# Southern Alberta Connectivity – Concept

The concept described below anticipates that certain municipalities along the:

- TransCanada Highway 1 corridor from Banff through Calgary to Medicine Hat to Walsh on the Saskatchewan border,
- Crowsnest Highway 3 corridor from Lethbridge to Medicine Hat, and the
- Highway 2 corridor from near Okotoks to Lethbridge

as shown on the map below, would arrange to:

- acquire a long term (twenty or thirty-five year) indefeasible right of use (IRU) on two dark fibres along each of these routes,
- access and light the fibre,
- operate the network and supply inexpensive wavelength-based backhaul services from each interested municipality to YYCIX at DataHive in Calgary, and
- establish an entity to finance, govern, and operate the network.
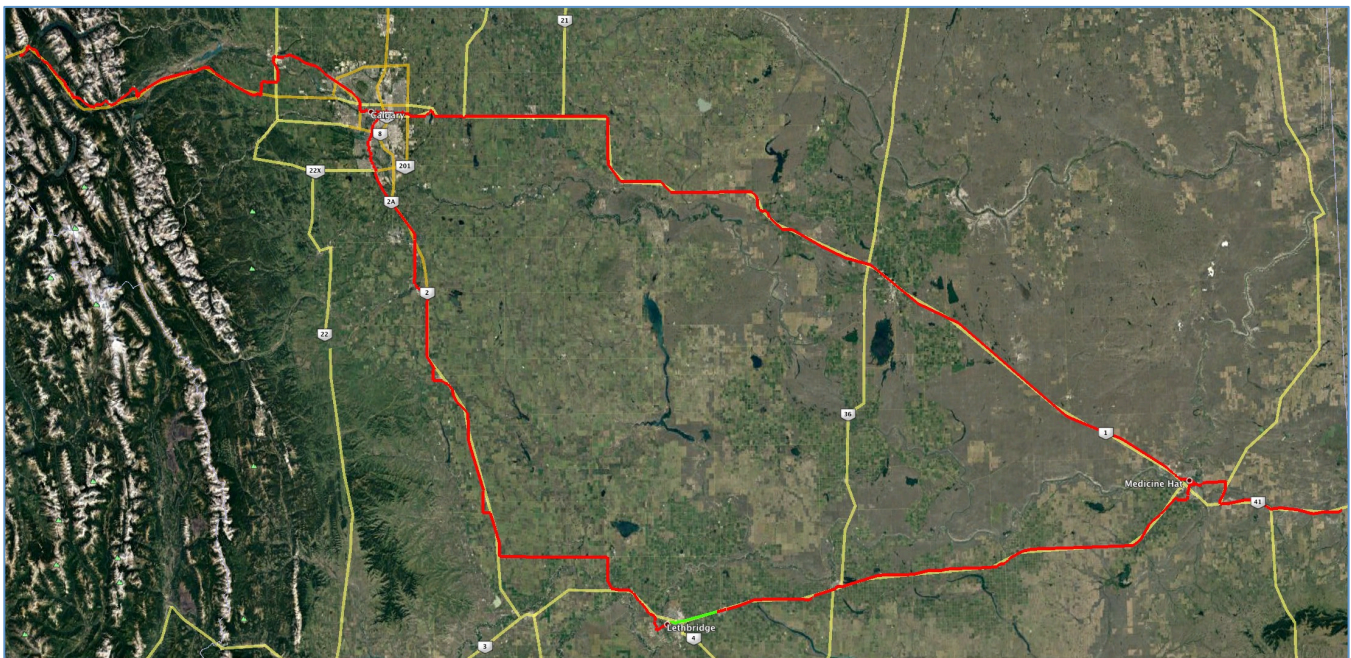
With inexpensive, long term backhaul capability, municipalities in southern Alberta will be better able to establish utility fibre and wireless access networks and operate them on a financially sustainable basis, providing enhanced competition, reach, reliability, and affordability to users.

As many communities have yet to establish plans to enhance broadband services, the ownership and governance structure must accommodate growth (i.e., increased numbers of participating municipalities over time).

Simplicity is key. Only one operational entity would be established and only wavelength-based services would be provided. With current technology, eighty wavelengths are possible on each fibre and each wavelength is capable of 100 Gb/s. Each participating community would get its own wavelength(s) that would connect it directly to YYCIX.

Context

Background

Municipalities throughout southern Alberta have been reviewing their options to enhance broadband connectivity and services for some time. Key to many of the more do-it-yourself (DIY) options is reducing the cost of the backhaul services needed to link local networks to an Internet Exchange Facility. Generally, municipalities had imagined there were only two backhaul options available. However, as we found out from David Basto (City of Calgary), in southern Alberta, there are actually three:

- *Build your own network:* deploy fibre, add opto-electronics, and either establish or outsource operations. Deploying fibre is expensive so typically only makes sense for large telecom providers and ISPs. At $60/m, it would take some $51M to deploy fibre along these three cross-sections.
- *Contract for lit fibre services:* a turnkey services-only version of the build option above that is from TELUS, Shaw, Bell, or Axia. While hassle-free, lit services are based on the bit rate required. A 10 Gb/s service, for instance, would cost 3-4 times that of a 1 Gb/s service.
- *Lease dark fibre:* obtain a long term (20 or 35 year) lease on dark fibre strands in existing cable, add opto-electronics, and either establish or outsource operations. As these leases are based on distance, once the circuits are established, a 100 Gb/s service costs about the same as a 1 Gb/s service.

Building is expensive, but managed lit services are too, and the costs of the latter increase with the bandwidth required. Dark fibre, however, provides a stable long term bandwidth independent pricing option.

The Palliser Economic Partnership (PEP) initially jumped on the dark fibre opportunity and then the Calgary Regional Partnership (CRP) followed. As the initial PEP requirements were focused on the Calgary – Walsh segment, the initial cost evaluations were developed only for that segment. Cochrane then spearheaded interest in the Cochrane – Banff segment and an analogous set of numbers was generated. In both cases, the potential savings were signficant, and particularly so when large bandwidths were required.

Just as the initial cost evaluations were completed, Electric Lightwave (ELW) was acquired by the Zayo Group. After some initial uncertainty, it became clear that Zayo was interested in supporting the dark fibre initiative they inherited with the acquisition. With the new owners, came several new possibilities:

- in addition to the 20 year IRU term from ELW, they would support terms up to 35 or 40 years.
- Zayo had its own dark fibre routes which could be used to augment the options available from ELW. In particular, their route on the Calgary – Lethbridge cross-section was indeed superior and is now the one being quoted. This alternate route picks up High River, Clairsholme, Stavely, and Granum, and is closer to Okotoks.
- Zayo will also quote on providing and installing the required opto-electronics and then operating the network on our behalf.

Though the opportunity to form a ring (Calgary-Medicine Hat-Lethbridge-Calgary) had been recognized, the ELW routing south of Calgary ran east of the most interested communities, namely Okotoks, High River, Black Diamond, Turner Valley, and western portions of the MD of Foothills. Two gaps in the routes remain:

- Coaldale to Lethbridge
- Cochrane to Calgary

Zayo will quote terms to run fibe to link Coaldale and Lethridge and has an option to do a fibre swap with Shaw to cover the Cochrane to Calgary cross-section.

Zayo's quote is due the week of May 1 and will provide costs for three options:

- Dark fibre IRU only, and
- Lit fibre IRU that we operate, and
- Lit fibre IRU that they operate.

Infrastructure Details

In terms of infrastructure, the available Zayo / ELW fibre is a bit of hodge-podge. While for most of the routes we're focused on, Zayo owns the cable – which includes both the sheath and all the fibres within it – on some cross-sections, most notably in the Medicine Hat area, their fibres are in a Shaw cable and for the Chestermere to Calgary leg, they own fibres within a Bell cable. As well, as mentioned above, there are two gaps in continuity. While their proposal will cover both, neither terms nor conditions are yet known.

Fibre Strands

Sheath
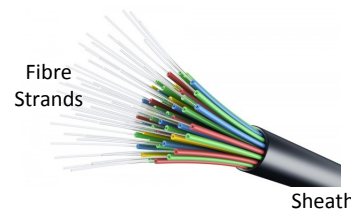
On all routes considered, the cables were direct buried, likely some twenty years ago. Had the cables been in conduit, upgrading to cables with more fibre strands would have been straight-forward. With direct buried cable, upgrades essentially require new builds.

When ELW acquired the fibre assets last summer, the fibres were tested for integrity and loss and all were within acceptable limits.

As our requirements solidify and our draft designs mature, we will require access to the the ELW fibre at various points along the routes. Where appropriate breakout points are not available, ELW has said it could make them available for about 15k/access point – to deploy a pedestal or cabinet and break in to the fibre bundle. To help with this, I have asked Optelian to provide some budgetary quotations on the equipment needed to light the fibre and run services over it.

Opto-electronics

As a single fibre can be divided into 80 individual channels, each capable of carrying up to 100 Gb/s, two fibres on any route will be sufficient – one to carry signals in each direction. The carrier-grade opto-electronics required to light the two fibres could initially be provisioned to support 40 wavelengths and then upgraded to add another 40 when needed.

Though break-in points and the associated opto-electronics required at each are rather expensive, burying new fibre along the route is likely more expensive. Hence, in many cases, when breakouts are required in close proximity – say 10 km apart when the signals could travel 200 – makes more sense than laying additional fibre.

When designing the network, the opto-electronics placed at each site depend on the distances between the sites being serviced. If the sites are several hundred kilometers apart, high-powered lasers, amplification along the route, and compensation for signal distortions (dispersion) will be required so that the received signals can be detected without errors. If an intermediate site, say half-way between the initial two is then added, the the laser power, amplification, dispersion compensation, and receiver sensitivities at each site will need to be adjusted (or changed out). If not, the high power laser signal arriving at the new intermediate site may burn out the receiver's electronics.

Redundancy

With the potential bandwidth that the proposed network will carry, some form of redundancy is required. Typically, this involves setting up the fibre routes into rings so that if the ring is cut, the signals simply travel to the destination in the opposite direction. If a ring cannot be established, then diverse alternate routing paths will need to be established via contracts for lit services from an ISP provider. To minimize costs, the diverse routes are often under-sized – in which case the higher priority traffic is protected and the lesser priority traffic-may not be. Should many communities along the route move forward with utility fibre systems and the required bandwidth requirements become significant, it may be less expensive to acquire the dark fibre strands from Calgary to Lethbridge and from Lethbridge to Medicine Hat to protect (by providing a geographically diverse fully redundant path) the traffic on the initial Calgary – Medicine Hat leg. Lit fibre contracts would still be needed to protect traffic on the two 'extension' loops from Calgary to Banff and from Medicine Hat to Walsh.

As there is significant interest for fibre in the communities southwest of Calgary, a second ring could be established to protect Cochrane traffic by constructing a new fibre route from south of Cochrane to Redwood Meadows, Bragg Creek, Priddis, and back through Okotoks to connect with the Calgary – Lethbridge route. The fiber could be routed to pick up Black Diamond and Turner Valley, but either way, the distances are extensive and the build would be an expensive one.

Comparative Costs

The preliminary evaluation of this opportunity consisted of developing two sets of cost comparisons for backhaul services served by dark and lit fibre solutions – one for the Calgary – Walsh route, and one for the Cochrane – Banff segment. Until the business model has been agreed to, developing business case numbers is not possible. Due to the uncertainty around which, if any, communities might move ahead, the comparisons were done for several deployment scenarios. Neither took redundancy requirements into account.

Once the budgetary proposal is received from Zayo (expected in mid-June) and a draft business model has been established a more comprehensive evaluation will be required.

Framework – For Discussion Only

Vision

Ubiquitous availability of unencumbered multi-Gb/s broadband connectivity to every premise in southern Alberta.

Mission

Provide cost-effective, bandwidth insensitive, carrier-grade connectivity between all communities and back to a global gateway.[1].

Suggested Values

Courtesy of some work by the Rotary Club in Cochrane:

Accountability:	We conduct ourselves with integrity in a responsible manner to build trust and confidence.
Customer Service:	We serve the public interest with a positive attitude.
Fun:	We believe that the use of respectful humour, laughter, and plain old fun are important and that it contributes to our individual and organziational well-being.
Healthy and Safe Working Environment:	We enhance the quality of life by minimizing risk and creating an environment where people are valued as individuals.
Innovation:	We are a creative leading-edge organization that embraces new ideas and new technologies.
Open Communication:	We communicate openly, respectfully, and promptly.
Participation:	We achieve productivity and success through involvement, teamwork, and recognition.

Principles

- For-profit company to recognize, and reward for, the risks being taken by municipalities putting in the required capital
- Owned by municipalities, and possibly REDAs (e.g., CRP, PEP) and public institutions (e.g., Medicine Hat College), for municipalities, public institutions, and their "partners" (e.g., EIDnet in Newell).
  - While ISPs and other private interests may come in as clients, they cannot become owners.
  - Control of the signal distribution from any breakout point will be up to the municipality to which the signal is provided
  - Support or access should not be granted to ISPs or entities that wish to compete with any utility-based network offerings supported by the municipalities
- Each community must pay their own way. Contributed equity will be based on required IRU and deployment capital.
- Communities entering later must pick up the entire cost of entry, so those already in will not be required to ante-up additional funds.
- All proceeds will be fairly distributed based on the share structure established.
- Service pricing will be cost-based and operations and service sets will be kept as simple as possible.
- All services are carrier-grade and quality-of-service must at least equal industry norms.
- Only wavelength-based services are offered.

[1] For Southern Alberta, this would be to YYCIX in Calgary.

Scope

- Southern Alberta, largely focused on the available dark fibre.

Evolution

For those on the Calgary–Medicine Hat–Lethbridge–Calgary loop plus Cochrane:

- **Phase 1 – (2017) Immediate Requirements:** Acquire two strands of dark fibre on the Banff to Walsh route (Zayo has a solution with Shaw to get from Cochrane to Calgary, so the route is continuous) and then construct and deploy equipment to service just those communities who are in now: Cochrane, Chestermere, Strathmore, Brooks, Cypress County, and Medicine Hat College. We'd strongly recommend that each of these communities retain their current connectivity services back to Calgary (perhaps with reduced bit rates) for redundancy during this phase.

  - Cochrane might finance the YYCIX to Banff component. The other communities would finance the YYCIX to Walsh component.

  - Though none of the eastern communities require the Medicine Hat to Walsh leg, that fibre would otherwise be stranded so the incremental cost of including it is likely minimal.

  - All communities on the eastern leg would contribute equally, even though their routes back to Calgary vary. The rationale for this is that the entire YYCIX – Medicine Hat route will be required for redundancy to protect all communities on the (eventual) triangle.

  - Access points in Phase 1 would be provided for only those communities participating.

  - As this route is not redundant, no additional breakout points can be placed until the ring has been established.
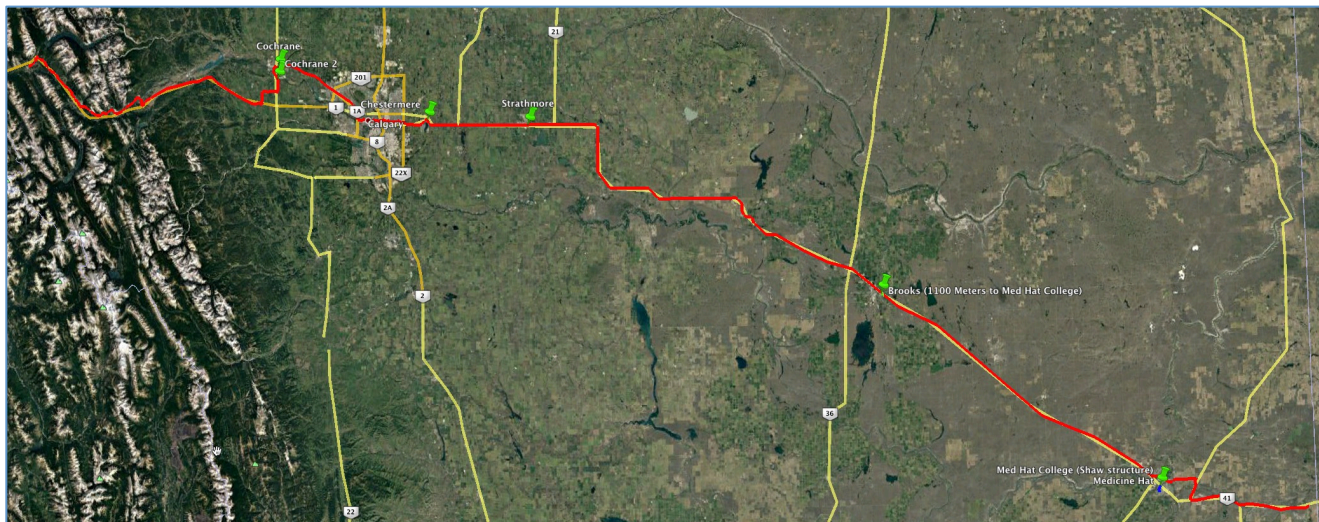
- **Phase 2 – (2018) Redundancy:** Acquire the Medicine Hat–Lethbridge–Calgary route and light it to provide full redundancy for those communities on the ring (this excludes Cochrane).

  Initial access points on this route would be provided in Bow Island, Lethbridge, High River, Aldersyde (which involves a short build), and east of Okotoks (Zayo's also quoting a build cost into Okotoks). Once operational, the legacy redundant systems in Chestermere, Strathmore, Brooks, and Medicine Hat College could be discontinued.

- The cost effectiveness of this approach to redundancy will need to be verified once the budgetary quotation from Zayo is received.
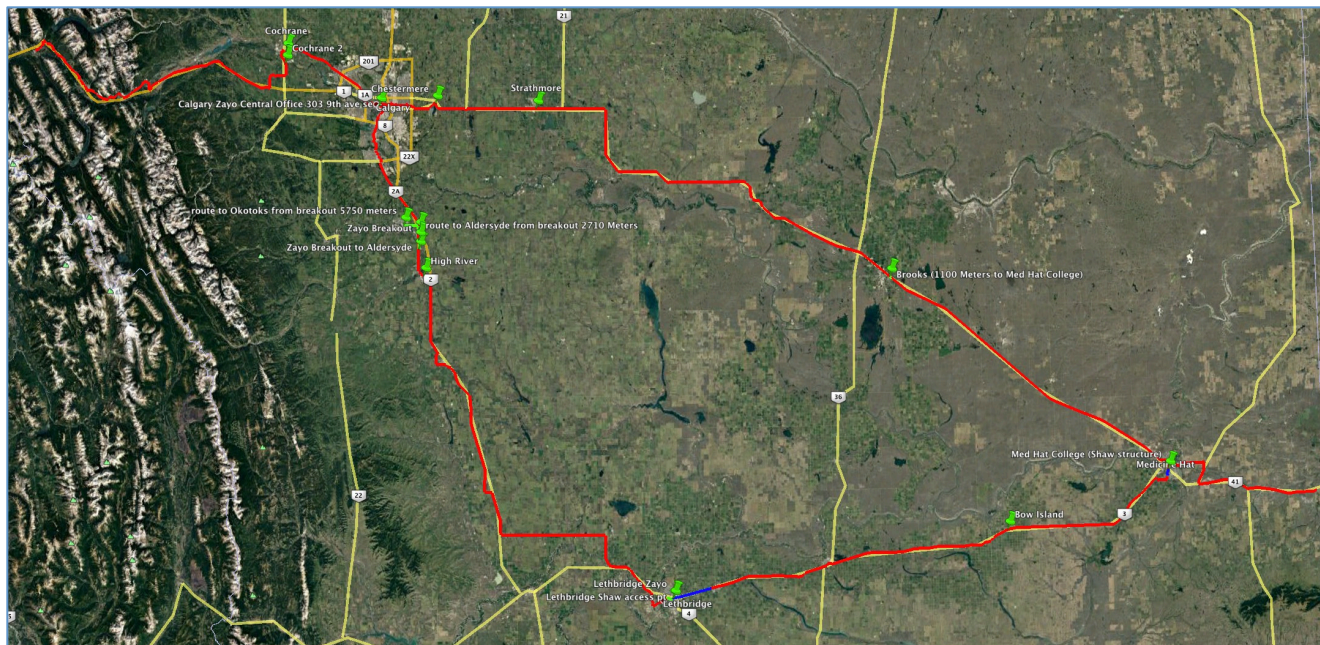
- **Phase 3 – (2020) Second window to join:** any of those communities on the loop – Gleichen, Bassano, Tilley, Suffield plus Seven Persons, and Grassy Lakes – could join.
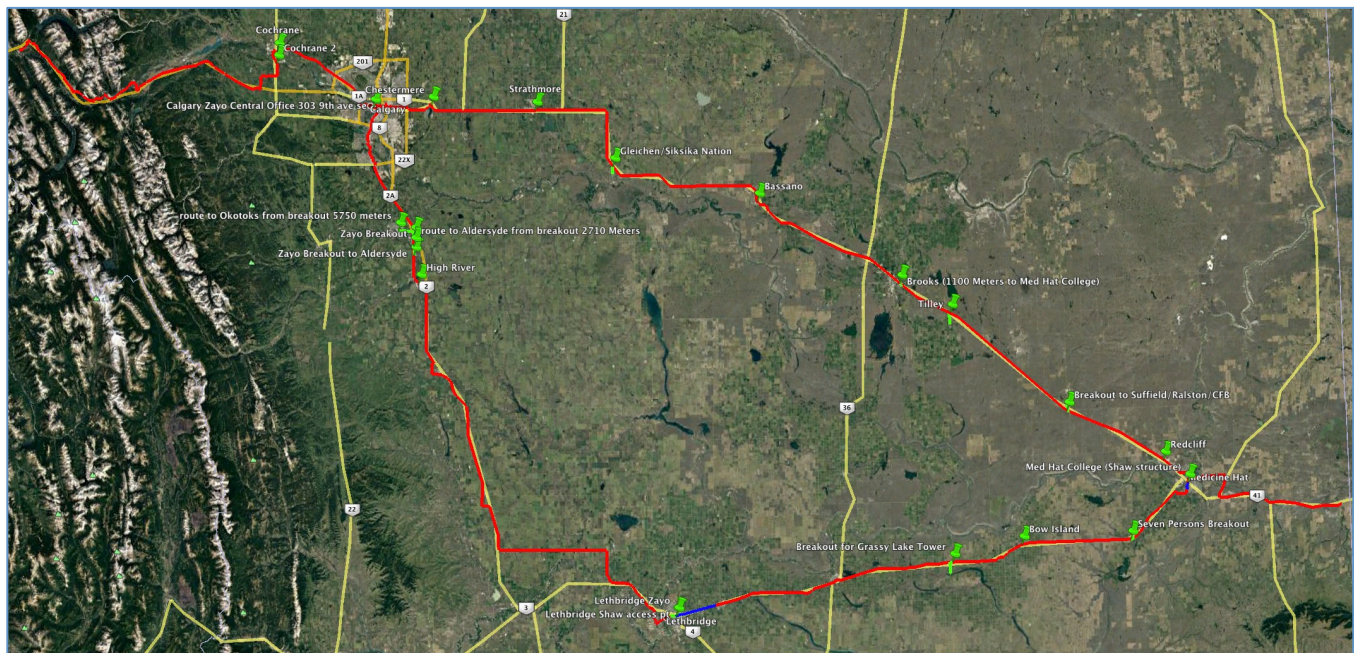
From the above loop there are three potential extensions which can be scheduled whenever the communities along those routes can get together and agree on timing:

- **Extension 1:** Though the Calgary-Banff leg was acquired as part of Phase 1, only Cochrane participated. Should Banff, Canmore, Exshaw, and Morley be interested, breakouts could be deployed and equipment added when these communities elect to move ahead. It may also be worth adding a breakout near Hwy #22 going south to Redwood Meadows/Bragg Creek, but that can be looked at later. Closing the loop via connections through Calgary is easy/inexpensive. Anything to close the loop or create a second one via Redwood Meadows, Bragg Creek, Priddis, Turner Valley/Black Diamond is going to be expensive.
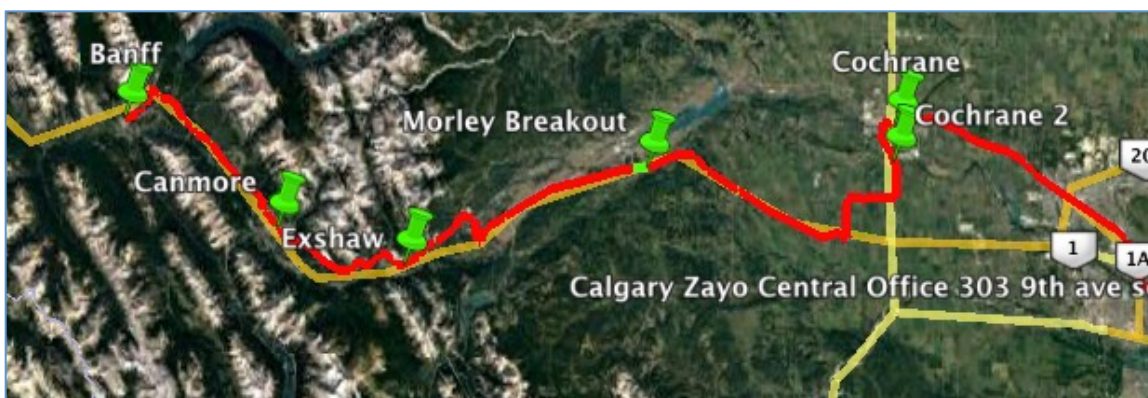
- **Extension 2:** Again, though the Medicine Hat–Walsh leg was acquired as part of Phase 1, nothing east of Medicine Hat College in Medicine Hat was built or lit. Should breakouts at Dunmore, Irvine, and Walsh, be needed, as with Extension 1, they could be added when the communities are ready

Ownership Structure

Ownership would be recognized by issuing shares in proportion to the amount of capital required for each municipality, REDA, or public institution to establish service. Initial members would presumably be issued Class A common shares and each municipality would get one seat on the board.

- Communities coming in later could be issued different classes of shares which may be voting or not.
- Presumably the voting structure would established to ensure that the initial members do not lose control of the Board.

With the support of the local municipality responsible for distributing the signal from the associated breakout point, an ISP could be provided service to connect a tower or other facility.

Based on some work by an Alberta community, some potential share classifications for the different stakeholders in the company, present and future, might be:

a. Initial Members
    i. Class A- $1000, common, voting 1 vote
    ii. Class B - $1000, common, voting 5 votes
    iii. Class D - $500, common, non-voting, 0 votes
    iv. Class G – preferred, voting, $600, 5 votes
b. Other communities
    i. Class A - $1000, 1 votes
    ii. Class H - preferred, voting, $600, 1 vote
c. Outside, local investors
    i. Class C - $1000, common, voting, 1 vote

Not all these may be needed and some calculations will be needed to evaluate the number and type of shares that would be required to meet the organization's objectives.

Business Model

The operation will provide each owner/member community with a wavelength service to/from YYCIX and a local breakout point. Control of the signal distribution from any breakout point will be up to the municipality to which the signal is provided. Support or access will not be granted to ISPs or entities that wish to compete with any utility-based network offerings supported by the sponsoring municipalities.

Service pricing will be cost-based plus a margin percentage. Costs will be inclusive of operations, principal payments and debt servicing. If a community takes two wavelengths, then they pay for two services. Margin on costs for services to private or non-owner/member entities will be higher.