Building First Nation Owned and Managed Fibre Networks across Quebec

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Abstract: In Canada, small rural and remote communities continue to struggle to access equitable and affordable high speed internet connections that address local priorities and needs. The First Nations Education Council (FNEC) is working with their community partners across Quebec to plan and operate a First Nation owned and managed fibre network to deliver broadband connections throughout each community. Public and private partnerships were established by FNEC to fund and construct the regional and local networks connecting these rural and remote communities. The paper describes the history of this development along with its future goals. Sharing infrastructure and network support services with all the other service providers (health, education, administration, justice, policing, homes, etc.) in each of these communities helps to sustain the ongoing operation and maintenance of the network.

Introduction

First Nations are politically autonomous Indigenous communities in Canada. In the province of Quebec, many First Nations have territories located in rural and remote regions where commercial telecommunication companies currently have weak or no broadband infrastructure. Because First Nations are politically autonomous, they need - whenever possible - to have control over the services and infrastructure in their communities. Given this geographical and political situation, First Nations in Quebec are building their own fibre network. This "first mile" infrastructure is an essential communication link for these First Nations as they build healthy, sustainable local economies for future generations (McMahon R. et al., 2011).

All across Canada, small rural and remote communities continue to struggle to access equitable and affordable high speed internet connections that address local priorities and needs. As the demand for more bandwidth increases in all sectors in every community, regional organizations are working with community partners to identify and develop strategies to effectively address this challenge. First Nation communities are creating innovative solutions to ensure their service organizations and members are able to access adequate high-speed connections that accommodate local requirements.

Quebec covers a very large area; the southern half of Quebec would absorb five of the smallest Canadian provinces combined. To accomplish the fibre build in Quebec, First Nations are working with their regional organizations to build and manage their local broadband networks supporting their information and communications technologies (ICT) (Whiteduck, T., 2010; Whiteduck et al., 2012). The First Nations Education Council (FNEC) is a regional First Nation organization located in Wendake First Nation, Quebec, that represents 22 First Nations in the province, most of which are in rural and remote locations. FNEC also works with other regional First Nation networks and communities in Quebec. In total there are 30 First Nations in Quebec partnering with FNEC's Technology Department to access their different network services.

Appropriate telecommunication infrastructure is a critical economic requirement in the First Nations working in partnership with the First Nations Education Council. First Nations need reliable telecommunication infrastructure to effectively deliver and support social and economic development opportunities. These rural and remote First Nation communities, accessible only by driving to the end of the road, have homes and facilities usually located near the water system that historically served as the main transportation system in days gone by. Internet connections in homes is a great benefit and is required in each of the communities but the most important aspect of broadband connectivity for these hard-to-serve First Nation communities is the provision of essential services such as e-Governance, e-Health, E-Education, E-Justice, ie the e-Community model supported by the Assembly of First Nations (Whiteduck, J., 2010).

FNEC is working with their First Nation community partners across Quebec to plan, build and operate a First Nation owned fibre network to deliver broadband connections throughout each community. Public and private partnerships are being established by FNEC to fund and construct the regional and local networks connecting these rural and remote communities. This paper describes the history of the development of FNEC fibre network and its future goals.

Background to the Fibre Build

Since its establishment in 1985, FNEC has been working with its 22 member First Nations to build a quality education system for First Nations children. In their vision statement on their web site at http://cepn-fnec.com, FNEC: "will ensure that the goal of quality, holistic education, as defined by our members, and attained through complete jurisdictional autonomy over our education programs, will be achieved in a spirit of collaboration, respect, sharing, and commitment". It was in this spirit of cooperation and collaboration that the First Nations leadership directed FNEC to begin supporting ICT development to serve their schools, students and staff in 1998.

Significant improvements in Internet connections were made through the national First Nations SchoolNet program. The primary objective of this program was to improve and sustain broadband connectivity services to First Nations-operated schools across Canada. In doing this work since 2003, FNEC developed a regional network that

successfully integrated information and communications technologies (ICT) into the First Nation member schools of FNEC network. Two fundamental goals were successfully achieved through this program: a) the upgrade to high-speed Internet in the schools and b) the installation of videoconferencing services.

The needs identified and the financial resources available at the time led FNEC to opt for the creation of a private high-speed Internet network with a minimum bandwidth of 1.54 Mbps (called a T1 connection by the telecom industry), using existing transportation infrastructures (essentially telephone cables and microwave networks). In all, 17 communities and 23 schools in Quebec and Labrador took part in the project which particularly facilitated the installation of videoconferencing services and enabled certain communities to be connected to a high-speed Internet service. The number of partner First Nations and schools could have been significantly higher if all the communities had been able to access to these equivalent telecom services.

Aside from the schools, other organizations from participating communities quickly showed an interest in videoconference services and accessing the T1 connection as they too were in need of high-speed Internet service. Certain federal government departments, including Health Canada, demonstrated their interest in the use of these technologies and community connections. In addition, other communities also expressed an interest in joining the network.

The development of the T1 project enabled participating schools to make significant savings, especially by reducing travel expenses by using ICT - particularly videoconferencing - as an alternative means of meeting and accessing resource people. The T1 network also made it possible to access and use all the potential of high-speed Internet connections. As a result, FNEC and the First Nations identified additional projects for Internet use that require increased bandwidth. However, the T1 network was set up on the network of existing telephone companies infrastructure (except for a few exceptions), which greatly limited bandwidth, meaning the capacity to transmit digital information. Only the installation of optic fibre would make it possible to significantly increase bandwidth.

Building the Fibre Network

In 2007 FNEC proposed the creation of a new fibre optic installation program in order to increase the effectiveness and the potential of its network. This project was entitled *Vision 2007: Broadband Information Highway for the First Nations of Quebec and Labrador* and proposed to provide the First Nations communities of Quebec and Labrador with broadband Internet connections that could reach speeds as high as 100Mbps, thus opening up a whole new world of possibilities. As a result of this proposal, from 2007 to 2009 FNEC was able to raise $1.3 million with 75% coming from Health Canada to develop local (internal) fibre networks in eight First Nations. The external connections outside of the First Nations reaching telecommunication providers networks still required some work to deliver the required bandwidth to each First Nation fibre network. By 2009, FNEC completed fibre development and deployment into 6 First

Nation communities (Wendake, Gesgapegiag, Listuguj, Kitigan Zibi, Odanak, Wôlinak) and two other projects were in development (Kanesatake and Wemotaci). FNEC led the expansion of connectivity services to other sectors and the deployment of fibre optic community-based installation.

Sharing infrastructure and network support services with all the other service providers (health, education, administration, justice, policing, homes, etc) in each of these communities helps to sustain the ongoing operation and maintenance of the network. The e-Community framework endorsed by the First Nation leadership at the Assembly of First Nations (Whiteduck, J., 2010) is now being deployed and supported by the First Nations Education Council.

The high level of collaboration, commitment, expertise, and leadership demonstrated by FNEC's IT department to complete the first phase of the fibre construction project supported both their member First Nations and the government to invest in the next phase of development. Establishing the proper private sector partners who were able to complete the fibre construction work and networking requirements helped convince the remaining FNEC partner First Nations that their communities needed equitable access to fibre and FNEC network.

In the spring of 2010, FNEC updated their Vision 2007 and submitted a successful funding proposal to the First Nations Infrastructure Fund (FNIF) of Aboriginal Affairs and Northern Development Canada (AANDC). Their proposal for broadband infrastructure construction funds was based on the mandate provided by the Chiefs of FNEC partner First Nations to secure appropriate broadband communications technology and systems to serve the present and future needs of the First Nations. FNEC was able to secure funding of $4.4 million from the FNIF to continue the work to construct internal fibre networks connecting the main administrative buildings in their partner First Nations. In some cases this funding also supported the interconnection with the regional telecommunication provider's fibre networks to deliver a private network connection back to FNEC core hub located in their offices in Wendake.

Before the fibre build, the established broadband applications were using all the available telephone circuits and bandwidth that the regional telecom provider could deliver to the First Nations. The infrastructure required a major upgrade to accommodate additional bandwidth demands that new broadband applications were placing on these legacy technologies. The telecom network design before the fibre network became available was only able to provide end-of-the-line connections without any self-healing and network diversity capabilities. In this regard it failed to provide the level of redundancy required to accommodate essential monitoring and program delivery services such as water, fire, e-health and administrative responsibilities needed in the First Nations communities. The existing diesel generated electricity for the repeater tower sites required to reach the First Nations demanded ongoing monitoring and maintenance while consuming massive amounts of energy and fiscal resources to operate. These infrastructure challenges created the opportunity for the First Nations to begin planning and constructing their own fibre network.

The new fibre optic cable backbone selected through an open competitive process as an energy efficient, green technology addresses all the short and long term telecom and broadband IP needs and the broadband internet communications needs of the First Nations partners in FNEC construction project. The local connectivity solution that was put in place in partnership with FNEC is proving itself as a long-term viable and sustainable network option for this harsh environment. Some of the partner First Nations are using either a local cable or a wireless network to reach the residential sector in their communities. The local distribution system is a "closed" system, virtually eliminating any interference and is inherently more secure. Several of the communities currently work with a private cable television service. All the systems are 'inherently designed' with future growth capacity and can accommodate 'cable' services, readily connecting any new home and institution. Modem 'drops' are in place to every building ensuring that everyone has access to the network. Adding new drops is locally supported with the simple installation of a cable or wireless modem. Local First Nation IT network technicians are being trained to complete new installations as required.

The fiber/coaxial network system's management is text console driven (from any computer) and is easy to maintain from remote locations and has automated scripts for routine maintenance. Typically, most of the regional network maintenance and monitoring is currently being handled by FNEC for the First Nations communities. Local network management is completed by a local technician using a web-based interface for adding, suspending, removing the household modems. The network is carrier class equipment that is specifically designed to deliver reliable, error-free access with a range of speed and priority classifications. Some of the First Nations are presently providing Voice-Over-IP services throughout their community for their local and organizations telephone service. Customer Premise Equipment (CPE) or 'subscriber endpoints' for cable and wireless solutions are readily available, ensuring that the system can grow faster and easier with the new fibre backbone. Subscriber installation is easier (less technical or physically demanding – once the drops are completed) and can be done by local Band personnel with minimal training.

FNEC Fibre Connections

Today's demand for broadband services in First Nations presents complex challenges as technologies continue to evolve. Given the fact that the majority of First Nations are located in rural and remote parts of the region, a gap remains in terms of the level of technology integration locally. Reasons for these gaps are broad, and range from local issues such as poor telecommunication infrastructure to the lack of a unified approach regarding resource support. The existence and level of expertise to foster technology integration in First Nations is a critical component in bridging these gaps in order to enable First Nations to develop and sustain their technology implementations.

Certainly local capacity can only exist or even develop if these technologies and the support systems have arrived in these areas. For years, First Nations advocated to government their need for infrastructure support that would enable them to implement or improve local infrastructure to all of their public sectors. Furthermore these

improvements must also address the social and economic needs for the general public, therefore concluding that the only possible approach to this issue is a holistic one. First Nations require that they own, control, access and possess (AFN, 2007) the infrastructure required to support their applications that demand on these communication networks.

As referenced earlier the Quebec First Nations and the government agencies serving them now rely on the communication and information facilities provided by FNEC under the First Nations SchoolNet program that began reaching their communities in the late 1990's. The reliance on these technologies and applications continue to evolve and expand, demanding reliable infrastructure and additional bandwidth in all sectors. The effect of the technology in the First Nations is pervasive and has built new foundations under services such as governance, health, education and justice. The technology is also essential for monitoring essential services such as water treatment and power generation along with all the other facilities in the communities.

FNEC developed working and resource partnerships that have extended technology support services and the broadband application, for example videoconferencing, to other public sectors in First Nations. It is this form of development and unified approach that needs to continue in order to develop and remove the broadband disparity that exists in many First Nations in Quebec. More importantly, the federal government needs to realize and carry out new measures of permanent support for First Nations that enables them to sustain and support their technology implementations.

FNEC Benefits for its Partners

The advantages of a regional network implementation, is that it simplifies configuration and support aspects while reducing the equipment requirements. Since all communities connect centrally to FNEC office, services are immediately available to all points along the network. FNEC is now a recognized leader in the domain of videoconferencing across Quebec and offers the complete suite of videoconference / audio conferencing services which include bridge management, recording, and video streaming services. Furthermore, FNEC was directly involved in the deployment of over 100 videoconference systems in the region of Quebec and continue to offer technical support and training to their clientele comprising of: Schools, Health Centres, Band administration, Tribal Authorities, and Treatment centres.

Working to improve technology advancements in all areas at the community level, FNEC continues to support and consult with other regional agencies to offer strategic guidance and expertise in the area of ICT. Health Canada, First Nations Health and Social Services Commission and INAC Quebec are examples of major partners. FNEC works closely with government departments, boards, agencies and authorities to ensure the IT components of their projects and services are effectively delivered. By proactively understanding the IT needs of its member (and non-member) communities, FNEC works strategically in its approach to support this development.

Building local capacity to support technologies is a key to long-term sustainability and continued development. FNEC continues to develop and deliver technology training for member First Nations using the latest methods to enhance delivery through distance learning technologies.

FNEC has established an Internet Network Operations Centre (NOC) that supports the following technologies and services:

- Multiple server park and Blade Server systems
- Fibre Optic connections are installed to provide Internet feed for 26 First Nations through subscribed connectivity services such as VPN and Trunking connections, whereby there are 15 and 11 communities respectively using these services. Dedicated services such as Lan Extension (LanX) are the preferred choice as we are able to achieve direct and dedicated connections to the hub. Availability of 10Base T (fibre) Lan extension service however is not available in many of the First Nations, therefore we are obligated to use VPN over other service providers to enable FNEC to support the management of local networks.
- Video/audio conferencing services; videoconference bridging services, video streaming and recording (RSS), teleconferencing
- Firewall/SPAM/Web-filtering services; Fortinet technology is used at the core to distribute services to all points along the regional network
- Co-location facility; FNEC offers collocation (server) services to support the distribution of online services and reporting systems.
- E-Learning Platform (Adobe Connect)
- Web/Email Hosting

With its helpdesk and a closely monitored resolution process, FNEC provides troubleshooting for all hardware and software issues to clientele in the domain of education, health, and community administration. Furthermore, their remote diagnostic methods of troubleshooting expedite the process of resolving technical issues. FNEC currently hosts several website and email systems for regional agencies and communities, including corporate level applications such as the CANO School Information System. Blade server technology facilitates the expansion of server needs while incorporating redundancy across all systems.

FNEC will continue to support broadband services through SchoolNet but new budget reductions further limit their ability to support First Nations. The National Budget of SchoolNet remains constant at $5.8M, whereas the Quebec allocation is $881K. Considering that 50% of this budget is earmarked to support recurring fees, FNEC's ability to support other projects is very tenuous given that their technical staff is providing technical support on a daily basis. FNEC uses the SchoolNet funding to support the following activities:

- Provide Internet connectivity subsidies to First Nations schools;
- Provide Helpdesk Technical Support services;
- Research and implement cost-effective broadband connectivity solutions for Schools and the greater community;

- Supply ICT equipment to schools that offers leading edge technologies and increased accessibility for students and teachers;
- Manage (and develop) software licensing agreements for schools (Microsoft and McAfee licensing);
- Develop and coordinate training activities addressing immediate needs of teachers, technicians and students;
- Coordinate and deploy the use of videoconferencing to First Nations;
- Continued development of the monÉcole-mySchool Internet website project;
- Collaborate with other regional and national programs in ICT that offer schools services in technology (Computers for Schools, Broadband program);
- Coordinate the First Nations SchoolNet Youth Employment Program.

The Future

First Nations invest significant amounts of resources external to their community to acquire technology services. These services can be strategically acquired from within the community when the capacity, support and infrastructure are available locally. Communities are seeking every opportunity to create local employment opportunities in the domain of ICT. This approach sees these investments remain in the community while supporting the development of local expertise. FNEC recognizes the economic benefits that broadband services offer. This fibre construction project aims to support First Nations build their capacity and enable employment opportunity creation at various levels.

The FNEC project included other components such as the SmartBoard and videoconference expansion project, the Voice-Over-IP (VOIP) project and the TeleJustice project but these initiatives were not eligible under AANDC's FNIF program. The First Nations and their organizations are still demanding these applications to support the sustainability of their networks. FNEC is continuing to work with different government programs and partners to identify the investment that will support these important applications.

The Atikemek communities of Wemotaci and Opitciwan still require additional financial resources to complete the external fibre connections to the nearest telecom provider's infrastructure. Working closely with the Cree Regional Authority, which had their fibre network infrastructure passing through the Atikemek Territory, FNEC invested $1.8 million from the existing project to purchase the required fibre (300km of 72 pair underground grade cable) and switching equipment (2 opto-electronic backhaul switches) for this project. FNEC and the Cree Regional Authority are now seeking the funds required to successfully connect these two First Nations to the network.

Some of the future opportunities that the fibre construction project brings to each First Nation includes:
- Business development opportunities by enhancing marketing delivery and visibility for local entrepreneurs;

- Broadband service businesses supporting the development of local Internet service providers and acquiring backhaul (external Internet solutions) agreements that permit communities redistribution authority;
- Public sector developments to create and support sustainable holistic broadband environments through the deployment of local fibre optic networks ensuring broadband solutions have long term capacity for growth that support evolving applications that leverage them while supporting the development of local expertise and local technicians;
- Regional level developments that continue to build regional network capacity bringing economies of scale, linkages to other networks, added value services, and the delivery of provincial and federal applications while working in collaboration with First Nation commissions to advance the delivery of their services to First Nations.

Conclusion

FNEC believes that this project will support the advancement of broadband development in their First Nations member communities; however it is equally important to support this development where it is needed the most, at the community level. FNEC is committed to completing all work presented as funding resources become available.

The work being completed by FNEC as documented in this paper highlights the importance of this intermediary technology organization to support these infrastructure developments in the First Nations. First Nations are developing the local capacity to support the operation and expansion of their local networks and applications. This First Mile work ensures there are local economic and social opportunities available for community members and future generations. First Nation self-determination depends on local ownership, control, access and possession of these infrastructures.

Acknowledgements

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