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Regional District of Bulkley-Nechako Broadband Study

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Submitted By:

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1 Executive Summary

Following on the heels of the "Better Broadband for the RDBN" Report by Sandbox Systems Inc. (the "Sandbox Report") tabled for the RDBN in November, 2018, TANEx has completed the next stage of analysis in order to better refine the considerations and steps to meet the RDBN's goal of 90% of Regional District premises having access to internet service at the new CRTC standard of 50Mbps download and 10Mbps upload ("50/10").

Based on a deeper analysis and new information, TANEx recommends an amendment to the RDBN broadband strategy to build a 500+ km fibre backbone along Highway 16, 27, 35 and the section of Topley Landing Road contained in the Sandbox Report.

TANEx obtained certain confidential information during the preparation of this Report which is not included in the Report. Such information has been duly considered in the preparation of this Report.

TANEx's recommendation is that the RDBN focus on completing gaps or areas that other projects do not provide but that are required to support the improvement of services across the region. A logical role for RDBN is to focus on constructing fibre to the premises (FTTP) where feasible and supporting existing local providers in the deployment of wireless infrastructure where it is not.

Additionally, certain funding sources require that the infrastructure be owned by the applicant to be eligible for that funding so we recommend that the RDBN position itself to own any infrastructure to comply with those requirements. In order to access the CRTC Bridging the Gap funding, we expect it will be necessary for the RDBN to enter into a partnership, joint venture or consortium of some kind with an entity having at least three years' experience in deploying and operating broadband infrastructure and being eligible to operate as a Canadian carrier as required under the funding requirement for that program.

We believe that the RDBN should focus on augmenting other defined projects including:

a. Identification of other defined projects and specific details of each.
b. Define RDBN projects to address the gaps identified and prioritize those projects according to need and financial viability.
c. Prepare a business plan/partnership/agreement with appropriate parties.
d. Obtain the design, detailed data and information necessary to confirm RDBN eligibility for grant funding from various sources and put RDBN in the best position to be successful in its applications.
e. Completion of the requirements necessary and secure funding.
f. Collaborate with providers where necessary or useful to implement the RDBN plans.
g. Develop a business framework for the RDBN to meet its goals while minimizing impact to existing providers currently providing service in the RDBN.

2 Broadband Study Overview

2.1 Background

In late 2018, the RDBN commissioned and received the Sandbox Report which was intended to map out a strategy for improving broadband service within the RDBN. TANEx has been provided with a copy of that report and has used it to further develop a strategy going forward.

In late February, 2019, TANEx was engaged with the following scope of work:

1. In cooperation with stakeholders from the RDBN, refine the deliverables and requirements for this study so TANEx is aligned with the RDBN.
2. Complete a broadband study report outlining the service delivery models that need to be considered ranging from the most simple model to a fully operational FTTP network.
3. Complete a high level construction strategy that provides a recommended delivery plan to bring broadband services to the underserved areas in the most timely and efficient manner possible.
4. Provide recommendations on the next course of action for the RDBN.
5. Support RDBN's work in reviewing potential funding opportunities and information required to complete them.
6. Review the final report with the RDBN.

In completing point 1 above and in preparation for completing this report, we worked with the RDBN staff and Director Newell to validate our assumptions and to clarify the nature of the problem. Together with the RDBN, we refined the deliverables to be the contents of this report as set out in the Table of Contents which was forwarded to the RDBN and confirmed as the appropriate deliverables.

2.2 Intended Audience

This report is intended for the purpose of internal RDBN staff as well as the RDBN directors' use in general future planning and, more specifically, as resource documentation for RDBN staff who are charged with developing and implementing the RDBN's broadband strategy.

2.3 Purpose of Document

This report is intended to, firstly, provide a basic understanding of the mechanics of providing higher capacity network connectivity to RDBN constituents. This helps to chrystallize how RDBN can provide the best leadership in its role as local government. Secondly, it lays out things to consider in optimizing the various stakeholders, their own internal strategies and how best to collaborate to solve the issue. Thirdly, it provides some budgetary estimates along with recommendations about where RDBN's time and money should be spent for greatest benefit. Finally, it provides a list of actionable items to move a strategy forward. This report is not intended to provide a detailed design for the RDBN to implement or detailed costs as that is outside the scope of work. To achieve a detailed design and more accurate cost estimates will require a clear definition of the scope of work for definable projects within the regional district.

2.4 Methodology Review

In order to solve a problem, it is important to first understand it. In other words, for this task specifically, what is the service area that a project of this nature will address. How is a gap in service defined and where do they actually exist?

RDBN has advised TANEx that there are large areas of the region that have unacceptably low connectivity, either because of limited capacity or limited reliability. The RDBN provided TANEx with a dataset of dwellings from which mapping was created that will be discussed further in Section 3 of this report. Structure density was overlaid onto a service map with areas 1, 3, 5 and 10 km from a highway to define how many dwellings fall within these defined service areas. The service mapping is based on best information available to TANEx from services providers and an attempt was made to verify its accuracy with the Board of the RDBN. In some cases, that verification was not possible, and, in some cases, we were able to refine the maps to better reflect the experience of constituents.

To date, we have not completed actual testing to obtain data to verify service levels in any form and have relied on the information provided by the RDBN and third parties. There are ways to obtain actual data that will verify the level of service in any area. See recommended next steps later in this document.

We prepared service area mapping which illustrates areas where we believe the service is poor or non-existent, adequate and good. Within the service level maps, we have defined four services levels:

Unserved – No Service – shown on the maps as white.

Barely Served - Less than 5Mbps download and 1Mbps upload and/or unreliable service – shown on the maps as red.

Underserved – Service less than 50/10Mbps but service is available reliably – shown on the maps as yellow.

Well Served – Service is at 50/10Mbps or better – shown on the maps as green.

We believe the main service providers serving the RDBN include:

- ABC Communications (“ABC”)
- CityWest Cable and Telephone Corporation (“CityWest”)
- Cybernet
- Evolve Communications Inc. (“Evolve”)
- Mascon
- TELUS
- Village of Granisle (“Granisle”)
- Xplornet
- Galaxy

We reached out to some Internet Service Providers in the RDBN to gain a better understanding of not only their existing state but also, impediments that restrict them from offering better service to RDBN as well as future plans. Future plans are confidential, of course, and have not been included in this Report.

In the interest of being mindful of budget and the fact that the Sandbox Report provided information about the providers, TANEx did not reach out to every provider but did get information from some, to get a sense of existing roadblocks. Service providers reported (not independently verified by TANEx) that barriers to better connectivity service include:

- Being at a disadvantage as they are not able to access the same licensed frequencies (for LTE) that incumbent carriers can access. This restricts the available technology for their use and ability to serve some customers, particularly those without line of sight to the wireless transmitter. Requiring line of sight impedes their ability offer more reliable, higher capacity service to more customers.

- Expensive backhaul which is the cost of providing external connectivity from the RDBN to the Internet (described later in this document). This annual cost is ongoing expense and tends to be a significant portion of the annual operating budget for a provider.

- High cost of licensed frequencies (spectrum). It is their opinion that the Industry Canada rates to licensed spectrum is considerable and defeats the business case for some areas.

- Access to funding. Current funding models are based on a minimum threshold of 50/10Mbps and without access to licensed spectrum, they do not provide the ability to reach this threshold. They feel that incumbent carriers have access to the licensed spectrum that they do not, and the incumbents are given advantages in the funding process that precludes the smaller providers from being able to access these programs.

2.5 Project Stakeholders

A project of this magnitude will need “all hands on deck” to complete. Individual stakeholders each bring a different perspective, capacity and approach to problem solving. We believe that stakeholders in this project include:

- RDBN constituents
- RDBN Board of Directors and staff
- Existing Internet Services Providers
- Provincial and Federal Government local offices and funding agencies
- Local Municipal Governments
- Regional Districts bordering the RDBN
- Industry partners and local business
- Local First Nations

2.6 Goals of the RDBN

TANEx understands that the RDBN’s high level goal is Regional District-wide Internet service at the new CRTC standards of 50/10.

The CRTC Universal Service Objective is that:

“Canadians in urban, rural and remote areas have access to voice and broadband Internet access services, on both fixed (50 Mbps down, 10 Mbps up) and mobile wireless networks (latest general deployed mobile wireless technology currently LTE)."

- Modern telecommunications services – The path forward for Canada's digital economy (Telecom Regulatory Policy 2016-496) – CRTC Website

That is a lofty goal giving the rural nature of the Regional District, the physical isolation of some of its population and the cost of construction. This report will help to illustrate how RDBN can begin to address the connectivity challenge with an eye on the longer term, high level goal.

2.7 Definitions and Acronyms

BSS – Business Support Systems
CO – Central Office
CPE – Customer Premise Equipment
DHCP – Dynamic Host Configuration Protocol
DNS – Domain Name Service
DWDM – Dense Wave Division Multiplexer
FDH – Fibre Distribution Hub
FO – Fibre Optic
FOC – Fibre Optic Cable
FOSC – Fibre Optic Splice Case
FPP – Fibre Optic Patch Panel
FTTP – Fibre to the Premise
GPON – Gigabit Passive Optical Network
IRU – Indefeasible Right of Use
ISP – Internet Service Providers
OLT – Optical Line Terminal
ONT – Optical Network Terminal
OSS – Operations Support Systems
PON – Passive Optical Network
POP – Point of Presence
POS – Passive Optical Splitter
ROW – Right of Way
RX – Receive
SDP – Service Delivery Pyramid
SUB – Subscriber or customer receiving service from the network
TX – Transmit

3 Current State of Broadband in the RDBN

3.1 General Analysis and Mapping Notes

To gain a more robust understanding of the connectivity challenge in the RDBN, TANEx analyzed the location of dwellings as well as information available about existing network services in the region. The data set for the dwelling locations were provided by the RDBN (the "Dataset") and were used by TANEx to create mapping for a visual depiction of the information and the ability to layer in additional information.

Maps included in the analysis depict:

a. Dwelling Distribution: dwellings within a certain distance from the four main highways in the RDBN;
b. Service Maps: service levels available in each area as broken down into polygons that share similar geography and groupings of dwellings;
c. Dwelling Distribution Graphs: the distribution of dwellings across the RDBN.

The small white dots on some of the maps depict non-vacant dwellings as designated in the Dataset and exclude dwellings within municipalities as designated by the Dataset.

The service level maps and the polygons on them denote services believed to be available to the constituents included in that area. The level of service available has been extrapolated from information sourced from local service providers, their websites, and other informational resources but has not been verified. Red areas depict service levels with up to 5 Mbps but this may be extremely spotty and unreliable.

The polygons on the service maps were drawn around clusters of dwellings that share common geographical areas that lie between significant geographical features (bodies of water, roads and highways, cliffs, and area boundaries). Where no coverage map could be obtained for a service provider, coverage was estimated to be within five kilometres of a confirmed service location for non-wireless and within ten kilometres for wireless.

The visual representation of the data gives a sense of four things:

a. the general location of the dwellings;
b. the location of dwellings in relation to main roads;
c. the general level of service available in each area; and,
d. which providers operate in each Regional District Area.

These maps are a foundational estimation and starting point upon which more in-depth planning and analysis should be completed.

A snapshot of each map is included in the body of this report, but the complete set of maps is available in the Appendix of this document.

3.2 Dwelling Distribution Maps

The dwelling distribution maps are a general overview of dwelling locations throughout the RDBN. These maps were created by applying a buffer radius from dwelling locations and aggregating the resulting areas into a contiguous shape, if more than one shape overlapped one another. The following is a map of the overall dwelling distribution in the RDBN. For area specific maps, please refer to the Appendix.

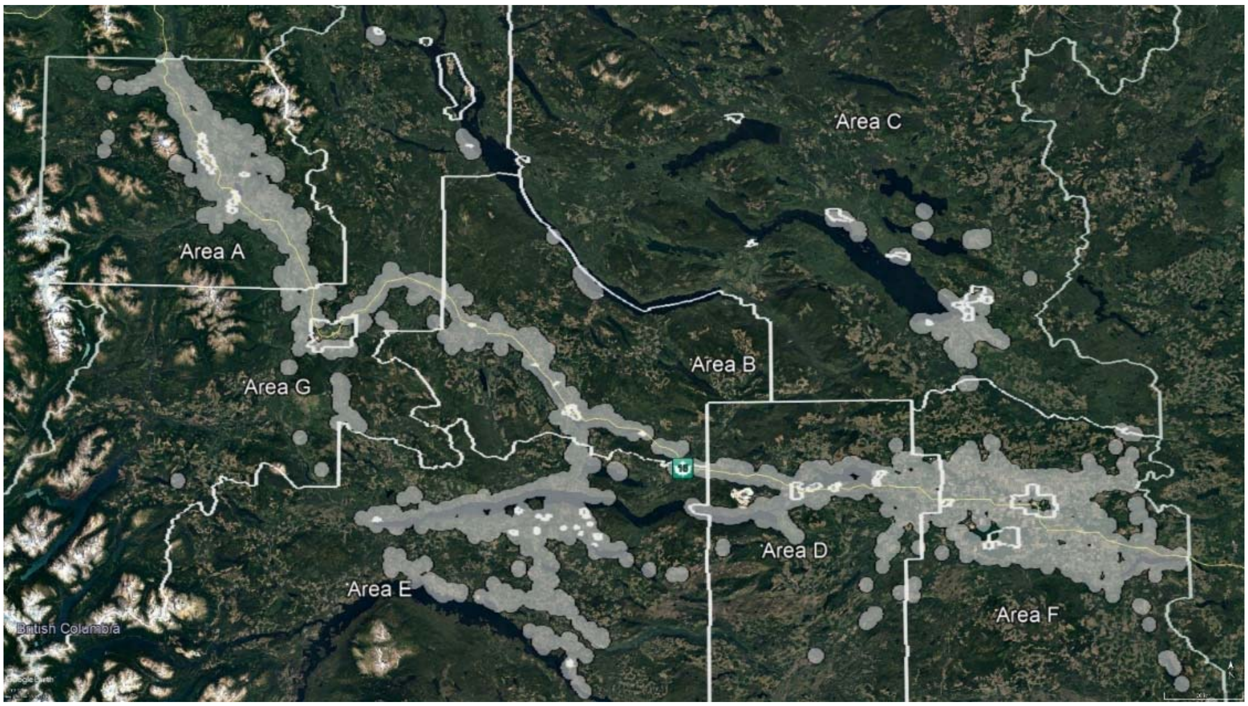


Figure 1 - Dwelling Distribution Map

3.3 Service Maps

The service maps are a depiction of the estimated level of service believed to be available to a constituent living within the borders of each polygon.

Areas in green that have the option of 50 Mbps download speeds or greater tend to be around higher density areas, typically within a municipality, with access to hard wired services such as DSL, coaxial cable or optical fibre.

Areas in yellow with service levels of between 5 to 50 Mbps down are commonly found on the outskirts or fringes of larger centres. There are also a few one-off places that are remote and likely receive their internet through satellite providers such as Galaxy or Xplornet.

Areas in red show places with poor coverage that is below 5 Mbps down or places that have spotty and unreliable coverage at best, such as in areas found in the southwest parts of Area E. Fixed wireless is more often than not the technology used to service these areas since hard wired connections such as coaxial cable and fibre are not presently available.

The maps and the information presented on them were created by extrapolating from information sourced from providers, their websites, and other informational resources. These maps do not serve as concrete verification of what level of service a constituent living in any of the areas can expect to receive but rather a general overview and estimation of the service levels available throughout the RDBN. The areas where service levels are generally lacking and where they are adequate is the most meaningful takeaway from the service maps. The following is a map that depicts the entire RDBN and the individual service areas within it. For area specific maps, please refer to the Appendix.

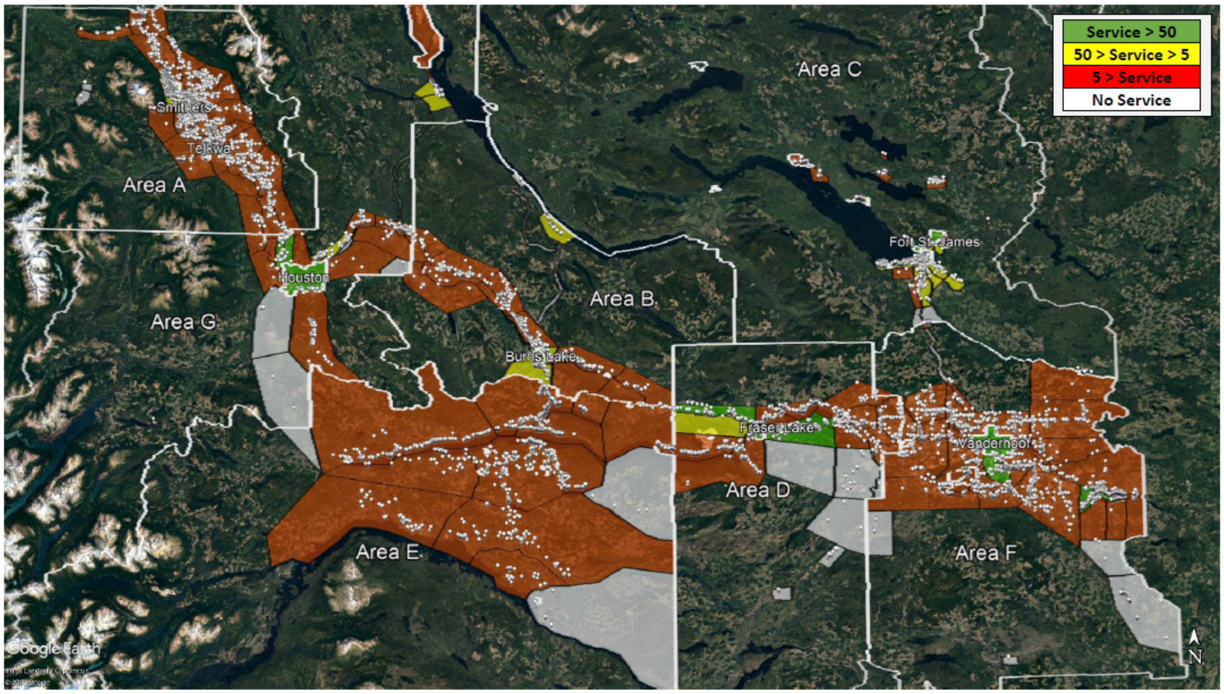


Figure 2 – Service Level Overview

3.5 Households Within the Service Zones

These graphs depict which of the total 10,107 dwellings fall within each stated service buffer zone distances of 1, 3, 5 and 10 kilometres from one of the main highways in the RDBN: the Yellowhead (Highway 16), Topley Landing Road to Granisle, Highway 35 to Francois Lake & Ootsa Lake and Highway 27 to Fort St. James. The following graph depicts the number of dwellings that fall within each buffer zone distance in descending order. For a more in-depth breakdown by service radius or by highway section, refer to the Appendix.

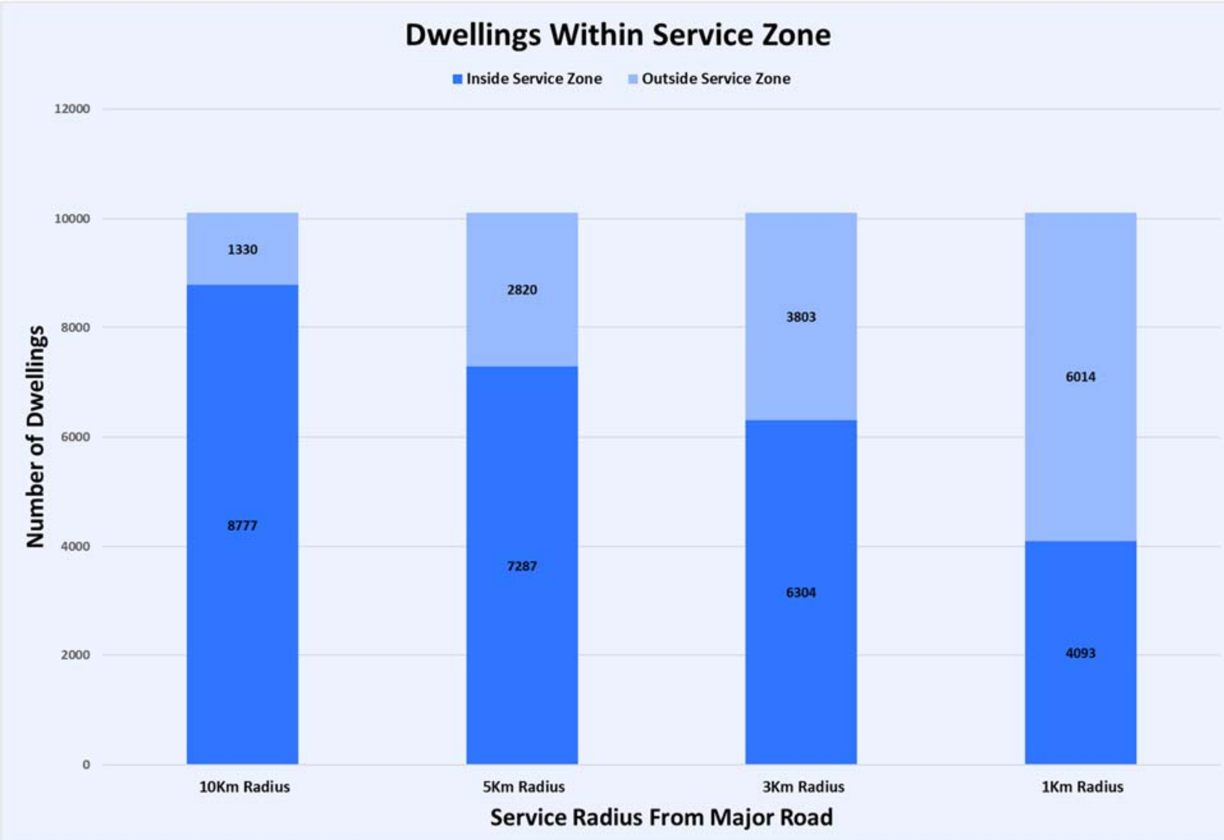


Figure 3 – Dwelling Count in Buffer Zones

4 Service Delivery in the RDBN

Delivery of connectivity to the residents and businesses in the RDBN through a network requires numerous components and layers of infrastructure. This Section is intended to provide a general overview of how a network is constructed and the various components involved. It is intended to provide a basic understanding of the technical components so that the RDBN can be educated in the terminology, construction, operational and business decisions that will be necessary to move the project forward and obtain grant funding. The construction and operations of a network will be broken down into layers. Each of these layers, the construction considerations, advantages, disadvantages, options and how each applies to the RDBN will be described in detail throughout this Section. In order to deliver an Internet or other telecommunication services to a resident or business, all of the layers need to be provided in some fashion. One decision for the RDBN is to determine its level of involvement in building those layers.

The service delivery outlined in this Section is intended to be a starting point in understanding the connectivity challenges experienced in the RDBN. Section 5 will build on it to outline additional information that outlines how this starting point could be augmented based on the current realities and existing projects in the RDBN.

4.1 Service Delivery Pyramid

The diagram below outlines the service delivery pyramid (SDP) that delineates the individual layers of infrastructure that must be provided and the relative levels of responsibility the RDBN must take on to satisfy the ultimate goal of improved services to the residents and businesses of the RDBN. Solving the connectivity problem for RDBN constituents requires that all layers of the SDP be realized in some fashion, either by one entity or by the collaborative efforts of numerous stakeholders. As the RDBN commits to and moves up the layers of the pyramid, increasing levels of complexity and involvement are required, with the benefit of increased control and influence on improvement of services in the region.

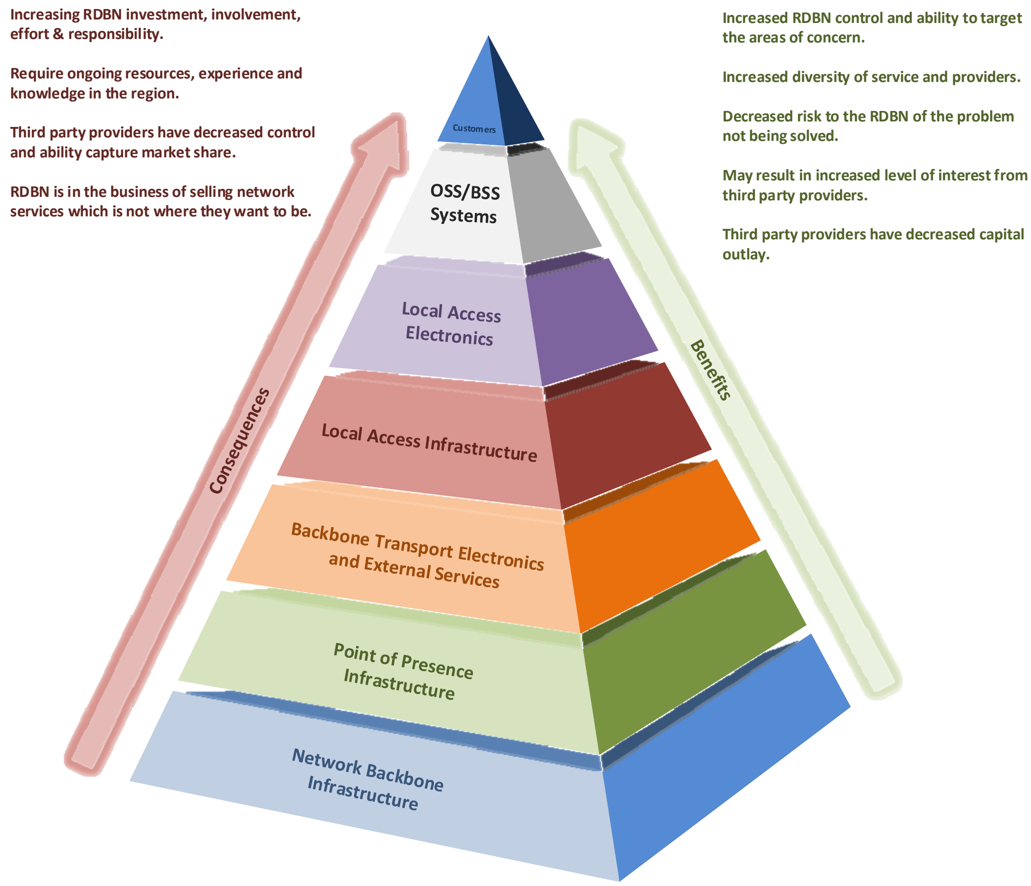


Figure 4 – Service Delivery Pyramid

The remainder of this Section drills down into each layer of infrastructure required to deliver a complete service to constituents. The graphic above is the basis to provide an understanding of the solution required to solve the problem. As the RDBN begins to provide each layer of the pyramid, it will be faced with increased involvement, investment and responsibility for the service delivery. Further, with more levels of the pyramid it must address the business challenges introduced by the RDBN essentially providing Internet service and being seen as competing with existing providers. While increasing involvement may seem negative, the RDBN will also have the advantage of increasing levels of control and ability to target the service delivery to RDBN priorities rather than having a third party dictate where services are delivered based on its business case.

For each layer of the SDP, the following information will be provided:

- Brief summary of the layer and how it applies to the RDBN.
- Brief description of the solution concept.
- Benefits to the RDBN.
- Considerations for the RDBN.
- Budgetary cost estimate.
- Actions required.
- Alternatives, advantages and disadvantages.
- Technical description.

It should be noted at this point, that this is not a detailed design but rather a starting point for a conceptual solution on how the RDBN may consider delivering services and solving the ultimate goal of improved service in the region. Further, the conceptual solution does not include detailed discussions with potential partners and other third parties at this point. While those are required in arriving at the final solution, they require significant effort and input from the RDBN as well as potential third parties and this is not within the current scope of work. Throughout this Section however, references have been made to where the RDBN may seek input or potential partnerships with these parties.

With respect to capital and operating costs outlined in this report, it should be noted that all estimates are based on typical unit cost assumptions from previous experience and are not based on a detailed design for the RDBN project. The numbers used reflect a very high-level approximate cost. In order to provide better cost estimates, a detailed project definition, design and business plan will be necessary. The estimated costs of operating a network business outlined in this report should not be relied upon, as a full analysis is beyond the scope of this report. Once the RDBN has made some decisions about service delivery and its role, further refinement of costs will need to occur along with any necessary business analysis and plan.

As set out earlier in this document, TANEx understands that the RDBN wishes to have a solution that provides service at 50/10 throughout the region. To achieve this objective, the solution will be comprised primarily of a fibre based solution and in areas where fibre is impractical or unaffordable to install, alternative service delivery models will be necessary.

4.2 Service Delivery for the RDBN

Every layer in the SDP is necessary to provide actual service to the constituents of the RDBN. In the following sub-Sections, each layer is described in more detail.

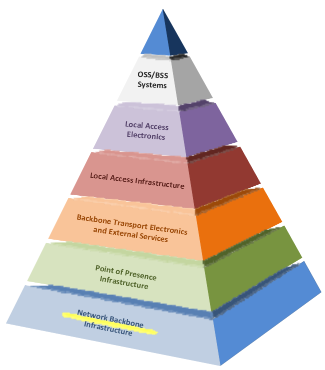
To provide a general overview of the solution and the challenges facing the RDBN to following must be considered:

- Many of the rural areas in the RDBN are currently unserved, poorly served or under-served and wireless coverage forms much of the solution outside the major centers.

- Current service providers in the area are using wireless and satellite technology to reach these areas primarily because currently, it is the only feasible method.

- There are many pockets of small numbers of potential subscribers throughout the RDBN with some a significant distance from the highway. The main issue with providing wired service to these customers is the distance and cost of constructing fibre or other wired technology. Quite simply, the existing providers cannot make a justifiable business case to serve these areas due to the high cost of capital required and the small number of potential subscribers.

4.2.1 Network Backbone Infrastructure



Summary: The network backbone refers to the fibre optic backbone connecting the major centers in each of RDBN Areas A through G. The fibre backbone provides the main long distance infrastructure allowing service providers to extend their networks by way of a dark fibre IRU allowing them to bring more and improved connectivity and capacity into the RDBN.

Solution Concept: The construction of the fibre optic backbone forms the main source of connectivity throughout the region. If none of the other layers of the SDP were constructed, the backbone would provide a dark fibre IRU to each service provider that wishes to use the fibre backbone to provide improved services in the area. Dark fibre is a term that describes a fibre cable that has no active electronics connected. In an IRU, the providers are given the right to use 2 or more strands of the fibre backbone to connect communities, their own POPs and local access infrastructure (i.e. wireless towers) along the route of the fibre. Other than providing access to the fibre backbone, the RDBN would have no responsibility for any other layer in the SDP and correspondingly, would have little influence on the level of service that may actually be provided unless it could contract for such influence.

In the RDBN, the fibre optic backbone would likely be constructed throughout the region generally as shown in the following diagram:

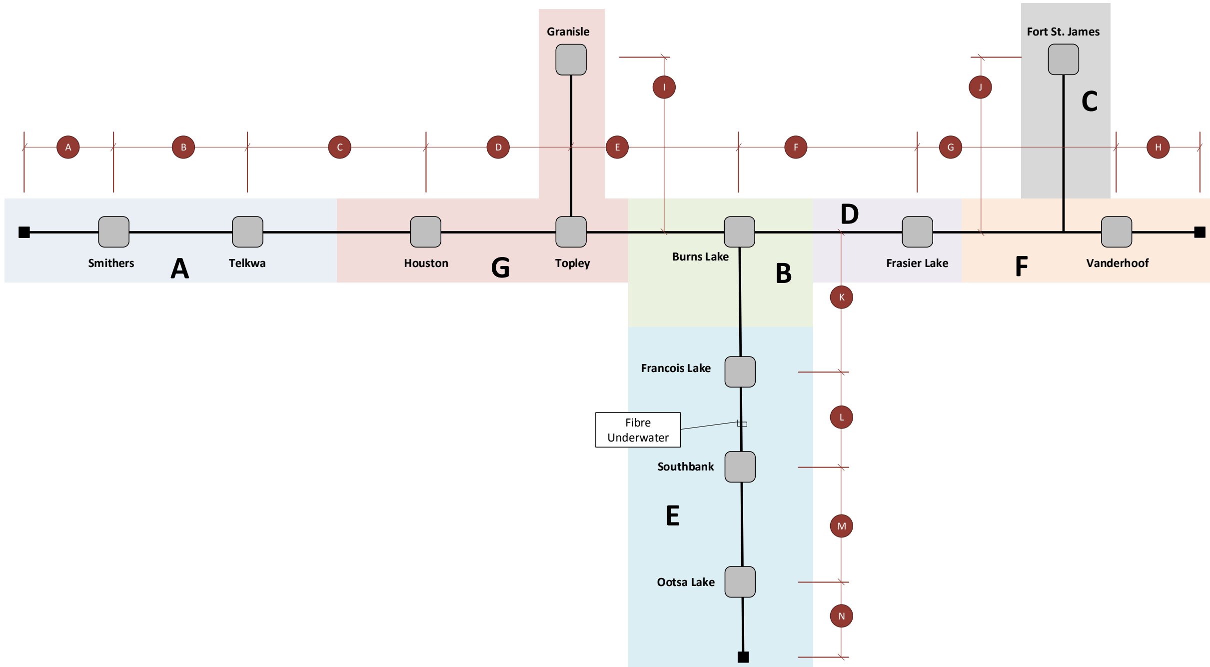


Figure 5 – RDBN Fibre Backbone

Benefits: The primary benefit in providing a fibre backbone is that it allows service providers to offset the large capital and/or operational costs that they must incur to bring high capacity services to the target areas. In order for a service provider to offer higher capacity to an already served area, they must acquire sufficient backhaul capacity (connectivity outside of the area) from the area in question, to the upstream connectivity required to reach the global Internet. If these services must be constructed or leased from another third-party provider that already has fibre capacity for example, then the return on capital or the increased operational costs must be recovered in the monthly fees charged to the subscribers. Given the lack of density of potential subscribers, it is unlikely that providers can form a valid business case to recover the capital and increased operational costs. High capacity, long distance connectivity is a major operational cost that must be considered in the business case. Should the RDBN invest in the backbone, it is conceivable that the barrier to entry for service providers can be dramatically reduced given a suitable business model provided by the RDBN.

Considerations: Some of the main things to consider if RDBN restricted its role to building this layer include:

- It may never make sense for a service provider to attempt to reach a small number of subscribers in remote areas even if backbone fibre exists. While the backbone fibre makes it possible and improves the business case, the provider must also consider additional capital and operating costs such as establishment of a POP, maintenance and repair, and the ability to deploy technicians in a timely manner.

- The business case for the provider may require that the RDBN essentially provide the IRU at zero cost for it to make financial sense for the provider depending on the area and number of subscribers.

- Unless there is a significant number of potential subscribers, it is unlikely that more than one provider will choose to serve an underserved area resulting in a lack of competition.

- Opens the door for providers to compete across regions that they have had a "gentleman's agreement" not to. Some providers may see this as a negative impact allowing other providers to begin providing services in an area that was traditionally their own.

- The RDBN fibre backbone may "overbuild" existing fibre back bones already constructed or yet to be constructed.

- The fibre backbone may bring improved capacity in the backbone of the network, but the local access technology and capacity may remain unchanged. Wireless technology is typically the easiest and least cost option in serving a community. However, wireless, by its nature, is bound by technology restrictions that are simply not an issue with a fibre network. Providing a fibre backbone is unlikely to make the provider's business case for a FTTP deployment make financial sense given the high capital cost and effort required, especially if there are few subscribers and they are not densely situated.

- The RDBN will need to understand where the third-party providers want to access to the fibre and how they would deploy their network. Each location where the providers needs to access the fibre will require a FOSC, POP or ability to break out the IRU strands.

- Establish a construction and ongoing maintenance strategy for the fibre asset. Maintenance of underground is considered relatively straight forward as there is limited preventative and daily maintenance required. Dark fibre maintenance can be contracted to an appropriate company with relative ease.

- A fibre interconnect point will need to be established to allow providers to bring their fibre to that point to connect to the backbone. The interconnect location would simply be a FOSC located in a strategic location on the backbone that is easily accessible by the provider.

- There is essentially no way to monitor the status of a dark fibre IRU. The RDBN will have limited real time knowledge of a problem with the dark fibre. In the event of the problem, the provider will be the first to notice and will have to call the RDBN to report a problem to initiate repair. The RDBN has little choice but to deploy a fibre repair crew in this case to locate and fix the problem.

Cost: The approximate cost is outlined below to construct and operate the fibre backbone. At this time, it is only an estimate and is based on an underground installation of the cable. A more accurate estimate can be developed in a detailed design phase based on on-site attendance.

The following provides a summary of the fibre backbone estimate with the following assumptions:

- A fibre backbone constructed as shown in the diagram earlier in this section along the major highway corridors for a total of about 531km.

- Assumed to be $60,000 / km for underground fibre.
- A margin of +/- 20% based on early estimates from construction companies.
- A breakdown of an initial definition of build segments follow.

Row Labels	Km	Seg Max Total Cost	Seg Min Total Cost
Area A	76.58	$ 5,513,760	$ 3,675,840
Area B	97.11	$ 6,991,920	$ 4,661,280
Area C	18.02	$ 1,297,440	$ 864,960
Area D	62.00	$ 4,464,000	$ 2,976,000
Area E	80.25	$ 5,778,000	$ 3,852,000
Area F	105.33	$ 7,583,760	$ 5,055,840
Area G	91.89	$ 6,616,080	$ 4,410,720
Grand Total	**531.18**	**$ 38,244,960**	**$ 25,496,640**

Cost Per KM	**$ 60,000**
Max Cost Per KM	**$ 72,000.00**
Min Cost Per KM	**$ 48,000.00**
Max (+%)	**20%**
Min (-%)	**-20%**

Electoral Area	Segment	Start	Finish	Distance (Km)	Max Per Km Cost	Min Per Km Cost	Segment Max Total Cost	Segment Min Total Cost
Area A	A	NorthWest Border	Smithers	29.65	$ 72,000.00	$ 48,000.00	$ 2,134,800.00	$ 1,423,200.00
Area A	B	Smithers	Telkwa	14.84	$ 72,000.00	$ 48,000.00	$ 1,068,480.00	$ 712,320.00
Area A	C1	Telkwa	Area G Boundary	32.09	$ 72,000.00	$ 48,000.00	$ 2,310,480.00	$ 1,540,320.00
Area G	C2	Area G Boundary	Houston	17.03	$ 72,000.00	$ 48,000.00	$ 1,226,160.00	$ 817,440.00
Area G	D	Houston	Topley	29.56	$ 72,000.00	$ 48,000.00	$ 2,128,320.00	$ 1,418,880.00
Area G	E1	Topley	Area B Boundary	4.34	$ 72,000.00	$ 48,000.00	$ 312,480.00	$ 208,320.00
Area B	E2	Area B Boundary	Burns Lake	46.46	$ 72,000.00	$ 48,000.00	$ 3,345,120.00	$ 2,230,080.00
Area B	F1	Burns Lake	Area E Boundary	34.03	$ 72,000.00	$ 48,000.00	$ 2,450,160.00	$ 1,633,440.00
Area E	F2	Area E Boundary	Area D Boundary	7.39	$ 72,000.00	$ 48,000.00	$ 532,080.00	$ 354,720.00
Area D	F3	Area D Boundary	Fraser Lake	28.02	$ 72,000.00	$ 48,000.00	$ 2,017,440.00	$ 1,344,960.00
Area D	G1	Fraser Lake	Area F Boundary	33.98	$ 72,000.00	$ 48,000.00	$ 2,446,560.00	$ 1,631,040.00
Area F	G2	Area F Boundary	Vanderhoof	24.43	$ 72,000.00	$ 48,000.00	$ 1,758,960.00	$ 1,172,640.00
Area F	H	Vanderhoof	SouthEast Border	45.14	$ 72,000.00	$ 48,000.00	$ 3,250,080.00	$ 2,166,720.00
Area G	I1	Yellowhead HW	Area B Boundary	23.64	$ 72,000.00	$ 48,000.00	$ 1,702,080.00	$ 1,134,720.00
Area B	I2	Area B Boundary	Area G Boundary	7.56	$ 72,000.00	$ 48,000.00	$ 544,320.00	$ 362,880.00
Area G	I3	Area G Boundary	Granisle	17.32	$ 72,000.00	$ 48,000.00	$ 1,247,040.00	$ 831,360.00
Area F	J1	Yellowhead HW	Area C Boundary	35.76	$ 72,000.00	$ 48,000.00	$ 2,574,720.00	$ 1,716,480.00
Area C	J2	Area C Boundary	Fort St James	18.02	$ 72,000.00	$ 48,000.00	$ 1,297,440.00	$ 864,960.00
Area B	K1	Yellowhead HW	Area E Boundary	9.06	$ 72,000.00	$ 48,000.00	$ 652,320.00	$ 434,880.00
Area E	K2	Area E Boundary	Francois Lake	14.38	$ 72,000.00	$ 48,000.00	$ 1,035,360.00	$ 690,240.00
Area E	L	Francois Lake	Southbank	2.95	$ 72,000.00	$ 48,000.00	$ 212,400.00	$ 141,600.00
Area E	M	Southbank	Ootsa Lake	38.24	$ 72,000.00	$ 48,000.00	$ 2,753,280.00	$ 1,835,520.00
Area E	N	Ootsa Lake	Wisteria	17.29	$ 72,000.00	$ 48,000.00	$ 1,244,880.00	$ 829,920.00

With respect to operational costs, we have assumed that the backbone will be an underground build, and accordingly, the annual operating costs are assumed to be minimal. At this time, we have not identified annual rights of way, or permits, or other costs that should be considered but such costs may exist depending on where the fibre is constructed. There are annual taxes for fibre assets assessed by the Province of BC, but further research is necessary to determine whether such taxes apply to the RDBN. We also have not included insurance costs, if any. Aside from these items, the annual operating costs would include maintenance in the event of a fibre cut or construction charges to make changes to the fibre backbone. It is difficult to estimate this as it would depend on number of maintenance activities required but we believe this would likely be minimal. An item that should be considered is a maintenance contract with a fibre construction company to perform emergency repair of the backbone but we do not have a quote available for this type of service.

Actions: In order to complete this layer of the SDP, the RDBN will need to assume responsibility for the following:

Capital Activities	Ongoing Operational Activities
Completion of a detailed fibre backbone design. Obtain funding. Coordinate with interested service providers to gain input on design … Obtain permits and approvals for use of right of way. Procurement and project management. Construction scheduling. Establish contracts and agreements for IRU.	Establish an ongoing maintenance contract with a fibre maintenance company that can respond to emergency outages. Establish an ongoing maintenance contract with a fibre maintenance company that can respond to scheduled work regarding the fibre, potential re-locates, etc. Register with BC Oncall and respond for fibre locates as required. Maintain documentation. Establish a process for providers to request additional or change dark fibre services.

Alternatives:

There are few alternatives to constructing a fibre backbone to provide 50/10 but it is possible for the RDBN to partner with or procure access to a backbone from an existing provider that already has fibre to obtain an IRU that it can use to provide connectivity for other providers. This, on its own, is unpractical as an IRU for a small number of strands on its own is not of much value for third parties without additional layers of the SDP being constructed. For this to be of value, the RDBN would likely have to complete at least the first three levels of the SDP.

Technical Description:

The fibre optic backbone is constructed by placing fibre optic cable along an approved right of way between two or more points of interest for the RDBN. The intent of the backbone is to connect the communities using the cable so that electronics can be placed and connected to the cable to deliver extremely low latency and high capacity communications. Once the cable is placed, the level and diversity of services that can be supported is almost limitless although delivery of the service requires appropriate electronics be placed along the cable at strategic points. The backbone fibre cable is generally intended to provide long haul, high capacity transport of many connections and all the traffic from the residents and businesses of the RDBN that are aggregated into small number of fibre optic strands.

Typically, and as pointed out in the Sandbox Report, the placement of the cable can be completed in two main ways -- aerial and underground (or some combination of each). Depending on the area, there may be some specialty construction techniques required such as underwater installation. The main advantages of each are shown on the following table.

Method	Advantages	Disadvantages
Aerial Installation	Less capital cost than underground. Construction time is less when using existing poles and ROW. Easily accessed for maintenance. Construction cost can be more predictable.	Must obtain approval to use existing poles which can be very time consuming and expensive. Usually there is an ongoing operational lease per pole. More susceptible to outages.
Underground Installation	Once the cable is placed, there are fewer annual operating costs. More robust and less susceptible to outages.	Must obtain approval for permits and right of way. Higher capital cost. Can be more difficult to access for maintenance. Road and water crossings require additional cost and complexity in construction. Can be unknowns that impact the cost of construction.
Underwater Installation	Used to reach locations that can only be reached by placing an underwater cable. Provides connectivity in hard to reach locations.	Must obtain approval for permits and right of way. Very difficult to access for maintenance.

While the construction techniques are different between the various methods, the basic goal is the same. The FOC is placed from the start of the segment to the end of segment, with FOSCs placed every number of kilometers. The FOSC is used to bring two or more cables into a common point where the individual strands can be spliced together according to the design and ultimately, provide a continuous path from point ‘A’ to point ‘Z’. FOSCs are placed to join long lengths of cable, before and after difficult areas of construction, locations where many bends are required or at areas where strands may be required to provide connectivity along the segment. Planning is required along the route to determine the appropriate location for FOSCs.

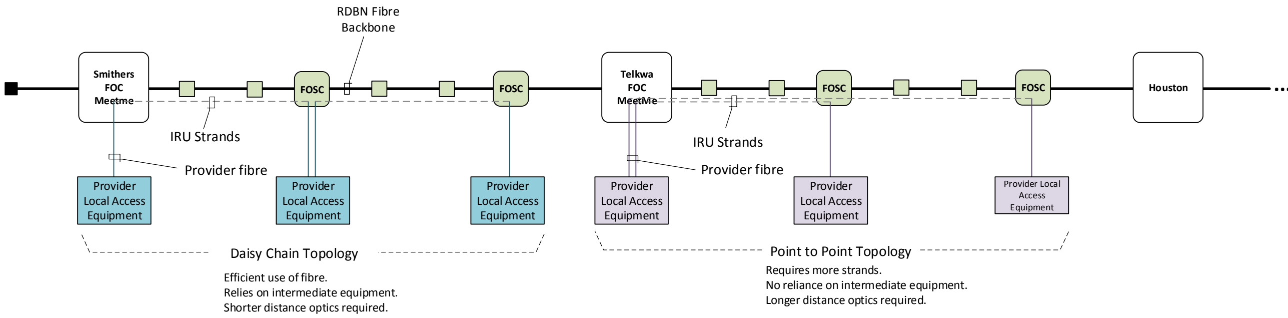


Figure 6 – Fibre Backbone Strand Allocation

A backbone fibre cable is not intended to have a fibre optic strand for every potential customer of the network. It does, however, require a minimum of one strand for every service delivery area along the segment. A typical FO backbone may provide 48, 96, 144 or 288 strands of fibre that are contained in tubes of 12 strands each. Each active strand will ultimately be connected to some electronic equipment to provide service.

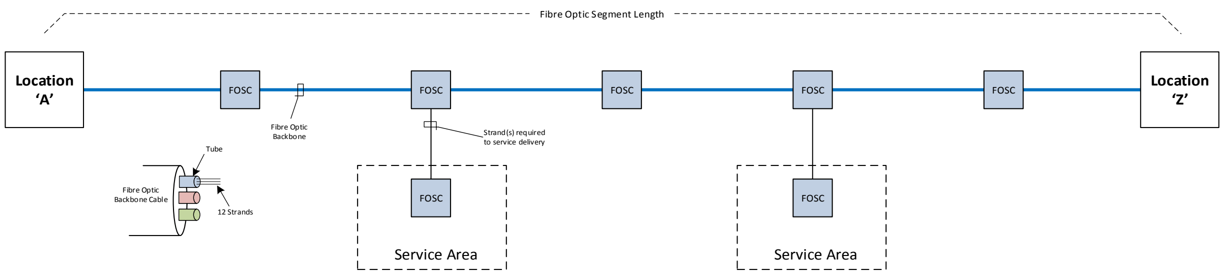


Figure 7 – Fibre Backbone Architecture

When underground FOC is constructed, it is typically placed inside a FOC conduit. The conduit used to protect the cable and also aid in the construction as the conduit can be placed and the cable pulled into the conduit later. The conduit is sized to support the number of physical cables required. They are many different kinds of conduit available depending on the detailed design of the construction.

As provided in the Sandbox report, the typical cost of constructing a fibre optic backbone segment can be estimated on a per kilometer basis but detailed engineering will provide a more accurate cost estimate as this would typically involve detailed planning of the route and construction required.

Considerations When Constructing a Fibre Optic Backbone

The following provides some of the main considerations in the design and planning of the fibre optic backbone:

- Distance between end points along the route. End points will require electronics to TX/RX the signals. When approaching distances of 70 – 80+ kilometers additional complexity and cost is required.

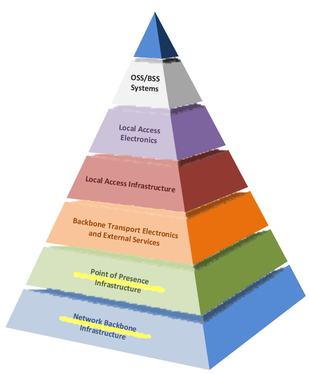
- Locations along the route that should be served by the FOC, how this will be accomplished and how many strands are required.

- Difficult sections to be constructed.

- Other parties that might want to use the cable for diversity of their own services. This may present potential partnering opportunities.

- Opportunities to complete diverse paths for the physical fibre. Backbone FOC typically provides service for thousands or perhaps tens of thousands of customers. A FOC break can severely impact service to many customers. Providers often desire alternate routes for their fibre optic services to ensure reliability should a cable be damaged or require maintenance that may impact service.

4.2.2 Point of Presence Infrastructure



Summary: Points of Presence (or also referred to as a central office or CO) are locations along the fibre backbone that are suitable for the deployment of network electronics and are strategically located in each of the locations that providers may wish to connect to the fibre backbone. The POP will provide a location to terminate the backbone to a fibre optic patch panel as well as potentially provide space for the providers to co-locate electronics for their network.

Solution Concept: In this layer, the network provider constructs POPs to establish a location for the providers to co-locate equipment, obtain proper power and other environmental controls suitable for electronic equipment. The POPs will be located strategically to ensure that the providers can provide efficient connectivity for the local access network that will ultimately connect the subscribers to the fibre backbone. The POPs supply suitable space, power, backup power, environmental controls, security and access suitable for multiple providers. For clarity, in this case, the provider is still obtaining access to a dark fibre IRU, but construction of the POPs removes another significant capital and operating cost that must be considered for the provider. A POP can be a standalone building, shelter, cabinet or perhaps a suitable space in a RDBN location such as an office, firehall or other appropriate building.

How Does This Help: Once the fibre backbone is in place, the next layer of the SDP is to establish a point of presence in the community to provide the local access connectivity. Construction of the POPs are a capital cost intensive aspect of a network build that may be inhibiting providers from improving or providing service to an area of the RDBN. Establishing a suitable POP as part of the RDBN project, removes this cost and effort from the provider by establishing a space to co-locate equipment. The provider no longer needs to consider the capital and operational aspects of providing this layer. The RDBN may be able to provide significant value as it likely has access to existing buildings and will be able to reduce the time and administrative tasks required to construct a POP. Further, by having the RDBN own and manage these locations, appropriate agreements can be constructed to allow the co-location of equipment for multiple providers encouraging economies of scale. In addition, this construction may be eligible for infrastructure funding grants.

Considerations: Some of the main considerations with building this layer are:

- Establishing a suitable location for the POP.
- Ensuring 7x24x365 unescorted access is available for providers to access their equipment.
- Establishing procedures and security between providers that may be sharing space.
- The RDBN may have access to already established locations that could be suitable POP locations, but unescorted access may require some security measures put in place. For example, a local fire hall typically may have appropriate space, power, etc that can be utilized rather than constructing new space.
- Maintenance and ongoing operations for POPs would be necessary but likely is something that the RDBN is already familiar with and may have appropriate resources and procedures to achieve.

Cost: The estimated capital and operational costs to construct the POPs are based on the following assumptions:

- POPs are defined as 4 different types. A type "A" is a larger POP capable of supporting more equipment and server infrastructure. "B" is smaller and contains only the necessary equipment to support the backbone. "C" is a passive cabinet used for distribution fibre. "D" is a simple fibre termination point.
- Type A: $175,000 +/- 20%
- Type B: $100,000 +/- 20%
- Type C: $20,000 +/- 20%
- Type X: $5,000 +/- 20%

Row Labels	Max. POP Cost	Min. POP Cost
Area A	$ 258,000	$ 172,000
Area B	$ 162,000	$ 108,000
Area C	$ 162,000	$ 108,000
Area D	$ 162,000	$ 108,000
Area E	$ 438,000	$ 292,000
Area F	$ 288,000	$ 192,000
Area G	$ 462,000	$ 308,000
Grand Total	**$ 1,932,000**	**$ 1,288,000**

Annual operating costs for the POPs include items such as power, fuel for a backup generator, annual maintenance on power systems. These costs do not include any costs of locating the POP such as lease costs or insurance. We estimate, assuming appropriate local resources are in place, that costs would be approximately $2,400 / year / POP ($200 / month) for normal operations and a semi-annual visit per POP for routine maintenance for a total of approximately $2,400 / year / POP (2 trips for 10hrs each at $120/hr). The total would be approximately $5,000 / year / POP x 16 POPs = $80,000 / year plus additional costs related to items like lease, insurance, etc that are not included in this estimate and need to be determined in a more detailed planning phase.

Actions: In order to complete this layer of the SDP, the RDBN will need to assume responsibility for the following:

Capital Activities	Ongoing Operational Activities
Strategically locate POPs in areas where backbone electronics or local access electronics and fibre termination are required.	Establish and maintain ongoing unescorted access procedures.
Construct POPs including retrofitting existing space that may be suitable or completing the construction of new cabinets or buildings.	Complete regular maintenance and testing as required. Address concerns and issues for the providers using the space.
Outfitting POPs with appropriate infrastructure including cabinets, power, cooling/heating, backup power, etc.	
Outfitting POPs with appropriate facilities for co-location access allowing third party providers access to the facility on a 7x24x365 basis.	

Alternatives:

There is no alternative to having a POP. As mentioned above, the main alternatives to consider is using existing buildings and facilities that already exist and be located appropriately. Consider the use of public buildings such as firehalls, community centers, village offices, libraries, etc as potential locations for a POP.

Technical Description:

In order for the fibre optic backbone cable to be utilized by the RDBN or any other provider, suitable electronic components must be placed at strategic locations. To do this, a provider will typically locate a POP in strategic locations and/or communities along or at the ends of the FOC. This POP provides the following functions to the network:

- Provides a location to terminate the FOC. The FOC is terminated to a fibre optic patch panel. The FPP is piece of fibre optic equipment that provides a physical location to complete the fibre optic cable and a method to connect the electronic components required to “light” the fibre.

- Provides a location to house the network electronics for the backbone provider and potentially other providers that might co-locate equipment in the POP.

- Provides suitable network equipment cabinets to mount the equipment in a secure and reliable manner.

- Provides suitable power, air conditioning and environmental controls to support the network electronics and ensure a reliable environment for these critical components.

- Provides a location to construct other fibre optic cables or local access infrastructure required to bring services to the residents and businesses of the area.

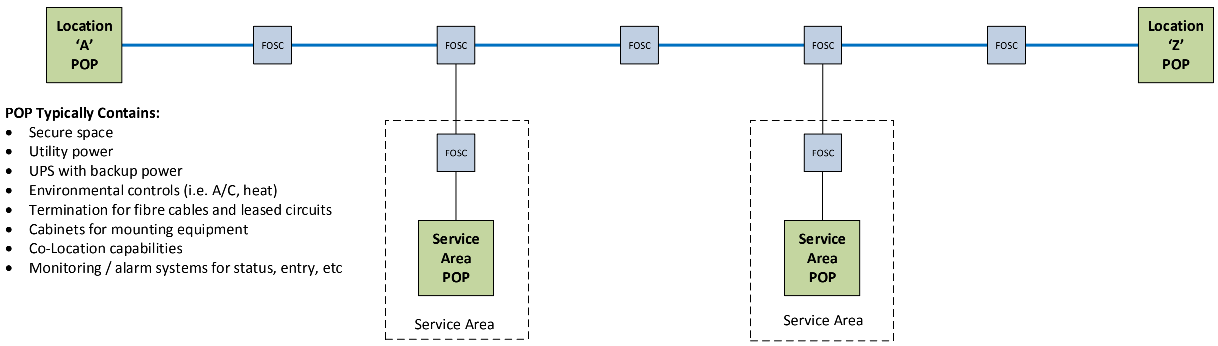


Figure 8 – POP Architecture

Considerations When Constructing a POP

The following provides some of the main items that must be considered in the design and planning of the POPs:

- POPs must be strategically placed to maximize their ability to connect as many backbone and local access cables as possible.

- POPs should be positioned in a location that is likely to be permanent as once the cable is constructed and terminated to this location, it is a very time consuming and service impacting to move.

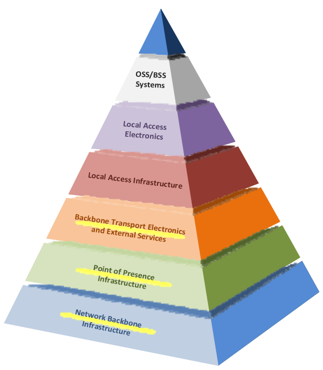
- POPs need to be located in a suitable ROW with proper permits.

- POPs house sensitive electronic equipment and can be critical to the reliability of the network. As such, they should be located in a secure location and be constructed inconspicuously to avoid attracting the attention for vandals or other criminals.

- POPs require proper utility power, air conditioning and other environmental controls and often include backup generator power. As such, they create noise, so they are ideally located where they do not impact others around them.

- POPs should be secured and equipped with proper environmental and security monitoring. In addition, the provider may wish to provide authorized to access to other third parties in a co-location scenario so access and security between third parties (i.e. partitioned cabinets) should be considered.

4.2.3 Backbone Electronics and External Services



Summary: Within each POP site, appropriate backbone electronics are required to light the fibre and this layer of the overall solution deals provides this. The RDBN business model now shifts from a model that sells a dark fibre IRU, to a model that sells capacity or bandwidth on an active network. As part of this, the RDBN may also provide connectivity to the global Internet through one or more POPs (or data centers) that are part of the network.

Solution Concept: Upon completion of this layer of the SDP, the RDBN will have active electronic components in the RDBN POPs and connectivity to the global Internet. The RDBN can now offer a managed service rather than a dark fibre IRU in which the provider needs to supply its own backbone electronics. The provider will no longer request strands of dark fibre from ‘A’ to ‘Z’ but rather will request a service between two or more locations on the network similar to services being offered by competitive carriers. As the RDBN has active electronics in the POP, it can, and must, now actively manage and monitor the network to be aware of service issues and respond to issues on the network more intelligently as it will have components on the network that provide statistics and remote diagnostic capabilities. Services can be sold to as many providers that may require them.

How Does This Help: All providers using the network will require electronics to transmit and receive data between locations on their network. If providers purchase an IRU from the RDBN, each must provide their own network electronics to utilize the fibre backbone for their respective network. This ultimately means that providers are investing capital into components that are being duplicated between providers. If the RDBN were to provide this function as part of its service offering, a single layer of backbone electronics could provide service to many providers. Providers no longer have the capital cost of installing their own electronics but rather shift to a model of purchasing a service from the RDBN that achieves an equivalent end to end result without the capital and operational cost of the components. In addition, the RDBN can offer improved service because it now has active components that can be monitored and remotely managed. The RDBN would be proactively aware of problems before being called by the providers. Further, repair is expedited because the RDBN can dispatch technicians on a specific area as it has more information to pinpoint a problem.

Considerations: Some of the main considerations with adopting this solution are:

- What services are required by providers and where do they need them.

- Deployment of the backbone electronics is a change in the level of knowledge and experience required to operate and maintain the system. Resources will require detailed technical knowledge and experience to operate the sensitive electronic components.

- RDBN is now “in the business” of selling service.

Cost: The estimated capital and operating costs are shown below using the following assumptions:

- Electronics are defined as 4 different types. A type “A” is a larger POP capable of supporting more equipment and server infrastructure. “B” is smaller and contains just the necessary equipment to support the backbone. “C” is a passive cabinet used for distribution fibre. “D” is a simple fibre termination point.
- The assumption is that the RDBN would not require the more expensive optical transport electronics given that this would be a new fibre backbone build with ample number of fibre strands to scale the capacity as required.
- Type A: $150,000 +/- 20%
- Type B: $100,000 +/- 20%
- Type C: $0
- Type X: $0

Row Labels	Max. Electronics Cost	Min. Electronics Cost
Area A	$ 240,000	$ 160,000
Area B	$ 120,000	$ 80,000
Area C	$ 120,000	$ 80,000
Area D	$ 120,000	$ 80,000
Area E	$ 480,000	$ 320,000
Area F	$ 180,000	$ 120,000
Area G	$ 420,000	$ 280,000
Grand Total	**$ 1,680,000**	**$ 1,120,000**

The annual operating cost for electronics is roughly 12% of the capital cost per year for manufacturer maintenance. At 12% it would be approximately, $200,000 / year. Personnel to monitor and manage these components and external connectivity for upstream capacity is covered in in the network operations layer.

Actions: In order to complete this layer of the SDP, the RDBN will need to assume responsibility for the following:

Capital Activities	Ongoing Operational Activities
Design suitable backbone electronics to meet the requirements. Purchase, commission and install the electronic components. Establish operating procedures, resources and appropriate monitoring and software tools to operate the backbone network. Locate suitable technical and business resources that can manage the backbone network. For external connectivity, procure and install the facilities required to provide the external connectivity.	Monitor and maintain the backbone network. Respond to the moves, adds, changes related to the operation of the backbone network. Address concerns and issues for the providers using backbone for network transport. Network electronics and software components typically have an annual maintenance fee associated which providers for product upgrades, technical support and warranty. This is usually an annual expense in the order of 15 – 20% of the list cost. External connectivity (backhaul) is usually associated with a monthly fee for the capacity required. This will be an ongoing operational cost.

Alternatives:

The main alternative to be considered with this layer of the SDP is how the RDBN may wish to operate and maintain the electronic components. Consider outsourcing the management and operations of these components to a company that is familiar with and has a business related to these functions. This company does not have to be located in the RDBN area and can manage the asset remotely. The RDBN may be able to provide local qualified resources that can provide onsite technical assistance should it be required under the direction of the management company. Proximity to the RDBN is a critically important consideration for on-site issue resolution both from the perspective of time and expense.

Technical Description:

Fibre optic infrastructure is only useful to a provider if it has the ability to transmit and receive data. The ability for the FOC to TX/RX data is made available by the electronic components that are placed in the POP and connected to the FOC.

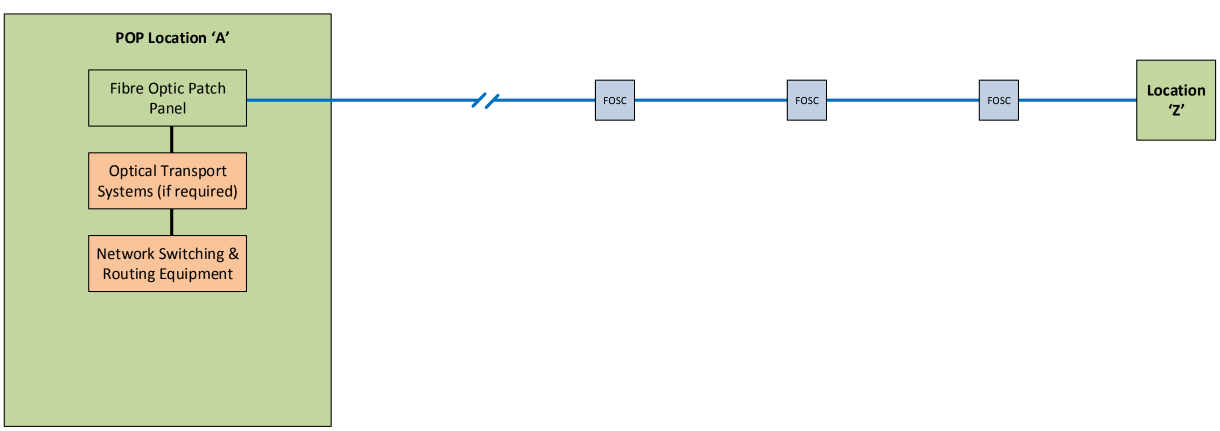


Figure 9 – Backbone Electronics Architecture

There is a variety of backbone electronic equipment available depending on what kind of services the provider is wanting to provide. Among others, the main types of components and services can be summarized as follows:

- **Optical transport systems**. While there are different varieties of this equipment, the modern version of these types of systems use a technology called Dense Wave Division Multiplexing (DWDM). These systems and electronics are used to provide very reliable, high capacity optical transport services over a long distance. Given the high construction cost of long distance fibre of cables, there is a desire to maximize the amount of data that can be transported over the cables. DWDM equipment makes very efficient use of the fibre to maximize the amount of data that can be transported. This equipment tends to be more costly and requires more expertise in the installation, operation and maintenance due to its nature. In the case of new backbone construction such as the RDBN, these components are less likely to be required due to the ability to construct larger numbers of strands as part of the initial build.

- **Network switching and routing equipment**. This equipment is usually connected directly to a fibre optic cable or a DWDM system described above. While it generally does not scale to the same capacity as a DWDM system, it often is required to interface between the backbone network and the local access network. This equipment can connect hundreds or thousands of customers from the local access network to the backbone network. While not as costly as a DWDM system, it is usually a significant cost and as such, providers want to maximize the number of customers aggregated on to this equipment.

External Services

While companies use communications networks for a variety of purposes, the interest for the RDBN and its residents is primarily access to the Internet. Connecting communities in the RDBN is of little value without a method to connect the RDBN fibre optic network to the Internet and all the services available on the Internet. In order to do this, the network must have connectivity to external services located outside of the RDBN.

These external services are provided by a second tier network that provides connectivity for the provider's network to other providers and ultimately the Internet. The Internet is merely a term used to describe the connectivity that all providers have between their networks. Without connectivity to the Internet, the network can only communicate to others located on the same network (an "Int<u>ra</u>net"). While local connectivity may be of value to some subscribers, it does not deliver many of the services desired by subscribers that are only available with global Internet connectivity.

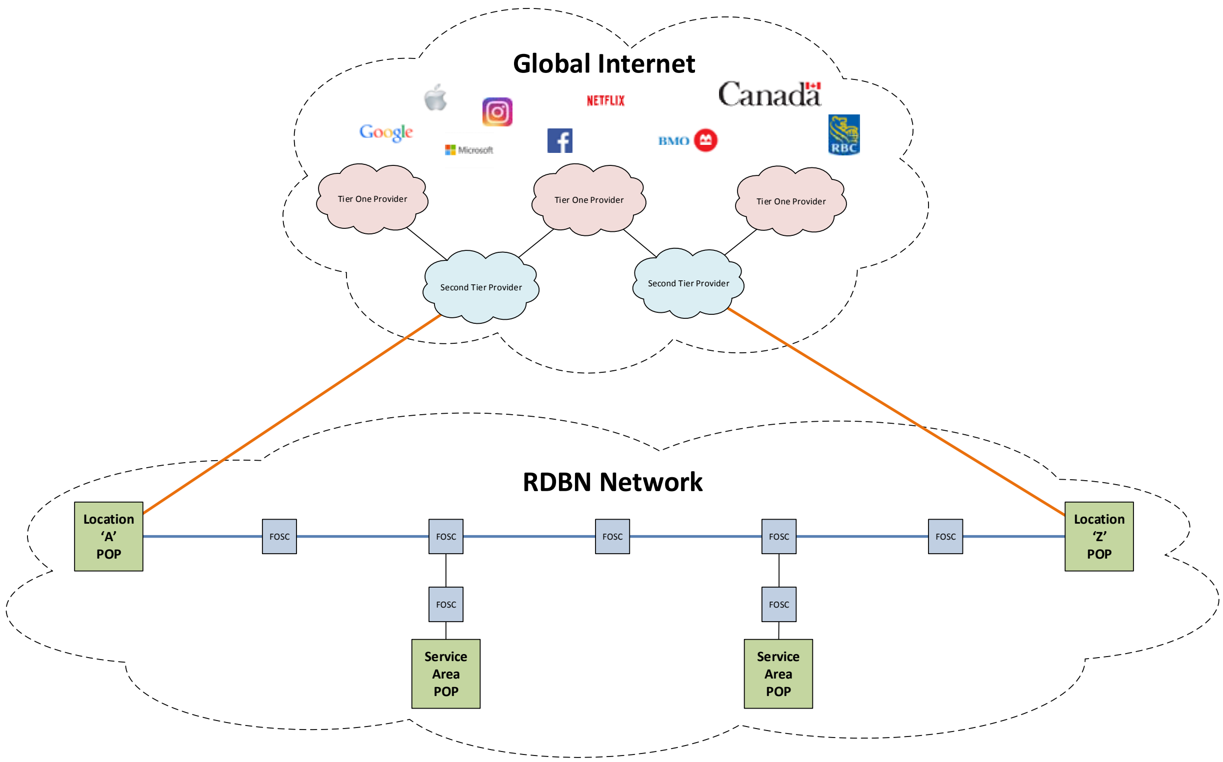


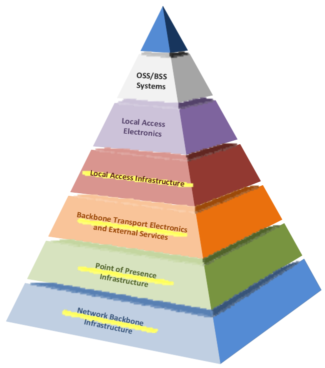
Figure 10 – Overall Network Architecture

Establishing connectivity to a second-tier network provider, or multiple providers, requires that the network have the infrastructure to connect between the local network and an upstream provider(s) that can establish global connectivity.

Given that this upstream connectivity may provide Internet services to all the residents and businesses of the RDBN, reliability, capacity and cost are significant factors in the considerations. External services are typically provided by well-established providers with large, high capacity network that have the ability to provide the services into one or more locations on the fibre optic network. The RDBN network will require access via fibre (or other leased services) to a POP that can provide connectivity to one or more upstream providers to reach the global Internet and the services it provides. More than one provider with geographically distinct locations, is desirable so as to ensure that an event impacting connectivity to one provider cannot impact services for the residents relying on that provider.

Establishing connectivity to an upstream provider typically has a capital construction cost and more importantly, a significant monthly operational cost. Operational costs can be handled in a variety of methods but typically, the upstream provider will charge a flat rate for a set amount of capacity with an incremental cost for capacity that is used over the fixed flat rate. The amount of capacity the RDBN requires will depend on how many end customers the network ultimately serves. This will require that the RDBN understand where these upstream services are available, at a suitable cost and reliability level.

4.2.4 Local Access Infrastructure



Summary: Local access (or also referred to as the last mile) construction of the FTTP infrastructure (eg. fibre optic cable and associate components) is required to connect the dwellings or subscribers in the service area back to the POP. The business model for the RDBN becomes one in which they sell bandwidth services up to the POP to third party providers and lease the local access fibre (to the premises) in the form of an IRU to those providers. The third party must place its own electronics in the POP and at the subscriber's premises to activate the fibre.

Solution Concept: Upon construction of this layer of the SDP, all of the infrastructure necessary to connect the residents and businesses of the RDBN to the backbone network will be in place. While the physical connectivity from the subscriber's premises to the POP has been established at this point, there are additional components required to deliver a service to the customer such as the electronic components necessary to activate the service between the POP and the subscriber. In order to complete this, the provider must deploy the electronics in the POP and begin connecting the subscribers to the POP electronics by placing the device in the subscriber's premises and activating the service.

How Does This Help: Completing the backbone and local access fibre is the major cost in the construction of the network and likely the barrier that prevents a provider from delivering a high capacity service to any of the residents, let alone remote residents that are not within a densely populated area. Completing the local access fibre removes the final cost barrier that inhibits providers from delivering the FTTP service. Providing the RDBN can cost effectively price the backbone and local access service it delivers, the provider is far more likely to be able to make a business case to deliver services to remote residents.

Considerations: Some of the main considerations with building this layer are:

- Providers may still be driven to deploy improved services to the more densely populated areas simply because it is easier to deploy and maintain. Ensuring that the time and money that the RDBN has invested is not wasted the RDBN may have to be "the provider of last resort" should not other third-party providers wish to service these areas.

- Delivering a service not only requires the initial deployment of the electronics to activate the service, but occasionally requires a site visit to address issues with the service.

- It is a large expense to build this layer of the SDP.

Cost: The costs outlined below to construct the FTTP are based on a number of assumptions to create an overall estimate. Actual construction costs depend on a number of factors so accurate estimates will require a detailed analysis which will require a site visit. Incremental cost has been factored in for dwellings that are further from the main backbone where the density is lower and they are further from the main center.

The assumptions used in this estimate:

- On average, the cost to connect dwellings within 1km of the major highways (and backbone) is $2700 +/- 15%.
- Costs to connect dwellings at 3, 5 and 10km is scaled up to $15,000/dwelling.

Estimated average cost needs to be considered as a whole for the project.

Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Cost Per	$ 15,000		$ 8,200		$ 5,500		$ 2,700	
Plus/Minus %	25%	-25%	19%	-19%	17%	-17%	15%	-15%
Households								
Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Area A	2441		2080		1842		1016	
Area B	928		923		901		771	
Area C	920		773		679		525	
Area D	1236		985		781		545	
Area E	967		612		506		331	
Area F	1979		1422		1151		569	
Area G	500		493		445		336	
Total	8971		7288		6305		4093	
Capital Cost (Capex)								
Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Area A	$ 17,579,913	$ 11,725,687	$ 10,811,163	$ 7,664,437	$ 8,480,086	$ 6,092,314	$ 3,154,680	$ 2,331,720
Area B	$ 3,541,322	$ 2,562,878	$ 3,447,572	$ 2,506,628	$ 3,232,094	$ 2,361,306	$ 2,393,955	$ 1,769,445
Area C	$ 6,299,925	$ 4,180,675	$ 3,543,675	$ 2,526,925	$ 2,622,997	$ 1,906,003	$ 1,630,125	$ 1,204,875
Area D	$ 9,918,086	$ 6,496,514	$ 5,211,836	$ 3,672,764	$ 3,213,769	$ 2,325,231	$ 1,692,225	$ 1,250,775
Area E	$ 9,850,480	$ 6,250,320	$ 3,194,230	$ 2,256,570	$ 2,156,019	$ 1,556,381	$ 1,027,755	$ 759,645
Area F	$ 18,617,073	$ 12,011,927	$ 8,173,323	$ 5,745,677	$ 5,519,028	$ 3,955,572	$ 1,766,745	$ 1,305,855
Area G	$ 2,347,411	$ 1,663,189	$ 2,216,161	$ 1,584,439	$ 1,746,027	$ 1,267,373	$ 1,043,280	$ 771,120
Total	$ 68,154,209	$ 44,891,191	$ 36,597,959	$ 25,957,441	$ 26,970,021	$ 19,464,179	$12,708,765	$ 9,393,435

The above table shows the estimated cost to connect the number of dwellings shown at each buffer zone of 1, 3, 5 & 10km. For example, to connect all dwellings located within 5km of the highway is a total of 7288 dwellings. The estimate shows that this would be between roughly $37M & $26M for the local access fibre only.

As with the fibre backbone annual operational costs, given the assumption is an underground build, the annual operating costs for fibre local access are assumed to be minimal. We have not identified annual rights of way, or permits, or other costs that should be considered but such costs may exist depending on where the fibre is constructed. There are annual taxes for fibre assets assessed by the Province of BC, but further research is necessary to determine whether such taxes apply to the RDBN. We also have not included insurance costs, if any. Aside from these items the annual operating cost to be consider would be maintenance in the event of a fibre cut or construction charges to make changes to the fibre backbone. However, given the number of connections that would be required, it would be unreasonable to assume them to be zero cost as fibre maintenance and testing will be required during the year. We have assumed that there would be 1 visit per year per 100 subscribers at a cost of $1,500 per day for a fibre repair crew. For 1km the annual cost estimate would be $60k per year, 3km = $95k, 5km = $110k, 10km = $135k / year. In addition, an emergency maintenance contract per fibre repair should be considered.

Considerations: Some of the considerations for the FTTP construction would include:

- What is the operational model for repair of the fibre?
- How far does the RDBN take the local access construction? Ie. to the splice case on the street, to the side of the dwelling or right inside the dwelling?
- Who is responsible for what?

Actions: In order to complete this layer of the SDP, the RDBN will need to assume responsibility for the following:

Capital Activities	Ongoing Operational Activities
Design of the local access infrastructure. Obtaining permits and ROW to locate the infrastructure. Procurement and construction of the local access fibre, splice points, fibre termination, etc in the POP. Restoration and completion of infrastructure.	Ongoing maintenance of the infrastructure which might include repairs or moves as required. Activities related to the connection of new locations.

Alternatives: The following are some alternatives to constructing local access fibre.

Provide access to a suitable wireless tower that can serve a group of residents rather than a FTTP deployment. The challenge with this is that small groups or isolated dwellings may have a very low number of subscribers that can be served from the tower. In extreme cases, this could mean a higher per subscriber cost than fibre and 50/10 may not always be met.

Technical Description:

As the RDBN proceeds up the service delivery pyramid to this level, the backbone infrastructure is largely in place. While this provides the foundation for the delivery of services on the network, it still does not provide the ability to deliver a service to the residents and businesses of the RDBN because there has not yet been a connection established from the residence to the backbone network. The local access network is required to provide the infrastructure necessary to provide this local access.

The local access technology can be provided using a number of technologies outlined in the following table.

Method	Advantages	Disadvantages
Wireless and LTE 4/5G	Lowest capital cost although LTE will have a higher capital cost than 2.4 & 5GHz wireless. Fairly easy and quick to deploy. Limited approvals, permits and rights of way required.	Limited scalability. Wireless spectrum is limited and technology dependent to make incremental gains in capacity. Wireless is a shared technology. The more customers placed in the spectrum, the less capacity each gets. Generally requires line of site for high capacity. Trees, hills and other obstacles impede performance. Can be subject to interference especially in the unlicensed 2.4 and 5GHz bands. Towers and infrastructure are generally not desirable in neighborhoods. Voice and video services have to be carefully engineered to support good reliable quality.
Satellite	Available almost anywhere. Can be mobile as the antenna can be moved and re-positioned fairly easily.	Lower capacity and high latency (time it takes to TX/RX data). Costly bandwidth due to the need for satellites.
Twisted Pair Copper DSL	If cable infrastructure already exists, then it can be fairly easy and cost effective to convert to a DSL network. Improved capacity over wireless technology. Can support multiple services.	Capital cost can be high to run cable to every house. Requires access to the aerial infrastructure or underground which requires approvals, permits, etc. Unless the twisted pair infrastructure already exists, it is unlikely it would be more desirable than a fibre network.
Coaxial Cable	If coaxial infrastructure already exists, then it can be fairly easy and cost effective to convert to a DOCSIS network. Much improved capacity over wireless and DSL technology. Can support multiple services.	Capital cost can be high to run cable to every house. Requires access to the aerial infrastructure or underground which requires approvals, permits, etc. Unless the coaxial cable infrastructure already exists, it is unlikely it would be more desirable than a fibre network.
Fibre Optic	Provides the highest capacity which is virtually unlimited.	Capital cost can be high to run fibre to every house.

Method	Advantages	Disadvantages
	Can be scaled by upgrading electronics rather having to replace cable infrastructure. Can support multiple services. Very reliable and not subject to interference.	Requires access to the aerial infrastructure or underground which requires approvals, permits, etc.

While a number of technologies are available, none of them can match the capacity and reliability provided by a fibre optic network. To construct a local access fibre network, the provider must construct fibre optic cable from each home or business in the service area, back to the nearest established POP. There are two main categories of local access fibre networks, those being Passive Optical Networks (PON) often referred to as GPON or active Ethernet. The difference between the two technologies is really in the physical deployment of the fibre optic infrastructure and how each customer gets connected back to the local access electronics located in the POP. The following table summarizes the two technologies.

Technology	Method	Advantages	Disadvantages
PON / GPON	Deployment is usually a single strand of fibre to each home or business (i.e. Subscriber). Strand of fibre is connected back to a local cabinet called a Fibre Distribution Hub (or POP) that contains passive optical splitters. A splitter takes multiple subscribers and combines them into a single strand which is connected back to the network electronics.	More efficient on the fibre construction. A strand of fibre from the subscriber only needs to get back to the nearest splitter so it reduces the need for large volumes of fibre to be deployed throughout the community. Splitters are passive (do not require power) so they can be deployed in convenient locations for strategic deployment of the fibre. Splitters make efficient use of the costly network electronics. Supports different service types. If some fibre already exists, then PON can save cost in avoiding additional fibre to be run. PON deployments can be very efficient when limited fibre is available and can have a large advantage when long distances are required to reach groups of subscribers.	Customers share a large capacity network port, typically 2.5Gbps downstream and 1.25 Gbps upstream. Depending on the splitter size, this means each subscriber gets a fraction of the total capacity. A very common splitter is 1:32. Providing higher capacities requires fewer subscribers per splitter which defeats the efficiency or a dedicated strand/connection. Providing dedicated connections to specific customers (eg. perhaps a large gov't institution) requires careful planning to ensure dedicated fibre is available from the subscriber all the way back to the POP. Many dedicated connections defeat the efficiency of a PON deployment.
Active Ethernet	Deployment is usually a single strand of fibre to each home or business	Every subscriber receives a dedicated port and is not sharing capacity from the POP	More fibre required. Every subscriber needs a fibre strand back to the

Technology	Method	Advantages	Disadvantages
	(i.e. Subscriber) back to the POP. Each strand of fibre is connected to a dedicated interface on the network electronics. The interface determines the speed and services available to the subscriber.	to their location. This means each subscriber can easily have 1Gbps+ dedicated to them. Much easier to scale some subscribers to higher speeds when required. There is no common aggregation point other than the POP. Supports different service types. Likely scales to higher capacities easier than PON.	POP. This could mean more POPs (with power, etc) if the fibre construction requires it. The network runs Ethernet so services need to be supported on Ethernet (not usually a problem these days).

The following diagram depicts the difference between how each of the above deployment methods are constructed.

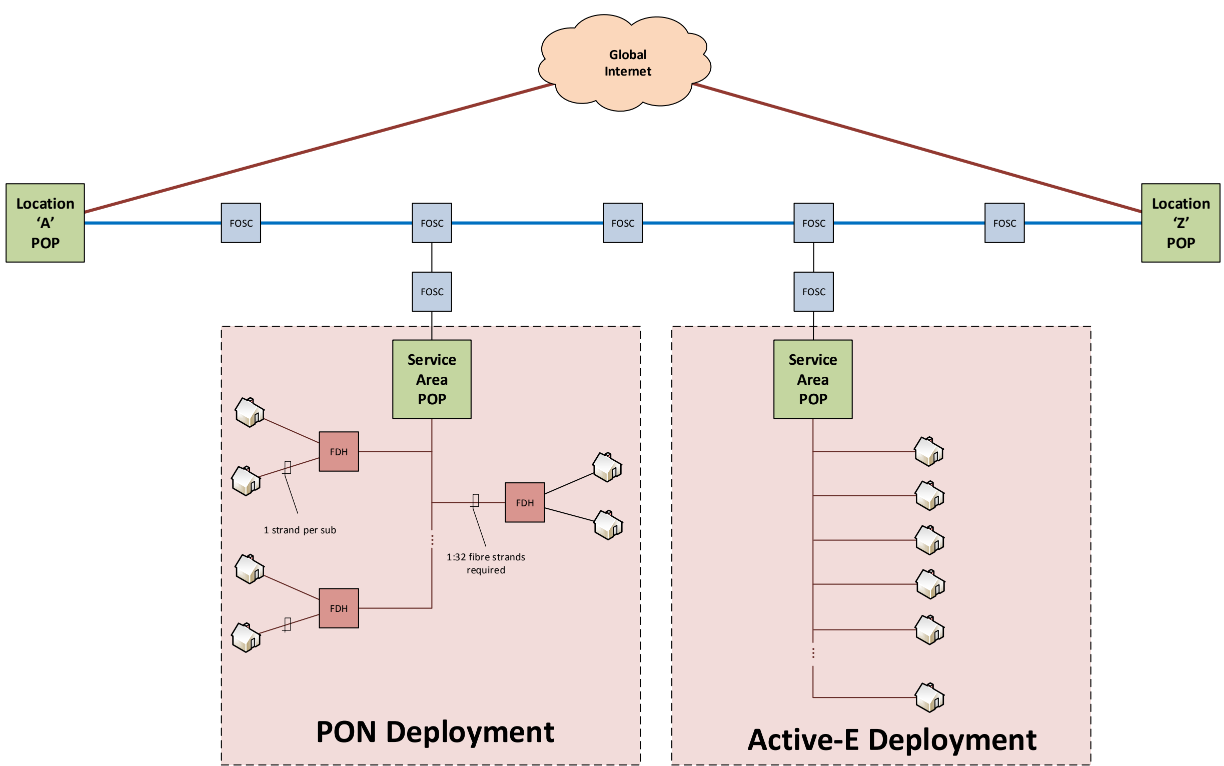


Figure 11 – Local Access Architecture

The following provides a summary of the construction method for each:

PON / GPON

- Single strand of fibre is run from the subscriber to the nearest FDH.

- An FDH can be a small cabinet that may terminate a small number of subscribers (ie. 100 - 200) to larger cabinets that may contains 100s or 1000s of subscribers.

- In the FDH, each subscriber is connected to a splitter (eg. 1:32) which has several subscribers connected to a single strand that goes back to the POP electronics.

- An FDH may also be a very small cabinet (perhaps pole mounted, or an aerial case) which contains a single splitter.

- The FDH could be located within a few kilometers of the POP or it could be located several 10's of kilometers away. The further away however, the more costly the electronics required. The advantage with PON however, is that 1 long distance strand can serve many subscribers.

- Each splitter in the FDH, is connected back to the POP on a single strand of fibre.

Active Ethernet

- Single strand of fibre is run from the subscriber to the nearest POP. The difference in this case between an FDH and a POP is that a POP will contain active electronics that require power, UPS, A/C, etc.

- Small cabinets can be deployed that contain the electronics to terminate a small number of subs (ie. 100 - 200) to larger cabinets that may contains 100s or 1000s of subs.

- The POP could be located within a few kilometers of the subscribers or it could be located several 10's of kilometers away. The further away however, the more costly the electronics required.

- The fibre strand from each subscriber is connected to a port on the network electronics that is dedicated to that one specific subscriber. There is no sharing of capacity.

In either of these deployment methods, the construction of the physical fibre is basically the same. Fibre is constructed either underground, deployed in conduits, or aerial. Fibre needs to be constructed along every street so that a single strand of fibre can be connected to each subscriber. For underground deployments, the typical method is to deploy splice tubs underground, along the street so a conduit can be run from each subscriber back to the nearest splice tub. Inside the splice tub is a FOSC (or other methods may have an optical tap) to connect the drop cable (the strand going to the subscriber) back to the main fibre cable. For aerial installations, a FOSC or optical tap is mounted near a pole and an aerial drop cable is run from the subscriber to the nearest splice location.

The fibre strand is typically terminated on the side of the home or business in a weather proof enclosure which takes the outside plant cable (i.e. the cable/strand going from the subscriber to FDH/POP) and transitions it to the inside plant cable which will be run into the home and terminated on the electronics located inside the customer's home or business.

The following provides an overview of the local access deployment.

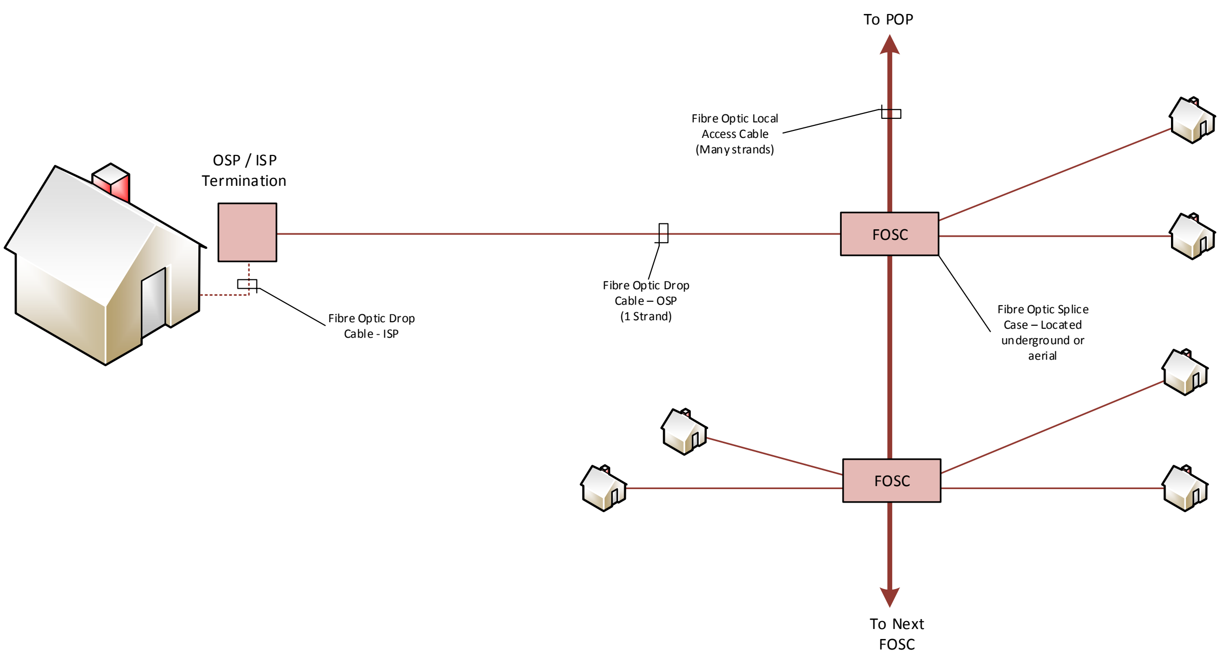
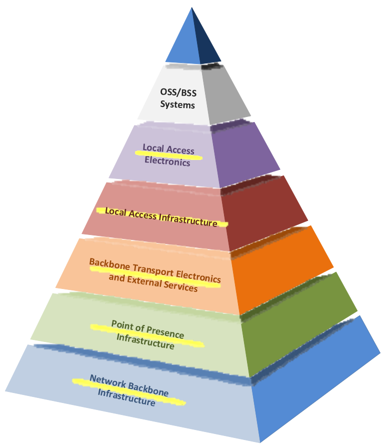


Figure 12 – Local Access Deployment

4.2.5 Local Access Electronics



Summary: The final step in activating the service to the subscribers is the deployment of the local access electronics required to activate the fibre from the POP to the subscriber including the placement of the device inside the subscriber premises. At this point, activating the service is merely completing the final provisioning of the service which is typically performed remotely by the network operations personnel.

Solution Concept: Placement of the local access electronics is the final step for easy management and activation of the subscribers' service. Once the electronics have been placed, there is little need to have a technician visit the site and perform and construction or installations. All the activation activities are performed from the service provisioning software that is usually provided by the equipment manufacturer or is part of the overall management system described in the final layer. The business model for the RDBN, at this point, is a revenue sharing model in which the RDBN and the provider share the monthly revenue. The goal of the RDBN is, at a minimum, to ensure it can cover the operational costs associated with maintaining the network to this point. The provider's motivation is to gain revenue and add more subscribers to its base with very little capital invested. Adding more subscribers allows that provider to upsell the subscriber additional value services it may offer. If the RDBN owns and maintains the network right to the subscribers' premises, it can truly offer an open access business model in which any provider can reasonably provide services to any subscriber in the entire RDBN region without considering the geographic challenges to doing so.

How Does This Help: Placing the local access electronics removes the final capital costs, operational and business challenges of providing services to remote subscribers or those outside of the service area. It creates an environment where any service provider in the RDBN, or perhaps even outside the RDBN can reasonably provide a service without concern for how it might deploy or maintain the physical infrastructure required to do so.

Considerations: Some of the main considerations with this layer are:

- What local access technology will be deployed and how does it align with other providers.

- In the case of the RDBN, how will the local access electronics be deployed? Who will complete the installations?

- Who is going to provision the services?

- Who is going to manage, monitor and maintain the electronics?
- What business model will the RDBN use for access to the local access network?

Cost: The costs estimated below for the FTTP electronics are based on a number of assumptions to create an overall estimate. Incremental cost has been factored in for dwellings that are further from the main backbone where the density is lower and they are further from the main center.

The following assumptions have been made in this estimate:

- On average, over a large area and number of dwellings, the average cost for electronics for dwellings within 1km of the major highways (and backbone) is $800 +/- 15%.
- Electronics for dwellings increase to an average of $1,000/dwelling for dwellings within the 3km buffer, $1,200/dwelling for dwellings in the 5km buffer and $1,500/dwelling for dwellings in the 10km.

Estimated average cost needs to consider the project as a whole.

Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Cost Per	$ 1,500		$ 1,200		$ 1,000		$ 800	
Plus/Minus %	25%	-25%	19%	-19%	17%	-17%	15%	-15%
				Households				
Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Area A	2441		2080		1842		1016	
Area B	928		923		901		771	
Area C	920		773		679		525	
Area D	1236		985		781		545	
Area E	967		612		506		331	
Area F	1979		1422		1151		569	
Area G	500		493		445		336	
Total	8971		7288		6305		4093	
				Capital Cost (Capex)				
Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Area A	$ 2,920,984	$ 2,010,816	$ 2,244,109	$ 1,604,691	$ 1,902,976	$ 1,374,624	$ 934,720	$ 690,880
Area B	$ 902,617	$ 658,783	$ 893,242	$ 653,158	$ 861,709	$ 631,891	$ 709,320	$ 524,280
Area C	$ 1,073,881	$ 740,719	$ 798,256	$ 575,344	$ 663,522	$ 484,478	$ 483,000	$ 357,000
Area D	$ 1,541,069	$ 1,045,531	$ 1,070,444	$ 763,156	$ 778,044	$ 565,956	$ 501,400	$ 370,600
Area E	$ 1,327,217	$ 871,783	$ 661,592	$ 472,408	$ 509,659	$ 369,941	$ 304,520	$ 225,080
Area F	$ 2,638,522	$ 1,757,278	$ 1,594,147	$ 1,130,653	$ 1,205,713	$ 868,687	$ 523,480	$ 386,920
Area G	$ 518,817	$ 372,983	$ 505,692	$ 365,108	$ 436,892	$ 318,708	$ 309,120	$ 228,480
Total	$10,923,107	$ 7,457,893	$ 7,767,482	$ 5,564,518	$ 6,358,516	$ 4,614,284	$ 3,765,560	$ 2,783,240

The above table shows the estimated cost for the electronics to connect the dwellings shown at each buffer zone of 1, 3, 5 & 10km. For example, to provide electronics to all dwellings located within 5km of the highway is a total of 7288 dwellings. The estimate shows that this would be between roughly $7.8M & $5.6M.

The annual operating cost for electronics is roughly 12% of the capital cost per year for manufacturer maintenance. At 12% the approximate annual maintenance would be as follows. Personnel to monitor and manage these components is covered in in the network operations layer. While these operational costs may seem high, remember that they are only applicable once the electronics are deployed to a subscriber and as such there is incoming revenue to offset the operational costs.

Operations Cost (Opex)								
Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Area A	$ 350,518	$ 241,298	$ 269,293	$ 192,563	$ 228,357	$ 164,955	$ 112,166	$ 82,906
Area B	$ 108,314	$ 79,054	$ 107,189	$ 78,379	$ 103,405	$ 75,827	$ 85,118	$ 62,914
Area C	$ 128,866	$ 88,886	$ 95,791	$ 69,041	$ 79,623	$ 58,137	$ 57,960	$ 42,840
Area D	$ 184,928	$ 125,464	$ 128,453	$ 91,579	$ 93,365	$ 67,915	$ 60,168	$ 44,472
Area E	$ 159,266	$ 104,614	$ 79,391	$ 56,689	$ 61,159	$ 44,393	$ 36,542	$ 27,010
Area F	$ 316,623	$ 210,873	$ 191,298	$ 135,678	$ 144,686	$ 104,242	$ 62,818	$ 46,430
Area G	$ 62,258	$ 44,758	$ 60,683	$ 43,813	$ 52,427	$ 38,245	$ 37,094	$ 27,418
Total	$ 1,310,773	$ 894,947	$ 932,098	$ 667,742	$ 763,022	$ 553,714	$ 451,867	$ 333,989

Actions: In order to complete this layer of the SDP, the RDBN will need to assume responsibility for the following:

Capital Activities	Ongoing Operational Activities
Design suitable electronics to meet the requirements. Purchase, commission and install the electronic components. Establish operating procedures, resources and appropriate monitoring and software tools to operate the backbone network. Locate suitable technical and business resources that can manage the backbone network.	Monitor and maintain the electronics. Respond the moves, adds, changes related to the operation of the backbone network. Address concerns and issues for the providers using network electronics. Network electronics and software components typically have an annual maintenance fee associated which providers for product upgrades, technical support and warranty. This is usually an annual expense in the order of 15 – 20% of the list cost.

Alternatives:

In the case of an FTTP network, the alternatives are essentially the different technology choices. Different alternatives have advantages and disadvantages. In the end however, the RDBN will need to decide on the business model it wishes to follow and then select the most suitable technology for that model.

The most likely alternative to a FTTP network would be a wireless technology. This is primarily due to the fact that if fibre is being considered, it is entirely likely that there is no existing wired technology (DSL or cable) deployed. For new infrastructure builds that will use a wired technology, fiber is the only logical choice.

Technical Description:

At this stage in the network deployment, nearly all the components are in place to provide a service to the end customer. The final component that remains to provide connectivity is the placement of the local access electronics. The local access electronics are used to connect the device located in the subscriber premises to the electronics located inside the POP.

The electronics selected to complete this will depend on the deployment architecture, PON versus Active-E for example, and many other factors some of these being: distance, capacity required, technology, manufacturer, services required, etc. There are two main categories of electronics required: 1) POP electronics that are located in the POP and aggregate all the subscribers 2) the subscriber electronics that are located in the subscriber's premises and are used to connect the customers equipment to the fibre network. The electronics required basically have the following characteristics:

Local Access POP Electronics

- Multiple ports / interfaces sized to connect the required number of subscribers.

- High capacity uplink interfaces to connect from local access electronics to the backbone electronics.
- Low cost per interface per subscriber as there may be 100s or 1000s of interfaces required.
- Reliable with redundancy features to reduce the possibility of failures.
- Remotely manageable and configurable so technicians can provision services and troubleshoot problems from a central location.

Subscriber POP Electronics

- Intended for a single subscriber deployment.
- Low cost.
- May have optional capabilities including wireless and firewall support, services such as Voice over IP, CATV outputs, etc.
- May have optional battery backup in case of power outages.
- Remote management and diagnostics capabilities.

The type of electronics required will depend on the architecture deployed. As discussion previously there are two main categories. The following provides a brief comparison.

Technology	Method
PON / GPON	Electronics in the POP are called the OLT (Optical Line Termination). OLTs are fitted with several GPON interfaces depending on the number of subscribers and the splitter ratio. For example, a 1:32 splitter will require 1 GPON interface for every 32 subscribers. Electronics at the subscriber are called the ONT (Optical Network Termination). A single ONT is typically required at every subscriber premises. ONTs may have built in wireless, firewalls, VoIP, CATV, etc

Technology	Method
Active Ethernet	Electronics in the POP are called a network switch or router (other terms may be used but they are typically manufacturer specific) Switches or routers are fitted with many optical interfaces each having the capability to TX/RX at typically up to 1Gbps. Each subscriber is connected back to an interface on the switch or router. Electronics at the subscriber are called the CPE (Customer Premises Equipment). A single CPE is typically required at every subscriber premises. CPEs may have built in wireless, firewalls, VoIP, CATV, etc

The following provides an overview of how the electronics are deployed.

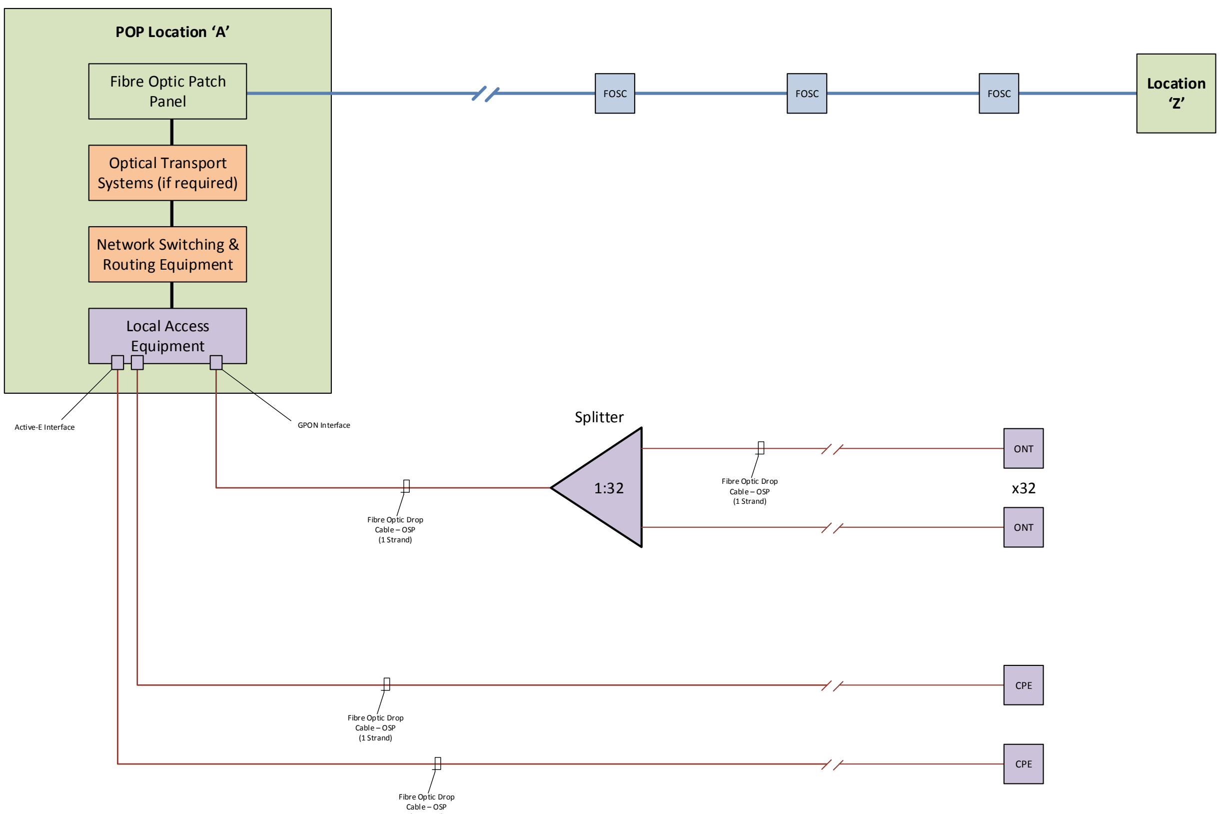
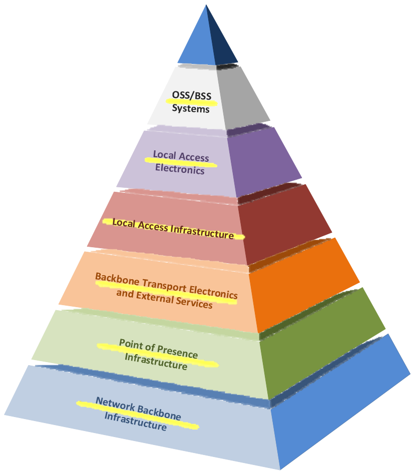


Figure 13 – Local Access Electronics Architecture

4.2.6 OSS / BSS Systems



Summary: While the previous layers provide the infrastructure required to enable services to the subscribers, they do not provide the resources required to effectively manage, monitor and obtain revenue from the network. The OSS/BSS layer provides all the infrastructure required to perform the operational and business functions required for the network to operate successfully.

Solution Concept: As described earlier, the OSS/BSS layer of the SDP is the layer that provides all the resources required to effectively operate the network. In this layer, we include items such as:

- Personnel with appropriate knowledge and experience with operating a network.
- The support system, which includes the personnel, required to effectively support subscribers of the network such as technical support and customer service support.
- The infrastructure and software applications required to effectively operate the network.
- The processes and procedures related to the operation of the business.
- The equipment and tools required to complete onsite activities.

In the case of the RDBN, the most likely solution to this layer of the SDP is to partner with, or source a company that can act as an operator for the network. This partner/company would be familiar with network operations and can provide cost effective economies of scale in the addition of the RDBN assets to an already established operating environment. A detailed business plan will be critical if the RDBN wishes to explore delivery of this layer of the SDP and what this looks like will be dependent upon the business arrangements that can be made with third parties.

RDBN's role in this aspect would then become more of a manager of the operations rather than having to provide and manage each aspect of the operation.

How Does This Help: By sourcing a suitable company, the RDBN has provided all the services and layers of the SDP in a manner that could provide cost effective management of network operations.

Cost: The capital cost is estimated below for the OSS/BSS systems that allow for management and operation of the network based on following assumptions:

- A fixed base capital cost is required for the hardware and software required to manage and monitor the network.
- $50 per port (or per dwelling)/year has been estimated for administration fees and resources required to support, manage and perform maintenance and operation changes to the network.
- The annual cost for upstream connectivity is based on requiring 1Gbps of upstream capacity per 1000 subscribers. The rate is assumed to be $35/Mbps/month. While these operational costs are considerable remember that this cost is only applicable as a result of the success of the network. These costs are offset by the operational revenue obtained from subscribers on the network.

Estimated capital cost for OSS/BSS hardware and software systems is shown below:

Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Plus/Minus %	20%	-20%	17%	-17%	16%	-16%	15%	-15%
Hardware/Software Cost	$ 200,000							
Administration Cost ($ Per Subscriber)	$ 50							
External Services Costs ($ Per House Per Mb)	$ 35							

Households				
Buffer Distance	10 Km	5 Km	3 Km	1 Km
Area A	2441	2080	1842	1016
Area B	928	923	901	771
Area C	920	773	679	525
Area D	1236	985	781	545
Area E	967	612	506	331
Area F	1979	1422	1151	569
Area G	500	493	445	336
Total	8971	7288	6305	4093

Hardware/Software Costs								
Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Area A	$ 65,304	$ 43,536	$ 66,911	$ 47,250	$ 67,844	$ 49,016	$ 57,093	$ 42,199
Area B	$ 24,827	$ 16,551	$ 29,692	$ 20,967	$ 33,185	$ 23,976	$ 43,325	$ 32,023
Area C	$ 24,613	$ 16,408	$ 24,866	$ 17,560	$ 25,009	$ 18,068	$ 29,502	$ 21,806
Area D	$ 33,067	$ 22,044	$ 31,686	$ 22,375	$ 28,765	$ 20,783	$ 30,625	$ 22,636
Area E	$ 25,870	$ 17,247	$ 19,687	$ 13,902	$ 18,637	$ 13,465	$ 18,600	$ 13,748
Area F	$ 52,944	$ 35,296	$ 45,744	$ 32,302	$ 42,393	$ 30,628	$ 31,974	$ 23,633
Area G	$ 13,376	$ 8,918	$ 15,859	$ 11,199	$ 16,390	$ 11,842	$ 18,881	$ 13,956
Total	$ 240,000	$ 160,000	$ 234,444	$ 165,556	$ 232,222	$ 167,778	$ 230,000	$ 170,000

In addition, estimated annual costs for administration including the resources and software subscriptions to manage a fully functioning network is as follows:

Households				
Buffer Distance	10 Km	5 Km	3 Km	1 Km
Area A	2441	2080	1842	1016
Area B	928	923	901	771
Area C	920	773	679	525
Area D	1236	985	781	545
Area E	967	612	506	331
Area F	1979	1422	1151	569
Area G	500	493	445	336
Total	8971	7288	6305	4093

Annual Administration Costs - (Installation, Repair, NetOps, Business Admin, etc.)								
Buffer Distance	10 Km		5 Km		3 Km		1 Km	
Area A	$ 146,460	$ 97,640	$ 121,911	$ 86,089	$ 106,938	$ 77,262	$ 58,420	$ 43,180
Area B	$ 55,680	$ 37,120	$ 54,098	$ 38,202	$ 52,308	$ 37,792	$ 44,333	$ 32,768
Area C	$ 55,200	$ 36,800	$ 45,306	$ 31,994	$ 39,420	$ 28,480	$ 30,188	$ 22,313
Area D	$ 74,160	$ 49,440	$ 57,732	$ 40,768	$ 45,341	$ 32,759	$ 31,338	$ 23,163
Area E	$ 58,020	$ 38,680	$ 35,870	$ 25,330	$ 29,376	$ 21,224	$ 19,033	$ 14,068
Area F	$ 118,740	$ 79,160	$ 83,345	$ 58,855	$ 66,822	$ 48,278	$ 32,718	$ 24,183
Area G	$ 30,000	$ 20,000	$ 28,895	$ 20,405	$ 25,835	$ 18,665	$ 19,320	$ 14,280
Total	$ 538,260	$ 358,840	$ 427,158	$ 301,642	$ 366,040	$ 264,460	$ 235,348	$ 173,953

Finally, estimated annual cost for external connectivity to upstream Internet services is:

Annual External Services Costs				
Buffer Distance	10 Km	5 Km	3 Km	1 Km
Area A	$ 1,025,220	$ 873,600	$ 773,640	$ 426,720
Area B	$ 389,760	$ 387,660	$ 378,420	$ 323,820
Area C	$ 386,400	$ 324,660	$ 285,180	$ 220,500
Area D	$ 519,120	$ 413,700	$ 328,020	$ 228,900
Area E	$ 406,140	$ 257,040	$ 212,520	$ 139,020
Area F	$ 831,180	$ 597,240	$ 483,420	$ 238,980
Area G	$ 210,000	$ 207,060	$ 186,900	$ 141,120
Total	$ 3,767,820	$ 3,060,960	$ 2,648,100	$ 1,719,060

Considerations: While this is the final layer of the SDP, it is not necessarily the easiest to achieve. Some of the main considerations are:

- Locating and securing appropriate resources that have the necessary experience to provide the business and technical requirements.
- Practical considerations of how the RDBN would provide cost effective coverage for onsite support of such a large region.
- Development of the processes and procedures requires a substantial amount of time and effort. These processes require overall guidance from resources that are familiar with the operation of a network.
- Though a partnership with a suitable company can expedite the delivery of the operational aspects, the RDBN will still require a small number of resources with some practical knowledge to effectively manage the operational entity.

Actions: In order to complete this layer of the SDP, the RDBN will need to assume responsibility for the following:

Capital Activities	Ongoing Operational Activities
Establish the hardware and software components required to operate, monitor and maintain the network. Establish the software components required to operate the business aspect of the network (eg. invoicing). Establish the resources (technical and business) required to operate the network.	Monitor and maintain the network. Respond the moves, adds, changes related to the operation of the backbone network. Address concerns and issues for the providers using backbone for network transport. Network electronics and software components typically have an annual maintenance fee associated which providers for product upgrades, technical support and warranty. This is usually an annual expense in the order of 15 – 20% of the list cost. Ongoing annual cost of labour for resources operating the network.

Alternatives: The main alternative to be considered as part of this layer is to contract an appropriate management company that can operate the network on behalf of the RDBN.

Technical Description: While all the previous layers discussed up to this point provide the connectivity required to deliver a service to the subscriber, it is very difficult to operate a network without the resource and systems required to assist in the operational and business processes.

The OSS/BSS layer must include, but is not necessarily limited to:

Resources:

- The personnel required to:
    - support and provision network services.
    - provide maintenance activities on the network electronics and other infrastructure.
    - manage subscriber requests for adding, removing and changing existing services.
    - Provide the expertise required to enhance services on the network.

- The support system, which includes the personnel, required to effectively support subscribers of the network such as technical support and customer service support.

- The processes and procedures related to the operation of the business.

- The equipment and tools required to complete onsite activities such as vehicles, tools, fibre splicing and testing equipment, network testing equipment, etc.

Business Systems:

- Customer database containing customer information.
- Billing systems to issue invoices and accept payments.
- Documentation storage.
- Reporting systems to gather, consolidate and report on customer usage that may be used for customer billing.
- Scheduling systems to book and schedule customer site visits and technician tracking that may be required.
- Remote access systems used to provide key support and business technicians access to the systems 7x24x365.

Operational Systems:

- Monitoring systems to monitor the network, locate problems, send alerts to support technicians, gather statistics, report on trends, etc.
- Trouble reporting systems to gather and maintain information on problems reported by customers for timely resolution.
- Provisioning systems to add, change and remove services to customers.
- Logging systems to log network and customer events.
- Documentation storage.
- Manufacturer specific software required to operate and maintain network equipment.
- Backup and restore systems to maintain configuration backups and restore when required.
- Network maintenance software.

- Network operation systems that are required to make Internet services function. Eg. Domain Name Service (DNS)
- Network authentication and registration systems such as RADIUS and DHCP that are required to activate subscribers on the network.

The personnel required to operate the network need the following skill sets:

- Overall management resources that are familiar with the operation of a network and can provide the overall guidance for the network operations.
- Technical resources that can effectively design, commission and support the electronic components of the network.
- Technical resources that can effectively design, commission and support the infrastructure components of the network such as POPs, power systems, environmental systems, outside plant, fibre, etc.
- Installation and maintenance skills that can provide the onsite support for the infrastructure, electronic components and subscribers.
- Customer service resources that can provide effective assistance to subscribers of the network.
- Sales resources that can manage new opportunities.

The hardware and software systems are typically located in one or more datacenters (or POPs) on the network. The intent is to have a location suitable for the equipment required to run the software applications required to effectively operate the network. As these systems will contain sensitive operational and subscriber information, they would typically be implemented in a manner that provides security from external sources such as the Internet. These systems contain the infrastructure that provide the daily operational functions for the network.

Along with appropriate resources and software applications the OSS/BSS systems include all the processes and procedures and physical equipment required to perform these functions. An example of a process would include the step by step procedure to install and activate a new subscriber on the network as a number of components need to be considered including the physical installation of the fibre drop, the equipment at the subscriber premises, connection of the subscriber in the POP, the activation of the service on the network, etc. Each of these functions needs to be completed in order for the service to be ready for the subscriber.

The following diagram depicts the OSS/BSS layer of the SDP.

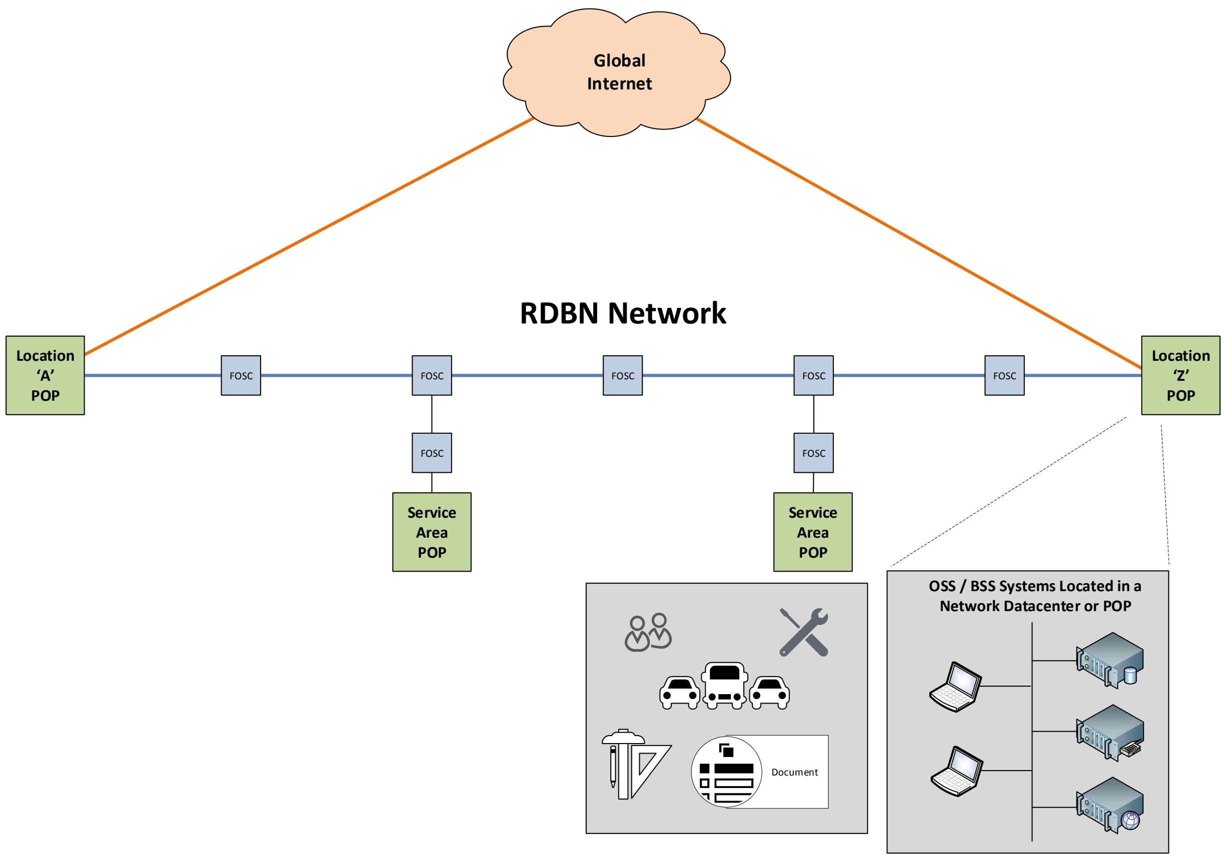


Figure 14 – OSS / BSS Architecture

4.3 Service Delivery Cost Summary

Throughout this Section, a description of each layer of the pyramid and the estimated costs have been provided. The costs outlined are an approximation based on estimated unit costs for various aspects of the network gained from past industry knowledge. They are an approximation only to provide an order of magnitude. To obtain more accurate cost estimates, a detailed design phase would need to be completed understanding the specific service delivery areas and assumption inputs.

A summary of the estimates for the complete construction of the RDBN area are as follows:

Pyramid Section	Description	Costs Inputs	Max/Min %
1 - Customers	N/A		
2 - OSS/BSS Systems	10Km Max/Min %		20%
	1Km Max/Min %		15%
	Hardware/Software Cost	$ 200,000	
	Administration Costs ($ Per Household)	$ 50	
	External Services Costs ($ Per Hs Per Mb	$ 35	
3 - Local Access Electronics	$ Per House at 10Km	$ 1,500	25%
	$ Per House at 1Km	$ 800	15%
	Opex %	12%	
4 - Local Access Infrastructure	$ Per House at 10Km	$ 15,000	25%
	$ Per House at 1Km	$ 2,700	15%
	Opex %	2%	
5 - BB Transport Electronics	Major Pop Site	$ 150,000	20%
	Minor Pop Site	$ 100,000	20%
	Fibre Distribution Hub	$ -	15%
	Termination Site	$ -	15%
6 - Point-of-Presence Infrastructure	Major Pop Site	$ 175,000	20%
	Minor Pop Site	$ 75,000	20%
	Fibre Distribution Hub	$ 20,000	20%
	Termination Site	$ 5,000	20%
7 - Network Backbone Infrastructure	$ Per Km	$ 60,000	20%

Electoral Area	Pyramid Section	Max Total Cost For 10Km Build	Min Total Cost For 10Km Build	Max Total Cost For 5Km Build	Min Total Cost For 5Km Build	Max Total Cost For 3Km Build	Min Total Cost For 3Km Build	Max Total Cost For 1Km Build	Min Total Cost For 1Km Build
Area - A Capex	All	$ 26,577,961	$ 17,787,879	$ 19,133,943	$ 13,324,217	$ 16,462,665	$ 11,523,795	$ 10,158,253	$ 7,072,639
Area - A Opex	All	$ 1,566,148	$ 1,393,472	$ 1,291,832	$ 1,171,413	$ 1,130,136	$ 1,031,087	$ 605,193	$ 558,635
Area - B Capex	All	$ 11,742,686	$ 8,087,492	$ 11,644,425	$ 8,030,033	$ 11,400,908	$ 7,866,453	$ 10,420,520	$ 7,175,028
Area - B Opex	All	$ 562,607	$ 512,341	$ 557,566	$ 510,507	$ 542,213	$ 497,942	$ 459,256	$ 423,925
Area - C Capex	All	$ 8,977,858	$ 5,990,763	$ 5,946,237	$ 4,172,789	$ 4,890,968	$ 3,461,509	$ 3,722,067	$ 2,636,641
Area - C Opex	All	$ 586,215	$ 522,538	$ 474,616	$ 432,012	$ 410,780	$ 376,563	$ 312,723	$ 288,665
Area - D Capex	All	$ 16,238,222	$ 10,728,089	$ 11,059,967	$ 7,622,295	$ 8,766,579	$ 6,075,969	$ 6,970,250	$ 4,808,011
Area - D Opex	All	$ 803,004	$ 710,265	$ 612,915	$ 555,229	$ 474,761	$ 434,506	$ 324,636	$ 299,661
Area - E Capex	All	$ 17,899,567	$ 11,603,349	$ 10,571,509	$ 7,206,880	$ 9,380,314	$ 6,403,787	$ 8,046,875	$ 5,462,473
Area - E Opex	All	$ 648,052	$ 565,060	$ 380,287	$ 344,700	$ 308,445	$ 282,028	$ 197,164	$ 181,996
Area - F Capex	All	$ 29,360,298	$ 19,172,342	$ 17,864,973	$ 12,276,473	$ 14,818,895	$ 10,222,727	$ 10,373,959	$ 7,084,248
Area - F Opex	All	$ 1,313,085	$ 1,151,243	$ 892,316	$ 806,138	$ 708,725	$ 645,829	$ 338,932	$ 312,858
Area - G Capex	All	$ 10,377,684	$ 7,043,810	$ 10,235,792	$ 6,959,466	$ 9,697,389	$ 6,596,642	$ 8,869,361	$ 6,012,276
Area - G Opex	All	$ 308,127	$ 278,916	$ 302,179	$ 275,239	$ 269,527	$ 246,979	$ 200,143	$ 184,745
RDBN Capex (Total)	All	$ 121,174,277	$ 80,413,723	$ 86,456,846	$ 59,592,154	$ 75,417,718	$ 52,150,882	$ 58,561,285	$ 40,251,315
RDBN	1 - Customers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RDBN	2 - OSS/BSS Systems	$ 240,000	$ 160,000	$ 234,444	$ 165,556	$ 232,222	$ 167,778	$ 230,000	$ 170,000
RDBN	3 - Local Access Electronics	$ 10,923,107	$ 7,457,893	$ 7,767,482	$ 5,564,518	$ 6,358,516	$ 4,614,284	$ 3,765,560	$ 2,783,240
RDBN	4 - Local Access Infrastructure	$ 68,154,209	$ 44,891,191	$ 36,597,959	$ 25,957,441	$ 26,970,021	$ 19,464,179	$ 12,708,765	$ 9,393,435
RDBN	5 - BB Transport Electronics	$ 1,680,000	$ 1,120,000	$ 1,680,000	$ 1,120,000	$ 1,680,000	$ 1,120,000	$ 1,680,000	$ 1,120,000
RDBN	6 - Point-of-Presence Infrastructure	$ 1,932,000	$ 1,288,000	$ 1,932,000	$ 1,288,000	$ 1,932,000	$ 1,288,000	$ 1,932,000	$ 1,288,000
RDBN	7 - Network Backbone Infrastructure	$ 38,244,960	$ 25,496,640	$ 38,244,960	$ 25,496,640	$ 38,244,960	$ 25,496,640	$ 38,244,960	$ 25,496,640
RDBN Opex (Total)	All	$ 5,787,238	$ 5,133,835	$ 3,579,613	$ 4,359,594	$ 3,844,587	$ 3,514,934	$ 2,438,047	$ 2,250,485
RDBN	1 - Customers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RDBN	2 - OSS/BSS Systems	$ 538,260	$ 358,840	$ 427,158	$ 301,642	$ 366,040	$ 264,460	$ 235,348	$ 173,953
RDBN	2 - External Services	$ 3,767,820	$ 3,767,820	$ 3,060,960	$ 3,060,960	$ 2,648,100	$ 2,648,100	$ 1,719,060	$ 1,719,060
RDBN	3 - Local Access Electronics	$ 1,310,773	$ 894,947		$ 932,098	$ 763,022	$ 553,714	$ 451,867	$ 333,989
RDBN	4 - Local Access Infrastructure	$ 170,386	$ 112,228	$ 91,495	$ 64,894	$ 67,425	$ 48,660	$ 31,772	$ 23,484

5 RDBN Broadband Strategy

The following provides a potential strategy. This is not a final strategy and it requires more discussion with the RDBN, and other potential stakeholders in order to further refine strategy, priorities and opportunities that minimize the capital investment while maximizing the value to the residents of the RDBN.

> **To summarize the basic strategy:** the RDBN should focus on defining local access projects that utilize and leverage infrastructure that exists or may be planned for in the area.

To provide more detail on this strategy, consider the following technical suggestions in a logical order to leverage existing infrastructure. It is fully expected that the RDBN will likely have business or other working considerations that need to be validated before the technical aspects can be completed:

1. Obtain further understanding of existing or planned infrastructure and how the RDBN may be involved in leveraging it to improve services.

2. Providing that suitable infrastructure is available, the RDBN should not pursue the construction of backbone infrastructure.

3. Secure a suitable service offering and competitive cost model to ensure all providers in the area have access to cost effective transport from the RDBN to areas outside the RDBN such as the Prince George fibre exchange and the Vancouver Internet Exchange.

4. As soon as possible, publish project scope of work and construction plans so other providers can position projects that align with the current projects.

5. Identify areas that can RDBN could easily add on to existing or planned infrastructure. Identify the gaps to identify easy and cost-effective additions that can be funded by the RDBN

6. Solicit existing providers or stakeholders to collaborate on infrastructure builds that align with the RDBN goals to bring improved services to unserved or poorly served areas. The intent is to find opportunities for the RDBN to augment or remove barriers to existing projects that other providers may have. This could be by:
   - Allowing access to RDBN infrastructure.
   - Participating in co-builds where the RDBN shares in the capital cost to construct the project.
   - Securing access to the backhaul capacity for a cost-effective rate.

7. Once the easy wins have been identified, identify priority areas to extend service. As part of a project like this, RDBN may need to address business issues around how it expends public funds to construct the infrastructure that one or more third party providers may use to offer services. This is discussed later in this document.

8. Once the priority areas and costs are identified, the RDBN will need to identify and establish definable projects with a defined service area that can maximize the ratio of subscribers served to capital and operating costs. During this process, the RDBN will have to determine what projects are feasible and in what order of priority. Completion of a project table such as the following will essentially need to be completed in order for the RDBN to make those decisions. Each of the service area defined as projects will need to be identified and a cost estimate will need to be completed for each. The following provides an example of the analysis that should be completed for the RDBN to make decisions on priority and to align with potential funding opportunities.

Project Name (Service Areas not Covered by 50/10)	Capital Cost Estimate	Operating Cost Estimate	Subscribers Served	RDBN Priority
Perow / Houston Rural	tbd	tbd		
Topley Landing / Granisle	tbd	tbd		
Palling (NW of Wet'suwet'en Village)	tbd	tbd		
Wet'suwet'en Village / Burns Lake	tbd	tbd		
Burns Lake / Francois Lake	tbd	tbd		
NW Francois Lake	tbd	tbd		
Southbank & Francois Lake Crossing	tbd	tbd		
Southbank / Takysie Lake	tbd	tbd		

Takysie Lake / Ootsa Lake	tbd	tbd		
Burns Lake / Tintagel	tbd	tbd		
North Frasier Lake	tbd	tbd		
Glenannan	tbd	tbd		
Fort Fraser / Vanderhoof	tbd	tbd		
Rural Vanderhoof	tbd	tbd		
Houston / Telkwa	tbd	tbd		
South Houston Rural (Buck Flats)	tbd	tbd		
Smithers Rural	tbd	tbd		
North Smithers	tbd	tbd		
Fort St. James Rural	tbd	tbd		

9. Solidify the business arrangement for the RDBN to construct these projects with public funds to benefit as many subscribers as possible while avoiding the exclusion of existing providers from benefiting in the RDBN projects and displacing existing providers.

10. Target funding submissions to the defined projects so each has a clearly defined scope, number of subscribers and cost to complete.

5.1 External Connectivity and Obtaining Access to an IX

In order for any provider to offer services in the RDBN, they require access external connectivity from their network to the Internet. As discussed with the Regional District of Fraser – Fort George, a fibre exchange is available in Prince George. As part of establishing the network backbone, the RDBN should ensure cost effective external connectivity from the RDBN to either to the Prince George exchange (if it makes sense), the Vancouver Internet exchange (VANIX) or both.

Direct connection to an Internet exchange is an advantage because it allows a provider to obtain high capacity, low latency connectivity to Internet services where many other providers exist. An Internet exchange is a point where networks can interconnect to each other allowing traffic to flow in the most efficient and direct manner as possible for typically lower rates then getting access directly in the community through a third-party provider. Once connected to an exchange, the provider may peer with other networks to offload expensive Internet capacity to much lower cost connections to other networks.

Internet exchange listings are available at: https://www.peeringdb.com/

5.2 Alternatives to Fibre

Given the RDBN's stated goal of meeting the CTRC target of 50/10Mbps to every home with 10km of the major highways and while fibre is the most scalable and highest capacity, the cost is significant and may not be realistic. That said, over the long term and appreciating the requirements for reliable and the ever-increasing capacity, fibre may still be the most cost effective when considering the lifetime of the infrastructure and the need to continually upgrade the technology for other alternatives.

Given our strategy, the next logical alternative to fibre is using wireless technology where the construction of FTTP is financially prohibitive. As noted, wireless service is a good option but is subject to limitations not experienced by fibre. Given the cost of fibre, however, wireless may simply be the only option available in some areas and it may not provide service levels reliably at 50/10 consistent with the stated goal. The RDBN will have to consider utilization of a wireless alternative in areas that are simply cost prohibitive to construct using fibre. Part of the detailed analysis to be considered for each defined service area will be to analyze improvement options for existing wireless coverage (eg. perhaps access to cost effective backhaul is the issue, additional towers are required, etc) or how or if areas that currently have no coverage can be served with wireless.

The solution to this cannot be completed at this time without further analysis and detailed discussions with existing providers.

5.3 Example RDBN Project – NW Francois Lake

To provide a summary of how RDBN projects could be solutioned, consider the example of the NW shore of Francois Lake. To complete this project, assuming suitable capacity provided the following actions would be completed:

- Define the service area and scope of the project. In this example, consider a project that captures all subscribers along the north side of Francois Lake.
- Determine the architecture required to connect all subscribers to a FTTP network in the defined service area. In this case, the likely solution would be to run fibre along the north shore and place a POP somewhere roughly half-way along the shore. Connect the subscribers east and west back to that POP.
- Determine the capital and operational costs to construct the network and acquire suitable backhaul capacity.
- Determine the number of potential subscribers.
- Ascertain where this project fits in the priority of other defined projects.

Figure 15 – Francois Lake Project Example

6 Business and Operational Considerations

RDBN will need to define the business and operational aspects of completing and maintaining the defined projects. Items to be consider may include, but are not limited to:

- Feasibility: What is considered a feasible project? Perhaps it could be expressed as a ratio of capital and operational cost per subscriber. A decision will be made to decide what is an acceptable ratio of cost/subscriber to be consider a feasible project.

- Certainty, Control and Risk Mitigation: If the RDBN wishes to pursue these projects, how does it ensure they are successful and deliver the value expected. As the RDBN reduces its involvement in the end product, it also increases the risk that the project does not meet the intended goal. The decision that needs to be made is what level of involvement does the RDBN wish to have in the construction and operation of the network it defines as a project? To what degree is the RDBN accepting of reliance on third party service providers to provide service?

- Revenue Sharing Models: What is the business strategy that will be used to support the capital and operational costs? For example, does the RDBN set a fixed monthly fee per subscriber a portion of which flows to the provider and portion flows to the RDBN.

- Agreements: What agreements are required between the RDBN and other partners, providers and third parties? What form of collaboration should be implemented as between the RDBN, other Regional Districts, other local governments and First Nations?

- Funding Requirements: What are the funding sources available and what are the requirements to apply for them. You will see below in Section 7.1 below that certain funding is only available for infrastructure owned by the RDBN so that may drive the structure of the RDBN projects.

- Anchor Tenants: Who are the anchor tenants within the proposed project and can they be captured to help augment the priority and business case.

- Services and Pricing: What is the pricing model for the services the RDBN will provide.

- Management and Operations: Who is going to manage and operate the defined network projects on an ongoing basis?

- Partnerships & Availability: What partners are available to share in the capital and operating costs for each of the projects.

6.1 Funding Opportunities

The following are some of the funding programs which may be accessed for funding for projects of this nature:

- CIP Rural & Northern communities funding is now closed for 2019.

- CRTC funding – Closing the Broadband Gap – The CRTC has a Universal Service Objective for voice and broadband Internet access services of 50/10 for fixed networks and LTE services for mobile wireless networks. In connection with upgrading infrastructure to meet that objective, the Broadband Fund has been established to provide funding of $750 Million over five years. The first call for applications was announced June 3, 2019 with an October 3, 2019 deadline, however, it is only open to Yukon, NWT, Nunavut and communities with no terrestrial connection at this time. There will be second call in the fall and it is **critical** that RDBN spends the next few months positioning itself to have the necessary information available to be eligible. A review of the existing guide should be a priority item so that appropriate work is commissioned now to be ready to go when the call is made. For the June 3 call, the following information is available on the CRTC website. See:

  https://crtc.gc.ca/eng/internet/guid.htm
  https://crtc.gc.ca/eng/internet/formu.htm

It should be noted that RDBN can apply on its own for this funding or as a member of a joint venture, partnership, or consortium with other eligible entities – These might be other regional districts, first nations, municipal government and service providers. This is an important thing to note as it is a requirement under this funding that "**the applicant, or at least one member of a partnership, joint venture, or consortium must have at least three years of experience in deploying and operating broadband infrastructure, and must be eligible to operate as a Canadian carrier**." There are a number of detailed requirements including quality community consultation and a logical design diagram for the project that must be included with the application. This takes time and money to develop so as a priority item, RDBN will need to define the projects it wishes to prioritize, create the necessary relationships and budget appropriately to develop the necessary supporting documentation for its application under the CRTC funding. There is no hard limit on the amount of funding that an entity can apply for and it is expected that projects will be completed within 3 years of funding award.

- Connecting BC is a BC-wide program administered by NDIT on behalf of Network BC. The program has, as its objective, the acceleration of the delivery of internet connectivity at minimum target speeds of 50/10 to homes and businesses in rural BC. There are three streams of funding under this program:

    - Connectivity Infrastructure Strategy Fund -- funding available under to Regional Districts for 75% of costs up to a grant max of $15,000 per project in connection with creating a connectivity infrastructure strategy. Eligible project types and activities include:
        - Community engagement activities to guide the design and implementation of broadband projects;
        - Relationship building to foster connectivity expansion initiatives;
        - Assistance to support applications to federal connectivity programs;
        - Research and reports that inform and support the design, build and operations of networks including technical specs, landing stations, and the preparation of engineer-stamped business cases;
        - Interpretation of regulatory decisions and advice on implications for community connectivity plans;
        - Development of comprehensive business documents for telecom services such as business case, value assessments, stakeholder plans, accountability matrixes, acquisition plans, governance plans and transition plans;
        - Benchmarking studies and best practice reviews;
        - Development of change management strategies and governance structures;
        - Project management, coordination and development

      The strategy must be completed by March 31, 2020. As a regional district, the RDBN is an eligible applicant as are First Nations. Much of the information contained in this report will be relevant to the creation of that strategy. See: https://www.northerndevelopment.bc.ca/funding-programs/partner-programs/connecting-british-columbia/connecting-british-columbia-phase-two-community-infrastructure-strategy-funding/

- Transport Infrastructure funding – This funding is for 50% of eligible costs. Applications will be reviewed and assessed on a first come, first served basis unless funds are committed. An applicant can apply more than once but the projects must be completed by March 31, 2021. While this funding is available to a regional district, in order to be eligible, the RDBN must agree to **own, operate and maintain the resulting network for 3 years** after the solution has been implemented. This funding is also available to local, regional or national service providers. For program requirements see: https://www.northerndevelopment.bc.ca/funding-programs/partner-programs/connecting-british-columbia/connecting-british-columbia-phase-two-transport-infrastructure-funding/

- Last-Mile Infrastructure funding - This funding is for 50% of eligible costs to improve last mile connectivity in underserved rural areas in BC. Applications will be reviewed and assessed on a first come, first served basis unless funds are committed. Applicants may submit more than one application, but the project must be completed by March 1, 2021. While this funding is available to a regional district, in order to be eligible, the applicant must agree to **own, operate and maintain the resulting network for 3 years** after the solution has been implemented. This funding is also available to local, regional or national service providers. For program requirements see: https://www.northerndevelopment.bc.ca/funding-programs/partner-programs/connecting-british-columbia/connecting-british-columbia-phase-two-last-mile-infrastructure-funding/

- Gas Tax Fund – funding for investments in infrastructure projects
  - Community Works fund eligibility – This is a direct annual allocation to assist local government with local priorities. The funds may only be utilized by one of the entities set out in the "Ultimate Recipient" definition within the GTA; the funds must be applied towards the eligible expenditures of an eligible project as set out within an "Eligible Project Category", and the project must meet the definition of "Infrastructure", as defined in the Agreement. "Infrastructure" is defined in Annex A as: "municipal or regional, publicly or privately-owned tangible capital assets in British Columbia primarily for public use or benefit." For Bulkley Nechako, current estimates of those funds are roughly $850,000 to $900,000 per year and any unspent funds from prior years could be spent on broadband connectivity.

- BC Rural Dividend Program– Three streams of funding providing up to $25 million a year to assist rural communities, both Indigenous and non-Indigenous, with a population of 25,000 or less to strengthen and diversify their local economies. There may be potential to access this funding to support the broadband initiative. The current intake is open from June 15, 2019 to August 15, 2019.

7 Next Steps

The next steps we recommend to move the RDBN broadband strategy forward are:

- Define funding alternatives available and requirements to apply including budgeting for the costs of preparation of the materials necessary to apply.

- Articulate the appropriate role of RDBN in moving the strategy forward in cooperation with existing service providers in the funding environment of open access and with an eye to the requirements for various funding sources.

- Gather data to identify and empirically support the need for investment in the area to improve broadband connectivity. Obtain data to support the anecdotal evidence of poor service levels in the RDBN. See for example, CIRA:

  https://cira.ca/better-online-canada/cira-internet-performance-test

  CIRA allows RDBN to register its geographical area and obtain access to speed tests conducted in the Regional District which will be plotted in a database for it to more accurately determine the level of service availability. Engage with Network BC to specifically define resident priorities through broadband workshops in various communities and finalize a broadband strategy.

- Define specific projects along with design and costing that address resident priorities and fill existing gaps.

- Secure funding for the priority projects identified.

- Detailed design and implementation of plan including the necessary business agreements, rights of way and municipal agreements.

8 Summary

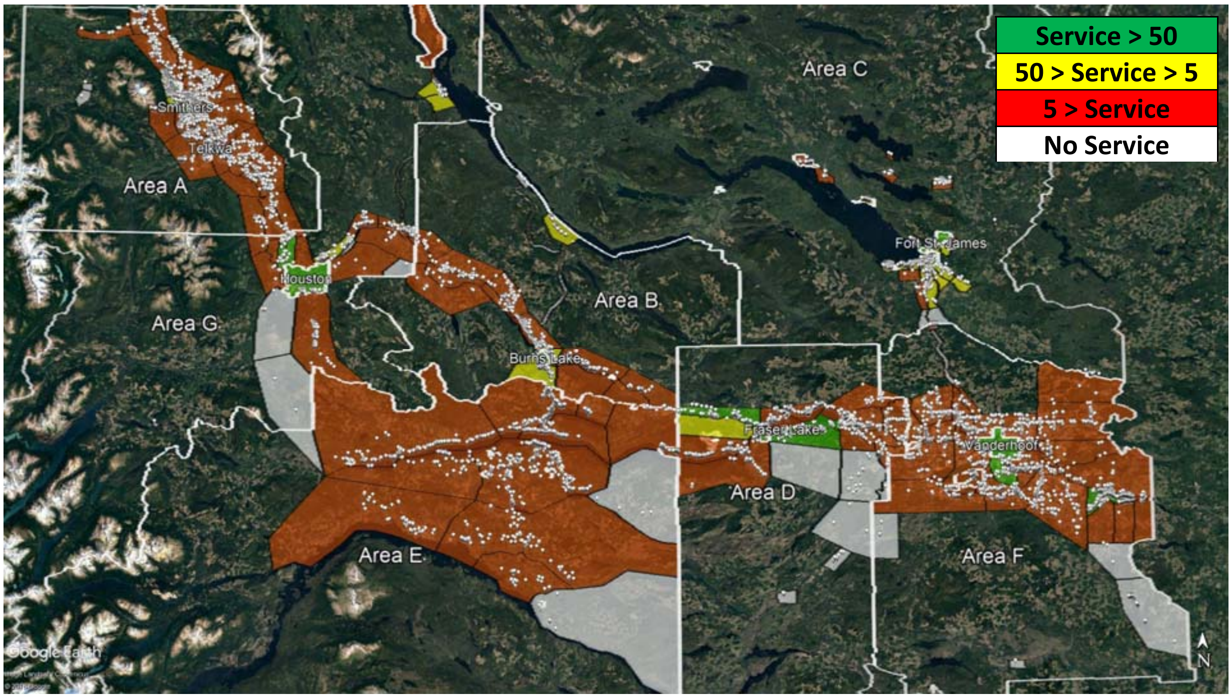
The RDBN is a large region with vast areas considered unserved or underserved at 50/10. While the major centers appear to have access to Internet services that are at or above 50/10, most rural areas have services that are well below that level.

The RDBN is faced with a challenging problem. Quite simply, the business case to provide services to many of the underserved regions is not viable for private companies. As such, the RDBN will have to make a dedicated effort to resource and understand the problem and define projects that meet specific goals in beginning to resolve the issue. Even with existing and future infrastructure, resolving this issue will not happen quickly given the length of time required to complete the necessary steps before construction can proceed.

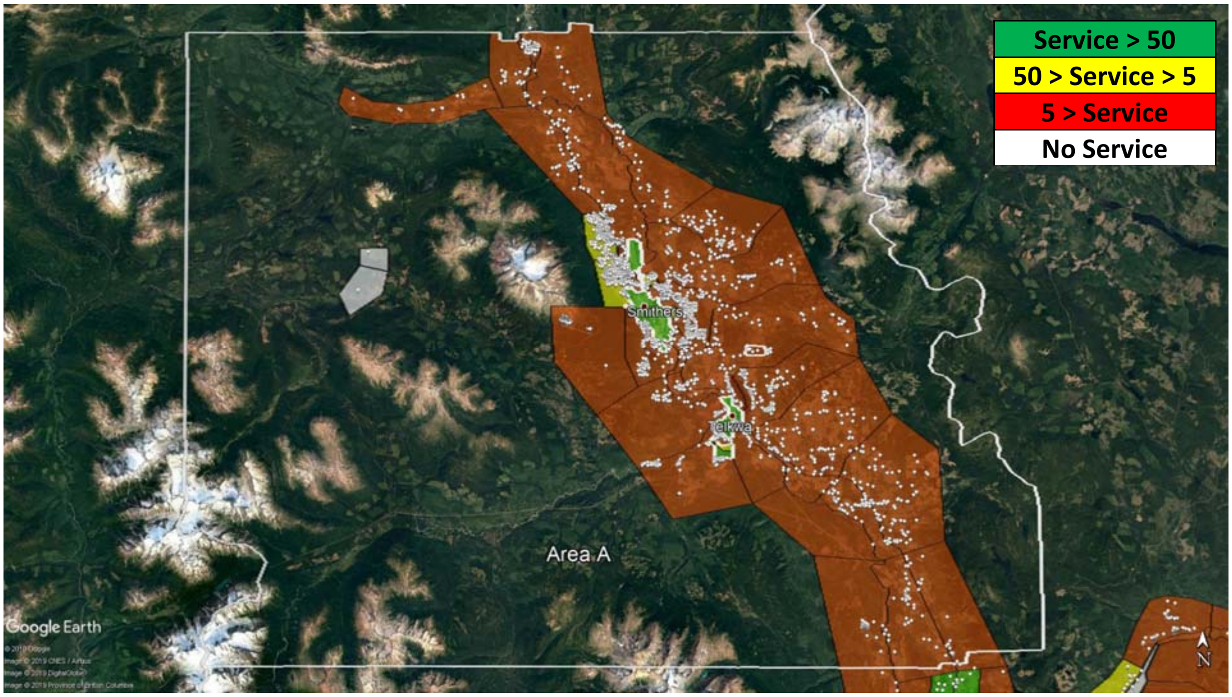
9 Appendices

9.1 Appendix A – Service Level Maps by Area

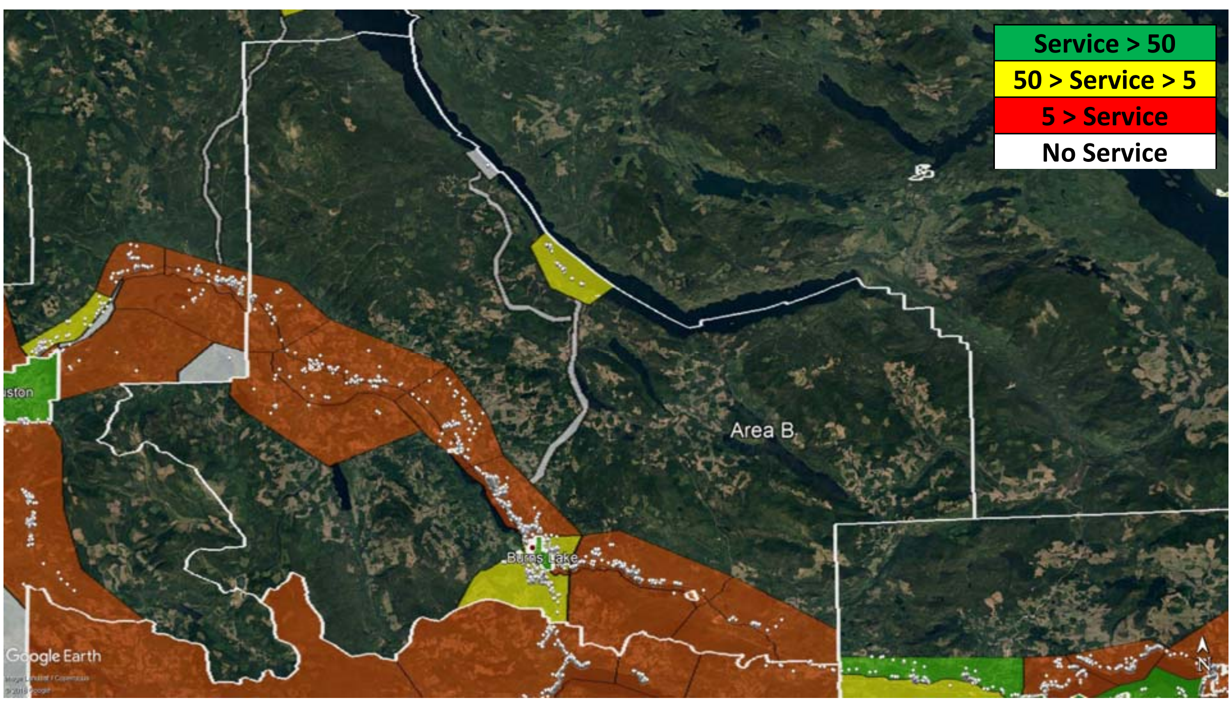
RDBN Service Level Overview Map



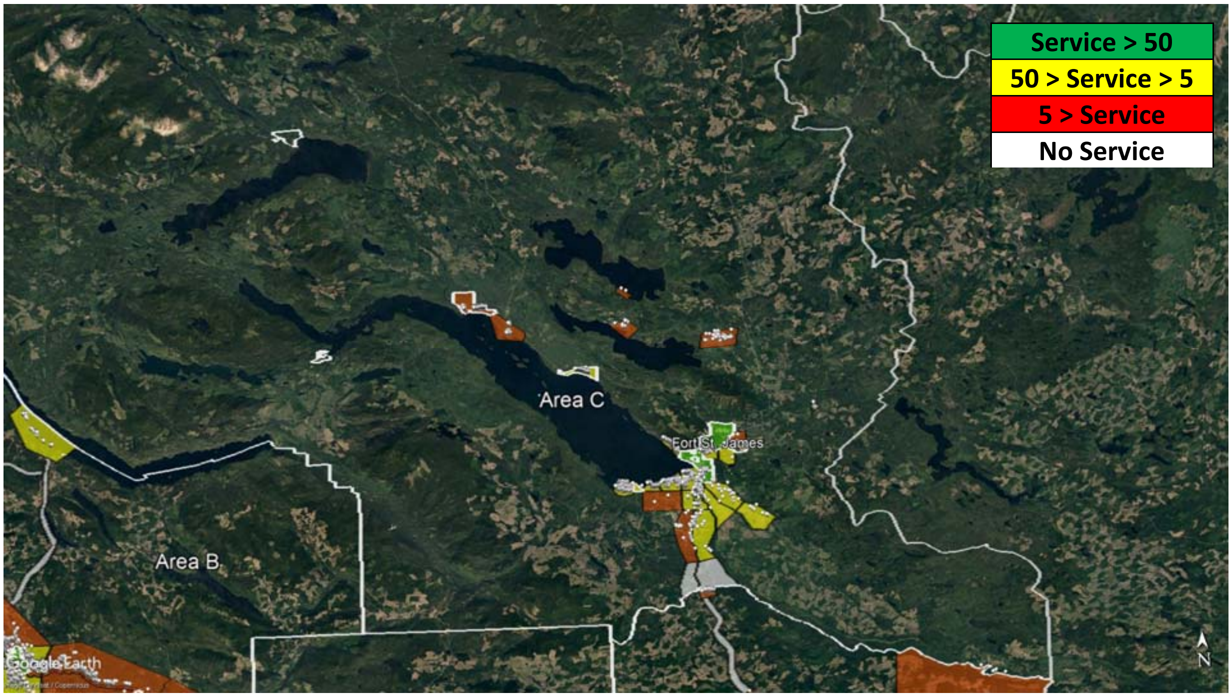
Area A - Service Level Map



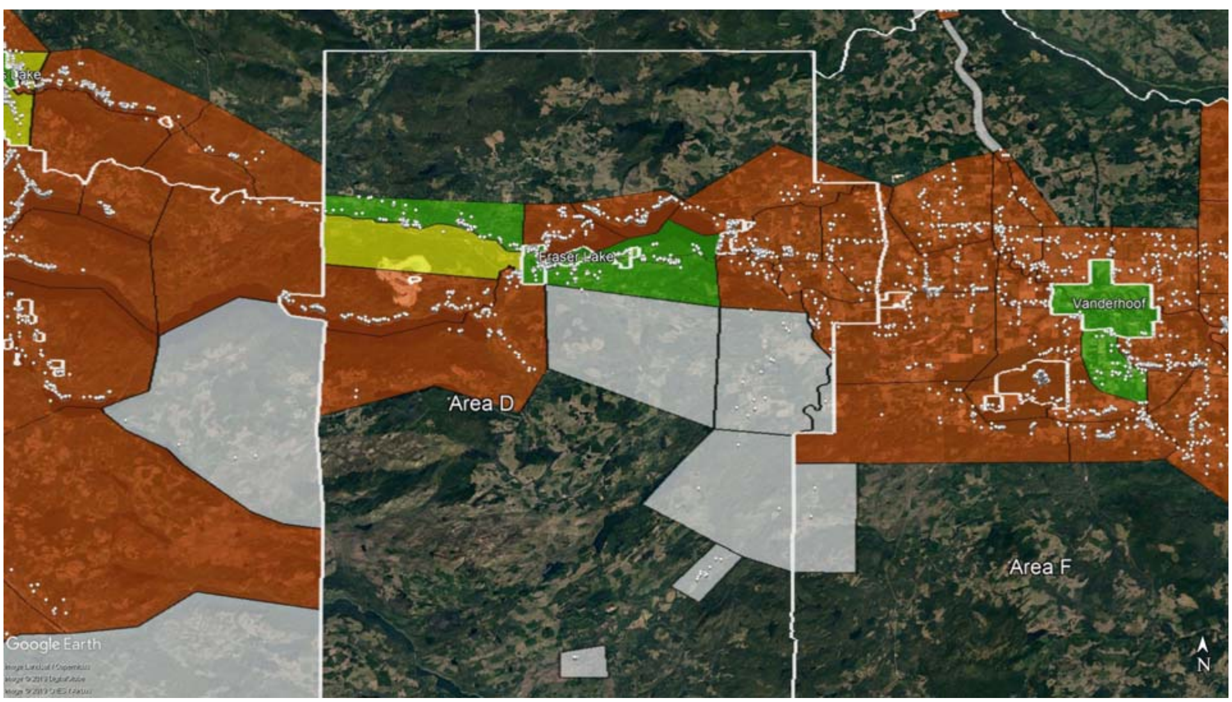
Area B - Service Level Map



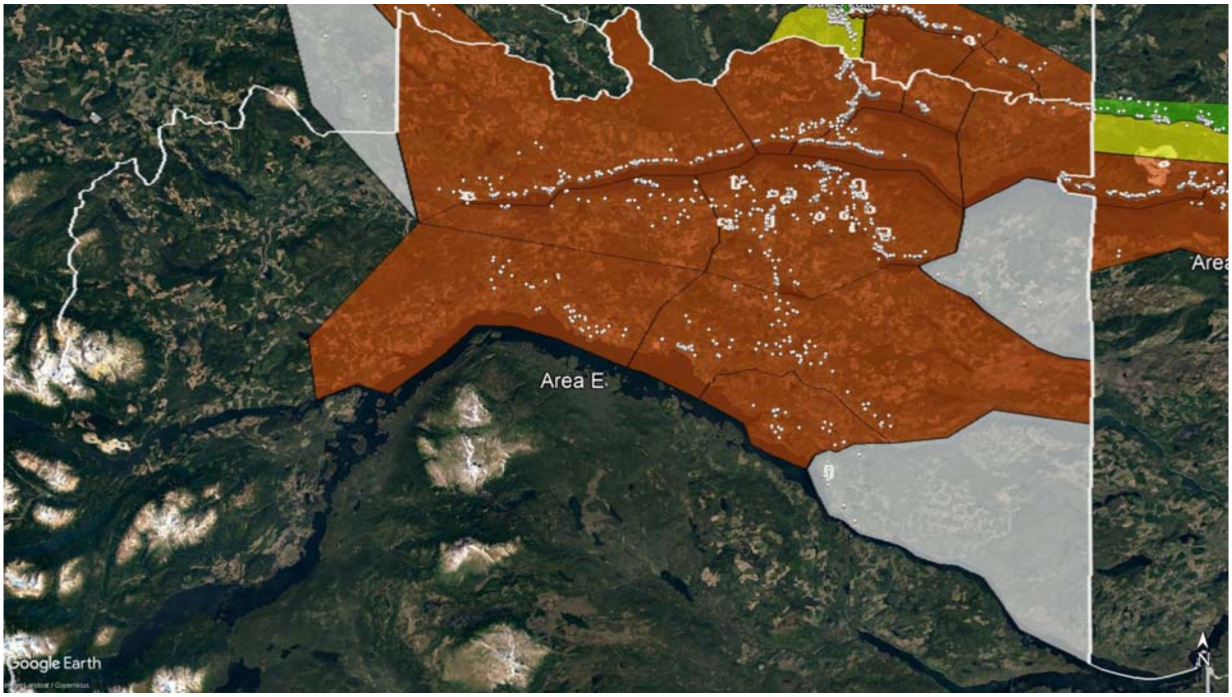
Area C - Service Level Map



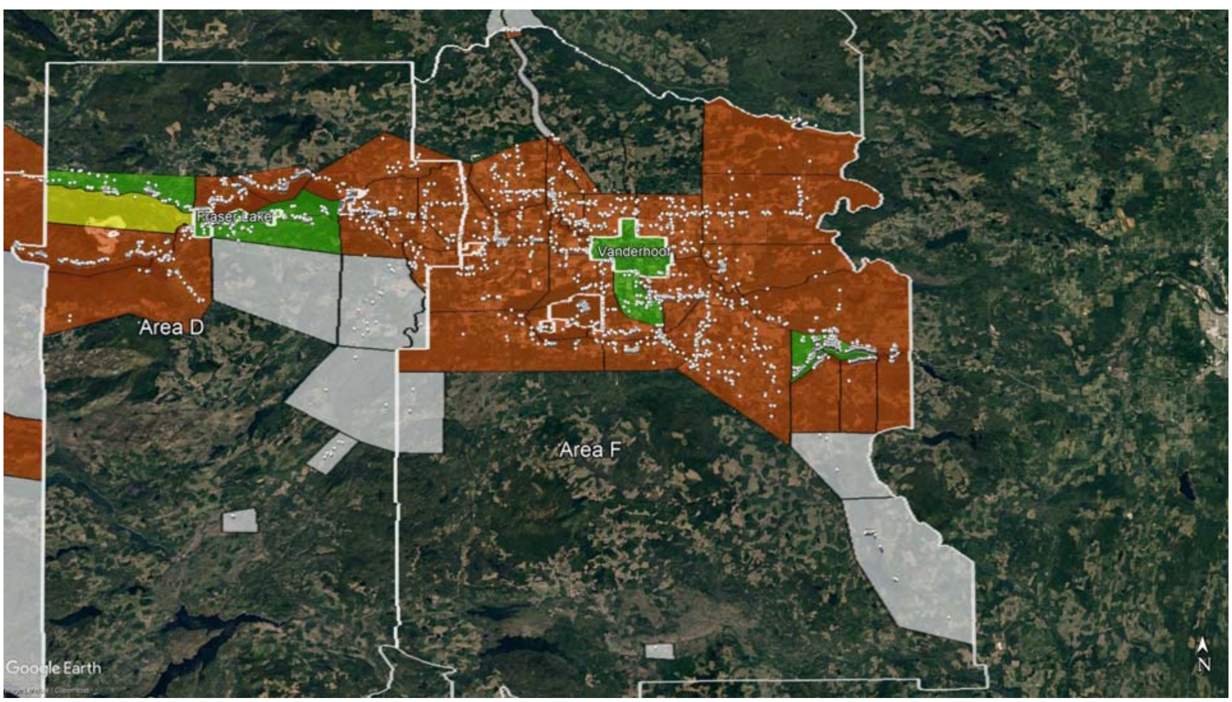
Area D - Service Level Map



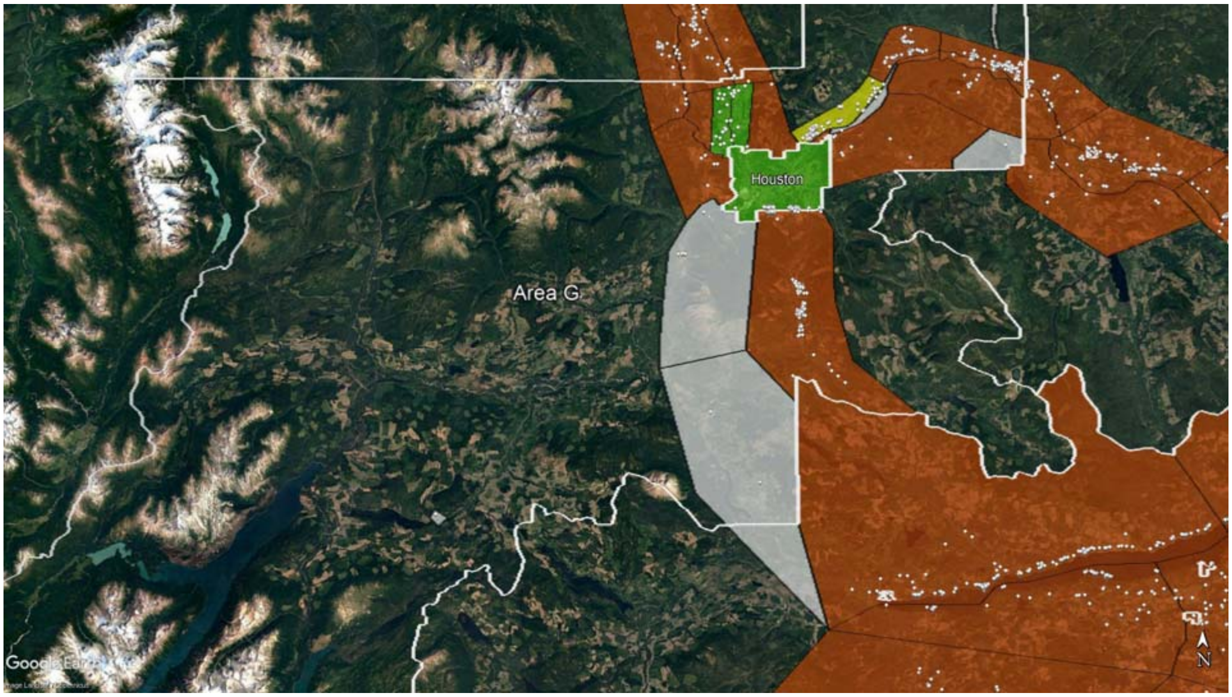
Area E - Service Level Map



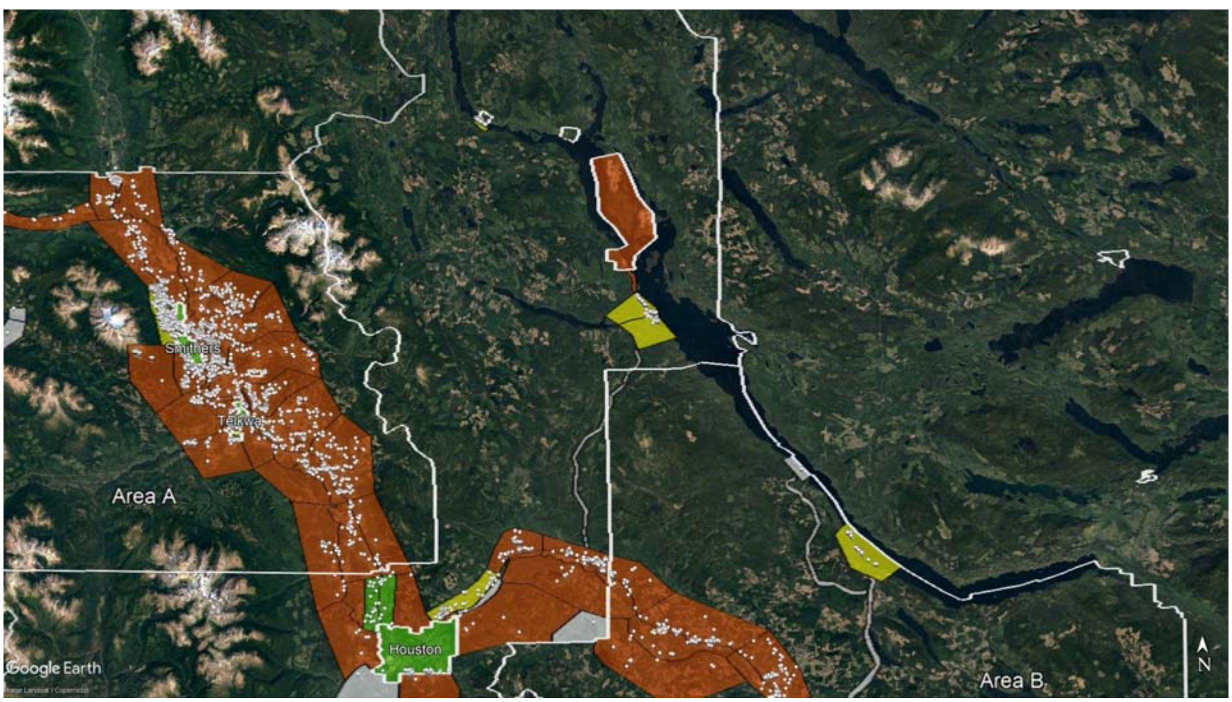
Area F - Service Level Map



<u>Area G Lower - Service Level Map</u>

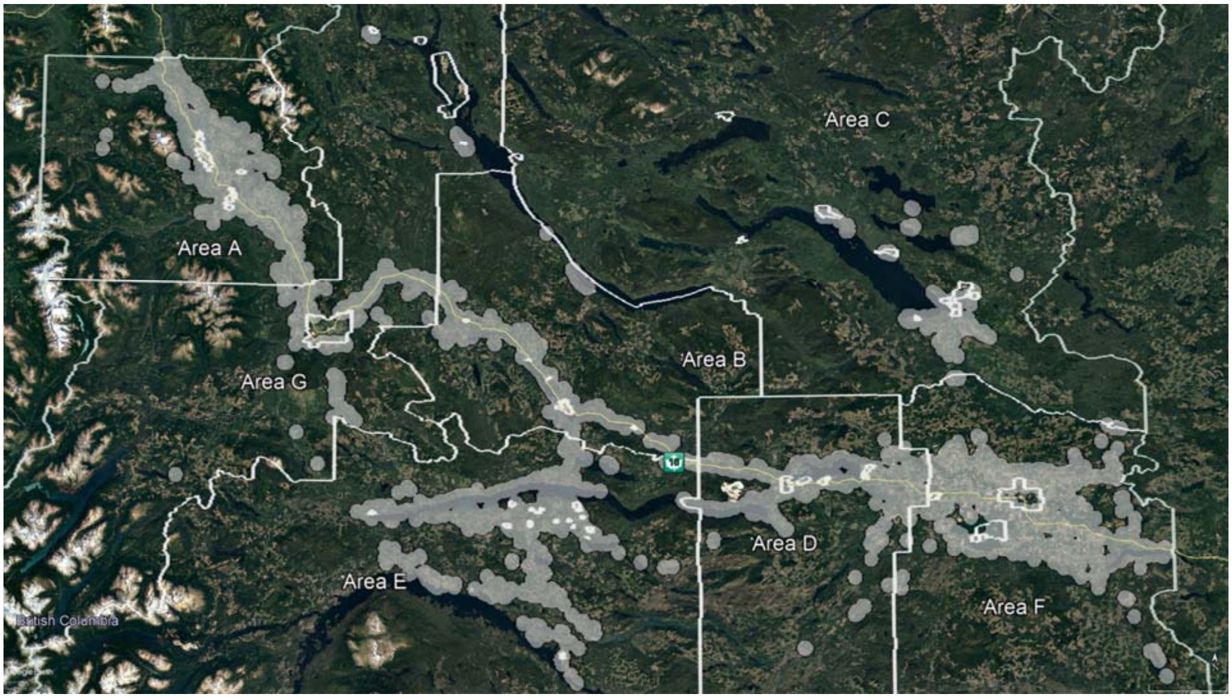


<u>Area G Upper - Service Level Map</u>

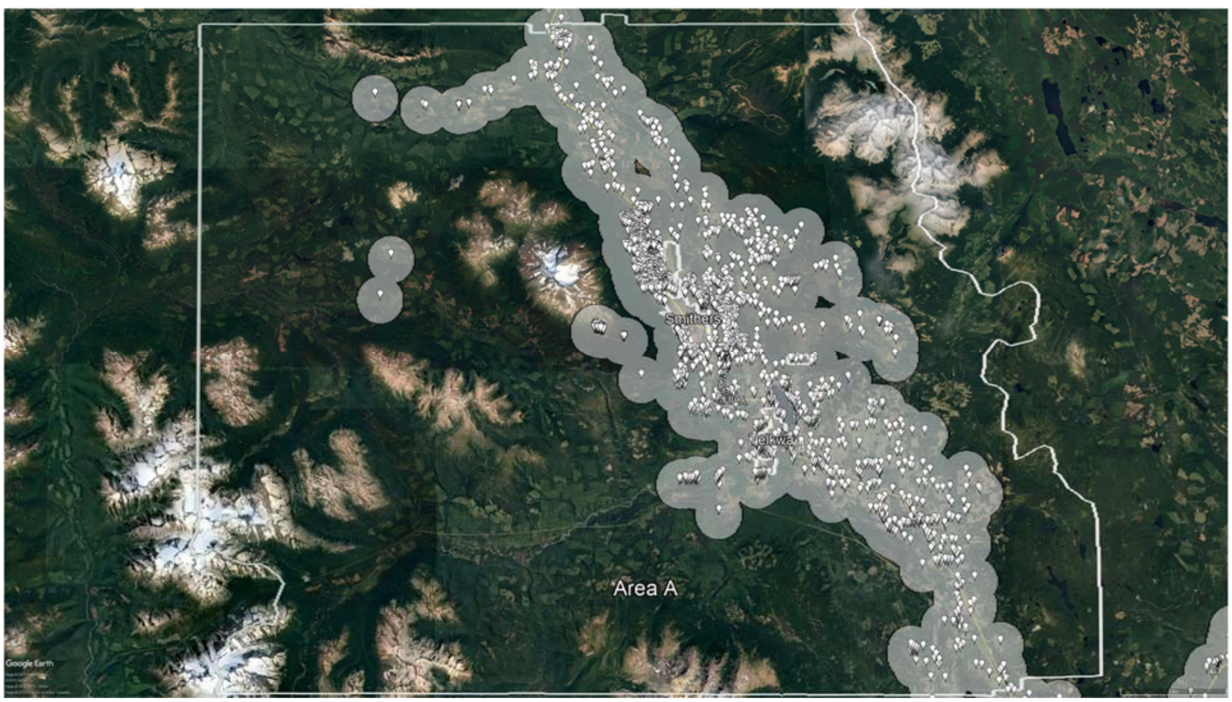


9.2 Appendix B – Dwelling Distribution

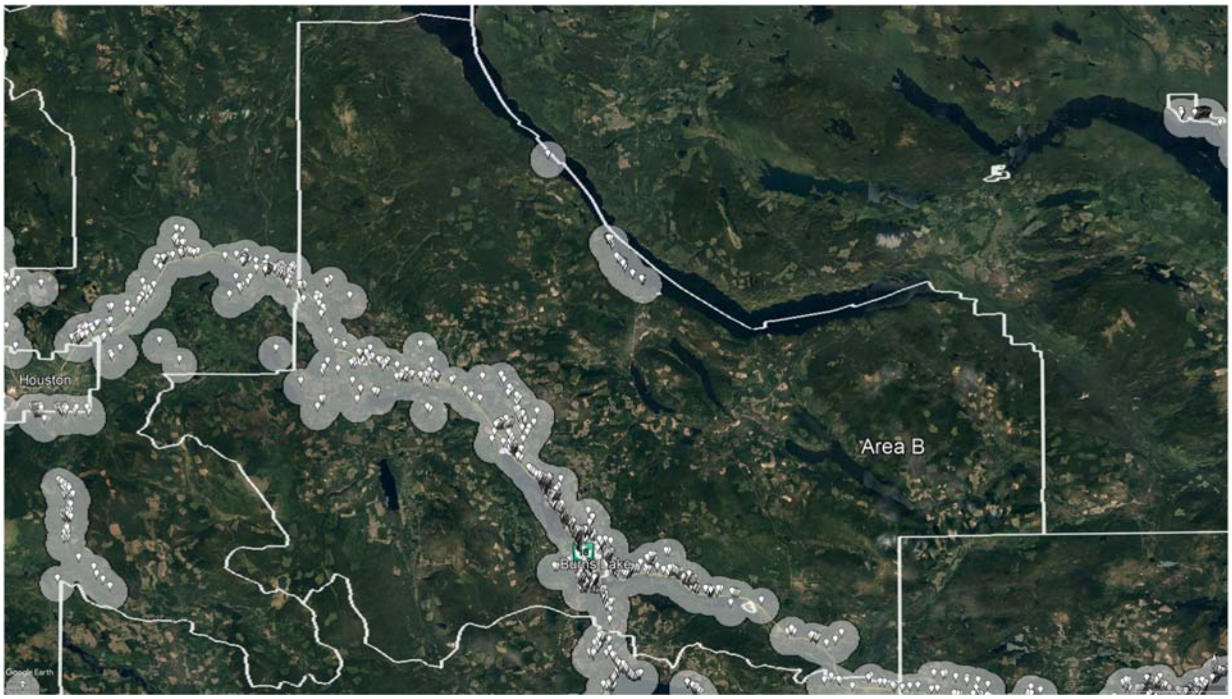
<u>RDBN Household Information – Overview</u>



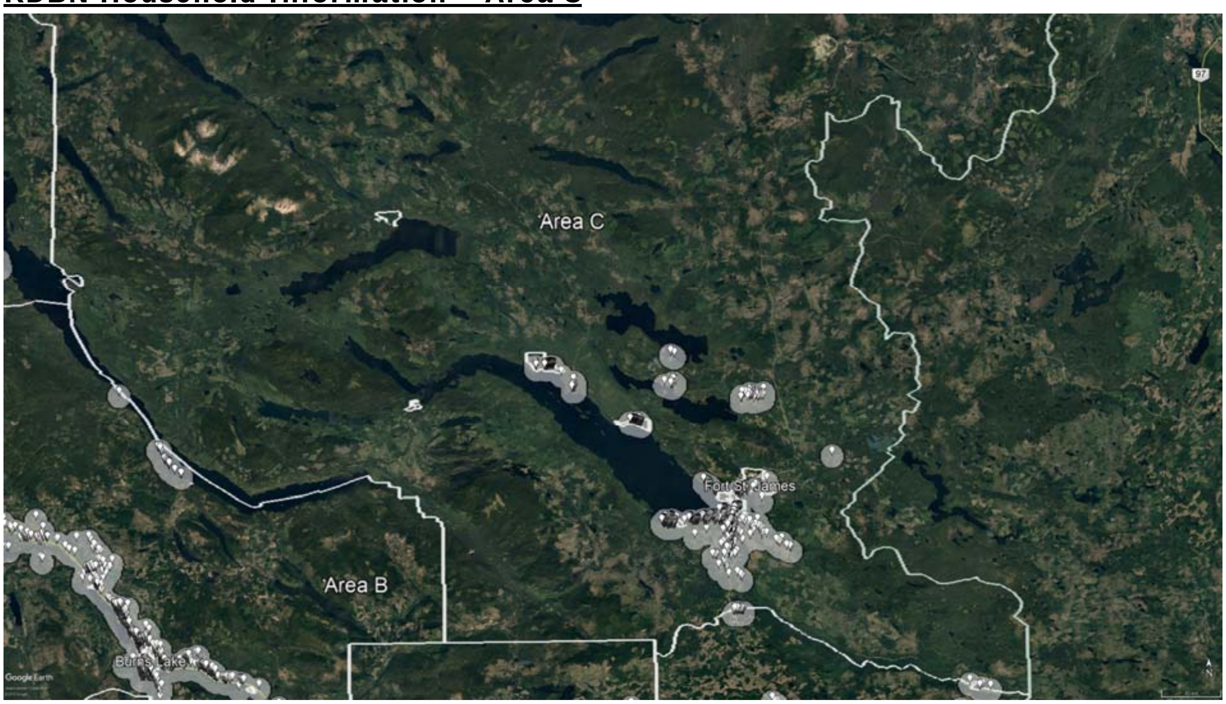
<u>RDBN Household Information – Area A</u>



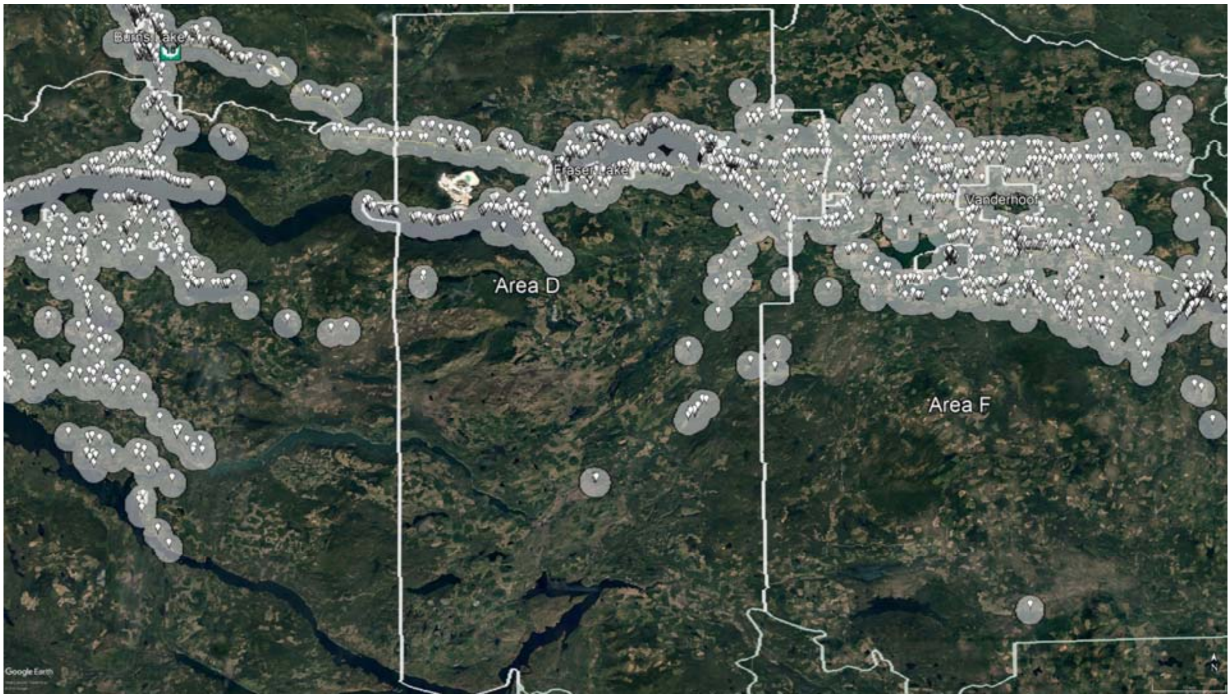
RDBN Household Information – Area B



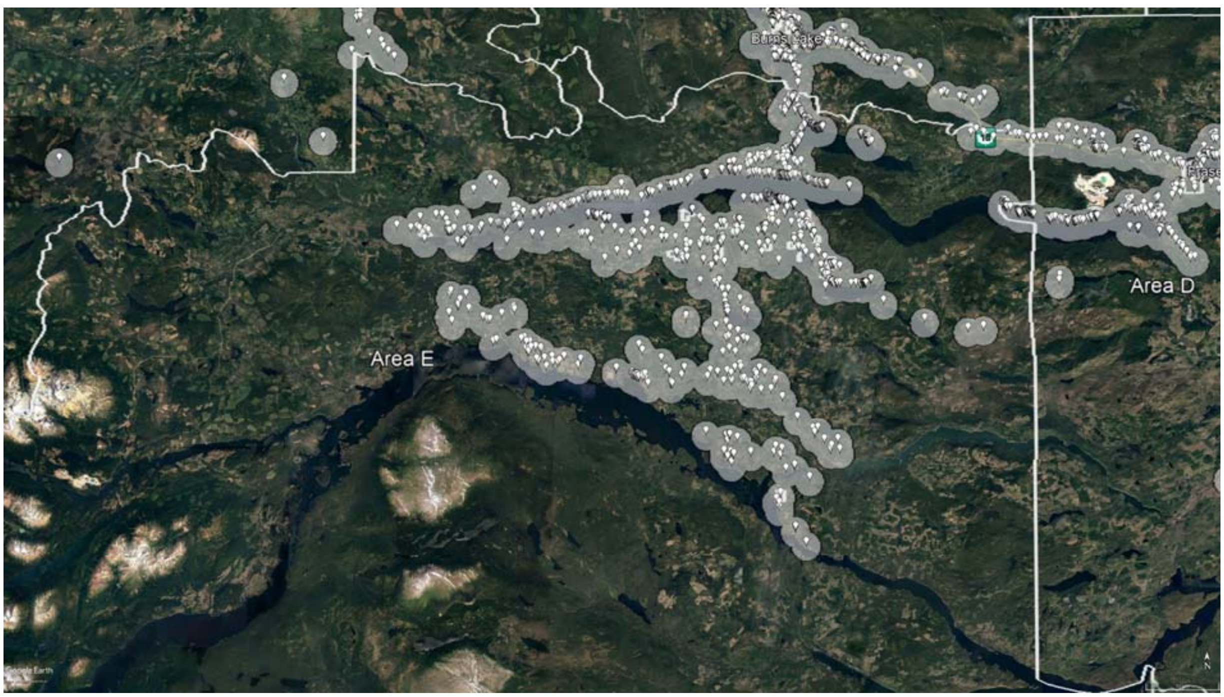
RDBN Household Information – Area C



<u>RDBN Household Information – Area D</u>

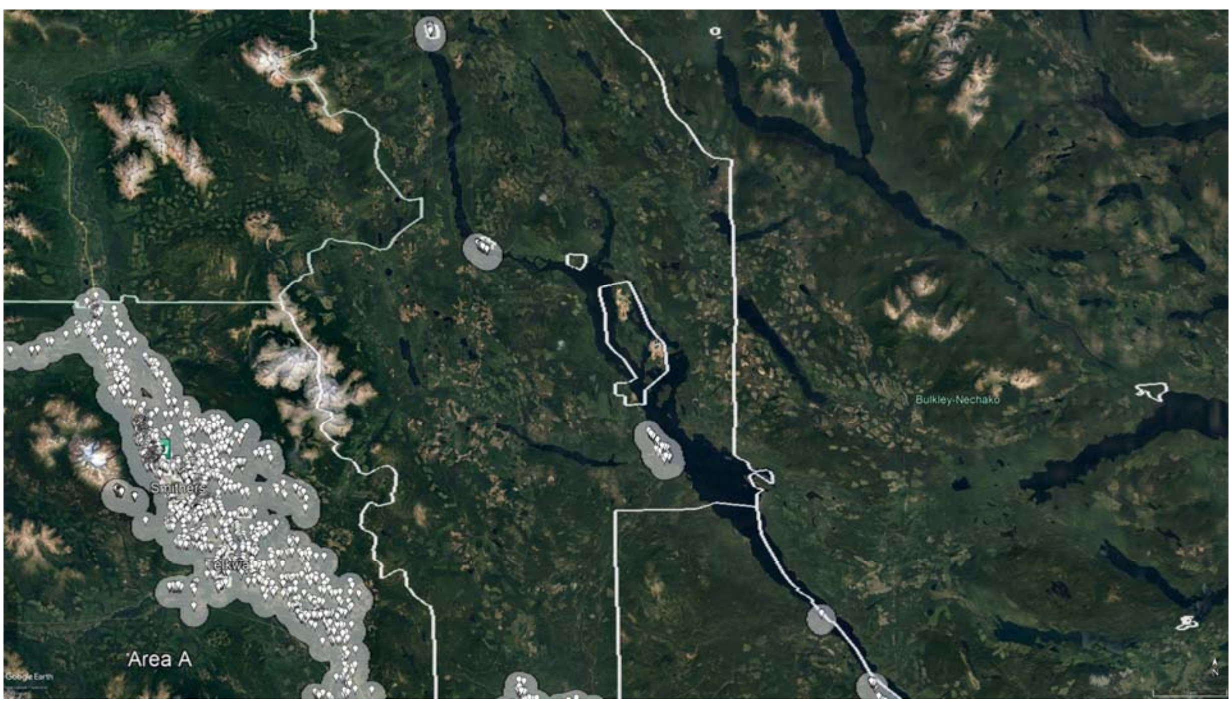


<u>RDBN Household Information – Area E</u>

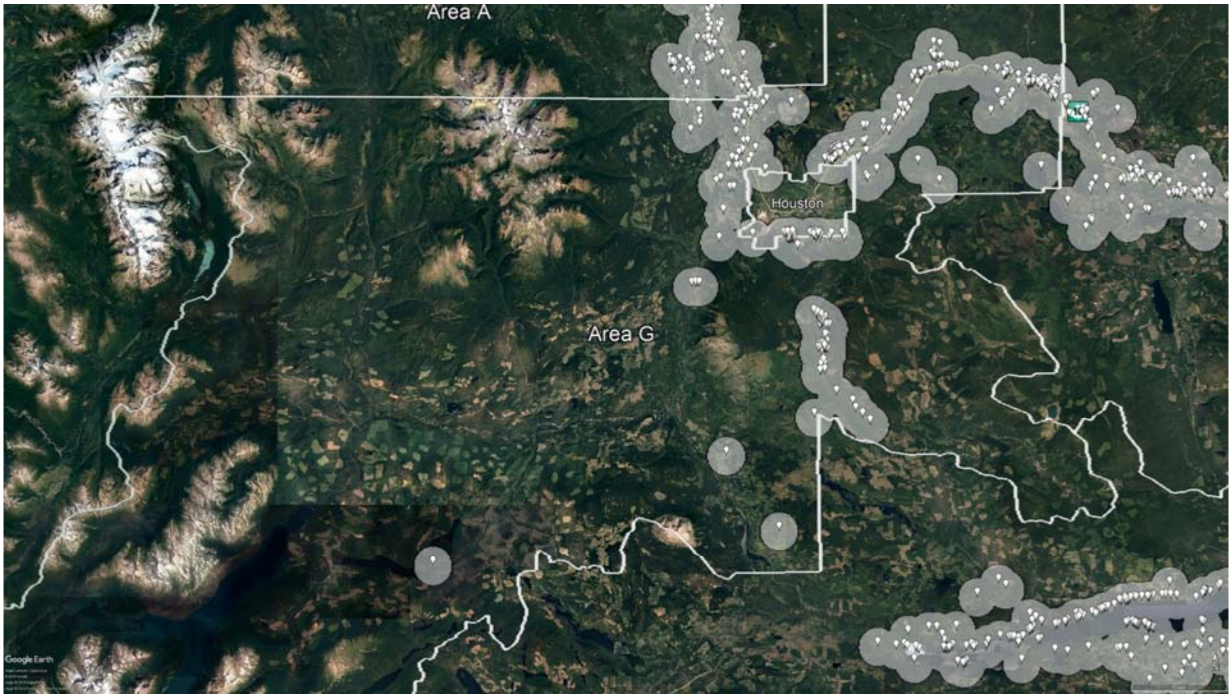


RDBN Household Information – Area F

RDBN Household Information – Area G Upper

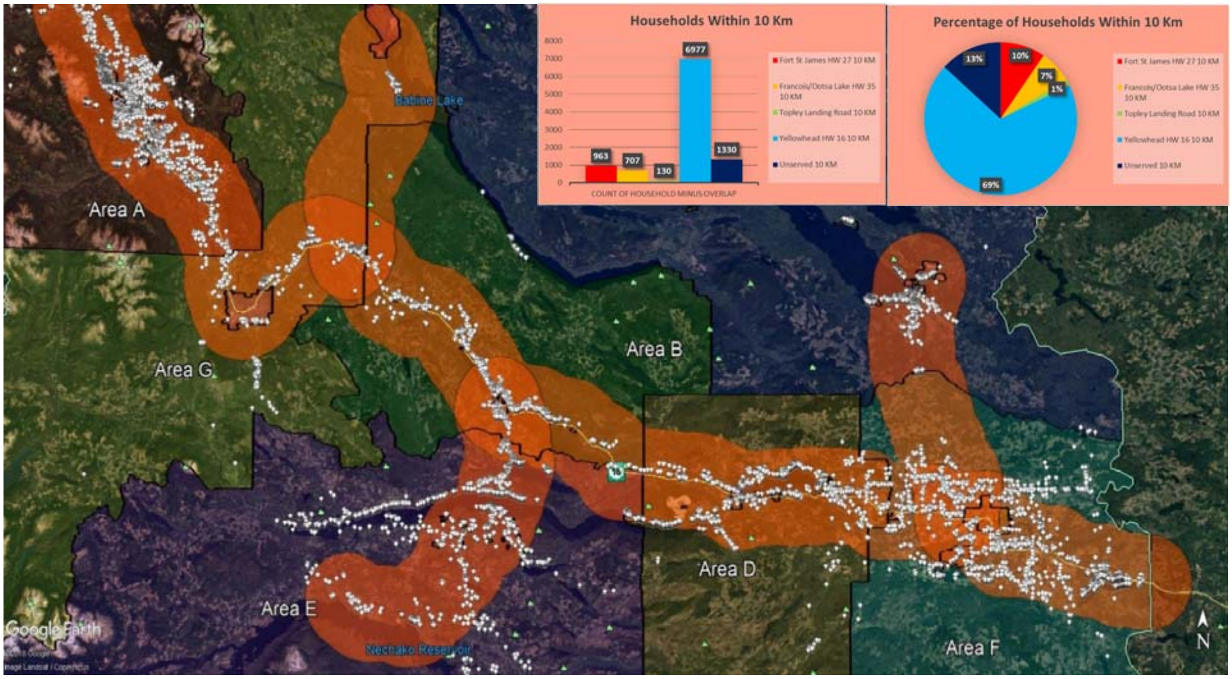


RDBN Household Information – Area G Lower

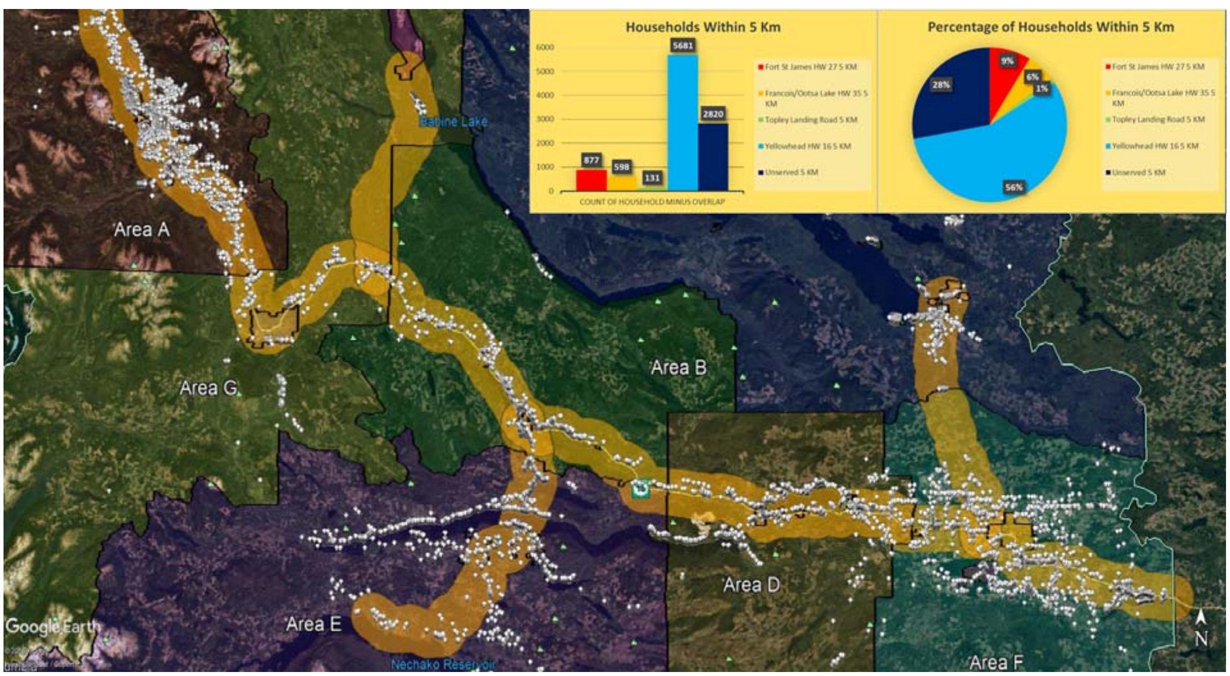


9.3 Appendix D – Households Within Different Kilometers

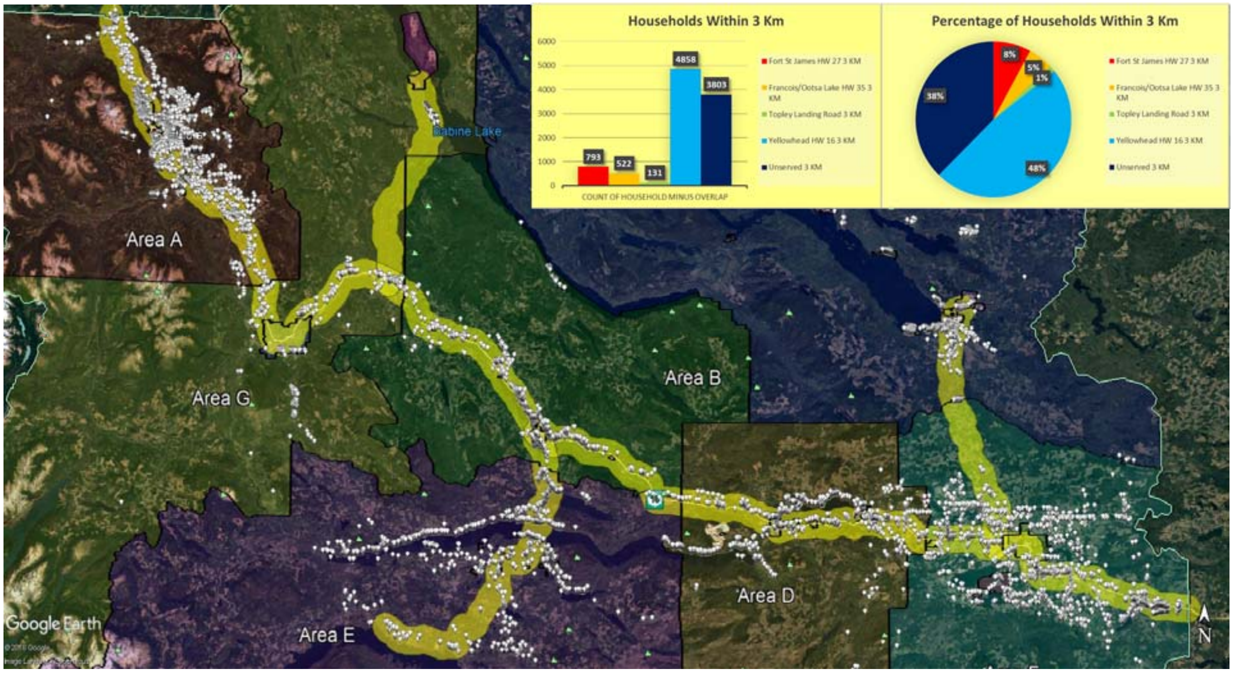
<u>RDBN Households Within 10 Km Information</u>



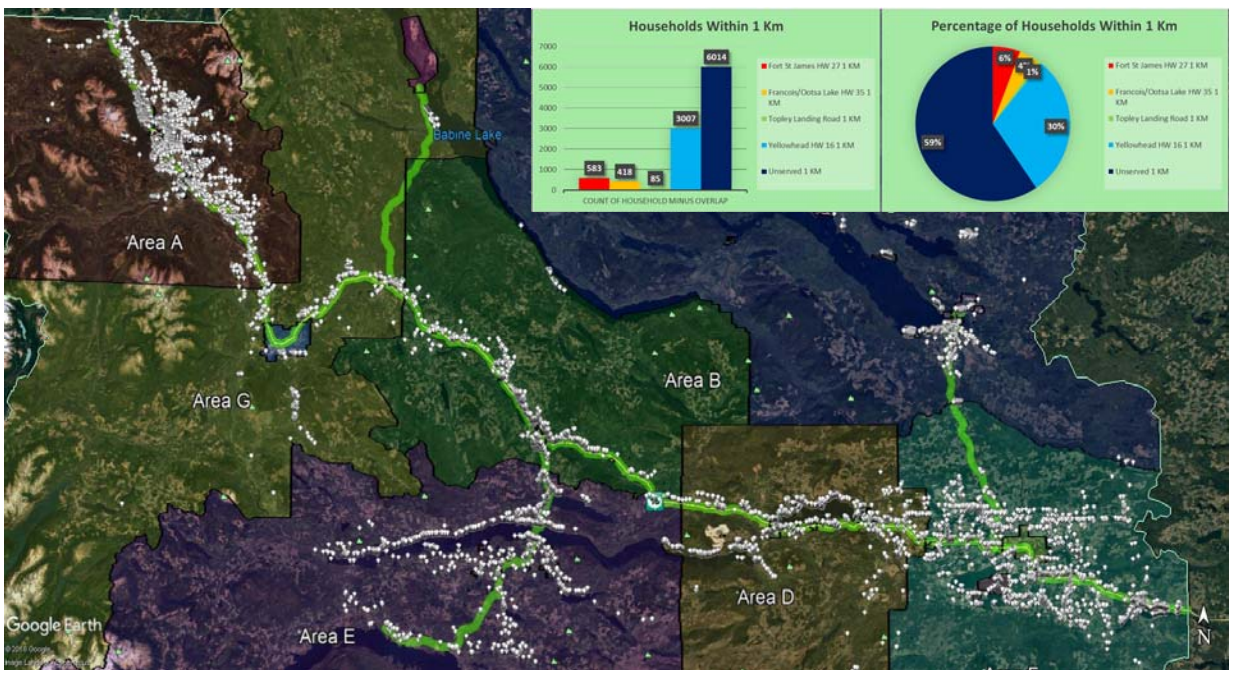
<u>RDBN Households Within 5 Km Information</u>



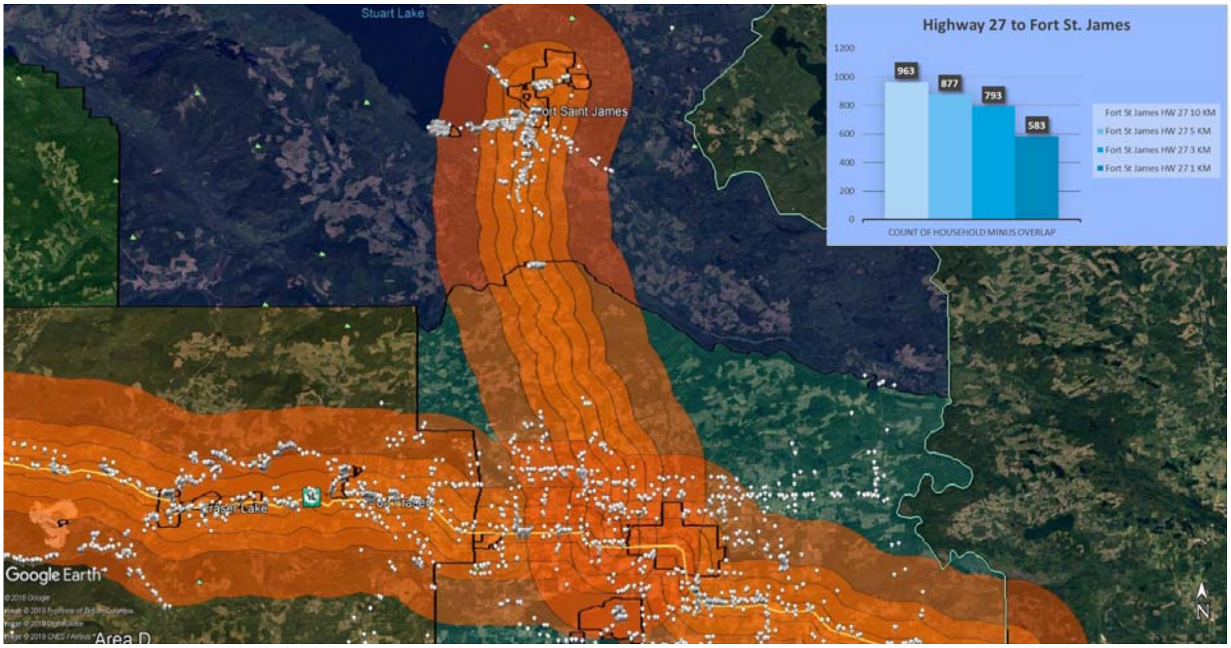
RDBN Households Within 3 Km Information



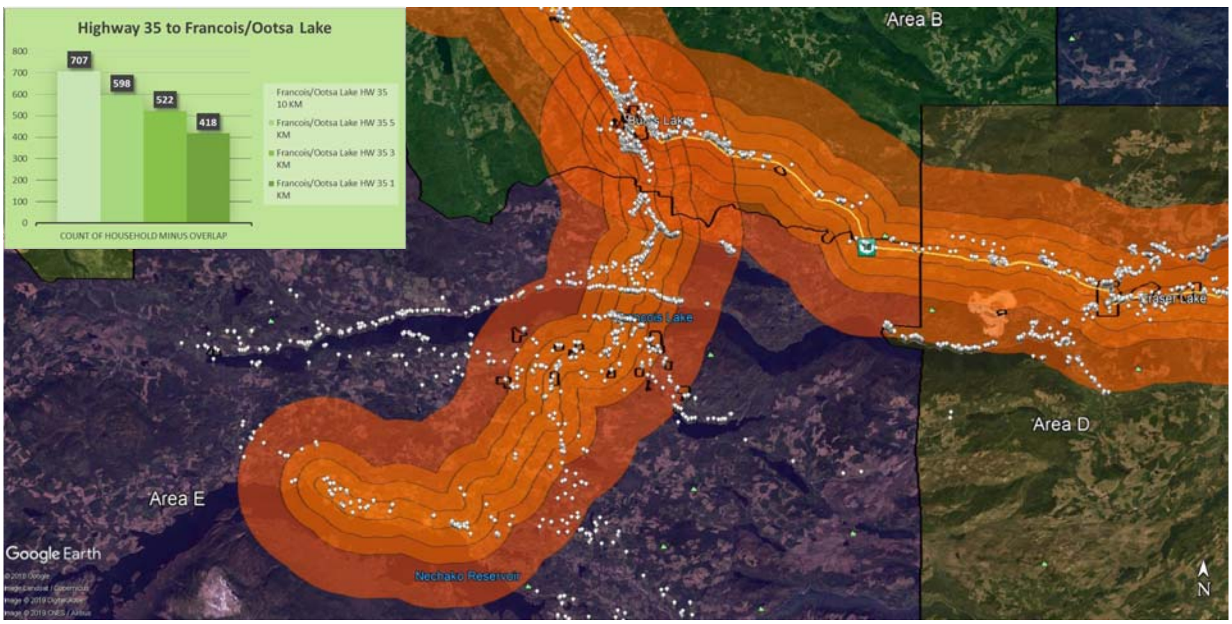
RDBN Households Within 1 Km Information



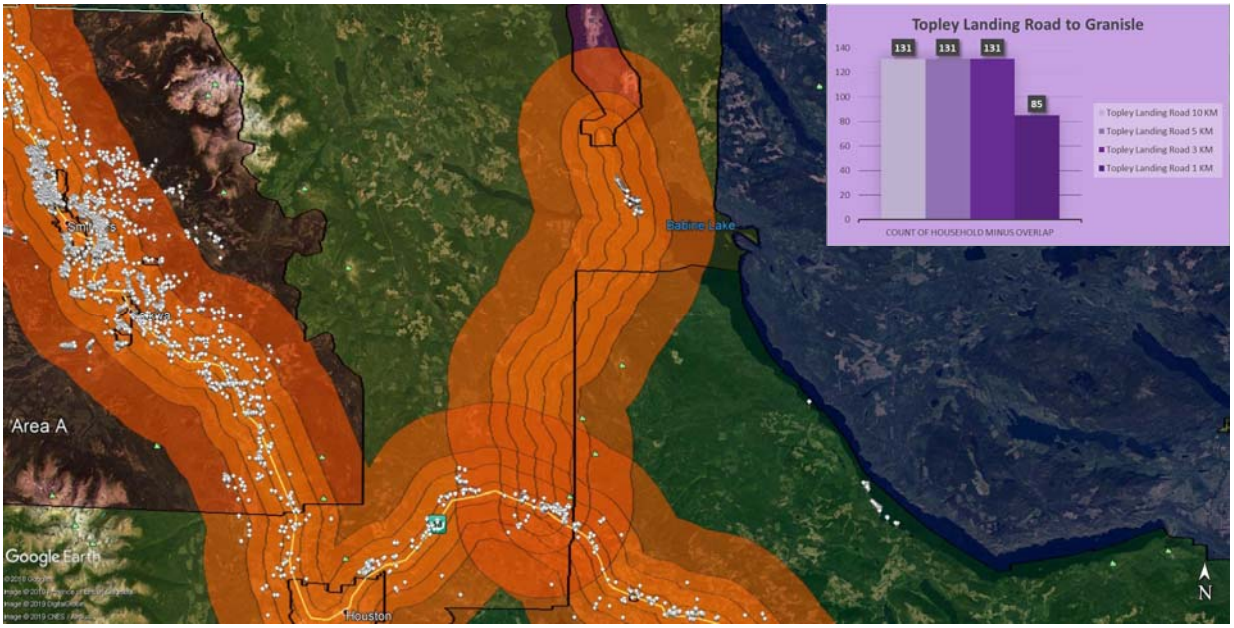
Highway 27 to Fort St. James Information



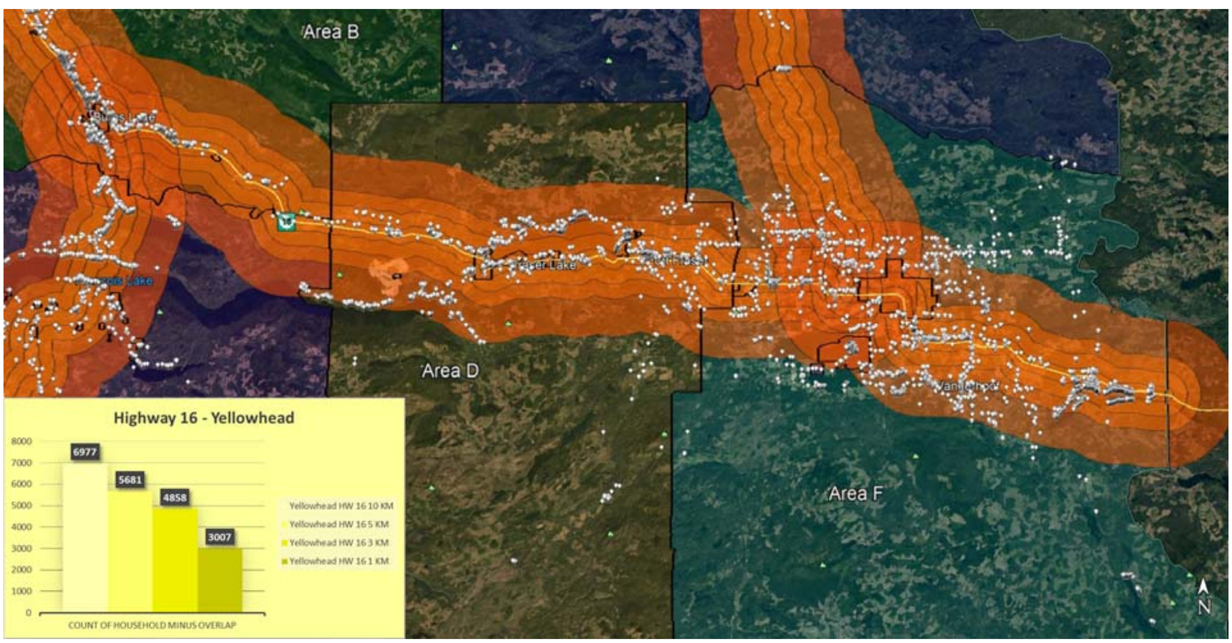
Highway 35 to Francois & Ootsa Lake Information



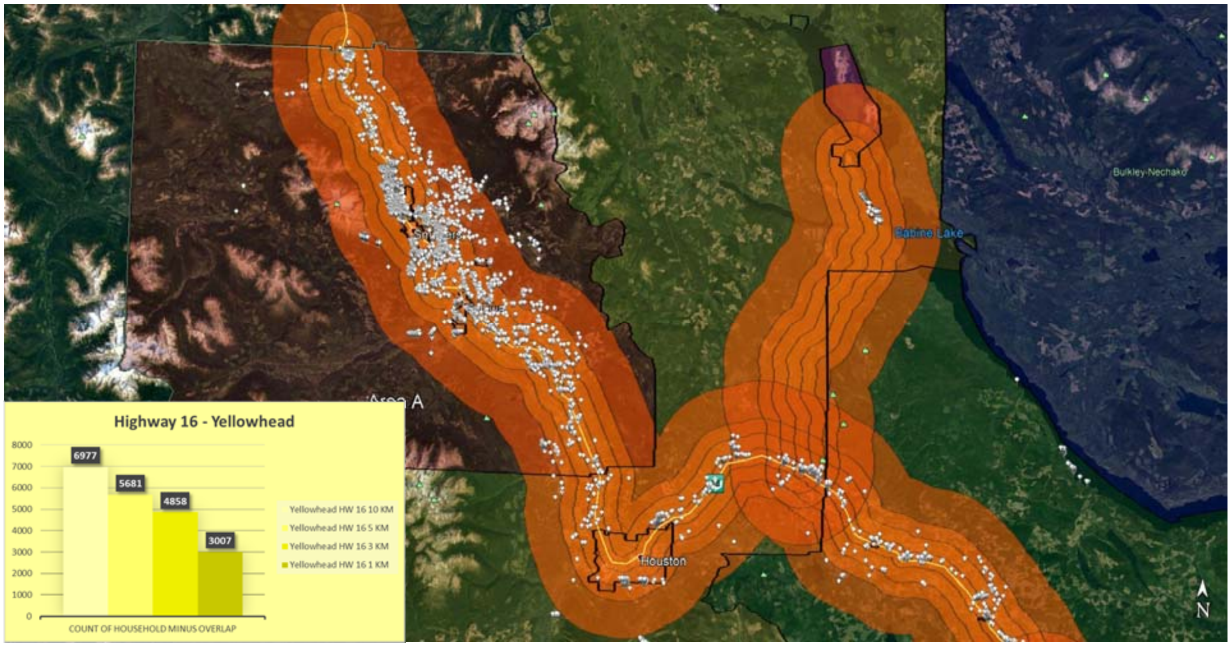
Topley Landing Road to Granisle Information



South Yellowhead Highway 16 Information



North Yellowhead Highway 16 Information



RDBN Households Unserved Outside of Service Zone Information