c spire

Rural Broadband Consortium

case study

Nascent ISP Business Model – LEO Satellite Backhaul

1 INTRODUCTION

The C Spire Rural Broadband Consortium is looking at various ways to encourage broadband deployment in rural areas. Governments of all political, partisan, and ideological stripes around the world have concluded that access to affordable, high-speed Internet and wireless connectivity is no longer a luxury but rather a necessity for individuals to take part in today's modern digital economy.

Among several countries leading the way, the Government of Canada has taken a global leadership position, pledging to deliver universal connectivity to every Canadian within the next ten years. Despite the clear benefits, bridging the digital divide is a significant economic and technological challenge. Many rural communities in Canada have limited or no options for broadband service, which stems from a range of issues:

- **Distance from existing fiber infrastructure**
- **Geography or topography of the region**
- **Low population density**
- **Challenging return on investment for providers**

Both large and small Internet service providers (ISPs) have attempted to expand their network to these rural communities to offer affordable high-speed broadband service, but often fail due to the high cost of backhaul and network deployment. This makes it challenging to entice ISPs to expand to these underserved communities. The current business model requires an ISP to make a large investment in an end-to-end network, which does not provide a sufficient return. The large network investment required also prevents new market entrants (i.e. nascent ISPs) to properly serve these communities.

To address these challenges, this case study explores the use of Lower Earth Orbit (LEO[1]) satellites for high-speed, low latency broadband services compared to other backhaul technologies and in conjunction with fiber and fixed wireless access technologies for deploying broadband Internet to rural communities in Canada. The case study will also examine different business models to help ease the deployment of a network solution. Specifically, it will focus on models that a third party could consider to cost effectively deploy a network solution by partnering with a LEO backhaul operator. The objective is to identify an economically viable network solution and business model that minimizes the total cost of ownership (TCO) for established and new (nascent) ISPs to deliver broadband in rural communities.

The business models and network solutions proposed in this case study are just a few amongst several viable models; certain models and networks might be more effective in different scenarios. Furthermore, this case is a hypothetical exercise; no network solutions were physically deployed in either community. However, the analysis performed is intended to help the consortium and other

[1] LEO network refers to the Telesat LEO network, specifically for backhaul cost and TCO of LEO solutions

2 COMMUNITIES STUDIED

All underserved communities in Canada were studied with two highlighted in this document. The rural settings are used to compare the costs of each network solution in communities of different sizes and distances from the core network. The two communities studied are Altona, British Columbia, and Cleardale, Alberta.

Altona, BC is a small, unincorporated rural community in Northern British Columbia. The nearest telecommunication infrastructure is ~100km away, which features both fiber and fixed wireless (FW) connectivity. Within Altona, the current connectivity options are not economical and do not meet the Government of Canada broadband internet standard of 50/10 Mbps. **Figure 1** shows an overview of a small portion of Altona. Other characteristics of Altona include:

- **Population: 250 people**
- **Households: 100**
- **Distance from core: 100km**
- **Population density: 21 people/km²**
- **Throughput required: 225Mbps²**

FIGURE 1:
Altona, BC Overview

Cleardale, AB is a rural farming community in Northern Alberta. The closest telecommunication infrastructure is ~250km away, which features fiber, fixed wireless, satellite and digital subscriber line connectivity. Similar to Altona, the current connectivity options in Cleardale are not economical and do not meet the Government of Canada standard. **Figure 2** shows an overview of a small portion of Cleardale for reference. Other characteristics of Cleardale include:

- **Population: 400 people**
- **Households: 170**
- **Distance from core: 250km**
- **Population density: 0.2 people/km^2**
- **Throughput required: 400Mbps**

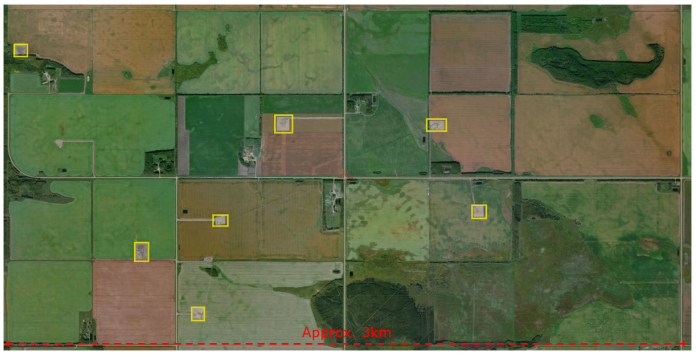

FIGURE 2:
Cleardale, AB Overview

*² Throughput is calculated using the 50/10 Mbps Government of Canada standard, combined with a contention rate of 25, multiplied by the number of households (example: Cleardale: (50+10)/25*170=~400 Mbps)*

3 TECHNOLOGIES CONSIDERED

The technology options considered for network access are fiber and fixed wireless, and for the backhaul network, technology options are fiber, fixed wireless and LEO satellite network. **Figure 3** shows a high-level diagram of the various network technologies.

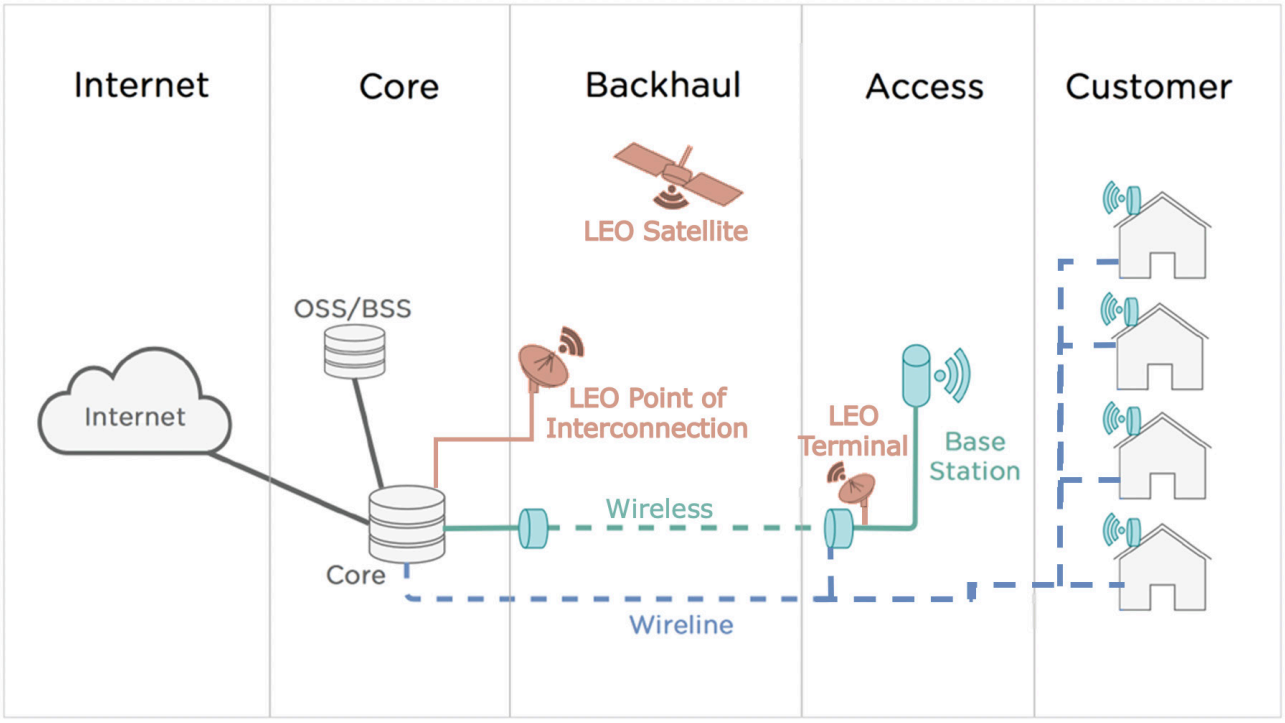

FIGURE 3:
End-to-End Network Configurations [1]

- **FIBER ACCESS AND BACKHAUL**
  - Pros – High-speed, reliable, long useful life
  - Cons – Expensive to build and maintain, challenging to connect sparsely populated regions
- **FIXED WIRELESS (FW) ACCESS AND BACKHAUL**
  - FW in this case study refers to point-to-multi-point wireless access and point-to-point microwave backhaul
  - Pros – Easy to connect multiple homes to an access aggregation point
  - Cons – Expensive to construct towers, requires a direct line-of-sight to another tower/home, multiple points of failure
- **LEO SATELLITES**
  - Telecom network using satellites in lower earth orbit ~1000km away from earth (~35 time closer than traditional satellites) that support high quality and low latency[3] broadband
  - Pros – Economical to connect communities that are a far distance from the core, ideal for medium to low density areas, easy to deploy, eliminates challenges related to line-of-sight, terrain and foliage
  - Cons – Not applicable for high density areas close to existing fiber infrastructure

[3] One-way latency ~50 milliseconds

4 NETWORK DESIGN AND COSTS

Six network configurations were studied for both communities when combining the access and backhaul portions of the network and are shown in **Figure 4**.

1. Fiber access with fiber backhaul
2. Fiber access with FW backhaul
3. Fiber access with LEO satellite backhaul
4. FW access with fiber backhaul
5. FW access with FW backhaul
6. FW access with LEO satellite backhaul

		Access	
		Fiber	FW
Backhaul	Fiber	1	4
	FW	2	5
	LEO	3	6

FIGURE 4:
Network Configurations

4.1 DEPLOYMENT COSTS

This section includes a TCO analysis on the costs associated with deploying each network configuration for the aforementioned communities. The TCO analysis is based on capital and operational expenditures over a 15-year lifespan. The goal of the analysis is to identify the network configuration that minimizes the TCO for each community. All graphs listed in the following sections show this analysis for each technology option and network configuration, normalized to the cost of the most expensive option (fiber access and fiber backhaul). More specifically, the costs associated with each technology for access and backhaul are:

Access:
- **Fiber: fiber design, access to end user site, customer equipment installation**
- **FW: FW design, FW endpoint to end user site, antenna installation**
- **Both: marketing, provisioning and billing, network/equipment replacement**

Backhaul:
- **Fiber: construction[4] of wireline from core to access point, fiber termination equipment, maintenance and operations, and provider margin**
- **FW: construction of FW relay towers, equipment and spectrum fees for FW links, land rental, power, insurance, and operation and maintenance on towers**
- **Telesat LEO Satellites: LEO satellite terminal, cost of recurring bandwidth required, and maintenance**

For this case study, a few key assumptions are made in order to compare the different technology options. In this case, line-of-sight issues are not considered for FW access and backhaul, which can drastically impact the effectiveness of FW solutions. Furthermore, it is assumed FW towers have a maximum range of 10 miles (maximum distance between FW backhaul hops is 10 miles). Cost of capital is also not considered for this comparison, which can be a limiting factor and severely increase costs for network solutions that require large initial investments.

[4] Includes construction equipment and labour, rights-of-way, permits/licensing, engineering, and splicing and testing equipment and labor

4.2 ALTONA, BC

This section examines the TCO to deploy each network configuration in Altona and provides a breakdown of the costs for each technology option.

4.2.1 ACCESS

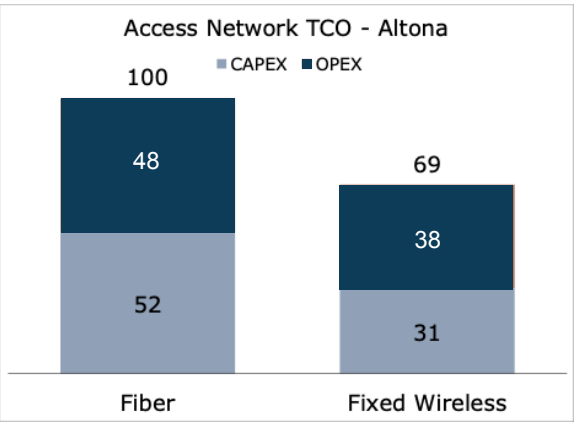

FIGURE 5:
Altona Access Cost Comparison

Access Cost Breakdown - Altona		
Cost Category	Fiber	Fixed Wireless
Network Design	1.05%	1.05%
Access Construction	2.69%	4.84%
Customer Installation	47.05%	24.32%
Marketing	0.72%	0.72%
Provisioning	7.15%	7.15%
Billing	7.15%	7.15%
Network Monitoring	7.15%	7.15%
Equipment Replacement	27.04%	17.00%
Total	100.00%	69.38%

FIGURE 6:
Altona Access Cost Breakdown

4.2.2 BACKHAUL

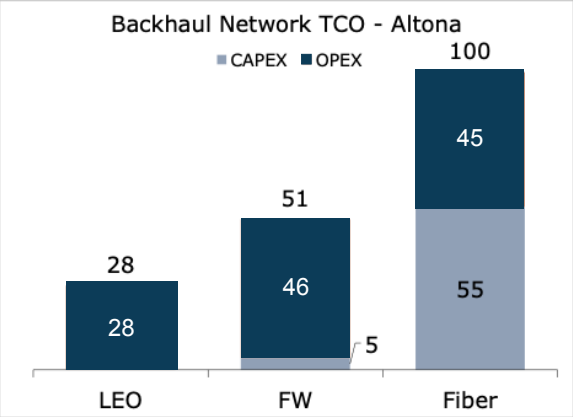

FIGURE 7:
Altona Backhaul Cost Comparison

Backhaul Cost Breakdown - Altona		
Tech	Description	Normalized
LEO	Capacity Cost	28.00%
	User Terminal (UT)	0.15%
	UT O&M	0.14%
Fixed Wireless	Tower Construction	3.57%
	Equipment and Spectrum	0.46%
	Land Rental	33.51%
	Power	0.78%
	Insurance	9.68%
	O&M per Tower	2.38%
	O&M per Base Link	0.13%
Fiber	Construction	54.51%
	Equipment	0.14%
	O&M	28.69%
	Provider Margin	16.00%

FIGURE 8:
Altona Backhaul Cost Breakdown

4.2.3 END-TO-END NETWORK (ACCESS AND BACKHAUL)

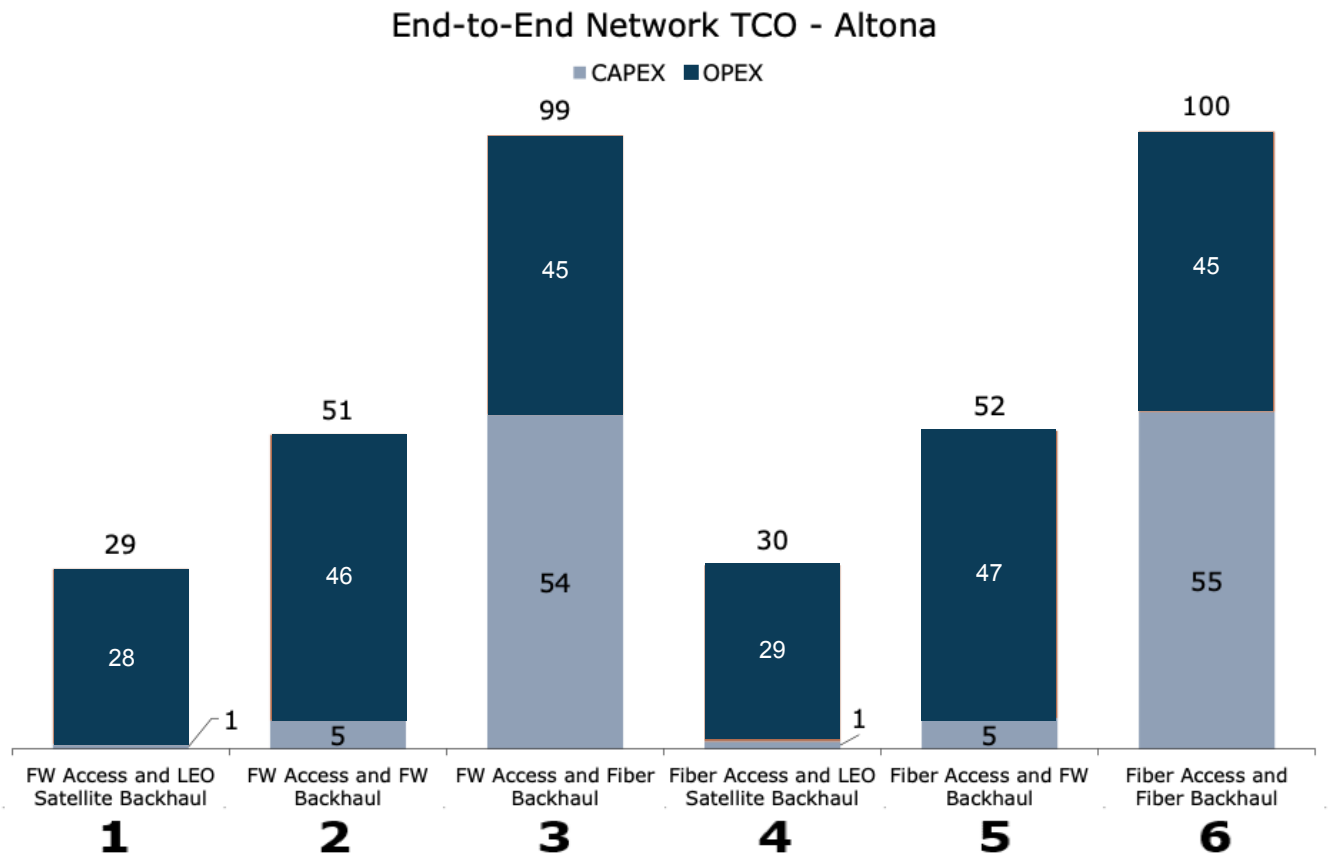

FIGURE 9:
Altona Network Configuration TCO Comparison

4.2.4 FINDINGS

Figure 5 & **Figure 6** show that FW access is 30% less expensive than fiber, and that a majority of the costs for both options are dedicated to customer installation and equipment replacement. **Figure 7** & **Figure 8** demonstrate that LEO satellite backhaul is at least 40% less expensive than either FW or fiber backhaul. **Figure 9** shows that LEO satellite backhaul paired with FW access is the most affordable option. LEO satellite backhaul with FW access is ~40% more affordable than either solution with FW backhaul and is 3-4 times less than the cost of a solution with fiber backhaul.

4.3 CLEARDALE, AB:

This section examines the TCO to deploy each network configuration in Cleardale and provides a breakdown of the costs for each technology option.

4.3.1 ACCESS

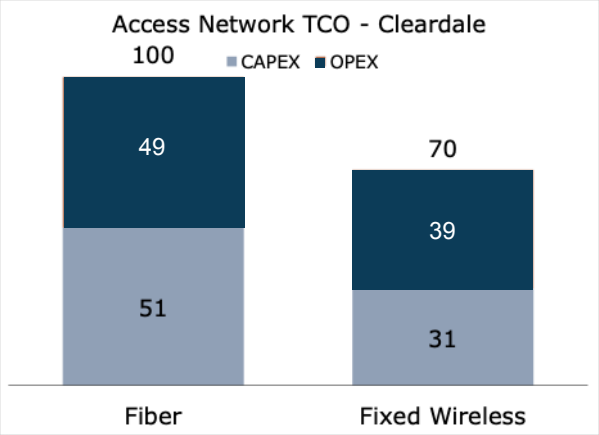

FIGURE 10:
Cleardale Access Cost Comparison

Access Cost Breakdown - Cleardale		
Cost Category	Fiber	Fixed Wireless
Network Design	0.60%	0.60%
Access Construction	1.55%	5.18%
Customer Installation	48.34%	24.98%
Marketing	0.63%	0.63%
Provisioning	7.35%	7.35%
Billing	7.35%	7.35%
Network Monitoring	7.35%	7.35%
Equipment Replacement	26.84%	16.48%
Total	100.00%	69.00%

FIGURE 11:
Cleardale Access Cost Breakdown

4.3.2 BACKHAUL

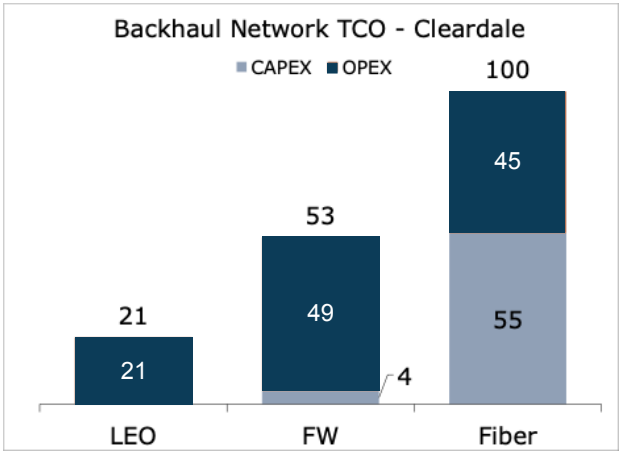

FIGURE 12:
Cleardale Backhaul Cost Comparison

Backhaul Cost Breakdown - Cleardale		
Tech	Description	Normalized
LEO	Capacity Cost	21.19%
	User Terminal (UT)	0.07%
	UT O&M	0.06%
Fixed Wireless	Tower Construction	3.78%
	Equipment and Spectrum	0.44%
	Land Rental	35.48%
	Power	0.76%
	Insurance	10.25%
	O&M per Tower	2.52%
	O&M per Base Link	0.06%
Fiber	Construction	54.59%
	Equipment	0.06%
	O&M	28.69%
	Provider Margin	16.00%

FIGURE 13:
Cleardale Backhaul Cost Breakdown

4.3.3 END-TO-END NETWORK (ACCESS AND BACKHAUL)

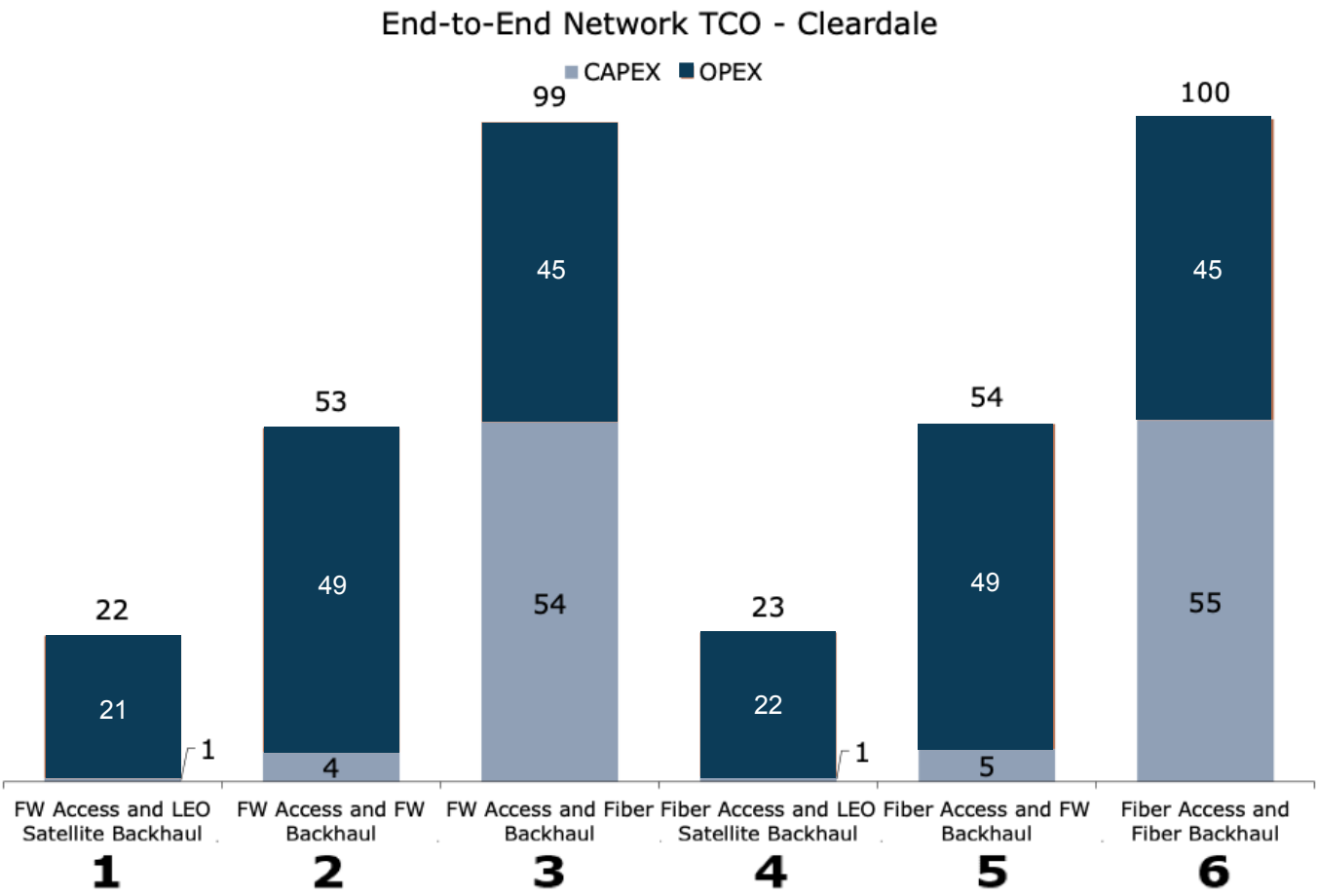

FIGURE 14:

Cleardale Network Configuration TCO Comparison

4.4 FINDINGS

Figure 10 & **Figure 11** indicate that FW access is ~30% less expensive than fiber while **Figure 12** & **Figure 13** demonstrate that LEO backhaul is the most affordable option. LEO backhaul is ~60% less than FW backhaul and ~80% less than fiber, with almost all the costs dedicated to purchasing capacity. **Figure 14** shows configurations featuring LEO satellite backhaul are ~60% less expensive than configurations with FW backhaul and ~80% less than configurations with fiber backhaul. The combination of FW access and LEO satellite backhaul is the most cost-effective solution for Cleardale.

4.5 TCO ANALYSIS SUMMARY

Overall, the network configuration featuring LEO satellite backhaul and FW access is considerably more affordable than the other network configurations for both communities:

- **Configurations with LEO backhaul are between ~40%-80% less expensive than configurations that use fiber or FW backhaul**
- **Eliminates large infrastructure investments of FW or fiber backhaul via a one-hop connection to the ISP's core network**
- **Low risk on investment, the only infrastructure required is an affordable LEO satellite terminal**
- **Significant decrease of TCO for communities with medium to low population density, and those that are far away from the core network**
- **Lowest OPEX cost of all backhaul options in all communities, costs primarily driven by bandwidth required to serve a community**

Note: In Figures 9 & 14, the TCO appears to be very similar between backhaul technologies regardless of choice of access technology. This is due to normalization of the end-to-end network costs. While Figures 5 & 10 show a clear difference in cost between access technologies, this is not represented in Figures 9 & 14 as the cost of the backhaul network completely overwhelms the cost of deploying the access network.

5 BUSINESS MODEL COMPARISON

This section compares three potential business models for deploying the network configuration with the lowest TCO for each community (FW access and LEO satellite backhaul). The three business models studied throughout this section are:

1. **LEO Satellite Operator Model**
2. **Established ISP Model**
3. **Nascent ISP Model**

5.1 LEO SATELLITE OPERATOR MODEL

A LEO satellite operator could choose to offer services directly to consumers in each community. In this model, the LEO operator would be responsible for all costs associated with deploying the end-to-end network solution, including a large upfront investment. While this model would allow the LEO operator to receive 100% of the revenue, the ability to serve individual users scattered across an isolated community is costly and logistically challenging for any single operator.

5.2 THIRD PARTY ENGAGEMENT MODELS

A third party engagement model would function as a partnership between a LEO operator and a third party, an independent ISP, where the LEO operator is responsible for the backhaul network and the third party ISP is responsible for the access network. Backhaul services provided by the LEO operator would enable the ISP to expand their network to new markets without the investment in a full end-to-end network solution.

The third party ISP would be responsible for acquiring customer profiles, as well as constructing and maintaining the access network. The third party ISP could generate revenue directly from customers by owning the customer profile, while paying the LEO operator for use of their backhaul network. Alternatively, the partnership could function under a revenue sharing model where each party receives a percentage of total revenue generated.

One option for a third party engagement model is with an established ISP; this could be an ISP serving a nearby territory or one already existing within the community desiring to upgrade service to the Government of Canada standard. This ISP's expertise in all other areas of deploying, running, and maintaining a service in a rural community are crucial to acquiring customers and managing the network's day-to-day operations.

If there are no established ISPs, the community itself could form and operate its own Nascent ISP to provide broadband in the community[5]. The Nascent ISP model looks very similar to the Established ISP model, but the Nascent ISP would need additional support in the start-up phase for areas such as provisioning and network monitoring. The Nascent ISP model also provides the community with much greater control over the broadband service provided to their community. The greater control allows the community to customize the services offered to residents; they will not have to select from pre-determined subscriptions. Furthermore, greater control over the network will allow them to ensure a high quality of service for all residents.

Figure 15 shows the cost breakdown of potential engagement models in more detail.

	Engagement Models		
	Operator Only	Nascent ISP	Established ISP
Network Design			
Backhaul			
Access			
Construction			
Backhaul			
Access			
Customer Acquisition			
Customer Equipment Installation			
Provisioning			
Billing (OSS/BSS)			
Maintenance + Operations			
Network Monitoring			
Equipment Replacement (Access)			
Equipment Replacement (Backhaul)			
Community Control	**N/A**	**High**	**Low**

Operator Provides	
Partner Provides	
Both Provide	

FIGURE 15:
Business Model Comparison

[5] Note that if the community has pre-existing infrastructure assets such as poles, buildings, or water towers that are used to build the fixed wireless access network, it can be considered an Infrastructure ISP.

Third party engagement models allow both parties to focus on their core strengths with each generating profit within a reasonable payback period. **Figure 16** shows the payback period for Operators and ISPs in Cleardale, for the three business models shown in Figure 15. The business model (as with the TCO) assumes all households in each community adopt the new service in the first year. The costs for each party are split and shared as indicated in Figure 15. The payback period for the Operator is longer in the Operator Only model as it assumes that a new employee would be necessary to serve Cleardale. If that new employee is not necessary, then the payback period for the Operator-Only model in Cleardale decreases to ~2.8 years. Note that the payback period for the ISPs is less than 4 years. Although not shown, the payback period for Altona is longer than that of Cleardale as there are fewer potential customers in the area.

While the Operator has a slightly longer payback period than that of the ISPs for this particular shared cost model, the Operator and ISP can work out different terms to adjust their respective payback periods as desired. The Operator may be willing to tolerate a longer payback period in part to spare itself the operational challenges of deploying in rural markets.

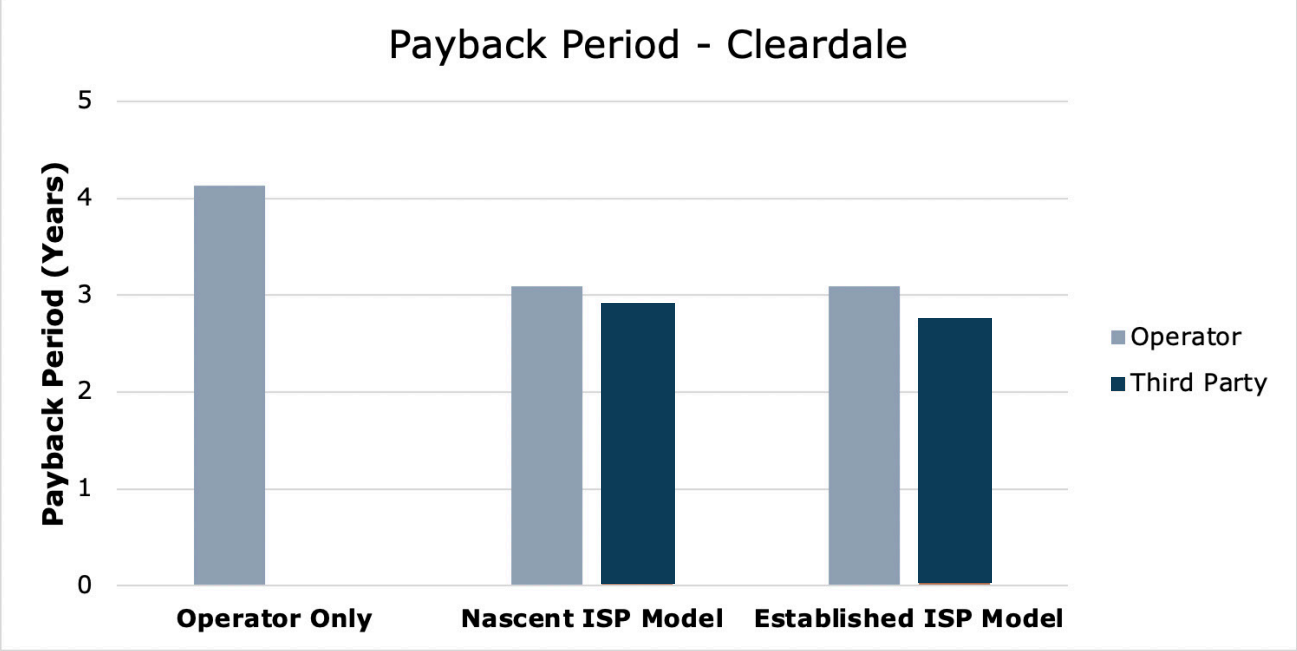

FIGURE 16:
Cleardale Payback Period for Operator-Only and Third Party Business Models

Major benefits for Established and Nascent ISPs that adopt a third party engagement model include:

- **Extended service and revenue generation in new, hard to reach markets**
- **Establish footprint without large investment in an end-to-end system**
- **Lower risk of losing customers by owning customer profile**
- **Improved control over quality of broadband service**

5.3 ROLE OF THE GOVERNMENT OF CANADA IN BRIDGING THE DIGITAL DIVIDE

Connecting rural and remote citizens is often times not possible without government support to help close the business case. As a result, many governments are actively investing in and supporting companies to close financial deltas that stand in the way of connectivity. The Government of Canada has focused on addressing the root causes of poor connectivity to rural communities by focusing its significant resources largely on backhaul connectivity and affordability.

To date the Government of Canada has put forth approximately C$6B of funding and incentives at the federal level to reach this goal. Nascent ISPs have and will be able to continue to take advantage of programs like the Government of Canada's Connect to Innovate program. Furthermore, Telesat and the Government of Canada have partnered to ensure access to affordable high-speed Internet connectivity across rural and remote areas of Canada through the development of Telesat's LEO Satellite Constellation. The partnership includes a contribution of $685M (CAD) from the Government of Canada, supporting the company's mission of deploying a transformational communications architecture that delivers affordable, high-speed broadband services across Canada and the rest of the world. These programs focus on bringing affordable backhaul connectivity into communities, which will enable nascent ISPs to effectively close their business cases and deliver affordable high-speed Internet and LTE/5G connectivity to Canadians.

The use of Telesat LEO backhaul would further benefit nascent ISPs by offering backhaul service at a subsidized rate through Government of Canada initiatives. Even more affordable LEO backhaul rates would further lower operating costs for ISPs and enable the creation of Nascent ISPs in rural communities. "Our government is leveraging innovative and disruptive technologies to improve rural connectivity and to ensure that Canadians in all areas of the country have access to the latest technologies. LEO satellite technology will substantially increase capacity and offer better speed and signal strength for Canadians from coast to coast to coast." – The Honourable Bernadette Jordan, former Minister of Rural Economic Development.

Furthermore, it is important that governments focus on their respective service objectives and remain technology neutral. For example, the Government of Canada is focused on delivering 50/10 Mbps with an unlimited data cap and are focusing on the objective of rapid, affordable and sustainable deployment of service. This approach along with investment will significantly reduce backhaul cost, which will result in Nascent ISPs being able to connect more households quicker and at more affordable rates.

6 CONCLUSION

For rural and remote communities in Canada, backhaul is the largest barrier to deploying quality broadband internet service. LEO solutions, as developed by Telesat, offer a new backhaul alternative that greatly reduces the capital investment and TCO of deploying an end-to-end network; ISPs can take advantage of LEO backhaul through third party engagement models that allow established ISPs to rapidly expand their networks and enable the creation of Nascent ISPs. The Government of Canada has also partnered with Telesat to offer subsidized LEO backhaul rates, which drastically reduces the cost for a Nascent or Established ISP to expand their network to a new community. This unique government-industry partnership results in another type of multi-party collaboration that encourages rural broadband deployment. The Consortium is studying the work Telesat is doing in Canada to see how it influences the third-party enablement model.

The Operator-Only business model is highly dependent on whether additional personnel are required to support the new rural market. By instead enabling a third party, such as a Nascent ISP, to serve rural communities through cost-effective backhaul the Operator can reduce its payback period while still providing a reasonable payback period for the Nascent ISP.

By significantly reducing the cost of backhaul, the cost of a deployment is significantly reduced. If customer installation costs can likewise be reduced, either through decreased equipment costs or reduced time to install, the business case for all parties would improve.

Overall, the most affordable network configuration for both communities in this case study features FW access paired with LEO satellite backhaul. Pairing this network configuration with the third party ISP business model would greatly accelerate broadband deployment in rural markets. This network configuration and business model requires a low capital investment, amongst other benefits:

- **Between 40%-90% lower TCO overall, including lowest OPEX**
- **Decreased time to market and faster deployment via a MEF[6] (Metro Ethernet Forum) standards-based plug and play model, similar to Telesat LEO**
- **Scalability to meet demand, flexibility to transfer bandwidth to other areas**
- **Revenue generation in new, hard to reach markets without a large investment in an end-to-end system**
- **Affordable backhaul rates for ISPs via subsidies from Telesat and the Government of Canada**
- **Lower risk and total initial investment for ISPs**

[6] An industry association of 200+ member companies, MEF (Metro Ethernet Forum) is the driving force enabling agile, assured, and orchestrated communication services that empower users with the dynamic performance and security required to thrive in the digital economy (https://www.mef.net/)

7 REFERENCES

[1] "Broadband Technology Options," C Spire Rural Broadband Consortium white paper, August 2019, https://www.cspire.com/resources/docs/rural/CS_RuralBroadband_BroadbandTechnologyOptions_TechPaper_201908_v2.pdf.

Learn more about the C Spire Rural Broadband Consortium:

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