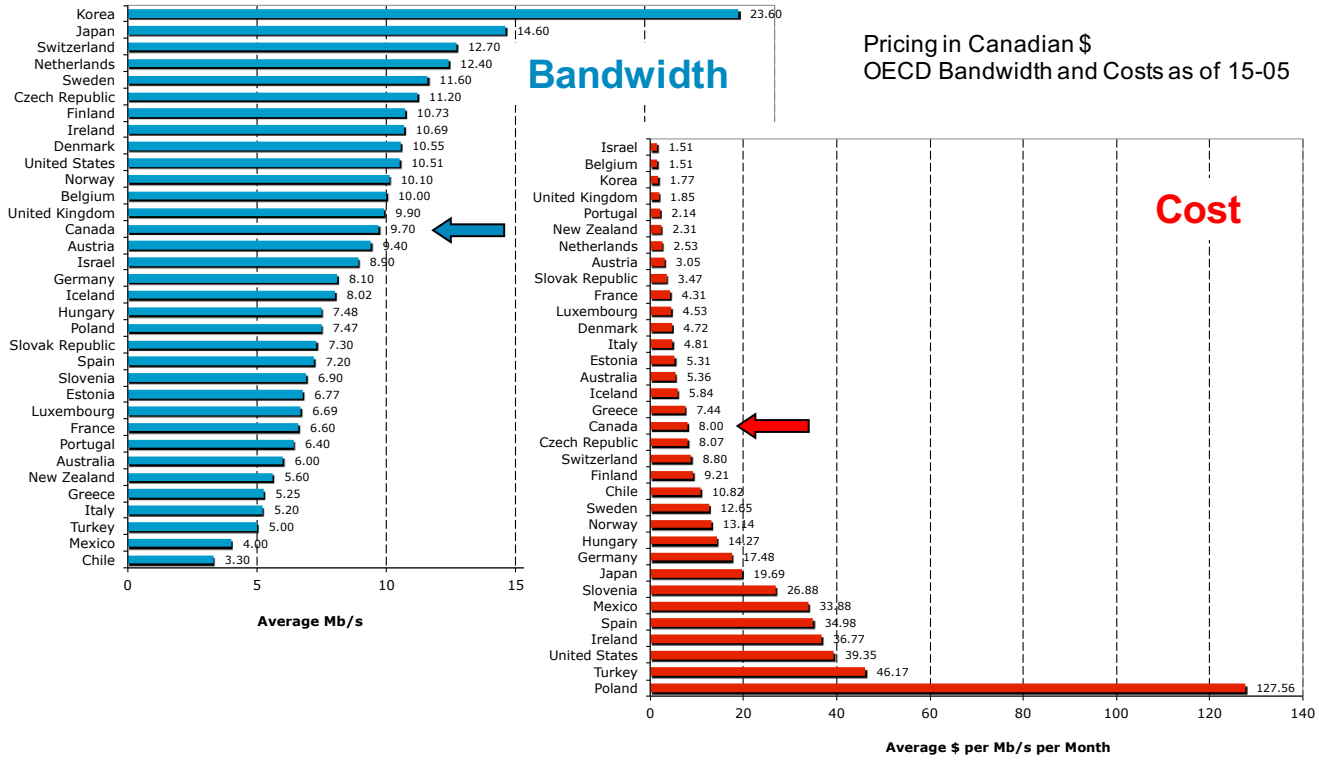
6 Community and Regional Fibre Networks

6.1 Learning from Abroad

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

The impact of this lack of policy is evident in the OECD statistics charted in Figure 27 on the next page – the latest statistics available.[69] As of early 2016, Canada ranked 14th in terms of average available download bandwidth, 18th in terms of cost, and 23rd in terms of fibre penetration. Whereas in Korea, the average download bit rate of 23.6 Mb/s is available for $ 1.77/mo. (13.3 Mb/s/$), in Canada, one can only expect 9.7 Mb/s for $8.00/mo. (1.21 Mb/s/$). Fibre penetration in Korea is 69.39% compared to 5.32% in Canada.

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



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

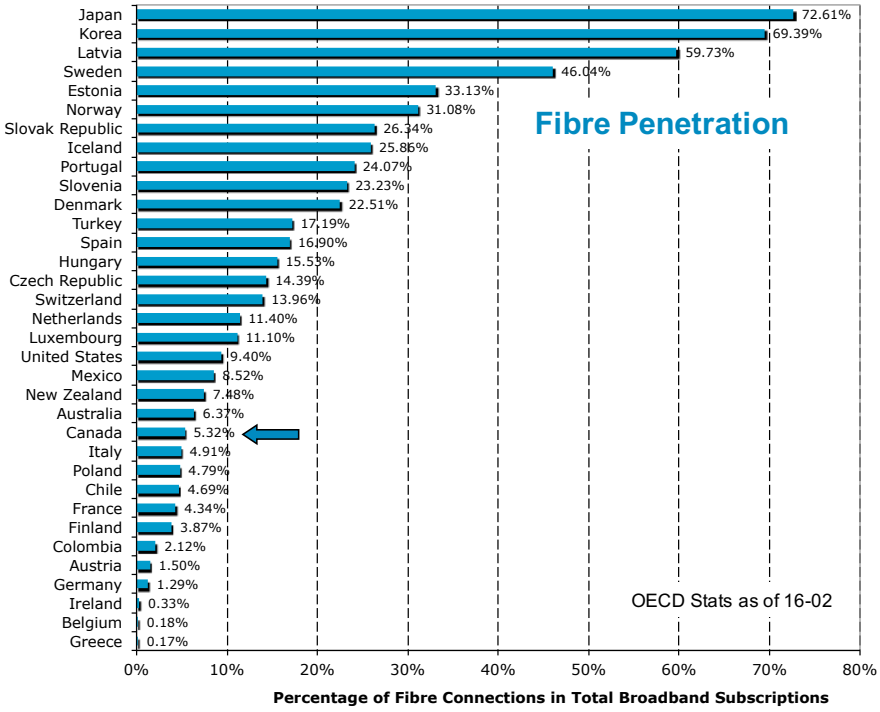


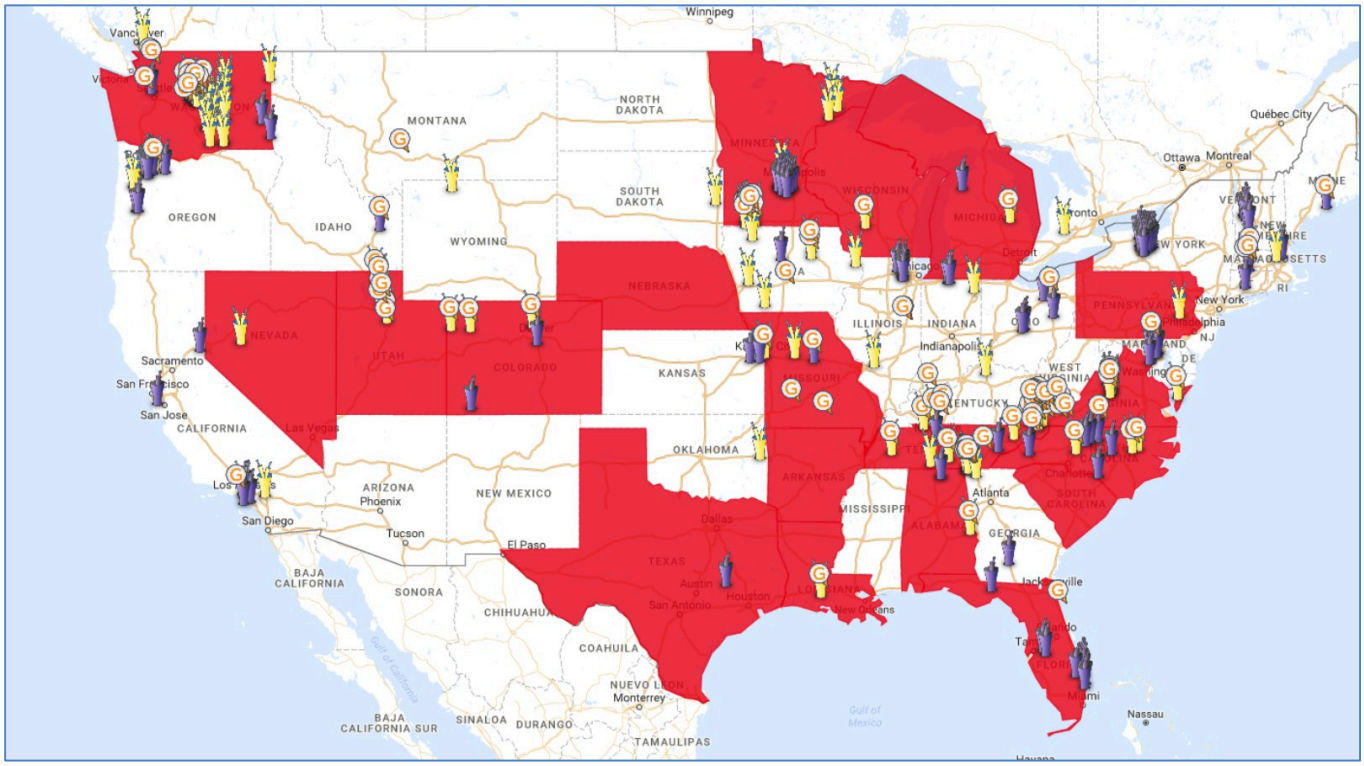
Figure 27 – International Internet service levels and pricing comparison.

An overview of the key models with which municipal and regional networks are becoming available internationally appears in Appendix 13.2.

Thanks to the initial Google Fibre Competition close to a decade ago, the value of broadband networks to both economic development and quality of life within communities, became self-evident to the more than a thousand initial applicants and, since then, community networks in the US have flourished. In addition to the over 200 networks shown in Figure 28, for example, 77 communities have publicly-owned cable networks and over 185 serve at least some portions of their community with fibre[70] – and this is in-spite of the fact that many US states actively inhibit (due to incumbent lobbying efforts) such approaches. Competition for talent amongst these *'gig'* communities is intense – see for example, the ads in Figure 29.

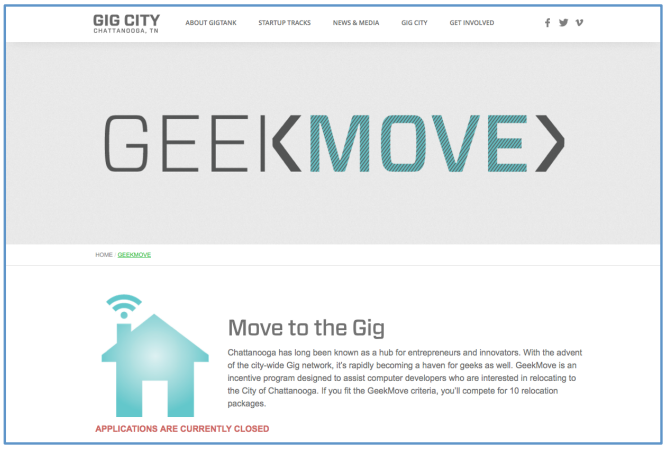
The business model options each community favours results from considerations ranging from size to risk, to priorities, complexity, and vision. What would seem to make the most sense to communities in northern Alberta would be a lit open-access utility-based model which can then leverage local ISP capabilities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

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

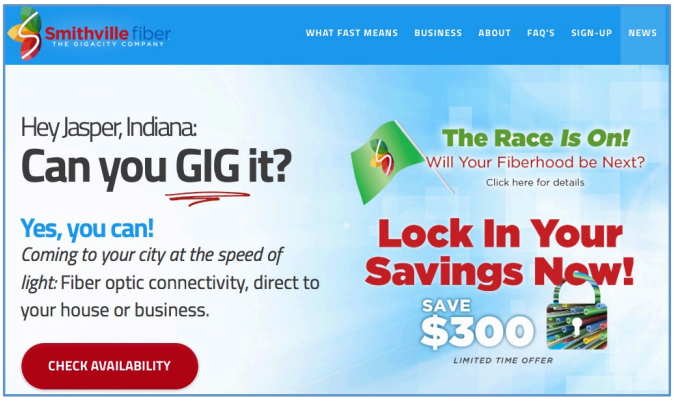


	95 Communities with a publicly owned FTTP network reaching most or all of the community.		Over 110 communities in 24 states with a publicly owned network offering at least 1 Gb/s services
	Over 130 communities with publicly owned dark fibre available.		19 states have barriers in place that discourage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

Figure 28 – Municipal fibre networks in the United States (updated to May, 2017).



Chattanooga, TN



Smithville, TN

Figure 29 – Talent competition among United States *'Gig'* communities.

6.2 Municipal Networks in Canada

6.2.1 Overview

As shown in Figure 30, Alberta ranks 11th out of 13 provinces and territories based on download speed – and Alberta has the SuperNet. Even Alberta's two largest cities do not fair well – Calgary and Edmonton are respectively ranked 11th and 21st out of 25.

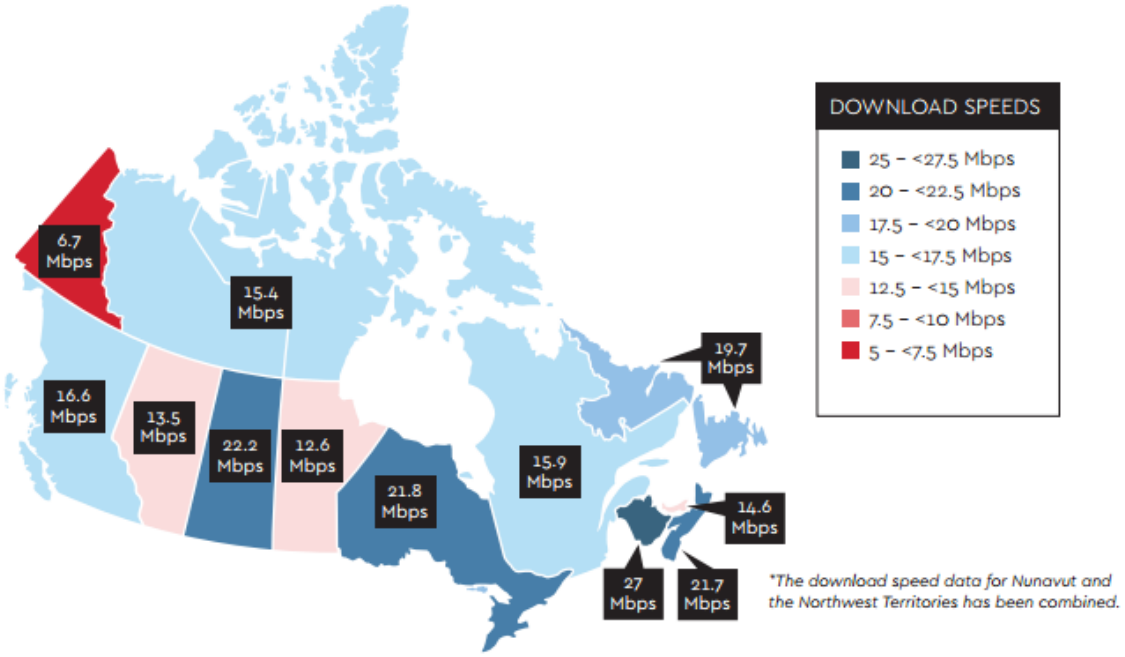


Figure 30 – Comparative Internet speeds across Canada. [71]

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

6.2.2 Alberta SouthWest

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

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

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

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

6.2.3 City of Calgary

In September, 2015, the City of Calgary adopted a dark fibre strategy based on the argument that facilitating Internet-based services is only one of six networks requiring connectivity[72] in the City and that providing the required connectivity for all networks is the City's responsibility, particularly as space in their rights of way is limited and the City does not wish to have their streets continually dug up – see Figure 31.

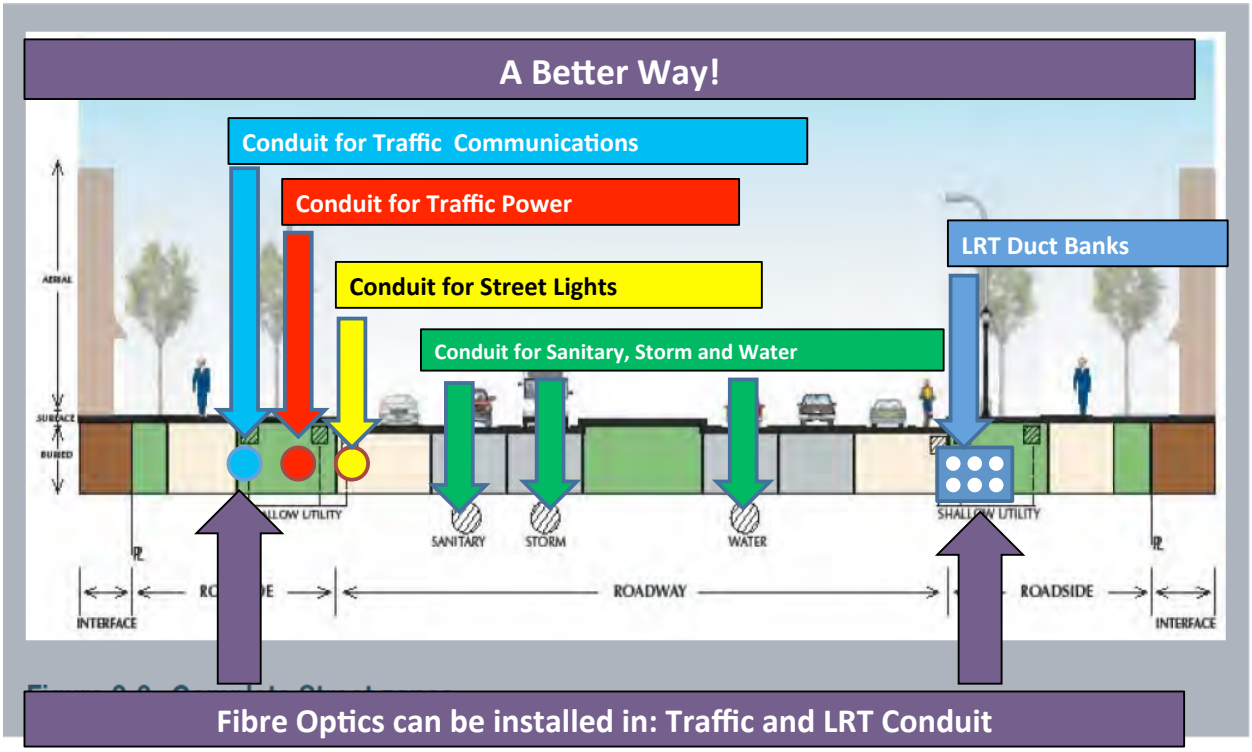


Figure 31 – City of Calgary – rights of way issues.

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

From the City's perspective, connectivity to some 230 remote offices, 450 traffic controllers, dozens of lift stations, and a multitude of transit and bus stations, traffic and security cameras, and so on is required.[73] Upon review, the City of Calgary found their four biggest challenges to be:[74]

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

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

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

https://youtu.be/dQMzkz6oaqg

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

6.2.4 Kainaiwa

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

6.2.5 Olds, Alberta

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

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

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

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

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

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

From the SuperNet, the Technology Committee then approached Shaw and TELUS. Shaw declined upfront, but TELUS indicated that should the network be deployed to their specifications, TELUS would consider lighting it and providing services. That did not materialize and they explored potential partnerships. In the end, the Technology Committee undertook to both deploy and light a state-of-the-art fibre network in Olds. When Bell Canada, Navigata Communications, MTS Allstream, and Rogers Communications then also declined to provide services, the OICRD established a wholly owned for-profit subsidiary to develop, provide, and operate a full set of triple-play (Internet, telephone, and television) services over the open, passive, OICRD network under the O-Net brand. In July, 2012, Olds became the first community in Canada with community-wide gigabit per second Internet.[75] O-Net became cashflow positive in the fall of 2015 and hasn't looked back since. Their Internet services table appears in Table 13.

Table 13 – Internet Services In Olds, Alberta

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

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

[75] Chung, Emily; *Small Alberta Town Gets Massive 1,000 Mb/s Broadband Boost*; CBC News; 2013-07-13.

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

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

http://youtu.be/Uc_plnE3W5U

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

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

6.2.6 Parkland County

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

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

6.3 General Financial Considerations

6.3.1 Off-balance Sheet Considerations

Whereas traditional business case numbers only consider direct revenues generated by the provisioning of triple-play services in the community, when it comes to Council considerations, a municipality may wish to capture broader community (off-balance sheet) benefits such as positive impacts on the community's quality of life, youth retention, business attraction, and competitiveness (Figure 32). At the Council level, the debate as to whether this new infrastructure will focus largely on private benefits (broadband fibre as a market commodity) or public benefits (broadband fibre as a utility to achieve purposeful public benefits) will be decided. The results will help dictate who should own and control the fibre assets, should a community elect to go that way, and how well the assets will achieve broader public benefits.

In more rural settings, by quantifying and including broader public benefits, fibre can be justifiably deployed far deeper into rural areas than generally realized based on a simple *'internet-only'* case. As can be seen in Figure 32, the inclusion of tangible, public benefits into the broadband business case for a set of First Nations communities in the Wood Buffalo area turned a marginal business case for fixed-wireless into a strong case for fibre.

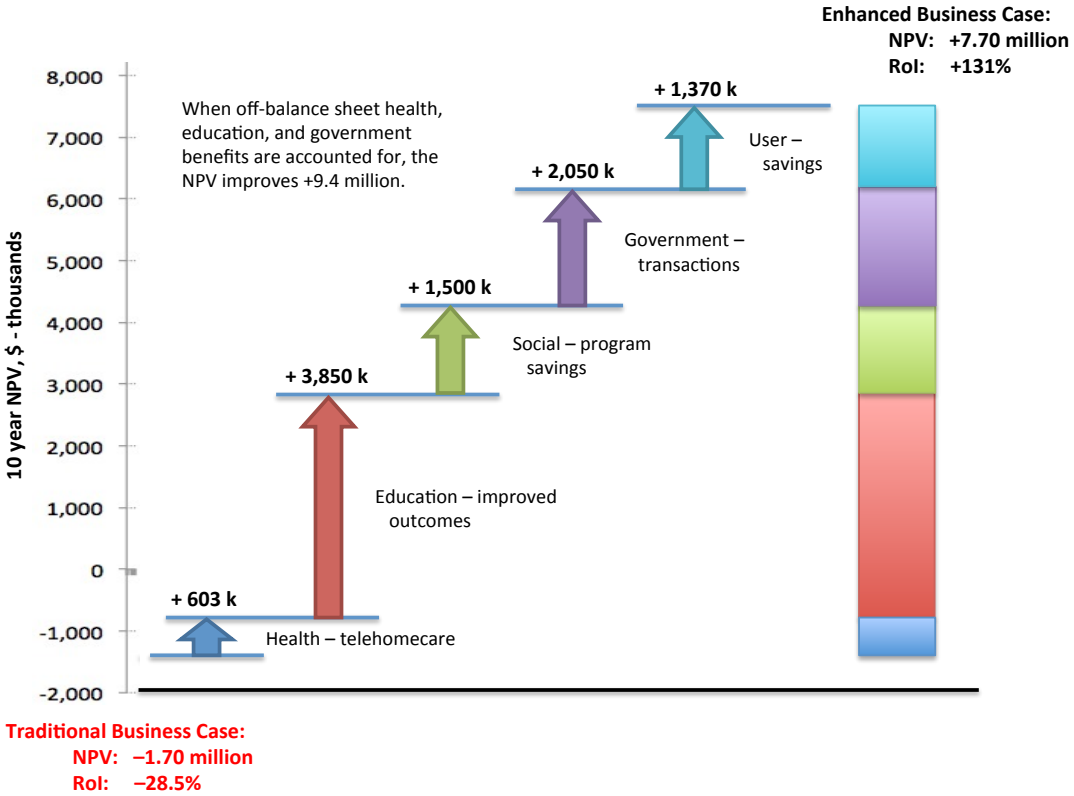


Figure 32 – Benefits assessment for RMWB First Nations.[76]

6.3.2 Wireless versus Wired

Though rural wireless solutions may initially be less expensive to deploy, they are both capitally and operationally more expensive over terms exceeding ten years. As home and business Internet usage tends to increase at rates exceeding 20%/yr, and has done so for over a decade, to meet this increasing demand, capacity must increase over five-fold per decade. Indeed, Neilson's Law suggests that this increase may be as high as 50%/yr for high-end users[77], – which implies that 1 Gb/s connections will need to be generally available by 2020. As scaling fixed wireless systems to keep pace with these demands becomes increasingly expensive, fibre/wireless cost comparisons should be done on a minimum ten-year total cost-of-ownership basis – in which case, fibre is generally found to be the least expensive technology to deploy.

In a sample design for a 200 square-mile rural area in Chamberlain, S.D., Vantage Point Consulting found that whereas the least expensive wireless deployment came in at $370 per Mb/s per client, fibre came in at $9. In this comparison, the wireless network was designed to support 4 Mb/s per client whereas the fibre network could support 1 Gb/s.[78]

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

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

[78] Thompson, L., et al; *Comparing Wired and Wireless Broadband;* Vantage Point Consulting; 2015-05-06.

There has recently been significant press regarding the development and potential rollout of 5G wireless technologies as early as 2020. With peak speeds of 10 Gb/s, the potential seems tremendous. The details, however, are not so encouraging:[79]

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

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

6.3.3 Aerial versus Buried Deployment

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

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

6.3.4 Grant Funding

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

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

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

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

6.3.5 Don't Delay

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

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

Other considerations include:

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

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

6.3.6 Public versus Private Financing

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

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

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

6.4 Business Models

6.4.1 Structure

Referring to Figure 33, counties and municipalities have the option to design, finance, and deploy lit home-run fibre networks to facilitate enhanced broadband services to their business and residential communities. Once the Community-Net (C-Net) infrastructure is in place, the community has several options to obtain services such as Internet, telephone, and possibly television. They can connect directly to a local service provider if one is available (say, CCI or MCSNet) or they can arrange backhaul to an Internet Exchange (IX) facility and there either connect directly to the global internet or cross-connect to an ISP that has a presence at the exchange.

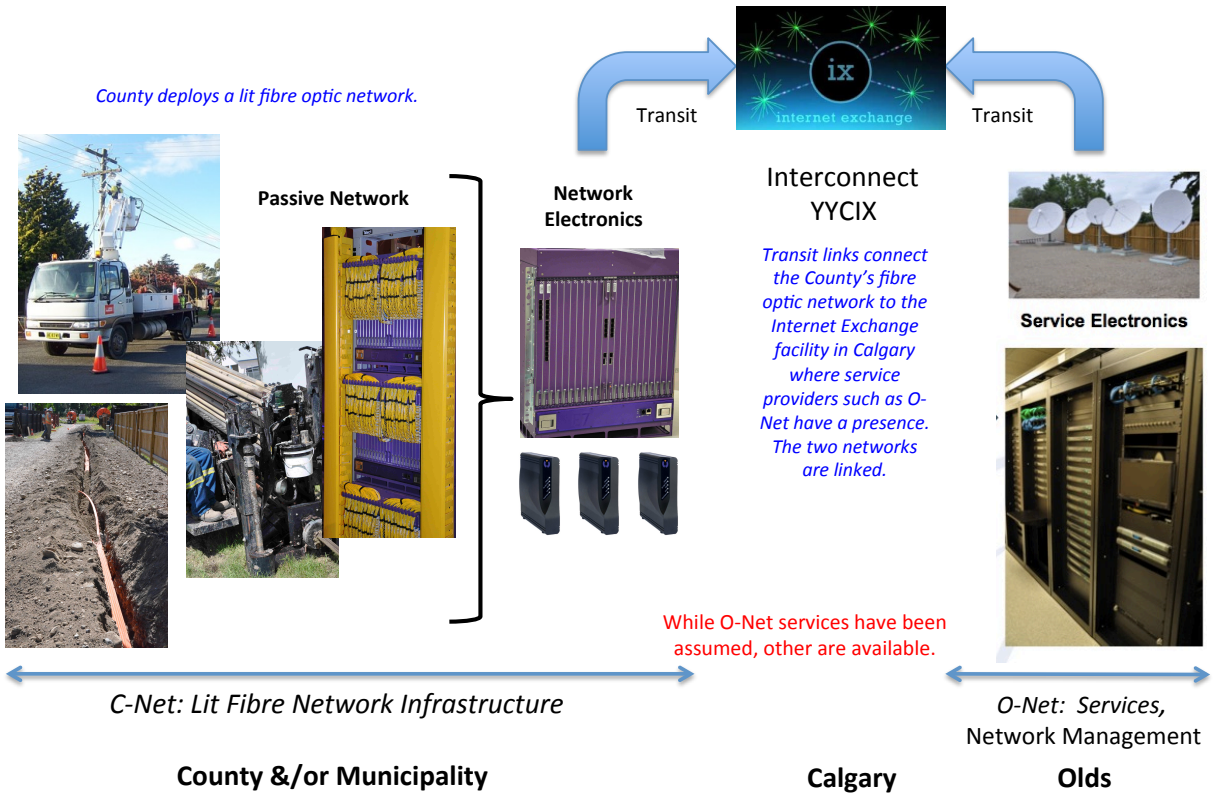


Figure 33 – Components of a telecommunications network.

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

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

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

Should the community choose the retail option, structurally, CommNet (service) and C-Net (network) operations could be one entity. Keeping them separate, however, leaves the door open to running C-Net as a local network utility on an open-access basis – in which case, CommNet may eventually be only one of multiple service providers on the network. Integrating them enables greater operational efficiency, but may inhibit open network operations down the road. In Olds, ISP operations are provided by O-Net and the network assets and operations are run by the Technology Committee of the OICRD.[80]

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

A schematic showing service delivery and money-flows with the wholesale network option appears in Figure 34. Here, O-Net becomes the (initial) retail services operator and pays to use to C-Net to connect with and deliver their services to residential, commercial, and industrial clients in the community. For convenience, C-Net will outsource network operations to O-Net. Network operations includes arranging for client connections (client yard surveys, drops, and opto-electronics) to the network as well as network monitoring, operations, locating, and repair services. Contractor charges for drop installations and cable-cut repairs as well as costs for the optical network terminals (ONTs) required in client premises to connect to the fibre optic cable, including installation, will be billed back to C-Net. Monthly costs for the software required to maintain and operate the ONTs will be C-Net's responsibility as well.

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

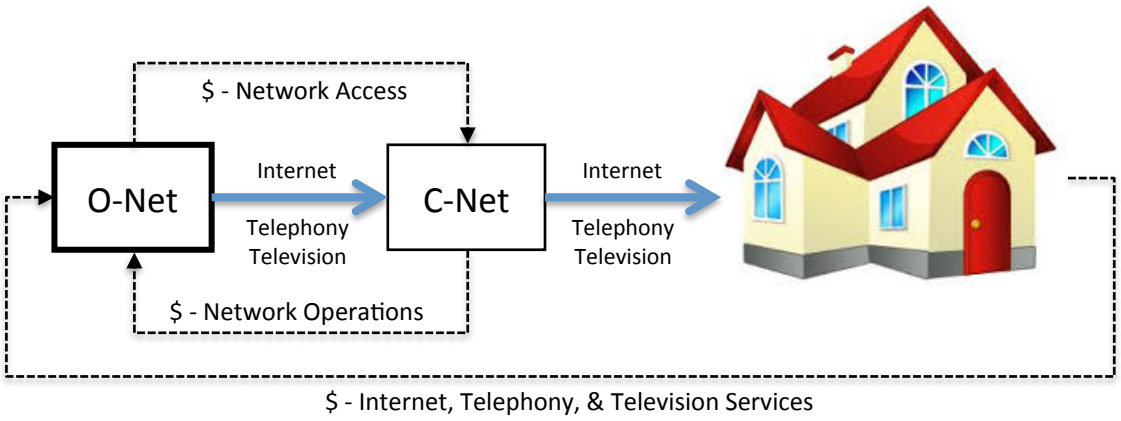


Figure 34 – A wholesale/utility network model.

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

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

6.4.3 The Retail Services Option – CommNet

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

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

A schematic showing service delivery and money-flows with the retail services option appears in Figure 35.

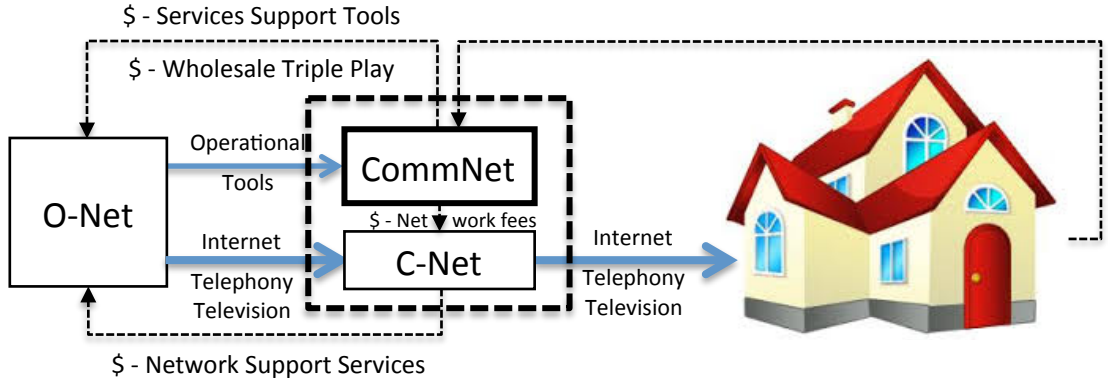


Figure 35 – A retail /ISP business model.

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

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

For the numbers to work financially:

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

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

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

6.4.4 Financial Considerations

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

Strategies to reduce capital requirements include:

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

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

6.5 A Default Model for the Analyses

6.5.1 Context

To avoid repetition in the many analyses included in this document, the default assumptions that will underlie all of them are outlined below. With the same basis for each analysis, comparisons between them are possible. Note though, that there are many options and considerations that go into a region's or municipality's decision to pursue a community fibre network and the pro forma financials presented very much depend on the options selected. Moving from a buried deployment to an aerial one might, if the pole infrastructure in a region is suitable and meets current standards, save an area up to 40% of the initial deployment cost. The default assumptions below are typical, however, and are sufficient to highlight the challenges that communities looking to deploy fibre infrastructure on a utility basis will have to deal with.

6.5.2 Business Structure

Each analysis assumes that the region or community deploys an open-access, lit fibre-optic network that will make world-class, fully scalable broadband infrastructure available throughout the region. In urban centres, the network will pass every home and business, with drops to the premises only deployed when service is orderd. In a region, the intercommunity network will generally connect to each urban centre and enable connections to key ISP towers. Key ISP towers are those that the ISP would upgrade, and thereby improve coverage throughout the tower's coverage area, if fibre to the tower were to be available.

To leverage local ISP capabilities, the wholesale network option is assumed, implemented on an open-access basis, and made available to all ISPs. Hence, the business model assumed for each community network is that shown in Figure 36 below. The local network entity, in this case TAt-Net for the Town of Athabasca network, will be labeled differently for each analysis.

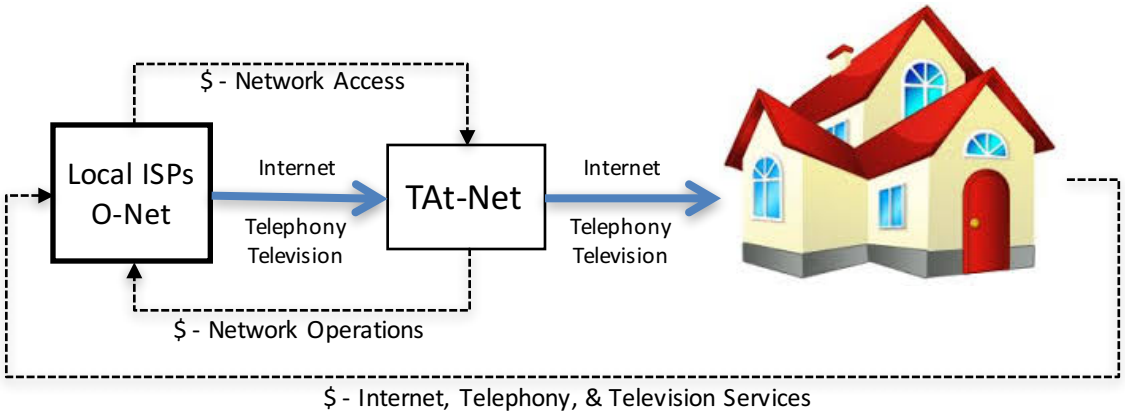


Figure 36 – Utility network model.

To keep things simple, it is assumed that each municipality outsources management of its network to O-Net, simply because O-Net has in-house fibre/opto-electronics expertise. Network operations include

arranging for client connections (client yard surveys, drops, and opto-electronics) to the network as well as network monitoring, operations, locating, and repair services. Contractor charges for drop installations and cable-cut repairs as well as costs for the optical network terminals (ONTs) required in client premises to connect to the fibre optic cable, including installation, will be billed back to, in this case, TAt-Net. Monthly costs for the software required to maintain the network and premise gateways (ONTs) will be TAt-Net's responsibility as well.

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

6.5.3 Deployment Capital

Deployment capital is estimated separately in each analysis. Home-run air-blown fibre architectures are assumed throughout.

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

6.5.4 Deployment Schedule

In general, deployments begin in 2018. Depending on the size of the deployment, it may complete in 1 year or take several. Deployment schedules are outlined in each analysis.

6.5.5 Opto-electronics and Backhaul

In addition to the deployments costs outlined above, capital is required for the opto-electronics and routing equipment required to '*light*' the fibre and establish a functional network, the electronics required in client premises, tools and test equipment, and so on. As the network is deployed incrementally over a number of years (drops are only installed as service is ordered), to provide a breakdown of the overall capital expenditures a cumulative multi-year view is needed. Using the cumulative capital expenditures over the first five years of operation, a breakdown of the expenditures is shown in a pie chart.

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

The backbone connection from the Edmonton Internet Exchange (YEGIX) to the TAt-Net also needs to be sized appropriately. Should only Internet and phone services be offered, a single 250 Mb/s connection would initially suffice. To support television services, a minimum of 1 Gb/s connections would be needed. As the client base grows, the required backbone capacity will increase.

6.5.6 Drop Capital

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

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

Inside copper wiring is simply reused.

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

6.5.7 Markets and Revenue

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

	Residential	Commerical
Wholesale Network: $/mo	80.00	80.00

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

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

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

6.5.8 Operations

The operational costs for wholesale network operation are straightforward as most are handled via outsourced contracts. Once the network build is completed in 2018 and the target penetration rates are realized, operational costs stabilize and a view of those calculated for 2022 are presented.

6.5.9 Financial Projections

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

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

Table 14 – Assumed Financial Parameters

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

Grant Funding	
Grant funding	0

Contingencies	
OpEx contingency	0.00%
CapEx contingency	0.00%

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

Long Term Loan	
Loan Principal Limit	5,000,000
Term, yr	25
Interest rate	3.076%

Short Term Loan	
Loan Principal Limit	800,000
Term, yr	7
Interest rate	2.430%

6.5.10 Options to Improve Financial Margins

Options to be considered to improve profit margins include:

- Partner with neighbouring communities to increase operational scale.
- Assist your ISPs with marketing to increase penetration rates above 50/70%; support efforts to create a '*culture of use*' among residents and businesses.
- If the power poles in the region are in good order, an aerial deployment would reduce deployment costs by 40%, thus decreasing the required debt load and repayment schedule.
- Reduce the debt service payments by perhaps (1) obtaining grant funding, (2) attracting local capital, or (3) covering some of the build (say the drops) via the tax roll.
- The wholesale network access rate is set to $80/mo/subscriber. While this could be increased to $85 or $90/mo, the higher rates decrease service provider margins. Other charging arrangements are also possible. B-Net, for instance might charge a much lower rate, but on all serviceable premises, regardless of how many take service.
- Reduce operational costs by leveraging local resources and staff or outsourcing to a competent service provider.

The actions above provide proactive ways that a region or urban centre could manage financial risks and create a path toward financial sustainability of their fibre operation.