PEACE RIVER
REGIONAL DISTRICT

Peace River Regional District Connectivity Strategy Report

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VALO NETWORKS

Table of Contents

Contents

Executive Summary

Over the last few decades, communications technology has undergone radical transformations. From a time when users had to choose between using the Internet or phone, Canadians now have real-time access to a world of information and entertainment. In almost everything we do, Canadians rely on the Internet to create meaningful content, contribute to Canada's economy and democracy, and connect with their friends, families, and communities.

Broadband Infrastructure connects rural and remote communities to the rest of the world, and allows them the same opportunities as urban areas. The availability of affordable, high-speed Broadband Internet is an important factor in where businesses and people choose to locate. With the increasing demand for new applications, consumers and businesses are consuming bandwidth at an ever increasing rate.

Overwhelmingly, rural and remote communities have identified challenges accessing affordable, high-speed Internet as the number one issue impeding their economic growth. The primary issues are speed, connection reliability and latency; which is often not sufficient for rural and remote Canadians to be able to take advantage of even a fraction of what the Internet has to offer.

The minimum target speed set by the CRTC for Canadians is 50 Megabits per second (Mbps) download with a 10 Mbps upload, however, connectivity demands are expected to continue to increase beyond the "50/10 Mbps target" due to the rapidly changing nature of information and communications technology, and their continue requirements for bandwidth.

Despite the development of multiple grant funding programs to upgrade or establish Broadband Infrastructure, the digital divide still remains. The challenges to connect are difficult. To overcome this divide, local governments must take an active role in the deployment of Broadband Infrastructure in their communities. Traditionally a service provided by the private sector, local governments across the country are now owning Broadband Infrastructure, and in some cases, operating Broadband networks. Local governments in British Columbia are being asked to provide leadership and innovation, and leverage Broadband opportunities to bring greater economic diversity, resiliency, and prosperity to their communities.

Communities throughout Canada are redefining themselves as the need for Broadband Internet evolves. To respond accordingly to communities' individual needs and challenges, local governments must develop a strong, comprehensive connectivity strategic plan that incorporates access, affordability and speed into the plan. (NDIT)

Given the critical nature of Broadband Infrastructure, the Peace River Regional District (PRRD) Board formed the Fiber Working Group (FWG) to explore and better understand various aspects of Broadband technologies and services. The interim findings and recommendations of the FWG are presented in this strategy.

The PRRD Connectivity Strategy is based on a collective vision from Electoral Areas B, C, D and E, and the City of Dawson Creek, District of Chetwynd, District of Taylor, District of Hudson's Hope, and the Village of Pouce Coupe.

Purpose

The purpose of the Connectivity Strategy is to identify options for the PRRD to pursue to ensure that critical high-speed Broadband Internet services are accessible throughout the entire district, and to outline how PRRD can facilitate and build Broadband infrastructure that is required to deliver Broadband Internet, and support competition.

This Connectivity Strategy is to be used as a framework to outline mid-to-long term goals for Broadband Internet connectivity throughout the region. It is intended to be forward looking and provide a benchmark to weigh future projects and opportunities against.

PRRD's Vision

> *"Residents, businesses, and organizations within the PRRD will have access to ~~equitable~~, ~~affordable~~, reliable, redundant, high-speed Broadband Internet services in their homes, businesses and public buildings, at performance levels that meet all of their needs for health, education, economic development, that are delivered now and into the future."*

Targeted Outcomes

- ✓ 100% of critical community assets in the PRRD will have access to Broadband Internet services.

- ✓ 100% of households in the PRRD will have access to Broadband Internet services that meet a minimum service level of 50 Mbps download and 10 Mbps upload to be revised on a periodic basis as standards evolve.

- ✓ There will be access to mobile wireless technology throughout every major transportation corridor in the Region.

PRRD Connectivity Strategy Recommendations

The following are the high-level recommendations that form the Connectivity Strategy.

1. That the Regional Board authorize an Internet Performance Speed Test Campaign to achieve accurate and up to date internet speed test data for the region.

2. That the Regional Board pursue a 'hybrid' model of governance for PRRD owned Broadband infrastructure, in partnership with a private wholesale operator.

3. That the Regional Board develop connectivity projects and proposals that will leverage funding from public and private partners.

4. That the Regional Board establish a Broadband Internet and Mobility Standing Committee to expand upon the work of the FWG and the PRRD Connectivity Strategy.

5. That the Regional Board develop a connectivity work plan, identifying timelines and deliverables for the proposed recommendations in the PRRD Connectivity Strategy.

6. That the Regional Board engage stakeholders to identify all broadband requirements across the district and identify those stakeholders that may play a role as consumers or providers of such services.

7. That the Regional Board engage with Broadband Internet and mobility providers operating within the PRRD to communicate service needs, identify gaps, and maximize their role in fulfilling the PRRD's Broadband vision.

8. That the Regional Board update policies, bylaws and official community plans to incorporate connectivity principles, and support for Broadband deployment.

9. That the Regional Board investigate the ability to develop and implement a 'Dig Once' policy for the PRRD.

10. That the Regional Board advocate to the Federal Government to develop a national 'Dig Once' strategy that coordinates with both provincial and local governments.

11. That the Regional Board determine what role the PRRD has when it comes to Broadband and Mobility Infrastructure approvals (i.e zoning), and review the development approval processes.

12. That the Regional Board advocate to the Ministry of Transportation and Infrastructure to increase resources dedicated to reviewing and processing right of way permit applications for Broadband Infrastructure deployment.

13. That the Regional Board engage with the Ministry of Transportation and Infrastructure to review their application and permitting process for Broadband Infrastructure deployment to see if it can be simplified.

14. That the Regional Board advocate to the Ministry of Municipal Affairs to amend the Local Government Act to allow regional districts to operate, construct, or maintain Broadband Internet or Broadband Infrastructure without requiring elector consent.

15. That the Regional Board advocate to the federal government for an early release of 3800MHz to compensate for the limited spectrum availability in 3500MHz.

16. That the Regional Board advocate to the federal government to ensure that spectrum allocations are within the same spectrum block to reduce cost of connectivity deployment initiatives.

17. That the Regional Board advocate to the federal government to implement a 'use it or lose it' policy to ensure that rural spectrum allocations are deployed.

18. That the Regional Board advocate to the federal government to update their spectrum pricing model, and base it on population served.

19. That the Regional Board create a Broadband Levy fee to fund connectivity initiatives.

20. That the Regional Board undertake an elector approval process to create a regional connectivity service function to support a PRRD transport network.

21. That the Regional Board undertake an elector approval process to create individual service functions for areas where last mile initiatives will be deployed.

22. That the Regional Board authorize the preparation of 'shovel-ready' last mile connectivity proposals so that the PRRD can apply for federal and provincial grant funding as opportunities are available.

23. That the Regional Board advocate to the federal and provincial government to commit to long-term and predictable funding for Broadband Infrastructure in rural and remote communities.

24. That the Regional Board advocate to the federal government to realign grant funding programs for communities with an urban core of less than 10,000 residents, which is aligned with Statistics Canadas's definition of rural and small town areas.

25. That the Regional Board engage the market to start building backhaul throughout the District where a lack of such backhaul is resulting in communities continuing to be unserved and under-served from a broadband and mobility service perspective

Connectivity Principles

In recognition of the growing importance of connectivity for public good, the PRRD recognizes the following connectivity principles:

- Connectivity is essential to strengthen the social, economic, ecological and cultural resilience within the region.
- Connectivity and technology shapes residents' choices, behaviours and needs.
- Connectivity is pertinent to all regional district planning and decision-making.
- The Regional District has a role in ensuring residents have access to ~~equitable, affordable,~~ high-speed Broadband Internet.
- The Regional District views Broadband infrastructure as an essential infrastructure. ~~, as it does with other essential services like electricity, water and sewer.~~
- The nature and expense of connectivity deployment requires a forward-looking vision to maximize potential and coordinate efforts within the regional district.
- Convergence of public and private infrastructure where it benefits the public and protects public interests is good public policy.
- Access to Broadband Internet and infrastructure must be leveraged through Official Community Plans, regional growth planning, and spatial planning (i.e. land use by-laws, sub-division by-laws) to maximize potential within the region.
- An understanding of the true drivers and needs for connectivity will inform decisions.
- Leverage one infrastructure to advance another (i.e. dig once policies) is in the public interest.
- Access to Broadband Internet and infrastructure allows the regional district to retain and grow businesses, create and retain skilled workers, and re-invigorate communities.
- Broadband Redundancy is essential to protect Internet, telephone, cellular, and essential government services throughout the region in the event of damage to Broadband Infrastructure at any time.

Background Information and Context

Broadband Internet

Broadband Internet service is the most used form of Internet access around the world due to the ability to provide high speed access. Broadband Internet, is a high capacity Internet connection that enables quick and reliable online service. Unlike dial-up, Broadband Internet is always on, can be assessed at any time, and can support more than one connection at a time. A more inclusive definition of Broadband Internet is "Connectivity". (Weeden, 2020)

Broadband Infrastructure

Prior to 2001, there was little discussion of Broadband Infrastructure among advisory organizations or levels of Government. From 2001 on, the term Broadband Infrastructure began to represent a way of promoting citizen access to information. (Middleton, 2007)

Networks around the world are now capable of handling enormous transfers of data and cannot function without sufficient Broadband infrastructure. Broadband Infrastructure is the infrastructure that enables Broadband Internet connectivity. (Weeden, 2020)

Broadband refers to a wide variety of technologies that are capable of transferring multiple data through high-speed transmission technologies, including, Digital Subscriber Line (DSL), cable, satellite, wireless, Broadband-Over-Power Lines (BPL), and fibre-optics. (Weeden, 2020)

Why is Connectivity Important?

Connectivity is an indispensable service in Canada, and plays an integral role to the economic and social welfare of all communities. Broadband Internet access is an essential service for everyday life. Connectivity benefits rural and remote communities by allowing them to participate and/or access education, healthcare, economic development, government services, public safety, and emergency services. (NDIT)

Universal Broadband Objective

On December 21, 2016, the Canadian Radio-television and Telecommunications Commission (CRTC), issued Telecom Regulatory Policy 2016-496, which set out policies and actions the Commission was taking to help Canadians access connectivity. The CRTC declared that access to Broadband Internet amounted to an essential service and adopted minimal performance standards across Canada. The CRTC determined that Canadian residential and business should be able to access speeds of at least 50 (Mbps) download and 10 Mbps upload, as well as the option for unlimited monthly data transfer. (CRTC, 2016)

To help meet the universal service objective, the Commission began to shift the focus of its regulatory frameworks to Broadband Internet services, and created a new fund to support building or upgrading Broadband Infrastructure for fixed and mobile Broadband Internet access. (CRTC, 2016)

High-Speed Access for All – Canada's Connectivity Strategy

Canada's Connectivity Strategy is a commitment to connect every Canadian to affordable, high-speed Internet no matter where they live. The Strategy is Canada's plan for delivering on this commitment: through new investments and collaboration with partners, ensuring high-speed access for all. (ISEDC, 2019)

Canada's Connectivity Strategy is built on three pillars: high-speed access for all, investing for impact, and partnering for progress. The Strategy aims to deliver 50/10 connectivity to 90% of Canadians by 2021, 95% of Canadians by 2026, and the hardest-to-reach Canadians by 2030. (ISEDC, 2019)

The Government of Canada has committed to providing funding and financial support ($500 million over 5 years) for Broadband Infrastructure for rural and remote areas, and advocates that all orders of government, including local governments, must be part of the solution to closing the Broadband gap and achieving the targets set out in this Strategy. It is clear that there is no one-size-fits-all solution, and the diversity of connectivity challenges that rural communities face will require a locally tuned approach. (ISEDC, 2019)

Digital Divide

The digital divide is the gap that exists between individuals who have access to modern information and communication technology, and those who do not. There are numerous factors that influence the digital divide, including, gender, social, education, digital literacy, income levels, and race. (DDC, 2019)

Despite numerous federal and provincial grant funding programs, and the declaration of Broadband as an essential service, there remains a national digital divide between rural and urban communities. Rural and remote communities experience slower or less reliable Connectivity than urban areas, largely due to a lack of access to Broadband Infrastructure. (Middleton, 2017)

In British Columbia, only 36% of rural communities and 38% of rural Indigenous communities have access to the Broadband Objective. (KPMG, 2019) Without comparable access to Connectivity, residents of rural areas cannot benefit from the same services as those enjoyed in urban areas. (INDU, 2018)

Challenges to Connect

Challenges to Broadband Internet deployment in rural and remote areas vary from community to community, and face many monetary and organizational challenges. Some of the main challenges include:

Access to Existing Broadband Infrastructure

Many rural and remote regions of Canada lack the Broadband Infrastructure required to provide high speed Internet to households and businesses, and thus have to rely on older, less reliable technologies, such as copper-based and microwave transport networks. (NDIT)

Broadband Infrastructure Construction Costs

Broadband Internet service is a commercial commodity, and the majority of Internet Service Providers (ISPs) are privately owned and operated. ISPs tend to invest in high density areas that are economically profitable. Due to density and geographical issues, the return on investment for Broadband capital projects in rural areas is often not profitable enough to attract private sector investment due to the low number of potential customers and the physical distance that must be covered. (NDIT)

Spectrum and Network Management

Many have criticized spectrum allocation in Canada. The scope of spectrum licenses is considered too wide as one license can encompass both rural and urban areas, pricing is outdated, and there hasn't been enough recognition of the fact that spectrum allocation is needed for rural connectivity. The wide scope of spectrum licenses disadvantages small service provides. By reducing the scope, and basing the spectrum pricing on population served, small Internet Service Providers (ISPs) could provide Internet services to rural and remote regions in an economically feasible manner. (INDU, 2018)

Regulatory Framework

Various regulatory issues pertain to the management of physical telecommunications infrastructure. According to the South Western Integrated Fibre Technology (SWIFT), Canada's telecommunications sector is complex to manage and regulate. (SWIFT, 2017)

Proximity to High – Speed Transport (Backhaul)

There are two important connections that an ISP must have access to for Broadband Internet; a direct connection (or third-party agreement) to the Internet Transport (backhaul), and an interconnection with an Internet Exchange (IX). This backhaul connection provides the link between the Broadband Infrastructure and the Internet. In British Columbia, the Internet Exchange is located in Vancouver. In Alberta, the Internet Exchange is located in Calgary and Edmonton. (EDC, 2016)

For rural and remotes areas that have neither a transport network or service provider willing to allow transport on their transport infrastructure, the ISP will have the additional cost of building the transport as part of their network. Further, for rural and remote communities, there may be only one transport route for the entire region, leaving the community vulnerable if the transport route were to become damaged. (NDIT)

Access to Existing Utility Infrastructure

Without access to "right of way', ISPs cannot modify or install Broadband Infrastructure for the purpose of delivering Broadband Internet services, and may incur higher costs to provide the services. Differences in regulatory frameworks mean that there are different rates being charged for identical services, such as Hydro and fiber, only because one is set by provincial regulators and the other is set by the CRTC. (INDU, 2018)

Federal Grant Funding Allocation

Federal grant programs provide funding to Internet service providers to upgrade or construct Broadband infrastructure in urban and rural communities who do not have access to high speed Internet. The CRTC uses Statistics Canada's definition for "rural," which is a community of less than 30,000 persons, but many rural communities are much smaller than that. ISPs tend to provide Internet Services in communities that have greater density and population to reduce construction costs while optimizing profits. (INDU, 2018)

A more appropriate measure could be realigning grant funding programs for communities with an urban core of less than 10,000 residents, which is aligned with Statistics Canadas's definition of rural and small town areas, or applying the 30,000 person population requirement to a larger geographic scope like an Electoral Area. By lowering the population requirement will ensure that public money is spent on communities that need it the most.

While the current federal funding is significant, it is still insufficient to address the amount of Broadband Infrastructure that is required nationally. The CRTC roughly estimates that the cost required to provide Broadband Internet to rural and remote communities in Canada will be $7 billion. This leaves a gap between the cost and public funds currently available. Further, while some communities and ISPs might need one-time capital investments, others might need ongoing funding support. By changing the way the Federal Government awards funding, the government could reduce risk for ISPs by committing to long-term and predictable funding for Broadband Infrastructure in rural and remote communities. (INDU, 2018)

Quantifying the Connectivity Gap

State of Connectivity in the PRRD

The availability of high-speed Broadband Internet varies significantly across the regional district. Broadband Internet access ranges from modern FTTP services for some residents and business, to a complete lack of service for others.

In economic terms, a "market failure" is a state of disequilibrium in which the quantity supplied of a good or service does not equal the quantity demanded by the market. This is exactly the state that rural and regional markets throughout Canada are experiencing with high-speed Broadband Internet.

In the PRRD, the demand for high-quality Broadband Internet services is simply not being met by the market. This means that if you live outside of Dawson Creek or Fort St. John, there is limited chance to access the CRTC's universal Broadband standard of 50 Mbps download and 10 Mbps upload.

Canadian Internet Registration Authority Internet Performance Test

The Canadian Internet Registration Authority (CIRA) is the organization responsible for managing the ".ca" country code top-level domain.

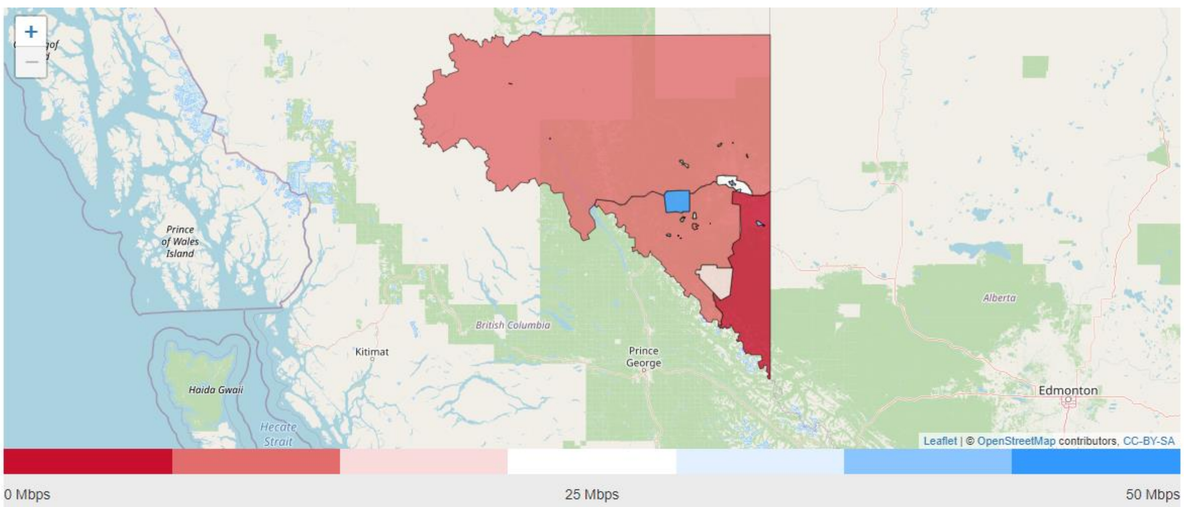
The Canadian Internet Registration Authority (CIRA) Internet Performance Test is a quick and easy way for residents to test their Internet Connection. CIRA Internet Performance Tests provide specific data about the actual state of connectivity and this data can be used to support the need to bring high speed Internet services to an area/region. Researchers use the information gathered by the CIRA speed test to understand better and improve the Canadian Internet. It also provides detailed technical diagnostic information and assists with determining eligibility for federal connectivity granting programs.

The CIRA Internet Performance Test is composed of test servers located throughout Canada at various Internet Exchange Points, allowing CIRA to run a variety of tests measuring everything from network speed and latency to blocking and throttling. Unlike other speed tests that test connection speed from the computer to the Internet service provider's network, the CIRA Internet Performance Test will test the connection from the computer to the Internet as a whole (within Canada). It will give a more wholesome comparison of the capabilities of performance on Canada's Internet infrastructure.

The CIRA Internet Performance Test uses a test called the Network Diagnostic Test provided by M-Lab that connects the resident's computer to a server within the Canadian Internet Exchange Points. As each user performs a test, their data is anonymously collected and aggregated into a large dataset that spans Canada. Residents can compare their connection speeds with other people in their neighbourhood, municipality, electoral area, and even across the country.

In March 2021, the PRRD partnered with CIRA to create a customized local government Internet testing portal for the PRRD that graphically shows the results of all the performance tests that have been run by users throughout the district. When viewed at a regional level it is clear that the PRRD has significant work to do to ensure that adequate Broadband is available throughout the district.

The figure below from the CIRA Internet Performance website shows the average Broadband speed for various regions within the PRRD. Dark red indicates an average of less than 8 Mbps download. Light red indicates less than 15 Mbps on average. Updated statistics for PRRD may be found at https://performance.cira.ca/prrd



RECOMMENDATION That the Regional Board authorize an Internet Performance Speed Test Campaign to achieve accurate and up to date internet speed test data for the region.

Connecting the PRRD

When discussing how to ensure that adequate Broadband Internet infrastructure exists in the regional district, it is important to distinguish between the various types of networks. Two ways networks can be classified is by the technologies they use (i.e. wired vs wireless networks) or by the type of traffic the networks carry (i.e. distribution versus backhaul). An illustration of how these network classifications apply to the PRRD may be found in figure 1 below.

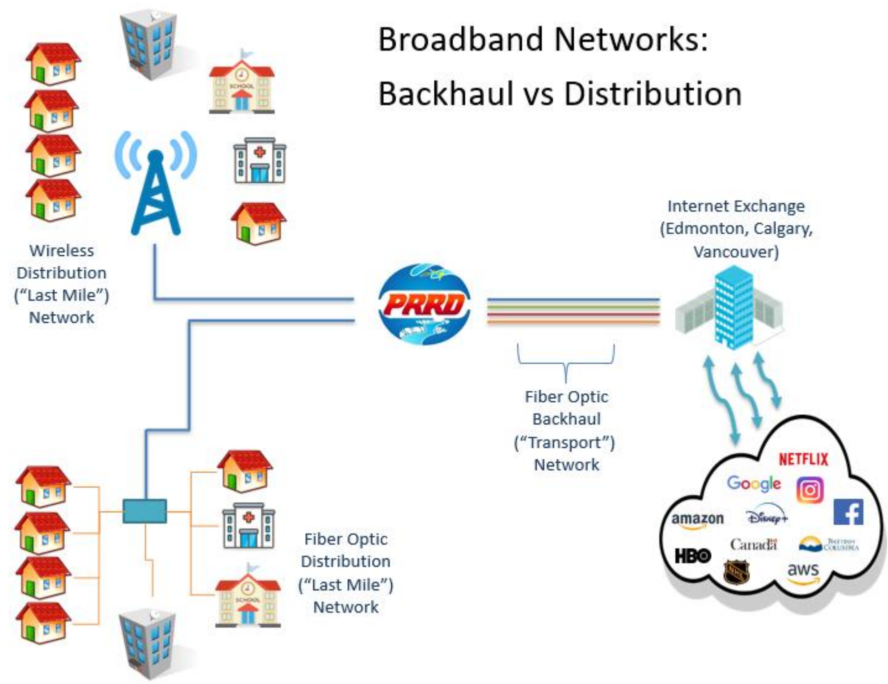


Figure 1 - Backhaul vs Distribution Networks

It is important that sufficient capacity and access exists in both types of networks. For long term viability and service levels, the PRRD wants to ensure it is served by high-capacity and commercially available backhaul networks that connect the district to a global Internet exchange. To deliver services within the regional district, a combination of wired and wireless distribution ("last mile") networks are required to ensure all residents have access to Broadband Internet services. **Appendix 1 – Wired vs Wireless Networks** discusses the pros and cons of the different network types and explores some of the technologies used.

The wired and wireless networks that are used for distribution of services to homes and businesses can be further divided by the type or technology they use to connect the end user via a wired connection (i.e. fiber vs copper) or a wireless (fixed wireless vs mobile). **Appendix 2 – 5G Wireless** discusses the next generation of mobile (cellular) networks that are being implemented by the mobile carriers. These networks not only provide mobile phone services but they offer Broadband Internet services as well.

Almost all new wired networks being built today are fiber-to-the-premise networks (FTTP). While FTTP networks are expensive to build, their ultra-high speeds solve the Broadband Internet connectivity challenge for the foreseeable future. One technology that potentially reduces the cost of building FTTP is where existing water or gas pipes are used to run the fiber cable (known as “pipe-in-pipe”). **Appendix 3 – Pipe-in-Pipe** explains the pros and cons of this approach.

Satellite networks are another means of delivering Broadband Internet to even the most remote locations. Earlier generations of this technologies were not ideal for Broadband Internet service delivery because of the propagation delay of the signal passing from the satellite to the receiving dish on the ground. The new generation of Low Earth Orbit (LEO) satellites address this delay challenge. The Starlink network by SpaceX is just offering beta or “test” services in the region. **Appendix 4 – Low Earth Orbit Satellite Networks** discusses this technology in more detail.

Business Models, Governance and Funding

Over the past 25 years, demand for Broadband Internet services has grown exponentially. Early wired (i.e. copper) and wireless Internet services provided access to Internet services that started as low as 56 kilobits (kilo=thousand) per second. As internet technologies improved, "high speed" Broadband Internet was defined as 1.2 megabits (mega=million) per second.

As new services were created (i.e. online interactive websites, video over IP, video conferencing, etc.), the Internet speeds required to support these services grew far beyond what the existing Broadband Infrastructure could provide, and new Broadband Internet infrastructure had to be built.

Broadband Infrastructure is very expensive to build and access. While privately owned incumbent internet service providers invested millions into upgrading their private networks in densely populated municipalities and communities, they could not justify the same investment in more sparsely populated rural and remote communities. As a result, rural and regional communities across Canada have been under-served in terms of the availability of high-speed Broadband Internet.

Although the private sector is the principal driver of telecom investment in Canada, to facilitate Broadband deployment in rural and remote communities, local governments may have to provide incentives for private entities to establish Connectivity in these areas. Local governments have started responding to the digital divide by engaging with Broadband Internet service providers to encourage the creation of new and modern Broadband infrastructure. In some cases, local governments have built community owned and operated Broadband infrastructure or partnered with the private sector in jointly owned networks. (INDU, 2018)

The governance of these community networks depends on the nature of the investment that the local government makes. There are a variety of governance models that may be utilized for these new Broadband networks. Options range from creating a local government owned and operated network that functions like a utility to leasing/selling bandwidth to private ISPs.

Considering the costs and challenges of providing access to Broadband Internet in rural and remote communities, local governments could form public-private partnerships (P3s) with internet providers. This model would utilize both public and private capital, while allowing the local government to have a voice in important aspects of the retail operation, such as competitive pricing, and wholesale services to the market.

RECOMMENDATION
That the Regional Board pursue a 'hybrid' model of governance for PRRD owned Broadband infrastructure, in partnership with a private wholesale operator.

RECOMMENDATION
That the Regional Board develop connectivity projects and proposals that will leverage funding from public and private partners.

Appendix 5 – Broadband Ownership and Business Models provides more insight and background into some of the business models available, and different approaches to governing the resulting infrastructure.

Broadband Internet and Mobility Standing Committee

Building a Broadband network is only part of the work necessary to ensure access to connectivity. Speed shouldn't be the only metric of success. Quality, affordability, and standards of parity between urban and rural centers are other important factors of Broadband Internet access in rural and remote areas. (Middleton, 2017)

To ensure that the Connectivity Strategic Plan is comprehensive, scalable, inclusive, and meets the needs of the community, local governments should engage with local ISPs, First Nations, funding partners, technical experts, government agencies, business and residents to understand the challenges and priorities of the community, identify goals, and addresses needs or gaps in service. (NDIT)

The role of the Standing Committee will be to engage with service providers and stakeholders, research and review current technologies and market trends, share information, examine funding opportunities, develop a connectivity work plan, and make recommendations to the PRRD Board regarding Broadband Internet and mobility policy to fulfill the PRRD's connectivity vision.

RECOMMENDATION
That the Regional Board establish a Broadband Internet and Mobility Standing Committee to expand upon the work of the FWG and the PRRD Connectivity Strategy.

RECOMMENDATION
That the Regional Board develop a connectivity work plan, identifying timelines and deliverables for the proposed recommendations in the PRRD Connectivity Strategy.

RECOMMENDATION
That the Regional Board engage stakeholders to identify all broadband requirements across the district and identify those stakeholders that may play a role as consumers or providers of such services.

RECOMMENDATION
That the Regional Board engage with Broadband Internet and mobility providers operating within the PRRD to communicate service needs, identify gaps, and maximize their role in fulfilling the PRRD's Broadband vision.

Funding Broadband Infrastructure

There are two broad sources of funding to build new Broadband Internet Infrastructure – private capital and public capital. Given the dramatic growth in Broadband Internet service demand, the private sector will continue to invest private capital into building new Broadband infrastructure and services. The challenge for the PRRD is that the regional district has little influence over where and when such private capital is deployed, and due to the return-on-investment requirements for most private capital, without government support, capital will continue to be deployed in densely populated communities where it can earn the highest possible returns.

In areas of the PRRD that are sparsely populated, it is likely that public capital, or a combination of private and public capital, will be necessary to build new Broadband Internet infrastructure. Public capital typically does not have the same return-on-investment requirements as private capital. Quite often public capital contribution to infrastructure projects is structured as a grant that does not have to be paid back. Where there is the expectation that the public capital be paid back over time, it is often at a low or zero interest rate.

In British Columbia, the sources of public capital available to the PRRD include:

Government of Canada	Via programs such as those managed through either Innovation, Science and Economic Development, CRTC and/or Infrastructure Canada (i.e. CRTC Broadband Fund and the Universal Broadband Fund)
BC Government	Via programs such as Connecting BC managed by NDIT
Regional Districts	Via Gas Tax funds, taxation, Broadband Levy Funds
Municipalities	Via individual programs within given municipality
All Nations Trust Company (ANTCO)	Indigenous owned Trust Company with various investment programs (e.g. Pathways to Technology)

Broadband Levy Fee

One method of generating a new, consistent source of funding for Broadband Infrastructure would be to create a Broadband Levy on property taxes. For example, to support the development of Broadband Infrastructure for their residents, the Town of Caledon established a Broadband Levy to its property taxes, at approximately $11 per household. (Weeden, 2020)

RECOMMENDATION
That the Regional Board create a Broadband Levy fee to fund connectivity initiatives.

RECOMMENDAITON
That the Regional Board undertake an elector approval process to create a regional connectivity service function to support a PRRD transport network.

RECOMMENDATION
That the Regional Board undertake an elector approval process to create individual service functions for areas where last mile initiatives will be deployed.

RECOMMENDATION
That the Regional Board authorize the preparation of 'shovel- ~~ready~~ worthy' last mile connectivity proposals so that the PRRD to apply for federal and provincial grant funding as opportunities are available.

RECOMMENDATION
That the Regional Board advocate to the federal and provincial government to commit to long-term and predictable funding for Broadband Infrastructure in rural and remote communities.

RECOMMENDATION
That the Regional Board advocate to the federal to realign grant funding programs for communities with an urban core of less than 10,000 residents, which is aligned with Statistics Canadas's definition of rural and small town areas.

More details on public funding sources may be found in **Appendix 6 – Broadband Funding Models and Sources**.

Policy and Advocacy

Local governments are uniquely positioned to advocate for and develop Broadband Infrastructure policy that reflect their community's specific needs and aspirations. Local governments must not only be the voice for what their communities need, but must lead the way in implementing strategic policies and investments for Broadband Infrastructure.

Reliable high-speed Broadband Internet, connected to Broadband Infrastructure, is as critical to a community today as other traditional types of infrastructure (transportation, water and sewer) (Weeden, 2020) Infrastructure at the local government level facilitates the delivery of public services. The design and location of infrastructure can have a significant effect on the community. This same approach can be used by local governments to ensure that Broadband Infrastructure serves the community's needs.

The digital divide between urban and rural communities will continue to exist until Broadband Infrastructure is included in all infrastructure plans, and receives a commitment from all levels of government to fund and build the required infrastructure. Local governments must ensure Broadband Infrastructure is included in critical planning processes, and is included in Official Community Plans, Strategic Plans, Economic Development Plans, and Asset Management Plans. (Weeden, 2020)

Examples of connectivity principles incorporated into policy and bylaws include:

- New parcels created through subdivision are to be provided with suitable broadband infrastructure.
- All future subdivision applications should demonstrate the provision of fibre ready facilities to enable fixed line connection, or the ability to access suitable telecommunications infrastructure via fixed wireless or satellite services.

RECOMMENDATION
That the Regional Board update policies, bylaws and official community plans to incorporate connectivity principles, and support for Broadband deployment.

Develop a 'Dig Once' Policy

One of the lowest cost and lowest risk options is for local governments to ensure that conduit and fibre-optic cables are installed as part of other capital projects, making the infrastructure easily accessible to ISPs to lease in the future. (Weeden, 2020)

Local governments should consider developing and implementing a 'Dig Once' policy that encourages installing dark fibre during road maintenance or construction activities. Construction costs represent the most expensive line item in broadband deployment, as opposed to the fiber and conduit itself. (Middleton, 2017) By lowering cost of deployment, 'Dig Once' policies allow for new and small ISPs to enter the market, creating competition ultimately can result in more options, lower prices, and higher quality of service for consumers. (Weeden, 2020)

RECOMMENDATION
That the Regional Board investigate the ability to develop and implement a 'Dig Once' policy for the PRRD.

RECOMMENDATION
That the Regional Board advocate to the Federal Government to develop a national 'Dig Once' strategy that coordinates with both provincial and local governments

Simplified Permitting Practices

Complex permitting processes, and unpredictable waiting periods for 'right of use' approvals can discourage ISPs and slow down Broadband investment in the community. Local governments that simplify and streamline this process can assist Broadband Infrastructure deployment. Creating an organized process to make information about permit applications accessible and easy to understand, and collaborating with ISPs to create a set of pre-approved designs can greatly simplify this process. (NCC, 2019)

RECOMMENDATION
That the Regional Board determine what role the PRRD has when it comes to Broadband and Mobility Infrastructure approvals (i.e zoning), and review the development approval processes.

RECOMMENDATION
That the Regional Board advocate to the Ministry of Transportation and Infrastructure to increase resources dedicated to reviewing and processing right of way permit applications for Broadband Infrastructure deployment.

RECOMMENDATION
That the Regional Board engage with the Ministry of Transportation and Infrastructure to review their application and permitting process for Broadband Infrastructure deployment to see if it can be simplified.

Regional District Participating Area Approval

Almost all regional district service establishing bylaws and most loan authorization bylaws require some form of participating area approval before they may be adopted. Local governments must obtain consent or approval of the electors before a municipal council or regional district board may proceed with certain matters. Section 338 (2) of the *Local Government Act*, lists exemptions for the requirement of the Board to first adopt an establishing bylaw for the service. By adding the provision of 'operating, constructing or maintaining Broadband Internet or Infrastructure' to the list would help reduce barriers for local governments to provide or fund the service.

RECOMMENDATION
That the Regional Board advocate to the Ministry of Municipal Affairs to amend the Local Government Act to allow regional districts to operate, construct, or maintain Broadband Internet or Broadband Infrastructure without requiring elector consent.

Spectrum Allocations

RECOMMENDATION
That the Regional Board advocate to the federal government for an early release of 3800MHz to compensate for the limited spectrum availability in 3500MHz.

RECOMMENDATION
That the Regional Board advocate to the federal government to ensure that spectrum allocations are within the same spectrum block to reduce cost of connectivity deployment initiatives.

RECOMMENDATION
That the Regional Board advocate to the federal government to implement a 'use it or lose it' policy to ensure that rural spectrum allocations are deployed.

RECOMMENDATION
That the Regional Board advocate to the federal government to update their spectrum pricing model, and base it on population served.

PRRD Regional Network

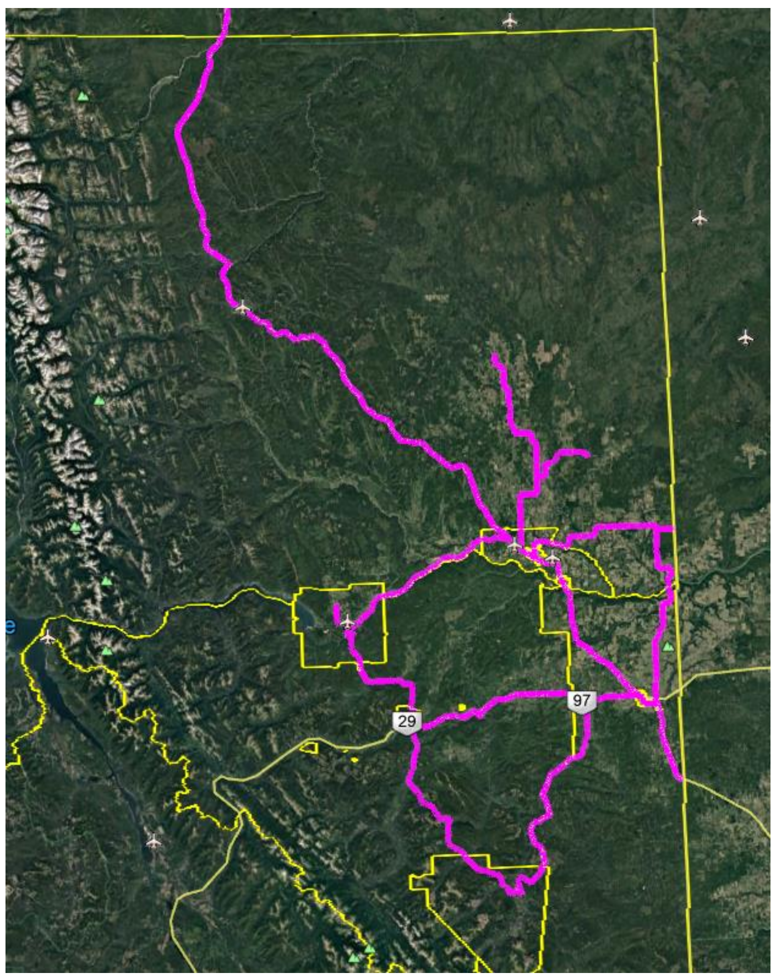
Backhaul Broadband networks provide network connectivity from the infrastructure used to connect individual users (fiber, cable, wireless, mobility) back to the Internet global gateways where those users are able to connect to the services they desire.

One of the primary recommendations of this strategy is that the PRRD should facilitate the creation of an open access backhaul Broadband infrastructure throughout the regional district to ensure that Internet Service Providers (ISPs) have access to adequate backhaul services to serve the community. The PRRD regional network could consist of a series of individual segments of backhaul network that over time would join together to form a regional network.

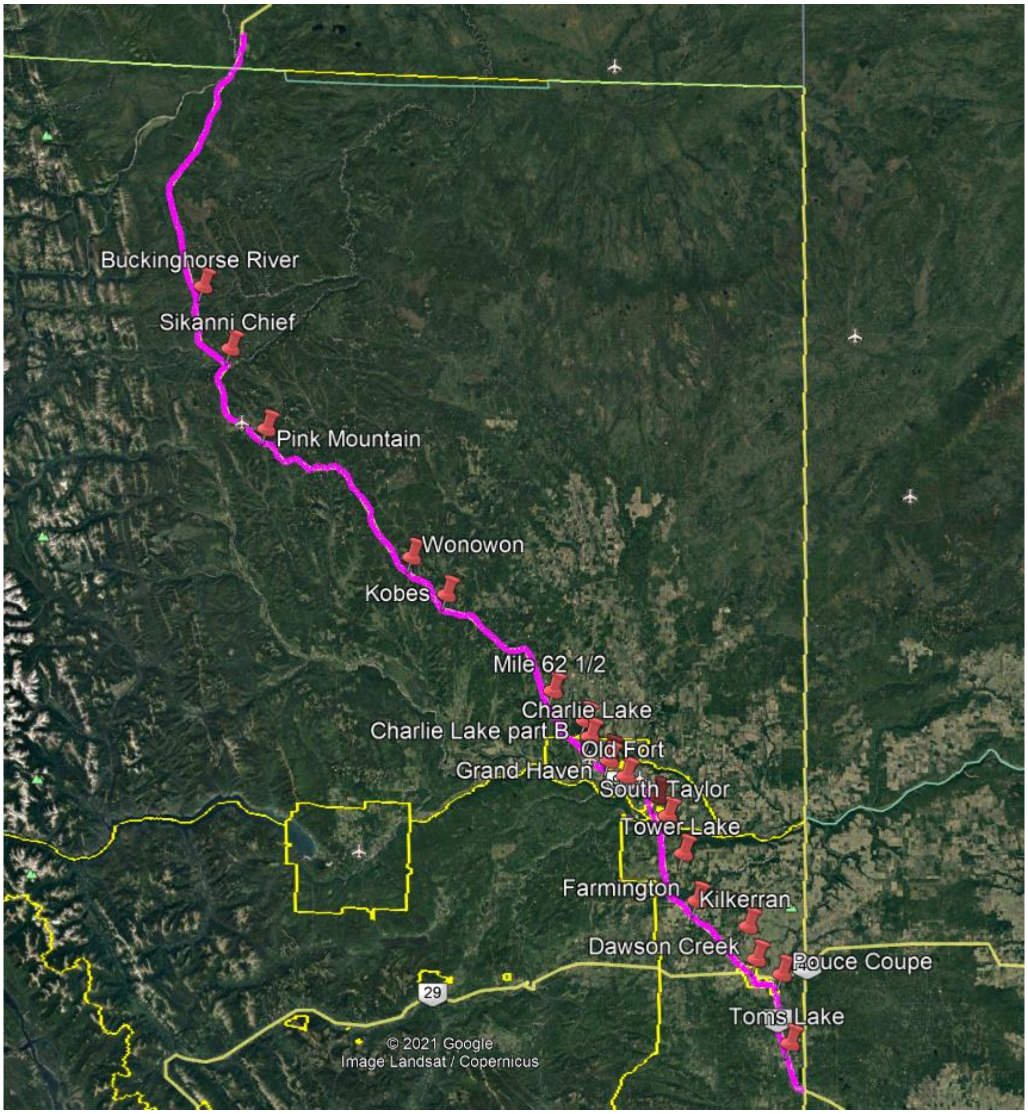
The segments play an integral part in creating a holistic community network with each one proving to be key, supporting service enablement in each of the electoral districts while creating resilient infrastructure to support the district and the residential and business communities within them.

RECOMMENDATION

That the Regional Board engage the market to start building backhaul throughout the District where a lack of such backhaul is resulting in communities continuing to be unserved and under-served from a broadband and mobility service perspective.



Highway 97 Segment

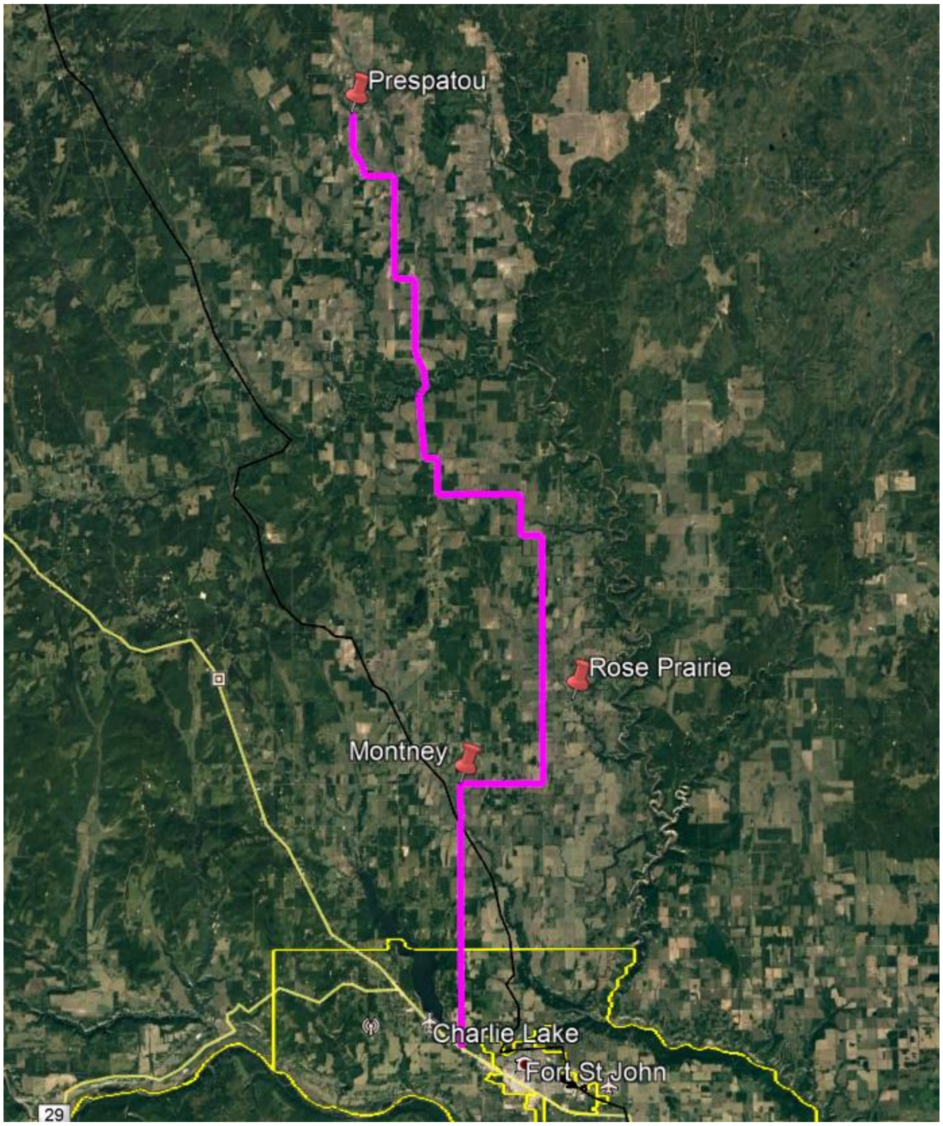


Route Distance: 403.5km

Estimated build cost: $16,500,000 (includes 2 river crossings and 13 creek crossings)

Fiber Size: 144F

Prespatou Road Segment

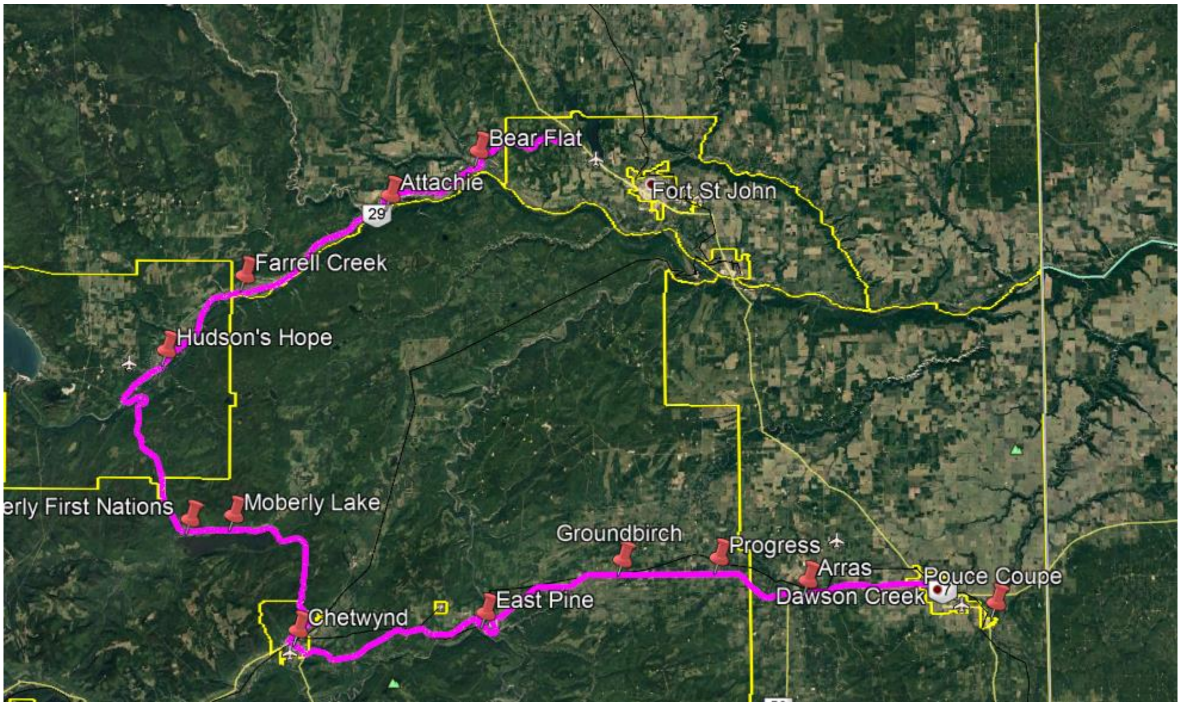


Route Distance: 93km

Estimated build cost: $3,547,500 (includes 3 creek crossings)

Fiber Size: 144F

Moberly Lake Loop

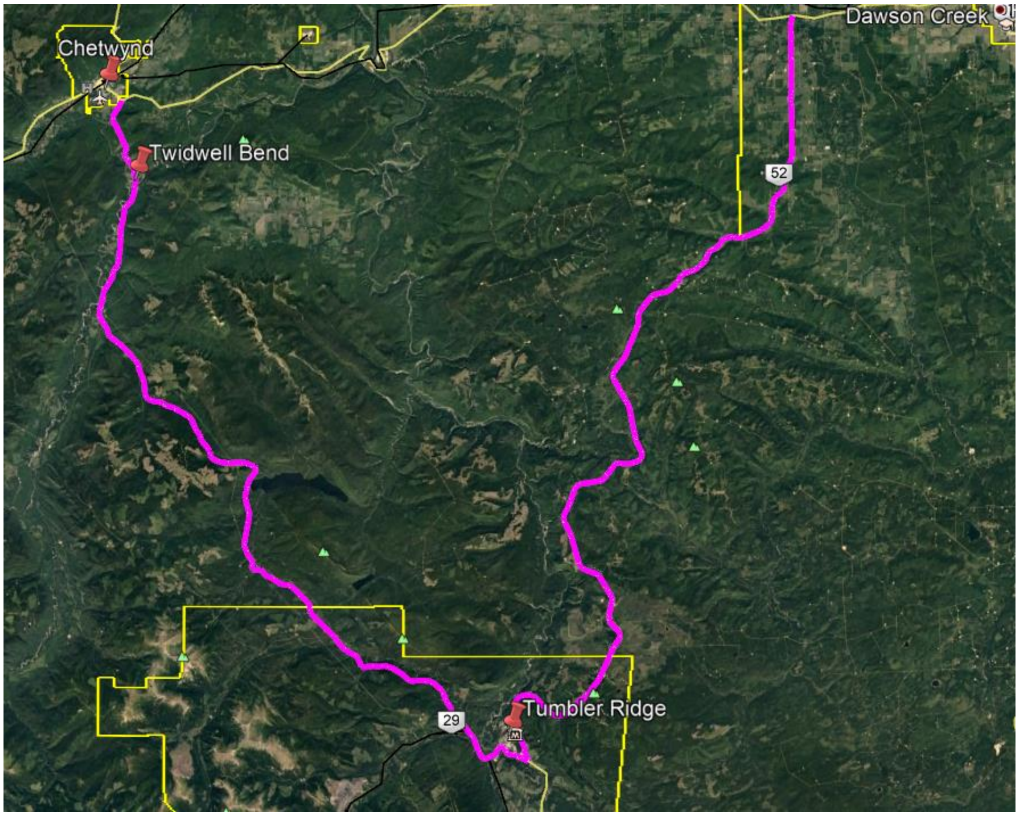


Route Distance: 239.6km

Estimated build cost: $8,676,000 (includes 5 river crossings and 2 creek crossings)

Fiber Size: 144F

Tumbler Ridge Loop

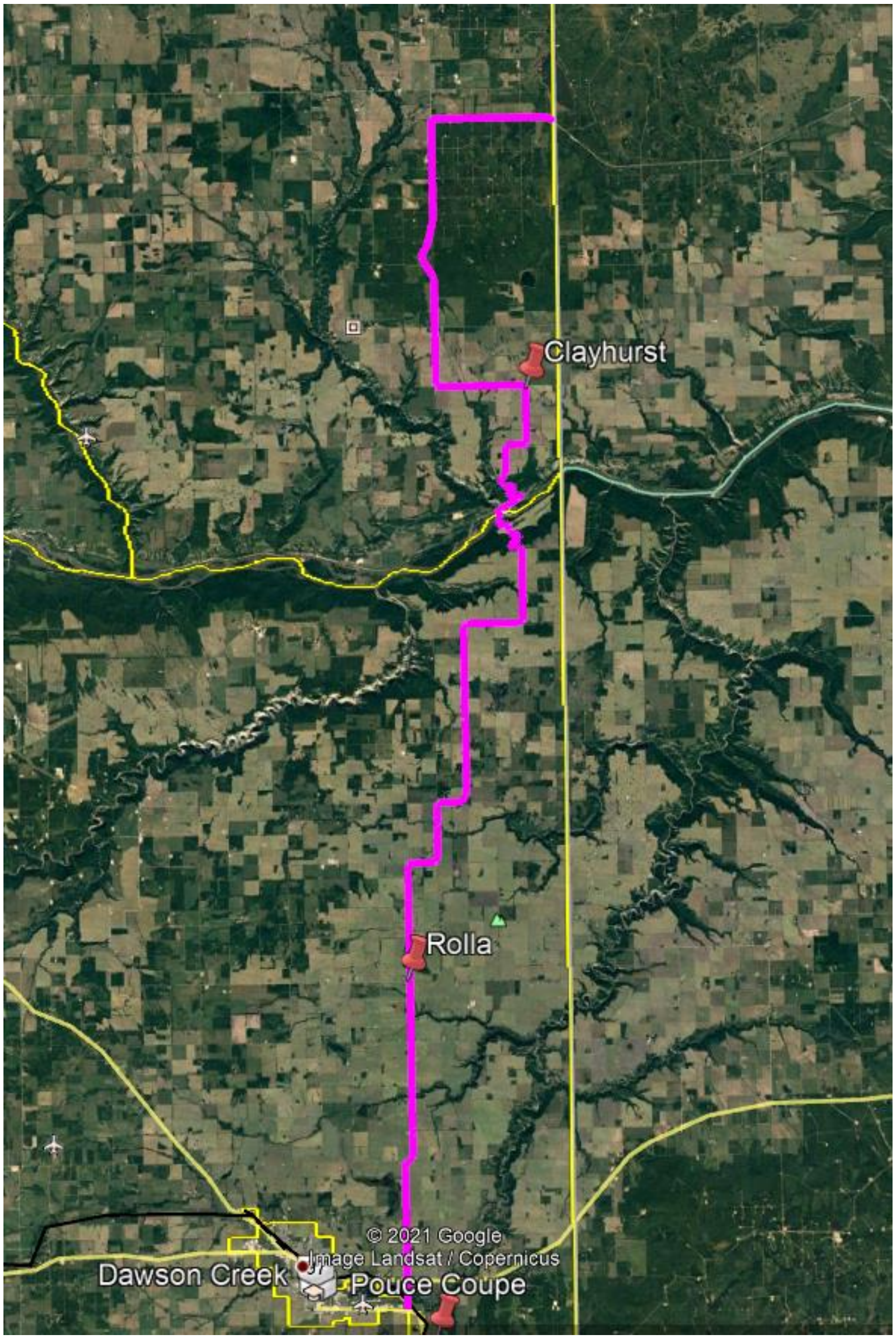


Route Distance: 192km

Estimated build cost: $7,130,000 (includes 13 creek crossings and 3 river crossings)

Fiber Size: 144F

Clayhurst Segment

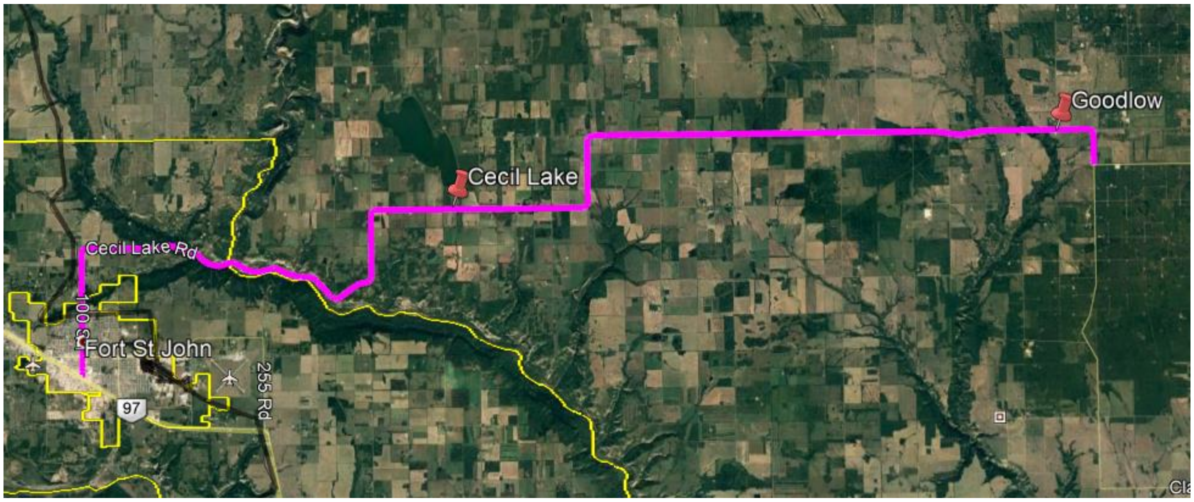


Route Distance: 88.25km

Estimated build cost: $3,258,750 (includes 6 creek crossings and 1 river crossing)

Fiber Size: 144F

Cecil Lake Segment

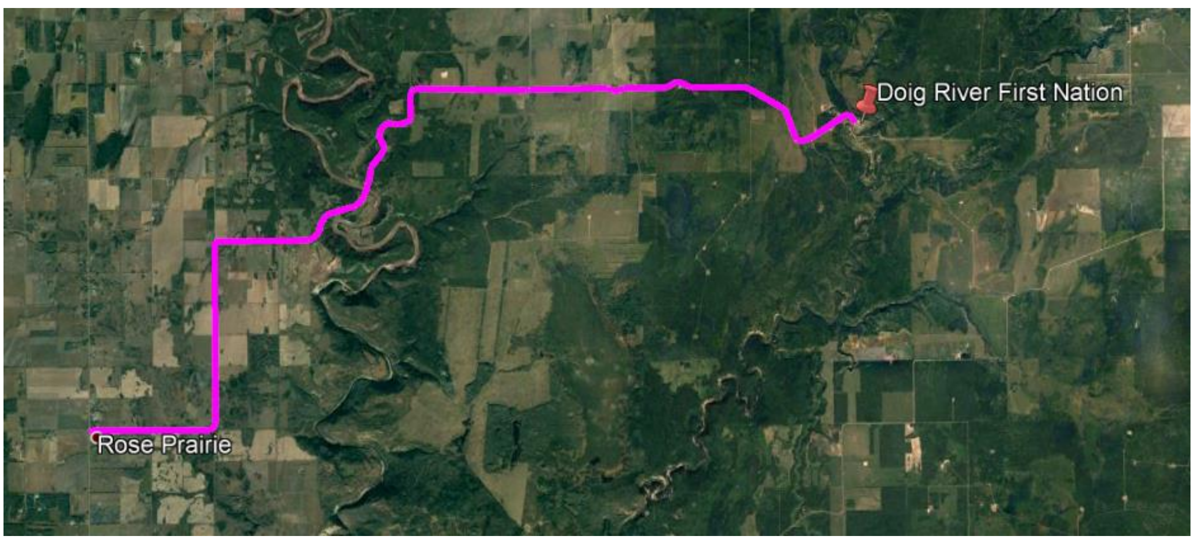


Route Distance: 60.3km

Estimated build cost: $2,482,000 (includes 1 creek crossing and 1 river crossing)

Fiber Size: 144F

Doig River Segment

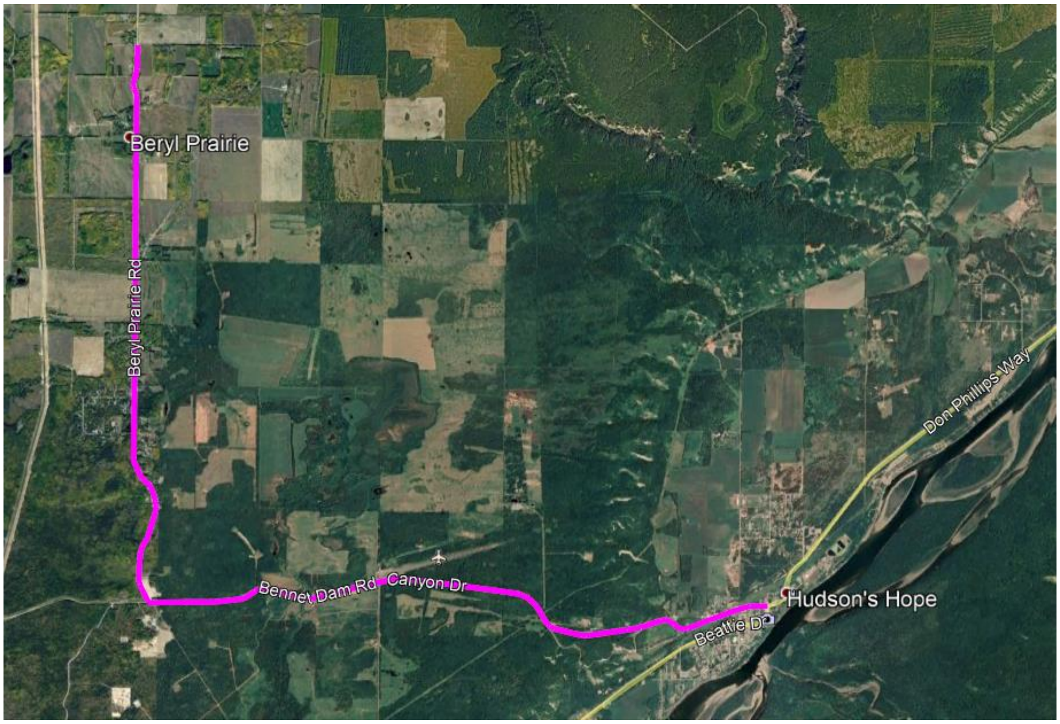


Route Distance: 282.2km

Estimated build cost: $1,037,000 (includes 1 river crossing)

Fiber Size: 144F

Beryl Prairie Segment



Route Distance: 16km

Estimated build cost: $560,000

Fiber Size: 144F

PRRD Local Access Initiatives

While efforts continue to develop the PRRD regional backhaul network, each electoral area and municipality within the PRRD should take the initiative to look at the specific market circumstances and Broadband needs within their communities.

In some cases, an electoral area or municipality could go to the market with a formal Request for Information (RFI) where they define their Broadband objectives and vision for the area, and solicit responses from the Broadband market to determine what the private market is willing to provide in terms of access, service, partnership opportunities, private capital, and timelines. With the insight gained from an RFI, the electoral area or municipality could proceed with a Request for Proposal to move to the next step, or enter into partnership discussions with prospective partners using the guidelines and metrics within this strategy to provide last mile.

Below we present some possible approaches and opportunities to creating local access (also known as 'last mile') initiatives within each community.

Electoral Area B

The PRRD Regional Transport network within the Electoral Area B will support numerous communities that it passes through in the north and east sections of the district. This infrastructure will provide the opportunity for broadband connectivity via a mix of FTTx and wireless infrastructure. Determining the approach to connect these communities requires additional planning between Valo and Electoral Area B stakeholders to determine the technology path and approach to support spurs off the mainline to bring broadband to communities such as Blueberry and Halfway River First Nations.

Electoral Area C

The PRRD Regional Transport network runs through the middle of Electoral Area C. This will provide opportunity to connect many rural properties throughout this portion of the district. Additional planning for how to deploy effectively in this area is required in order to maximize residents reached across this densely populated area of the transport path.

Electoral Area D

Communities and residents located on and adjacent of the PRRD Regional Transport network transport line have the opportunity to recognize broadband connectivity via FTTx and wireless solutions enabled by the infrastructure. Planning to connect via spurs from the transport line is required to support connecting residents located in and around areas such as Bessborough, Sweet Water and Triangle Road.

Electoral Area E

There are several communities along the PRRD Regional Transport network fiber backbone throughout Electoral Area E. These communities can be connected via a mix of FTTx and wireless technologies. Ongoing planning on the strategy is required with key stakeholders within the Electoral Area and Valo to map out the strategy to get the homes and business connected to broadband. In addition to this planning it is the time to begin planning spurs from the mainline to support connecting Lone Prairie, Jackfish Lake and residents in and around Braden Road.

Municipalities within Peace River Regional District

Opportunities lie within each municipality to leverage the PRRD Regional Transport network infrastructure that passes through each of them. Discussions are required to plan for connecting these communities and plan the appropriate strategy to deploy broadband throughout Chetwynd, Pouce Coupe, Hudson’s Hope and the District of Taylor.

Valo Investment to support Local Access Project

Should the PRRD enter into a Letter of Intent with Valo Networks, Valo is prepared to begin planning of its investment into the project. The key part to enablement of the local access network is the connection between Fort St. John to the Global Gateway in Edmonton. Investment would include providing the required connection back to the Global Gateway at an estimated project cost of $30 million dollars. Additional investment includes Valo support with community stakeholders for the planning of community deployment, bringing its Business In A Box solution that has over $3 million dollars invested to date, and the electronics required to operate the network, and the enablement of an open access network to provide a competitive ecosystem of retailers for the community. Throughout the process Valo also commits to find ways to drive down costs associated with the project.

Summary

A significant market shift has occurred over the last few years, as local governments have started to realize that incumbents are not going to invest in Broadband Infrastructure in rural and remote communities in the scope or timeframe that is needed. The business case just isn't there.

Despite the CRTC's universal Broadband Objective, actual Broadband speeds in Canada substantially lag behind many countries that invest more in Broadband Infrastructure. The CRTC estimates that reaching target speeds in rural areas will take 10 to 15 years, however, some stakeholders argue that the affected Canadians cannot wait that long.

In order to address the digital divide between urban and rural communities, a collaborative and inclusive approach involving all levels of government is important to effectively deliver connectivity to all of rural Canada. (Middleton, 2017)

Experts argue that the worst thing that local governments can do is assume that someone else will take care of their Broadband infrastructure needs – whether that's the provincial or federal government, or the private sector.

Local governments have resources that can be leveraged to encourage investment in Broadband Infrastructure. Local governments who are proactive, will attract more invest from ISPs. As local governments become responsible for more of their own community economic development investments, Broadband must be considered as critical infrastructure, and must be made a priority in key local government strategies to ensure investment decisions match community priorities and are front of mind during decision making processes.

Appendix 1 – Wired vs Wireless Networks

Broadband Internet Technologies

Technologies being used to distribute broadband internet services throughout the PRRD can be divided into two broad groups:

- Wired (or wireline) technologies such as copper telephone lines (i.e. twisted pair), copper cable TV lines (i.e. coaxial cable) and fiber optic cables; and,
- Wireless technologies such as mobile telephones (i.e. LTE/4G), point-to-multipoint wireless radios, satellite and WiFi.

Comparison of Wired and Wireless Networks

Characteristic	Wired Networks	Wireless Networks
Types	• Telephone (twist pair) networks are the most common wired network, followed by cable TV (coaxial), and then fiber optic networks	• Wireless networks are largely differentiated by the frequency of the spectrum that is used to propagate the wireless signal. This spectrum can be 'licensed' or 'un-licensed'. Mobile phone spectrum (i.e. LTE, 5G, etc) is licensed spectrum whereas and Wi-Fi spectrum is unlicensed.
Construction	• Wired networks involve either burying cable or hanging it from poles. • Must be constructed to each premise to be covered.	• Construction of terrestrial wireless networks require radios distributed throughout the service area where those radios are attached to purpose-built towers or existing structures. • The radios can be connected to each other wirelessly, but eventually the radios must be connected to a wired (typically fiber optic) network. • Satellite based wireless networks uses satellites to bounce broadband signals from a ground station to a satellite receiver.

Build Cost	• Wired networks are costly to construct because of the civil construction requirement to build long distances for backhaul network or the requirement to build through urban areas where minimizing disruption to roads, sidewalks and existing utilities is necessary along with the requisite remediation.	• Terrestrial wireless networks can be less costly to build because of the fewer points of distribution. • Land acquisition, and attaching the radio towers to a wired network is expensive and limits the coverage of wireless networks. • Satellite wireless networks are extremely expensive to build.
Coverage	• Coverage provided by a wired network only extends to those premises that are directly attached to the network.	• LTE/4G – an antenna can cover 3-10 km2 depending on frequency and placement. • Point-to-multipoint antennas can cover hundreds of meters to 25 km. • Point-to-multipoint antennas must be line-of-sight between the tower and a receiver radio meaning there can be no trees or obstructions in the way. • WiFi coverage is 150-300 feet. • Satellite coverage areas can be extremely large depending on the number of satellites deployed and the height of their orbits.
Service Cost	• Wired broadband services are less expensive on a "per Mbps" basis that wireless solutions. • A 1 Gbps residential service that retails for $100 per month results in a per Mbps cost of $0.10 / Mbps. • A 100 Mbps cable TV broadband service costs 10X as much at $1.00 / Mbps. • Wired broadband services generally provide a very high, or in some cases unlimited, cap to the amount of data that can be downloaded.	Wireless broadband services are either much more expensive per Mbps (i.e. the typical residential LTE service is $100 per month for 25 Mbps, or $4.00 per Mbps) or they are priced by the amount of data that can be downloaded (i.e. "data cap") rather than the speed of the service. For instance, a mobile phone company will offer a 2 GB package for $45 and once you exceed 2 GB of downloaded date your service either slows down considerably or you are charged a much higher rate per unit of downloaded data. Satellite broadband

		services are typically low bandwidth (i.e. 5-10 Mbps / 0.5 Mbps), low "data caps" and expensive (i.e. start at $100/mo)

Performance	Commercially available services (download/upload):
	• Telephone (twisted pair): Up to 25 Mbps / 3 Mbps
	• Cable (coaxial): Up to 600 Mbps / 15 Mbps
	• Fiber:
	  o Residential: Up to 1 Gbps / 1 Gbps
	  o Business: Up to 10 Gbps / 10 Gbps
	  o Enterprise: Up to 100 Gbps / 100 Gbps
		Commercially available services (download/upload):
		• LTE: Up to 25 Mbps / 3 Mbps
		• Point-to-Multipoint: Up to 300 Mbps / 150 Mbps depending on frequency and distance. Typically offered at LTE speeds.
		• WiFi: Up to 7 Gbps over very short distances (i.e. 10 m)

Reliability	Generally, very reliable. However, telephone and cable broadband services degrade rapidly with distance from the central office. Fiber most reliable over distance.	Unreliable based on number of users in the coverage area, distance from tower and local weather conditions and other obstructions

It is clear that PRRD needs both wired and wireless technologies as widely available throughout the regional district as possible. Each technology has its specific applications and strengths. For "fixed" applications such as broadband to residences, businesses, government and industrial sites, a fiber optic wired solution provides the best performance, reliability and cost of service over the long term. Constructing copper networks (whether telephone or coaxial cable) is no longer a viable wired network solution because they do not offer a material construction cost savings (if any savings at all) and they are technically inferior to fiber optic cable.

Wireless broadband (including mobile phone services) is the only solution for broadband service delivery on the go or to sites where the civil construction costs for wired services are untenable. The technical performance of wireless services does not match wired services – although with the next generation of mobile technology this gap will be narrowed. Notwithstanding wireless broadband advances, the performance and service cost of wireless services will continue to be less attractive than wired services.

The two broadband technologies are symbiotic in that wireless broadband requires wired networks to connect their wireless antenna locations and wired networks require wireless networks to extend their reach where it is not cost affordable to build wired connections.

Each Electoral Area has parts of its region that are appropriate for the construction of fiber optic wired networks and parts of its region where a wireless network solution makes the most sense. This PRRD Connectivity Infrastructure Strategy considers the appropriate uses and relative merits of each broadband technology and makes its recommendations on this basis.

Future Technologies

The technologies that will be relevant to PRRD in near to mid-future (i.e. 2-10 years) include:

- **Delivery technologies** involve new ways to deliver broadband services to the premise. Future delivery technologies include mobile 5G networks and Low Earth Orbit satellite networks and White-space wireless networks.
- **Application/service technologies** are technologies that leverage high-speed broadband to deliver services to the end-user. Future application/service technologies especially relevant to PRRD include a group of technologies called "Smart City" technologies that are delivered or enabled by wired and wireless broadband networks.
- **Deployment Technologies** are technologies that utilize a new approach to deploying wired or wireless networks. Pipe-in-pipe is a deployment technology that uses defunct or operational pipe networks to deploy fiber optic cable.

For wired networks, fiber optic cable is the only relevant solution we see in the long term (i.e. 25^{+} years). All the wired network technologies in the research labs today are not looking to replace fiber optic cable, but rather they are researching how to transport more data down each fiber strand at less cost. For this reason, wired fiber optic networks are a long-term network infrastructure solution for PRRD.

Wireless networks have a few new technologies that are here or on the relatively near horizon – 5G wireless networks and Low Earth Orbit Satellite networks and Whitespace radio systems.

Whitespace Wireless Technology

Whitespace wireless technologies are a subset of wireless broadband technologies that utilize wireless spectrum that was previously used for broadcast television signals. With the advent of digital TV not as much spectrum is required for TV broadcasts. This reduction has created "white spaces" in the spectrum that can be utilized for other purposes. It turns out the characteristics of this part of the radio spectrum is especially suited for broadband applications.
They offer a unique integrated gigabit fixed wireless point to multipoint solution providing the technological edge to fixed and mobile operators who want to:

- Expand existing networks
- Take advantaged on pre-fiber first mover advantage
- Offer wireless triple play
- Offload mobile traffic
- Deploy high speed capacity backhaul.

With this ad microwave radio access operators can provide all the services that residential and SOHO users are looking for today – gigabit ultrafast broadband, 4k digital TV content, VOIP telephony, VOD, Telemetry and so on.

Suited for Backhaul and Last Mile

This Fixed Wireless system is a last mile solution that can also be used for back haul for other available technologies. It enables the operator to extend its service range or penetrate underserved and hard to reach markets. It provides a cost-effective alternative to FTTH, cable and fixed LTE deployments.

AIR enables operators to quickly, with low cost deploy this network which can be seamlessly integrated into existing infrastructure. The business case with a Return on Investment (ROI) of 10 to 36 months become reality, also because of the pay as you go model.

Integrates to Existing Standards

This is a bidirectional microwave wireless communication system. It supports several access platforms ranging from Docsis / EuroDocsis to LTE and 5G. The LTE, 5G or Docsis access platform is directly connected to the AIR base station which is communicating with the end user's equipment.

Current Deployments

Whitespace technology is being rolled out around the world as spectrum is being made available. This technology has been commercially deployed this technology in the following countries:

- Slovenia – Triple Play (Internet, IPTV and VoIP)
- Slovakia – Triple Play (Internet, IPTV and VoIP) for 30,000 subscribers
- Russia – IPTV and Internet for 6,000 subscribers
- Spain – IPTV and Internet for 10,000 subscribers
- Kazakhstan – Triple Play (Internet, IPTV and VoIP) for 4,000 subscribers
- Mauritius – Triple Play (Internet, IPTV and VoIP) for 15,000 subscribers
- Annapolis Valley, Nova Scotia Canada – Internet and IPTV delivery.

Conclusions for PRRD

Whitespace radio broadband solutions are relatively new to North America and offer a significant performance improvement over existing wireless broadband solutions

Opportunities and benefits include:

- Last mile connection speeds for new Whitespace wireless deployments can be up to 500 Mbps symmetrical service (i.e. upload and download). This is a considerable improvement over existing fixed wireless broadband solutions.
- These whitespace wireless networks can be built by or in partnership with the PRRD and incorporated into the connectivity infrastructure. In such a case the wireless services would be offered to the ISP market as a wholesale service.
- Whitespace wireless towers connected to fiber optic backbone networks creates the exact synergy necessary to maximize broadband coverage in the regional district.

Appendix 2 – 5G Wireless

5G or "fifth generation" refers to the next generation of mobile wireless standards and technologies that are just starting to be rolled out by the mobile phone companies. 5G will enable a fully connected and mobile society, and deliver unprecedented benefits to citizens, industry and government.

While current networks focus primarily on data transmission, 5G networks are being designed to not only provide faster transmission speeds but also to ensure more widespread coverage, to handle more connected devices and traffic types, and to support different use cases. 5G will connect infrastructure, vehicles, sensors, buildings, machinery, and people in a way that will change the way we work, play, and interact. Some of the key benefits of the 5G standard include:

Superfast speeds

Under ideal conditions, 5G is expected to have a peak download speed of 20 Gbps. That is 20 times faster than the 4G peak download speed of 1 Gbps. To put that in context, at peak speed you could download a standard feature-length movie over a 5G network in less than a second, or 20 movies in the time it takes you to download one movie at peak 4G speed.

While peak download speed represents what could occur in ideal conditions, it is important to look at what kind of speed a user should reliably expect in average conditions. While speed can be affected by many factors, the 5G benchmark for reliable download speed per user is a minimum of 100 Mbps. While lower than 5G's peak download speed, it is still 10 times faster than the reliable download speed per user benchmark for 4G.

Ultra-low latency

Latency refers to the time it takes for data to get from one point to another over a network. Today's networks allow us to experience multimedia and connect with other people and machines wirelessly, but the performance of these interactions are at times affected by transmission delays.

The 5G benchmark for what is referred to as Ultra-Reliable Low-Latency Communications (URLLC) is a minimum of 1-millisecond; much lower than the 50-millisecond latency benchmark for 4G networks. URLLC will allow us to interact and connect in real time. This opens up a vast world of possibilities that did not exist prior to 5G. Examples include:

- Telemedicine, where doctors using connected robots will be able to remotely examine, test, diagnose, and even perform surgical procedures on a patient;

- Emergency response, such as firefighting robots that can be remotely operated to rescue individuals and put out fires without endangering the lives of human firefighters; and

- Connected cars, which will be able to receive critical data from sensors embedded in roadside infrastructure, buildings, and other cars, enabling drivers or autonomous car systems to take swift action to avoid danger.

URLLC will also greatly enhance the capabilities of augmented and virtual reality which will be able to match human interaction with these digital environments in real time. This will better enable Augmented Reality / Virtual Reality use for education and training purposes. When paired with other technologies that permit users to feel the actions of another – the so-called "Tactile Internet" – training professionals will be able to instruct and correct the actions of the trainee simultaneously.

Massive connectivity

The number of physical devices, or "things", connected to the internet (commonly referred to as the Internet of Things, or IoT) is growing exponentially. While estimates vary, the number of IoT devices – fixed and mobile – is expected to jump from tens of billions to hundreds of billions over the next decade. While not all connected devices require superfast speeds or ultra-low latency, the sheer number of connections will strain the capabilities of today's networks.

If you have attended a large gathering such as a concert or a sporting event, you may have found it was difficult to connect to the cellular network, or that service was not completely reliable. That is because today's networks are limited in the number of connections they can support within a defined area. For IoT to reach its full potential, the connection density of our wireless networks will have to increase dramatically.

5G networks will be designed to support large numbers of connected physical devices, even in confined spaces. The benchmark for connection density is 1 million devices per square kilometre, compared to around 2,000 devices per square kilometre for 4G.

Low power consumption

More efficient power consumption by connected devices, both when sending and receiving data and while in sleep mode, is another key component of the 5G specification. In meeting this specification, instead of requiring a wired power source, some wireless modems will be able to run on battery power for up to 10 years. This is particularly important when deploying massive numbers of sensors and other physical devices as it reduces the costs of installation, maintenance, and replacement, and enables deployment in areas where wired power sources are not readily available.

Factors influencing the rollout of 5G

The widespread implementation of 5G wireless networks will provide a significant increase in the speed and quality of mobile broadband services available in the market. There are several factors that will influence when 5G services will become available in the PRRD, and the effect they will have in the market:

- Towers and Antenna Sites – The area covered by a typical 4G antenna is a 1-3 km radius around the tower. With 5G, the coverage area around each tower can shrink to 300-500 m. This means many more antenna sites will be required for a full 5G rollout, and Telcos will start the 5G deployment in large metropolitan centers. It took approximately 5-8 years for Telcos to rollout 4G out to rural and regional parts of Canada. It is very likely that it will take at least as long for the 5G rollout.

- Fiber Availability –Each 5G antenna site must be connected directly to a fiber network, or no more than "one hop" from a wireless network. If the PRRD has invested in and facilitated the expansion of fiber throughout the regional district, then that fiber could be available for the Telcos to use and thereby reduce the capital investment required by them to role 5G out in the regional district. The net effect will be that 5G services will be available sooner than if there is no fiber network in the region.

- Wireless commercial model – When 5G does arrive it is very likely that it will be priced using the mobile telephone pricing model. That means the price per Mbps will be much higher than wired fiber optic networks and it is likely there will be data caps to the amount of data that can be downloaded. Therefore, it is very unlikely for mobile 5G networks to replace fixed fiber optic networks in the medium to long term future.

Appendix 3 – Pipe-in-Pipe

Pipe-in-pipe is a deployment technology that uses defunct or operational pipe networks to deploy fiber optic cable. In principle, any pipe network can be used. Fiber has been deployed through unused water pipe, storm water pipes, gas pipes and active water distribution pipes.

Atlantis Hydrotec

Atlantis Hydrotec is a 'pipe-in-a-pipe' solution in which a special purpose, small-bore 'Messenger Pipe' is inserted into existing water pipelines or similar for the purposes of installing ultra-fast fiber optic communication cables.

Once the Atlantis Hydrotec solution has been installed, it is possible to install a fiber-optic communications cable within the special purpose 'Messenger Pipe' which is designed to fully isolate the cable from the water, meaning that the cable never comes into contact with the water.

Whilst Atlantis Hydrotec is designed specifically for water, it is perfectly suitable for use with other liquids, including distillates and gas.

Benefits of Pipe-in-pipe

This simple but effective solution overcomes the difficulties associated with more conventional FTTP delivery solutions: specifically, the problems relating to digging up roads and driveways to the building, costs of excavation and time to install the fiber.

- There are variants of Atlantis Hydrotec pressure fittings to suit all pipe sizes and pipe material
- The Atlantis Hydrotec pressure fittings interface with industry standard pipe saddles or flange fittings
- All 'wet-parts' are water industry approved and certified as safe to use within potable water networks by WRAS and NSF
- Fiber provides a fully future proofed solution with ultra-fast connectivity suitable for all Next Generation communications and SMART Water Network requirements.
- The infrastructure is already there - so why not us it? Water pipes already link Water Company asset, communities and businesses so they provide an ideal ready-made conduit for providing next-generation true fiber communications exactly where they are needed
- The Atlantis Hydrotec system is particularly appropriate for extra-urban and rural locations
- Installation is primarily trenchless, so it is rapid, cost-effective, and achieved with a bare minimum of civil works and associated disruption, plus it is a very green and eco-friendly technique.
- Uses are many and may include:
  - High capacity data links
  - True-fiber communication links for broadband access; particularly in hard to reach rural areas

- Water company control, monitoring & telemetry
- Evidential grade CCTV for enhanced asset protection and new generation homeland security measures
- Distributed & real-time pipe internal condition monitoring and leak detection combined with asset perimeter and access road security.

Current Deployments

Atlantis Hydrotec pipe-in-pipe deployments have taken place in the following jurisdictions:

- Anacortes Washington – Leak detection monitoring, Intrusion detection and FTTP
- Muscat, Oman – Leak detection monitoring and FTTP network
- Milan, Italy - Leak detection
- Vic, Spain - Leak detection monitoring and FTTP network
- Priston, United Kingdom - Leak detection monitoring and FTTP network

Conclusion

Pipe-in-pipe deployment technologies provide another means of building fiber optic infrastructure with minimum disruption to civil infrastructure, and ideally at a lower cost of traditional buried or aerial deployments. Pipe-in-Pipe technologies provide the added capability of leak detection in the networks in which they are deployed. Such leak detection is a valuable tool in managing and maintaining water networks. These pipe-in-pipe technologies are not applicable to many fiber network builds due to the nature of the water infrastructure and/or the topology of the network, but where requirements, capabilities and applicability line up, they can be an effective deployment tool.

Appendix 4 – Low Earth Orbit (LEO) Satellite

Low Earth Orbit (LEO) Satellites are satellites that are deployed no further than 2,000 km from the earth. Most satellites deployed today are LEO satellites.

LEO satellites can only cover a portion of the earth's surface at any point in time, therefore, a network of LEO satellites is necessary to provide complete coverage of the earth at any point in time.

One of the first successful commercial satellite networks was the Iridium satellite phone network. The first Iridium satellite was launched in 1997. Today the Iridium network provides complete coverage of the earth for low-bandwidth data and telephone calls with 82 satellites.

Starlink

Starlink is a satellite internet constellation being constructed by SpaceX providing satellite Internet access. The constellation will consist of thousands of mass-produced small satellites in LEO working in combination with ground transceivers. Starlink is ideally suited for areas of the globe where connectivity has typically been a challenge. The attributes of the Starlink network is as follows:

Thousands of Satellites

The first iteration of Starlink plans to launch approximate 1,600 small (500 lb) satellites into orbit. The satellites will be connected to ground stations and to each other via laser links. The extremely large number of satellites will enable high speed bandwidth (i.e. greater than 600 Mbps) to any site on earth that is covered by the satellites. As of March 16, 2021, there have been 1325 "first generation" Starlink satellites launched into space. These test satellites do not have full functionality such as the satellite to satellite laser communication system.

No Handsets

The Starlink receivers will be about the size of a pizza box. This precludes the use of handsets to access Starlink internet.

Uncertain Coverage Schedule

Starlink has published very little regarding the exact schedule of their deployment and what parts of Canada will be covered first. It is likely that the roll-out will take longer than expected. Some predict that Starlink's initial services will be backhaul services to a ground station in a region and the 'last mile' service will be provided by more traditional wired or wireless networks.

Interim Pricing

Starlink is currently offering a "Beta Test" service. The cost of the initial equipment is $499 USD and the monthly service fee is $150 USD.

Conclusions

LEO satellite networks like Starlink, will be a complementary addition to the marker, but will not solve all issues of broadband internet and connectivity in region. There are significant technological, market and regulatory risks to waiting for such a satellite network to launch commercial services. Some of the risks facing LEO satellite networks are:

- The technologies at the core of these networks all have to work exactly as planned in order to provide the speed and breadth of service that they were designed for. Phased array antennas and laser satellite-to-satellite communications are just a couple of those innovative technologies.

- It is estimated that Starlink will cost over $5 billion to deploy. It is possible that Starlink changes or scales back its plans before rollout. Alternatively, the network could run into financial difficulty or even go bankrupt.

- Starlink has filed for permission to launch a network of up to 42,000 satellites to meet future speed and capacity requirements. There is a significant controversy around the environmental impact of such a vast network. Furthermore, astronomers and astrophysicists are very concern about what the Starlink satellite network of thousands or tens-of-thousand of satellites will do to earth based observatories.

- Need to put something in here about doesn't help education, industry, health care, mobility, etc.

Appendix 5 – Broadband Ownership and Business Models

There is a spectrum of approaches to structuring the ownership and governance of broadband internet infrastructure. New broadband infrastructure can be built as completely privately owned and operated; it can be publicly owned, and operated infrastructure could or it can be built in a collaboration between the private and public sectors.

On the privately owned end of the ownership and governance model, the existing telecommunications companies like Telus and Shaw will continue to invest in their proprietary networks. The challenge with this model for local governments is that they have no ability to direct or influence where or when these private operators will make investments in new infrastructure to serve their constituents. If parts of the Regional District do not warrant new investment according to the private sector return on investment requirements, then those areas continue to be underserved from a service perspective.

Some local governments have responded to this private sector challenge by deciding to become network owners and operators themselves. They build and operate new broadband infrastructure where it is needed first and foremost rather than where it will make the greatest return. This approach has the benefit of directly addressing the public policy mandate of serving underserved parts of the district. However, it also means the local government must take on the risks and obligations of being in the broadband business. In many cases, local governments are not willing to take on those risks and contingent liabilities.

Between these two ends of the spectrum – completely private and completely public, there exists a wide assortment of public-private options where local governments can perhaps own broadband infrastructure and play a governance role in how that infrastructure is utilized without having to expose themselves to all of the challenges and risks of operating such infrastructure.

One particular example of where the public and private sectors can partner to create critical Broadband Infrastructure is described below. The objective of the 'hybrid network company' is to combines publicly owned Broadband infrastructure in rural and regional areas together with a private wholesale operator who contributes private capital and operational expertise to manage the network and offer competitive wholesale services to the market.

Hybrid Network Company

The Hybrid network company is designed to leverage the advantages of both public and private sector participation in the network. Hybrid networks can utilize a number of ownership models from a stand-alone corporation to some form of public-private partnership. Ownership and governance models for such hybrids could take the form of investing in an existing company, forming a Local Government Corporation or establishing a society, cooperative or trust. Fundamentally, the hybrid approach enables both private and public capital to be utilized in the construction of the infrastructure. It also recognizes where there is public capital deployed by a local government, it is appropriate to provide some level of public governance and/or ownership.

Again, the hybrid approach applies to how the communication infrastructure is capitalized, deployed and governed. However, the business scope of the wholesale operator is not included in the scope of the infrastructure company. That is not to say the wholesale operator can not be a shareholder of the infrastructure company. The model only limits the wholesale operator's activities at the retail service provider level. That is, the wholesale operator is precluded from offering retail services to the market in order to promote competition at the retail level. However, there is no reason the wholesale operator cannot be an owner of the infrastructure as well.

The chart below illustrates the primary attributes and roles within a hybrid network company.

	Regional District / Municipality	**Private Sector Wholesale Operator**
Parties' Roles	Provide public policy mandate. Contribute capital to new builds.	Provide infrastructure expertise. Contribute capital to new builds.
Connectivity infrastructure	Facilitate rights-of-way and access	Contract construction. Operate and maintain.
Mandate	Ensure availability of infrastructure.	Create infrastructure to realize mandate. Create viable commercial entity.
Service Provision	User of infrastructure for public sector needs.	Provide connectivity infrastructure access to wholesale operator.
Commercial Proceeds	Provision to refresh infrastructure. Limited commercial proceeds.	Private capital returns allocated first.
Transfer of Ownership	PRRD owns assets	Assets could be purchased at end of a determined time period

Fiber Ecosystem Model

Utilizing the Hybrid Network Company model above, it is possible to implement a regional broadband solution that involve stakeholders from both the public and private sectors. Regional districts, rural municipalities (towns, villages), the network operator, network builder, possible retail service providers, and possible private investors are all parties that could be a part of a regional solution. This regional network would assemble the critical Broadband Infrastructure that is necessary to support the entire community – not just the most populous communities within the region.

Then, on top of the Broadband Infrastructure it is possible to build a fiber ecosystem that will deliver the services that the market demands while providing as much choice and competition as possible. The connectivity infrastructure will likely integrate both fiber and wireless technologies. There are different options as to how to approach ownership of the infrastructure.

In modern telecommunication networks that they are an interconnection of various components each with potentially different owners. However, we believe that it is how a regional network is operated and governed so that aligns it with the policy and market outcomes that PRRD is seeking. A high-level description of a possible PRRD ecosystem model is outlined below:

1. Dark Fiber and Wireless Connectivity Infrastructure – At the core of the regional network is the fiber and wireless infrastructure that provides connectivity throughout the regional district, not just to its largest municipalities. In rural and regional markets like the PRRD, large geographic areas together with sparse population and business densities make it necessary to leverage both public and private capital to build this connectivity infrastructure. PRRD has a role to play through facilitation and direct investment in the connectivity infrastructure. The primary objective is to drive the fiber as far as possible into the regional district to create a fiber backbone and then enable existing and net-new wireless infrastructure where fiber is not practical. Existing fiber infrastructure can be utilized where it is commercially available and leads to fulfilment of PRRD's objectives. An engagement with existing wireless providers to determine how PRRD's activities might support their wireless services to non-fiber-to-the-premise areas is also undertaken during this time.

2. Wholesale Internet Service Provider (ISP) – Once the connectivity infrastructure is in place, it should be operated in such a manner to provide the Internet Service Provider (ISP) market wholesale access to this essential infrastructure. Again, large geographic areas together with sparse population and business densities mean that economies of scale have to be created to ensure services are offered throughout the regional district. We propose those economies of scale are created by a single wholesale ISP operating the network. This single wholesale ISP installs electronics on the fiber (i.e. "lights" the fiber) and provides wholesale internet, bandwidth, IPTV and VOIP telephony services to Retail Service Providers (RSP). These RSPs will then own and manage the relationship with the end customers. Utilizing this approach effectively creates "open access" connectivity infrastructure in the PRRD.

3. Retail Service Providers (RSP) – Part of PRRD's objectives for creating connectivity infrastructure include ensuring that critical internet services are available throughout the regional district and ideally having competitive services throughout the network. This proposed ecosystem model is designed to enable competitive RSP services. In order to encourage competitive services, the wholesale ISP must exclude itself from the RSP market. While the infrastructure is being built out it may be necessary to assign a 'preferred' RSP that has the obligation to provider services throughout the network and in exchange is granted an exclusivity for a short period of time. However, the clear policy direction is creating a market for competitive RSP services on the PRRD connectivity infrastructure.

The fundamental building blocks of the fiber ecosystem presented above provide a viable market structure for creating connectivity infrastructure within the PRRD. Possible approaches to ownership and governance; stakeholder engagement and funding can be explored and evaluated by the Broadband Internet and Mobility Standing Committee proposed as one of this strategy's recommendations.

Appendix 6 – Broadband Funding Models and Sources

Potential Funding Sources

Potential funding sources required to achieve this plan will be quite varied. The predominant funding sources are listed in the following table:

Government of Canada	Via programs such as those managed through either Innovation, Science and Economic Development, CRTC and/or Infrastructure Canada
BC Government	Via programs such as Connecting BC managed by NDIT
Regional Districts	Via Gas Tax funds, taxation
Municipalities	Via individual programs within given municipality
All Nations Trust Company	e.g. Pathways to Technology

Funding Opportunities and Options

Regardless of the ownership and governance model that is used to structure the connectivity infrastructure company, there are a number of publicly available sources of financing.

Some of the funding agencies below provide grant funding that requires matched or prorated funding from the application. The Canadian Infrastructure Bank provides project loan financing at very attractive rates.

Government bodies providing grant funding look favourably on regional solutions that address the digital divide that exists in rural areas of less density.

CRTC Broadband Fund

The CRTC Broadband Fund (CBF) is a fund totalling $750 million over five years that has been established and administered by the CRTC. This money is allocated as $100 million in year 1, $125 million in year 2, $150 million in year 3, $175 million in year 4, and $200 million in year 5. As the first intake for applications opened in summer 2019 and closed October 2019, 2019 can be set as year 1, making 2023 year 5 of the CBF. The currently open second call deadline has been extended to April 30, 2020 due to the Covid-19 pandemic. While the next intake for the CRTC Broadband Fund is unknown, it is anticipated that three more calls will follow.

The CBF is targeted at helping close the digital divide that exists in the rural areas of Canada. These areas are grossly underserved (or not served at all) due to the economic unviability of a business venture into these areas. Private companies look for returns within 2 to 3 years of a project and this simply isn’t feasible for a high-speed fiber project in sparsely populated areas. Despite this, there has been research and analysis done that show making such an investment in broadband infrastructure will result in significant gains for the community, and ultimately Canada's economy.0F1 The CBF is only available to inhabited areas where there is no access to internet connectivity of at least 50 Mbps download and 10 Mbps upload. This level of service has been titled as the CRTC's Universal Service Objective (USO). These areas can be seen as green hexagons on the CRTC's map.1F2

As part of an application, the CRTC Broadband Fund specifically inquires as to the community consultation and engagement activities that have taken place.

Connecting British Columbia

The Connecting British Columbia (CBC) program is funded by the Province of British Columbia and administered by Northern Development Initiative Trust. The CBC program and CBF follow nearly identical criteria and objectives, that being to meet the CRTC USO. CBC program has been designed to work in conjunction with the CBF, as any funding received under the CBC program can be identified as "other sources of funding" on a CBF application.

CBC program funding can be requested for up to 50% of transport project funding. Access projects can request funding up to 50% of the project costs, although a baseline funding level of $250,000 per community will also be used. A sample awarding calculation is offered in their application guide:

Sample Project – Last-Mile: Community	**Total Eligible Project Costs**	**Program Funding Request**
Community A	$750,000	$450,000
Community B	$500,000	$250,000
Community C	$250,000	$50,000
Total	**$1,500,000**	**$750,000**
Average per Community = $250,000		

Connecting British Columbia's current phase, and last that is announced at this time, will see $50 million awarded to projects from two intake dates. One intake deadline has passed (February 15), with the final intake deadline coming up on June 15, 2020. Projects that are approved for funding should be completed by March 31, 2022.

Canadian Infrastructure Bank

Another funding option that can be accessed is the Canada Infrastructure Bank (CIB). The CIB is a Crown corporation established in 2017. It has been allocated $35 billion over the span of 11 years (ending in fiscal 2027-28) to invest in infrastructure projects in Canada. The CIB will invest in projects as a means to help attract private-sector investments to those projects. Core areas for

[1] A Cost-Benefit Analysis of Alberta Rural Broadband Deployment. https://8027113f-922d-49f1-8cab-0a74f30812a1.filesusr.com/ugd/a556b1_d4f116fe94904d519321a3d15ff22240.pdf

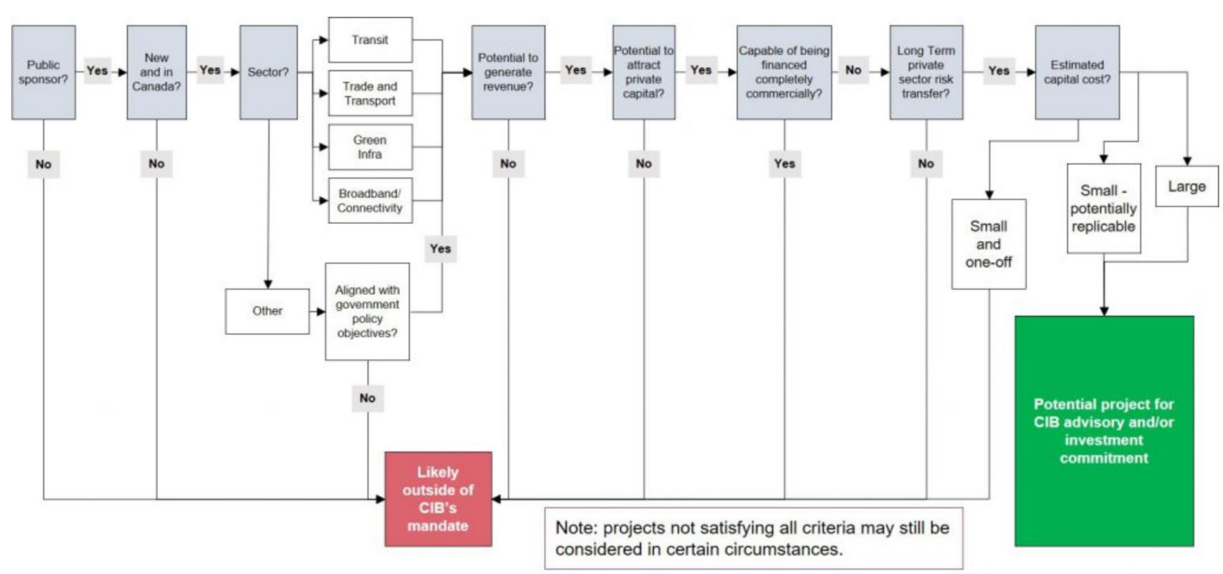
[2] https://crtc.gc.ca/cartovista/fixedbroadbandandtransportye2018_en/index.html

investment have been identified as: transit; trade and transport; green infrastructure; and broadband/connectivity. The CIB has a focus on "large, transformational projects that are in the public interest, linked to national strategic economic priorities, and developed and delivered in partnership with public sector sponsors and private and institutional investors."2F3

The CIB made its first investment in August 2018, a $1.283 billion investment into a transit project in the Greater Montreal area. The investment will be administered via four draws and the investment has an effective blended 15-year interest rate of 1.65%.

Moving forward, the CIB has set investment goals. For 2019-20, they hope to receive 100 project proposals with a total in excess of $20 billion, shortlist 9 of those and make at least 2 investments. By 2023-24, these numbers increase to 100 proposals received with a total in excess of $30 billion, shortlist 20 and make up to 5 investments.

The CIB also provides business planning support and encourages organizations with projects to contact them early so that the project can be developed with a greater chance of receiving funding. The CIB's decision flowchart is below.3F4



The CIB provides funding via various mechanisms (debt, equity, etc.) to infrastructure projects that fall within their mandated areas; as identified above, broadband infrastructure is one such area. The CIB operates to bridge the financial gap of infrastructure projects that are not economically feasible for the private sector. This is a well-known issue for rural broadband projects, making the CIB a very valuable and viable resource. A limitation of the CIB is that their threshold of investment is $20 million at a 50/50 contribution. Thus, a project totalling $40 million

[3] Canada Infrastructure Bank Summary Corporate Plan 2019-20 to 2023-24, page 1. https://cib-bic.ca/wp-content/uploads/2019/06/2019-06-05-%E2%80%93-CIB-Summary-CP-%E2%80%93-EN-Final.pdf

[4] From: https://cib-bic.ca/en/partner-with-us/investments/project-intake/

with minimum of $20 million from the project sponsor(s) but be achieved before accessing CIB funding becomes an option. Working with the regional district as a whole may be a method of amassing a project of sufficient size to meet this threshold.

Universal Broadband Fund

The Federal Government announced the Universal Broadband Fund (UBF) as part of its Budget 2019. The UBF will provide up to $1.75 billion over seven years starting in 2020. Focused on unique needs of rural and remote communities, the fund included a $150 million "Rapid Response Stream" that closed its intake on February 15, 2021. The UBF will have the same target as the CBF, that being meeting the 50/10 broadband speed objective across all of Canada.

Economic Stimulus Post-COVID-19 Pandemic

Both provincial and federal levels of government have announced stimulus packages that will be made available to stimulate economic activities once the Covid-19 pandemic has passed. Given the known priority on broadband connectivity through existing programs such as the CRTC Broadband Fund, Universal Broadband Fund and Connecting British Columbia, it is expected that a portion of the stimulus funding will be allocated to broadband. Details on such stimulus packages are not yet known but can be monitored and applied for once available.

Appendix 7 – Criteria for Prioritizing and/or Evaluating Broadband Projects and Requests for Letters of Support

- ☐ **Number of communities benefiting** – the more communities included in a project should mean the project is more attractive than a project addressing fewer communities.

- ☐ **Number of residents/households/businesses within those communities** – the larger the total number of residents/businesses that will be covered by the project should mean the project is more attractive than a project addressing fewer residents/businesses.

- ☐ **Magnitude of connectivity gap (i.e. how underserved is the community?)** – A the project is providing services to a community that only has 5Mbps/1Mbps services available to it is more attractive than a project in a community that currently has 25Mbps/5Mbps services.

- ☐ **Cost per household/business** – The total project cost divided by number of households/businesses service is the cost per household/business. The lower the better and this metric is used by some funding agencies.

- ☐ **Capped Services** – What are the service caps for the proposed project?

- ☐ **Service Levels** – what are the minimum service levels being offered by the proposed project?

- ☐ **Affordability** – is a key consideration in determining acceptable high-speed service.

- ☐ **Existence of willing funding partners** – Does the project have committed and adequate funding?

- ☐ **Existence of community champions** – Are they organizations in the community that will work to secure the success of a project or perhaps act as "anchor tenants" for the project?

- ☐ **Existence of technical, project management, and financial expertise required to complete and operate a project** – Can the project demonstrate a high probability of success based on the experience and expertise of key project resources?

- ☐ **Long term sustainability** – Can the project demonstrate a viable business plan with realistic expectations around adoption of services and resulting revenues?

- ☐ **Choice and Competition** – Does the project create choice and competition of services for households and businesses, or is it a single provider. Competition is preferable to a single provider.

- ☐ **Scalability –** A key consideration is ensuring that the technologies used in the proposed project are scalable for future years. As the capacity and need for faster Internet services arise, will the proposed project be able to adapt.

- ☐ **Reliability and Redundancy** – Does the proposed project provide redundancy to the area, so that a single cut to the fiber will not result in a loss of service.

- ☐ **Open or Closed Access Network -** In an open access network, all ISPs are offered the same opportunity to deliver Broadband Internet services to the community by utilizing the local government owned infrastructure. This model allows greater competition by opening the market to smaller providers who may not have the capital to invest in large networks of their own, who in turn, compete for customers.

- ☐ **Economic Development –** what is the potential economic development impact to the region of the proposed project?