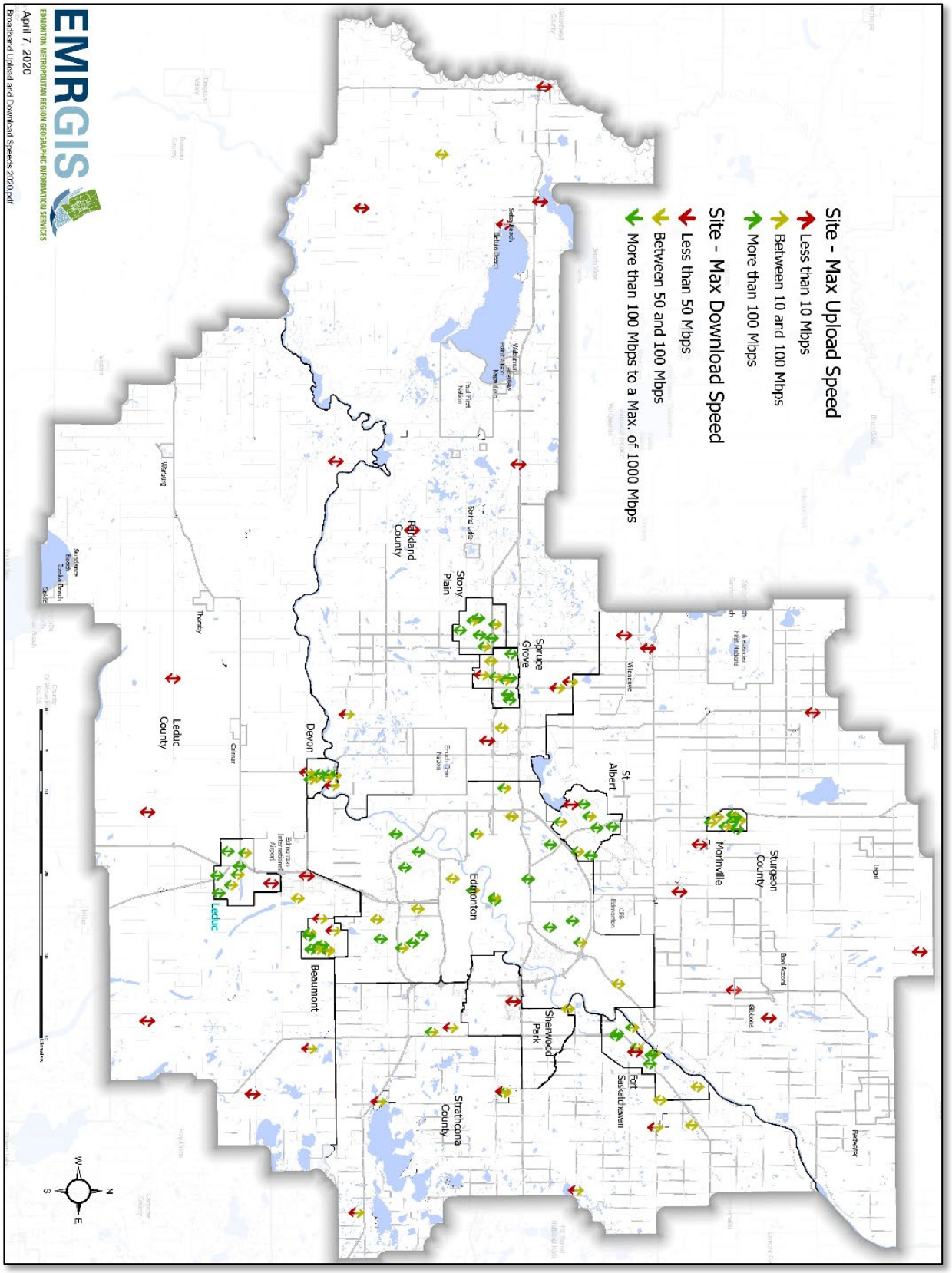


Figure 110. Maximum Advertised Upload and Download Speeds in the Region Map

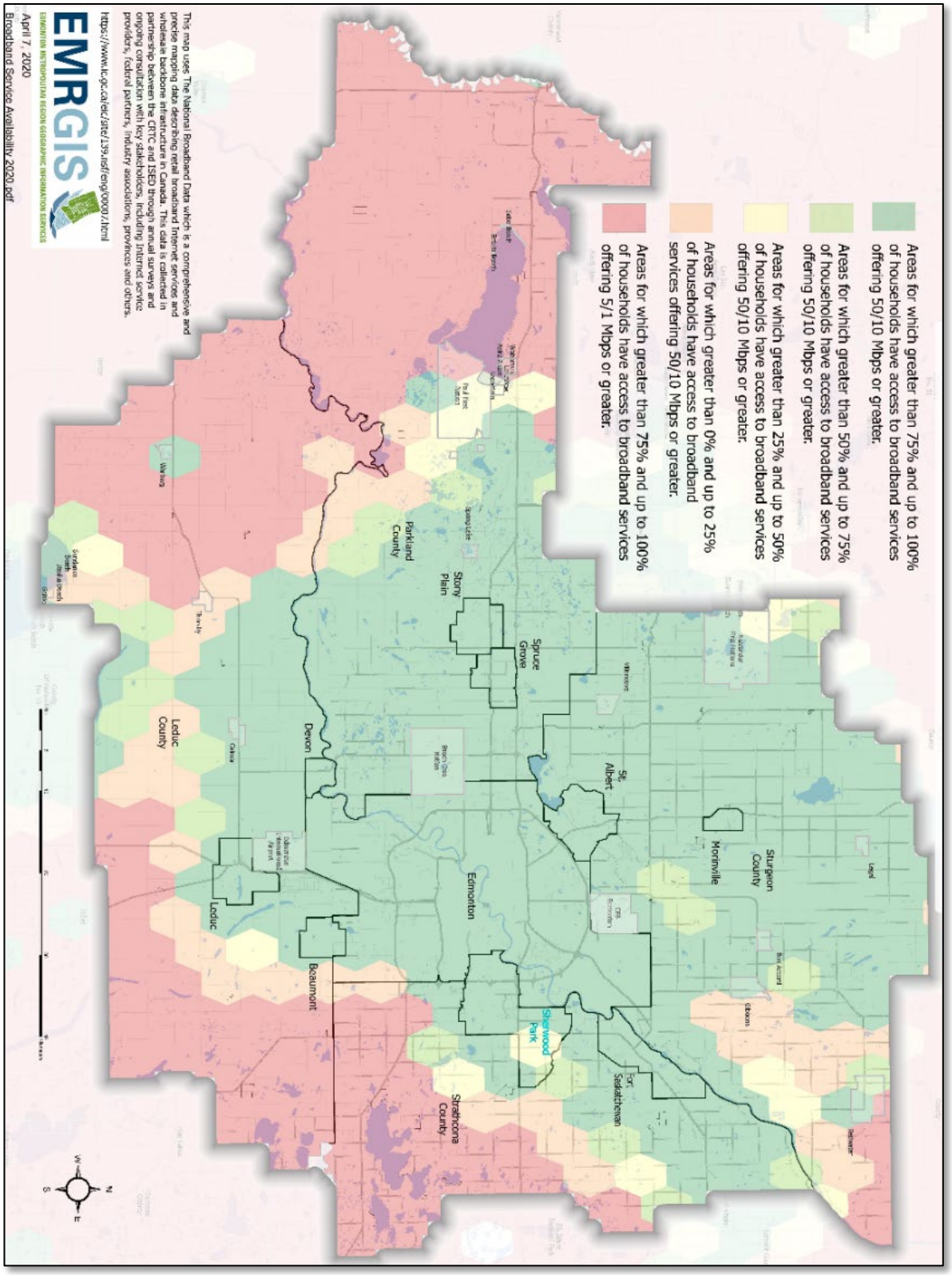
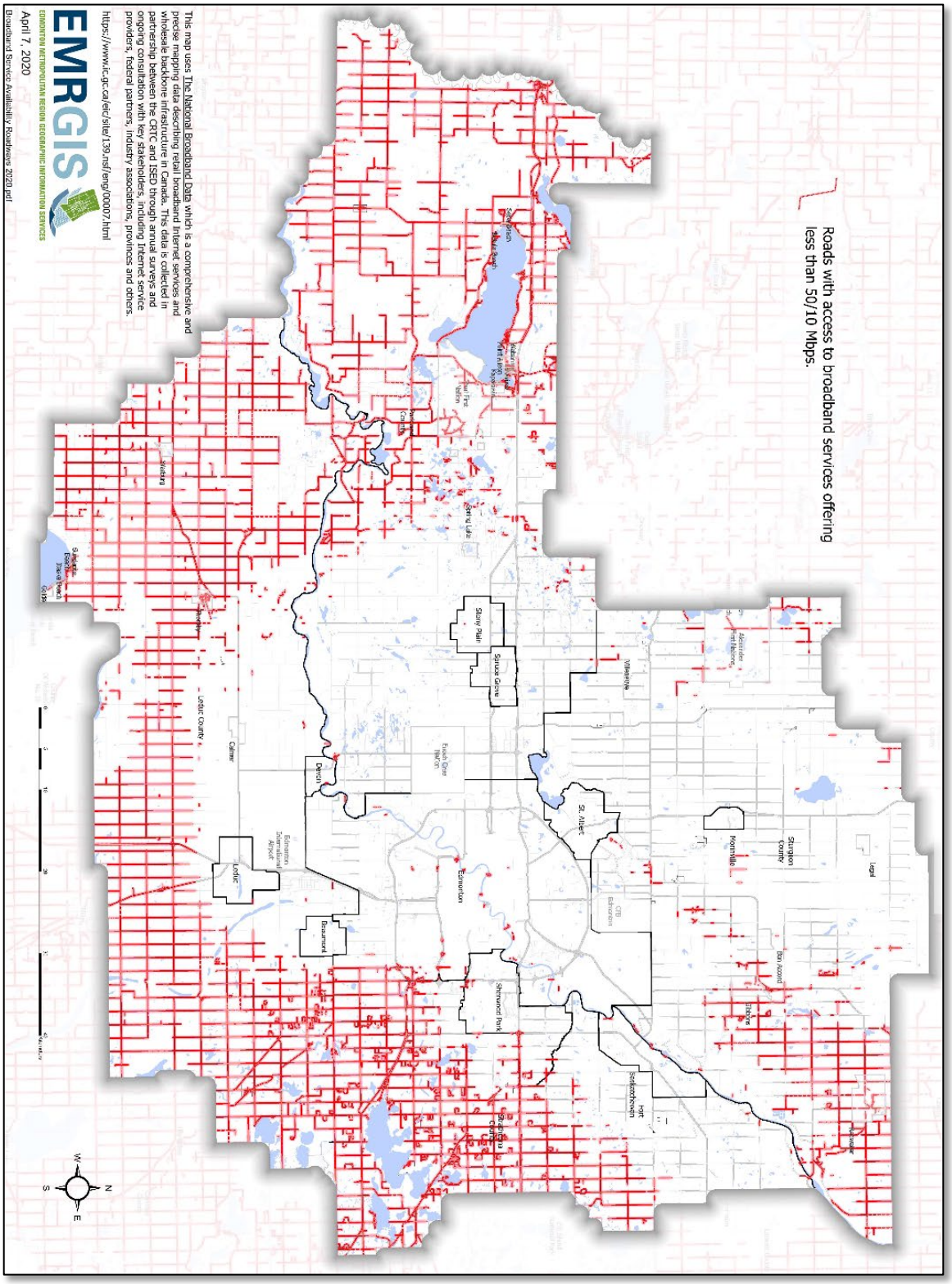


Figure 111. Broadband Service Availability by 25km2 Hexagons in the Region Map



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