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**Making Information Technologies Work at the End of the Road:
Using Broadband to Build Sustainable Remote and Rural Communities**

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Abstract

In this paper we discuss both how the Internet and broadband networks generally are supporting a centralization of power and also how they have become the basis for a very significant decentralization of power. We document the development of this decentralizing counter-trend within the context of a "first mile" approach to telecommunications - specifically, the case of First Nations (indigenous) people living in small, jurisdictionally¹ autonomous communities in remote parts of Canada. The paper will further examine how a community-based (community informatics) approach to the institutional management of the telecommunications infrastructure and applications has in turn supported and enabled the development of a range of community-based semi-autonomous institutions and services -- including in education, health and governance -- developed and managed and responding to specific local requirements at the "edge".

Introduction

One of the guiding theoretical constructs of the Internet has been the notion of the Internet as enabling and empowering the edges within various technical, economic, political and social communicative networks. To a considerable degree that initial (in part utopian) vision has been derailed, as the

¹ cf. Assembly of First Nations (2007) *O.C.A.P. Ownership, Control, Access and Possession: First Nations Inherent Right to Govern First Nations Data*. Ottawa, Assembly of First Nations, July.

Internet's role as an agent for the centralization and concentration of power and resources has become more visible. In particular, it can be argued that the world wide web is now sustaining the dominant position of commercial and governmental institutions in society. While the social web to a degree lateralizes communication within social networks the technical drivers for these developments have, if anything had the effect of reinforcing centralized technical and other forms of technologically-mediated power.

The widespread availability of broadband appears at first glance likely only to reinforce and if anything accelerates these broad trends towards centralization of power or perhaps severely limit the options of users and communities to those deemed acceptable within the framework of existing corporate and organizational structures. Thus while broadband users perceive they have choices, their choices and those of the communities they live in are determined in a manner accessible only to those in positions of power who have control over the technology. For example, while there seem to be limitless possibilities for developing applications on a broadband platform, in practice the opportunities to design services and applications are limited by lack of control over the platform itself (for example being able to determine access to the platform, variations in throughput on the platform, managing the costing elements of platform access and use, and so on).²

For most broadband users these issues are likely to be of little immediate consequence since the "openness" of the networks and of access to the platforms is such as to ensure that there is an almost infinite variety of services and applications available for choice and for purchase. Thus the availability of consumer choice and the competitive marketplace is probably sufficient to satisfy most demands and where a demand is not satisfied and can be articulated by a sufficient number of users then a supplier will almost certainly come forward to provide that good or service.

In the context of market dominance and market based policies with respect to more or less all issues concerning the Internet, the overall orientation in these issues is to leave the resolution of concerns to the marketplace with the notion that if consumers or particular communities have problems either the supplier will resolve them (to retain these users as customers) or competitive options will appear in the marketplace. At the same time, governments intervene heavily in the telecommunications marketplace by providing significant subsidies of public funds to those corporate interests who claim to have no 'business case' for developing their services to meet the needs of users in remote and rural regions - the communities at the end of the road. Significantly, these public funds are given directly to corporate interests who make decisions about how to build the broadband networks and develop Internet services without meaningful consultation with the communities they propose to serve.

As well, these overall policy approaches - so-called "leaving development to market forces" while at the same time heavily intervening by giving significant subsidies directly to corporate telecommunications companies - have been built into both the legal and regulatory (or absence of regulatory) frameworks governing Internet/broadband deployment. The result is that there is no broad framework for the Internet and Internet-based services based on the needs of communities, especially those communities in remote and rural areas most in need of telecommunications to access services and activities unavailable locally. Further, the regulatory and legal frameworks do not include end user rights (for example the rights of "netizens" in the territory of "cyberspace"), or options for those who wish to take an alternative approach to broadband development. This leaves many communities on the margins for whom the existing approaches both from a technical access and from a service provision perspective do

² cf. McChesney, R.W., *Digital Disconnect: How Capitalism Is Turning the Internet Against Democracy*, New Press, 2013

not serve their needs - they are left pretty much to their own devices to try to find a resolution to their concerns.

Traditionally, when we have been approaching an understanding of publicly provided services such as, for example, education, health care, policing/security, and even governance itself, the understanding and the overall approach from an end user/citizen perspective and from a supplier/governmental perspective has been that the design and delivery of the service has been largely under the control and direction of the central authority most often located in urban environments --governments, school boards, hospital managers and so on. This approach has been taken more or less as given -- delivery systems and the infrastructures that support them -- roads, buildings, training programs, administrative management structures etc. etc. -- have been costly, slow to build, difficult to replace, solid and more or less immovable if not immutable and seen as difficult and extremely costly to change and to adapt to highly localized and individualized contexts.

This approach and these understandings have been transferred more or less holus bolus into the digital sphere to be reproduced in form and function on the various delivery platforms and most currently (and effectively) via broadband. But as we all know and is every day becoming ever more visible there are numerous alternative options in the digital sphere. Community, social and public services of all kinds can be designed and re-designed, deployed and re-deployed, configured in whatever way might be most suitable for whoever might need the end product and all of this can be done extremely quickly and very cost-effectively if sufficient design input can be provided by the end users of these services.

Unfortunately there has to date been little incentive on the part of the existing service providers (primarily governments and public service organizations) to undertake that degree of transformation in the nature of the services they are providing. In Canada, to a large extent, this situation is politically sustained because the current system is "working" for the 80% of Canadians living in urban centres who have the voting power; it is not working for the 20% of citizens living in the remote and rural areas of the country who experience a vastly reduced level of services and have little political clout to force any change in the status quo.

Governments and centralized institutions are thus the primary support for the digital infrastructure that is delivering these services especially to those at the margins; they are in a position to prevent alternatives from being developed and marketed to end users/citizens living in communities at the periphery who might want, need and make best use of services redeveloped using digital infrastructure to better meet their needs. And however much the platform may in principle be "open" at both the technical and service levels, the design and deployment of the adapted/transformed services require access to and control over these service delivery platforms in order to ensure the degree of quality and continuity of service delivery that is a legal requirement for these types of services. As long as government, education and health institutions choose to pay corporate telecom providers for the connections they require instead of working directly with the communities they are supposed to serve, the people requiring their services will be challenged to access the opportunity to develop their own infrastructure and applications.

In this context then the lack of a regulatory framework which allows end users/citizens and the communities they live in to have access to a degree of "control" over the networks at the network level severely inhibits opportunities for the deployment of a whole range of local services most effectively adapted for delivery and use in a digital environment.

Further the quite specific experience of broadband and service delivery in the very small, very isolated and highly dispersed First Nations (Indigenous) communities of Northern Ontario, Canada, is both an extreme instance of use of broadband for local service delivery and how these can be developed and

deployed to respond to the specific needs of people living in communities at the end of the road. These remote First Nations, can through analysis from a policy lens, be seen as providing an extremely interesting and valuable case study of both the nature and use of "sovereign" power in a digital environment and directions for how those without access to such sovereign power might develop surrogates for this which would allow them to derive the kind of capacity for intervention and service redesign and redevelopment which these communities so significantly display.

As in the case of most products and services, the actual design and deployment and ultimately the "control" of the service (and in many cases elements such as the "ownership" of the intellectual property provided by and even through the service) are retained by the service provider. Thus issues such as adaptation of the service to specific local requirements/needs, decisions concerning changes to/evolution of the service, determining who is eligible to receive a service (and who is not) are retained and held quite closely by the service provider/owner. As well, of course, issues such as data privacy, data ownership, data retention, data sharing and data sales are in many jurisdictions left entirely up to the service provider and the rights of end users in these regards are limited to those that might be available under for example consumer protection legislation.³ These challenges provide the communities and the service provider with the opportunity to innovate so that the services and applications may be adapted to address local needs and priorities

Before the Internet it was not possible physically to exert control over the infrastructure. Now with the Internet the basic infrastructure for services of this type are not physical but rather electronic and certain organizations servicing those "at the end of the road", by exerting control over their own infrastructure have thus been able to exert control and reconfigure/redesign the infrastructure of certain of the public services for which it has a need. In this way possibilities for innovative services and service delivery institutions better adapted to local requirements have been opened up.

This approach to local control of broadband infrastructure has been called the "first mile" approach to broadband development (McMahon et al., 2011). As outlined in O'Donnell et al., (2011a) "first mile" concepts share a synergy with the First Nations' policy or set of principles known as OCAP - ownership, control, access and possession (Schnarch, 2004). The Assembly of First Nations, the national body representing the Chiefs of the more than 600 First Nations across Canada, has applied OCAP principles to data (Assembly of First Nations, 2007). In the "first mile" context, First Nations' ownership, control, access and possession of local digital infrastructure, data and communications are essential variables to address local needs and priorities in service delivery and community development.

First Nations in Canada⁴

Many of the more than 600 First Nation (Indigenous) communities in Canada are in rural or remote areas accessible only by air. Similarly to many rural Native American and Australian Aboriginal communities, First Nations people live a land-based lifestyle within a wealthy and increasingly urbanized and commercialized nation-state. The Canadian Constitution recognizes First Nations people as one of the founding nations of Canada. The Constitution also recognizes the First Nations' right to self-determination, to negotiate the terms of their relationships with Canada, to establish the governance structures they consider appropriate for their needs, and to determine how they wish to develop their communities. Owning, controlling, accessing and possessing their local infrastructures including ICT

³ These issues vary considerably currently from jurisdiction to jurisdiction and to the extent where there is considerable disagreement and negotiation consumer/end user rights with respect to data with some such as the Europeans taking a much more end user oriented position than others such as the US, who in fact, is currently taking the overall position that extending rights to end users (through data protection for example) is an inhibitor of trade.

⁴ The following two sections are adapted from Whiteduck et al., 2012.

networks and their associated applications is an essential economic driver for local development and employment. Accessing the resources required to sustain these essential tools and infrastructure is an ongoing challenge for these communities and their leaders.

The Canadian government continues to struggle to live up to the requirements outlined in its own constitution in its relationship with the First Nations. Like their counterparts in the United States and Australia and elsewhere, First Nations people in Canada have their rights defined in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP, United Nations, 2007). The UNDRIP passed in September 2007 with Canada voting against it until finally accepting it in principle in November 2010 after several years of court and civil challenges by First Nations.

In contrast to the principles of freedom from state oppression outlined in the UNDRIP, the Royal Commission on Aboriginal Peoples (1996) found that the historical treaties with First Nations were replaced with Canadian state policies intending to remove First Nations people from their homelands, suppress First Nations and their governments, undermine their cultures, and stifle their identities. Thousands of First Nations people are, with the support of their families and friends and organizations such as the Aboriginal Healing Foundation and Canada's Truth and Reconciliation Commission, learning to heal from the devastating destruction wrought by the state imposed and church-managed residential school system. Over 150 years of forced removal of First Nation children from their homes and communities to attend residential schools has resulted in an ongoing legacy of individual, family and community breakdown.

Many First Nations still struggle with poverty, environmental and resource challenges such as ensuring clean drinking water, inadequate housing and high unemployment, often described as third world living conditions. Poverty and unemployment, especially in small, remote First Nations in the northern regions across Canada affects 80 to 90 percent of the people living in reserves. These remote and rural communities are considered as being controlled by the Federal government's Indian Act and an urban-based, centralized Aboriginal Affairs and Northern Development (AAND) department, governance and funding structures that are forever changing and are at the discretion of people who have little or no knowledge or experience in living and surviving in these challenging culturally sensitive environments. The centralized foreign government structure is counter to the Canadian Constitution that recognizes First Nations as self-determining with the rights to establish their own governance and development strategies that meets their needs and respects their traditional values and culture.

Historically First Nations have been using whatever means available to rebuild and revitalize their communities - entailing a constant cycle of having to find and fight for the resources to effectively deliver essential community services and activities. This includes the ongoing struggle to develop and maintain an adequate level of information and communication technology (ICT) infrastructure, applications, training, and ongoing support and maintenance so that the communities can use these technologies effectively to reach their development and economic goals.

Broadband Development by and in Remote & Rural First Nations: Relationships, Sharing and Networks

Canada has a universal service requirement for telephone service but not for Internet service and the required broadband infrastructure. Commercial telecommunication service providers are reluctant, slow or refuse to develop infrastructure in most remote and rural regions of the country without significant government investment. Consequently it is always very challenging to build the partnerships necessary to develop broadband infrastructure and provide equitable and affordable Internet services in these communities across the country. Government policy to support broadband in remote and rural First Nations communities is underdeveloped and uncoordinated among many different departments and program areas. Since 1996, a variety of funding initiatives, strategies, and projects were implemented to

support development of broadband infrastructure and increased use of ICT in First Nations communities. Too often, many of the program requirements made it impossible for First Nation ownership, control and development of the infrastructure, the networks and the local resources required to address the ongoing growth in demand and forever changing technologies.

Broadband development in First Nations across Canada is led by the needs of First Nation communities in these rural and remote regions. These communities are autonomous entities each with their own elected government responsible to deliver a variety of services to and support activities by community members. Increasingly these services and activities have a requirement to use broadband networks and ICT and the need for bandwidth is always growing. Unfortunately the result of this patchwork effort by the federal and provincial governments is many remote and rural First Nation remain today without the infrastructure or resources to support essential broadband applications and services that the same governments utilize and require for accessing their funding initiatives and ongoing reporting.

First Nation communities are linked together regionally and nationally through a complex and dense web of interconnected relationships and networks. These relationships and networks are the spaces through which First Nations share ideas and resources and collaborate to develop their local networks and link into the broadband infrastructure connecting their communities with the wider world. First Nation owned and controlled organizations at the regional and national levels are in place and continue to be led by the local First Nation leaders.

First Nation owned and managed networks include the infrastructure, the jobs, the opportunities, and the local enterprises being developed and supported by broadband applications and services. The interconnections that First Nations share with their neighbours and the world require regional networks and organizations to support the local operations and delivery of the community services through utilizing and sustaining the local networks. These regional organizations and networks are interconnected with other networks and service agencies through the effective deployment and utilization of video, voice, mobile, data, and other digital tools and applications.

KO-KNET: Innovative Broadband Development in Remote Communities in Ontario

On the national level the federal government has supported some First Nation organizations in the regions across Canada to identify, develop and deliver connectivity solutions and opportunities to do the work required to make these different ICT infrastructures and developments happen. Some of these organizations did move into working with the local networks and provided a variety of IT services and broadband applications. As well, over the years these organizations have influenced and supported policies by engaging with universities and other research institutions to produce research, evaluations and publications that highlighted some of these developments. At the national level, the community leadership working with their representative body, the Assembly of First Nations, worked to bring this work forward and support the development of a national eCommunity framework to foster the creation, utilization, and sustainable operation of the First Nation networks. One of the regional First Nation organizations is KO-KNET which provides broadband services to remote and rural First Nations across Ontario but in particular in the northern region (Beaton et al., 2004; Carpenter, 2010).

The Canadian province of Ontario is sparsely populated in the North. The most northerly communities are geographically isolated First Nations. The winter road network connects these communities during a short period each winter but for the rest of the year everyone flies into or out of these First Nations. The Nishnawbe Aski Nation territory in northern Ontario - Treaties 9 and 5 - is roughly the size of France. This region is home to about 25,000 people, mostly Indigenous First Nations people living in remote communities with 300 to 900 inhabitants.

Their geographic isolation results in additional isolation from the decision-making and policies that

influence their communities and members. These remote First Nations are innovating in many ways to ensure their ongoing survival and self-determination. Having community control over governance, education, health and the many other services that communities need is an important element of their political self-determination.

In 1991, the leadership of seven First Nations in Northwestern Ontario formed the Keewaytinook Okimakanak tribal council to ensure more First Nations control over community services, operations and activities. Keewaytinook Okimakanak (KO) means Northern Chiefs in Oji-Cree. The languages and cultures in these communities are Oji-Cree, Cree and Ojibway. The six KO First Nations today include Fort Severn, North Spirit Lake, Keewaywin, Deer Lake, Poplar Hill and McDowell Lake. All are remote fly-in communities without all-season roads.

In 1994, the KO organization and KO First Nations developed a “Stay in School” project to establish a computer bulletin board system (BBS) so that parents in the communities could have regular and reliable communications with their children in school in the far-away urban centres. At the time, telephone service only existed in three of the six First Nations. The new network was called the Kuhkenah Network, shortened to KNET. *Kuhkenah* is an Oji-Cree term for *everyone, everywhere*. And the journey on the winter roads of digital telecommunications in the far north began.

With vision and determination, the KO First Nations developed KO-KNET over 18 years from a basic bulletin board system to a regional support service for vibrant and active e-Communities - community-owned and operated broadband infrastructure that makes possible many community-managed services and interactions.

Today the carrier-class broadband network managed by KO-KNET is the core of its operations. KO-KNET is a First Nation community owned and operated, not-for-profit business. As a business, KO-KNET has contracts with many organizations, including First Nations, governments and private companies. Today KO-KNET has points of presence – or POPs – in 94 First Nations across Ontario alone and works with many other communities and regions across Canada to support the network services within a cooperative framework. Government departments pay KO-KNET to use the network for the many community services it supports including telehealth, distance education, justice services by videoconference and others.

As a business, KO-KNET is a cooperative operation with its budget and strategic plan developed in collaboration with the leadership of the KO First Nations. KO-KNET’s management team includes a coordinator, business, operations and network managers. Most of KO-KNET’s dedicated staff of 16 are First Nation people from the region, and staff turnover is very low. KO-KNET’s business contracts for its network services, training services and other KO-KNET services support all its operations, with surplus revenues dedicated to further capacity building and network upgrades in the First Nations it serves.

Training with and in First Nations is a primary focus of KO-KNET’s operations. KO-KNET has successfully expanded its training services to other First Nations across the district. Specific training for youth includes summer technology camps and many opportunities for young people to develop their ICT skills to the professional level. Training with community members and community services staff is also important, including training for schoolteachers and administrators in the use of educational management systems, training technicians for community water plant operations (Gurstein et al., 2009), telehealth technicians and many others.

KNET also works with educational institutions to develop and deliver distance education courses to community members using the KO-KNET videoconferencing system, for example Confederation College's Aboriginal Teacher Assistant Program and the teacher education degree program from Brock University.

KNET has also been creating and supporting the development of skilled employment positions in First Nations. Employment, especially youth employment is a big priority. Many new jobs were created when KO-KNET became one of Industry Canada's SMART communities and secured the resources required to hire and train staff in the KO communities.

Support for effective use of information and communication technologies has been another core focus. The KO-KNET support services includes toll-free telephone service, online support and a fully staffed support helpdesk. Again, the support extends well beyond the KO communities to many other First Nations across Ontario. In 1996, KO-KNET services began maintaining a helpdesk for the First Nation SchoolNet program. This support for First Nation schools throughout Ontario continues to the present day. KO-KNET supported the Community Access Program development in the KO First Nations and other remote First Nations, involving establishing, staffing and maintaining public access points, or e-Centres in the communities.

KNET has been developing many kinds of broadband infrastructure in partnership with the communities and strategic partners. From 1999 to 2001, KO-KNET Services led extensive telecom infrastructure development in its service region, including upgrades to digital radio services, satellite services and digital data services in its KO member First Nations and the wider Sioux Lookout zone. At the same time, KO-KNET supported the development of a wide area computer network to provide remote support for the Band Office programs, Health services and Education services in each KO First Nation.

Construction of First Nation cable plants and community-owned cable networks connecting all the buildings in each First Nation began in 2001. The cable networks provide Internet access for community homes, administrative offices and community organizations and businesses. Now there are 24 First Nation owned cable networks working with KO-KNET to provide Internet and other services throughout each community. The Community Cable Network Management software along with the Bandwidth Management Software lets local technicians manage their own networks, adding and suspending customers as required.

In 2005, KO-KNET, with its Indigenous partners in Quebec and Manitoba, officially launched the Northern Indigenous Community Satellite Network – or NICSN - that began operating in 2000 in two remote First Nations. KO-KNET continues to support the NICSN network and is now working with several First Nations to move from satellite to their new fibre infrastructure. The major Bell Aliant fibre network build that will reach 24 remote First Nations in the region over the next few years is another example of the work KO-KNET is doing on major infrastructure developments in partnership with the First Nations and telecom corporations.

One of the most ambitious telecommunications infrastructure development projects launched by KO-KNET in collaboration with partner First Nations is Keewaytinook Mobile, or K-Mobile, a First Nations community-owned cellular and data services network. Among the many innovative features of this service is a billing system devised by KO-KNET that allows K-Mobile customers to manage their own service and cell plans. The K-Mobile service has been extremely popular in First Nations and valuable for community members as both a communication tool and safety device while out on the land.

KO-KNET is developing and supporting new core First Nation community services using the network. Two of the most notable success stories evolving from KO-KNET Services are the Keewaytinook Internet High School (KiHS) and KO Telemedicine (KOTM). KOTM, the only Canadian telehealth network managed and operated by Aboriginal people, provides telehealth services in First Nation communities across northwestern Ontario. KOTM recognizes the importance of incorporating First Nation values and beliefs into its operations and the value of respecting and instilling local beliefs and culture to ensure the adoption

and acceptance of new health tools and methods (Carpenter and Kakepetum Schultz, 2011, Williams, 2010).

The Keewaytinook Internet High school - KiHS - the first accredited First Nations digital school in Canada began delivering online courses in 2000. KiHS is a network of more than a dozen high school classrooms located in remote First Nations in Ontario's far north connected to each other by a robust broadband network supported by KO-KNET (Potter, 2010; Walmark, 2010).

Keewaytinook Okimakanak's Research Institute (KORI) partners with academics, institutions and governments to research and document many of these ICT developments in the KO First Nations. Graduate students and researchers work with KO and KO-KNET staff to gather and share information using respectful and inclusive strategies to ensure local ownership and control of their stories and data. Five doctoral and several masters theses have been written documenting the work and achievements of KO-KNET.

KO-KNET has been creating, adapting and making available many other new ICT applications, resources and services. KNET's web-based email service, an immediate hit in the remote communities in the region when it was introduced in the early days, remains the most popular email service in First Nations in Northern Ontario. Alongside the email service, KO-KNET developed the MyKnet.Org social networking service that was also a huge hit with more than 20,000 home pages. Even after the introduction of Facebook, MyKnet.Org remains a popular way to communicate among friends and family in the north.

KO-KNET's introduction of videoconferencing network and bridging services in 2000 in each of the KO First Nations and with First Nation partners across Canada is another example of KO-KNET's leadership in telecommunications services. The ability to connect face-to-face yet separated by distance opened up a new way of doing business in the First Nations. KO-KNET's bandwidth management software ensures that community members have a quality video experience. Now KO-KNET supports desktop videoconferencing to make video technology even more accessible.

One of the most innovative aspects of KO-KNET operations is its development of new applications to ensure the most effective use of the network and technologies. Examples include the videoconference booking system, the cable plant management system and others that support remote troubleshooting and management of community networks (Fiser and Clement, 2009).

KO-KNET strategically uses web-based environments and open source software, adapting it to the specific requirements of First Nations. An example is the Moodle platform that KO-KNET has configured to support the Keewaytinook Internet High school and many online meeting spaces. KO-KNET's use of Drupal to support online environments and Linux for operating systems are other examples. Along with these new applications, KO-KNET has developed a wide range of online resources including a KO-KNET news service, numerous videos, photographs and other digital media available online.

KO-KNET is heavily involved in developing strategies to provide adequate broadband infrastructure and telecommunication services in not only the KO First Nations but also all the First Nations across Canada as well as negotiating agreements with strategic government and commercial partners to benefit the First Nations. KO-KNET is working to support the development of federal, provincial, regional and local First Nation and government telecommunication policies that are appropriate for First Nations. This includes KO-KNET's active participation in the Assembly of First Nations national IT working group as well as representation on national policy bodies such as the National Broadband Task Force. KO-KNET makes numerous submissions and presentations involving policy consultations at regional, national and international levels, most recently to the World Summit on the Information Society working group on Indigenous ICT development.

An outstanding policy achievement is KO-KNET's development of the e-Community model of community-owned and managed local broadband infrastructure. In 2005, KO-KNET presented the e-Community model to the Canadian Prime Minister Paul Martin. The e-Community has become the core model nationally for First Nations telecommunications development, supported by the Assembly of First Nations. Most recently, KO-KNET is again leading the way with implementing a KO e-Community learning and information exchange using Drupal and Facebook to engage community members and raise awareness of technology developments and opportunities in their community.

Case study of broadband development in a remote community: Fort Severn First Nation⁵

The Washaho Cree Nation at Fort Severn is on the bank of the Severn River near where it flows into Hudson Bay. Fort Severn is a member of the Keewaytinook Okimakanak (KO) Tribal Council and the Nishnawbe-Aski Nation (Treaty #9 area). The community, the most northern Arctic community in Ontario, is home to about 400 people; another 250 community members live elsewhere most of the time. Most community residents speak Cree, and the school-educated people speak English. Every two years, Fort Severn community members elect their local government: a Chief and Band Council. Elders also have a prominent leadership role in the community.

Much of the community life happens outdoors. For many community residents, life is seasonal and grounded in the environment, lands and resources. Many social and community activities, as well as individual and educational activities, involve hunting, trapping, and being on the land, or fishing and being on the water and ice. Almost every household depends on hunting and trapping for food, and the region is rich in wildlife, fish and berries.

For about two months each winter, Fort Severn and other remote communities in the region are connected by winter roads and it is possible to drive to Sioux Lookout, the closest regional centre, in about 24 hours. After the winter roads have melted away, Fort Severn is very isolated and expensive to visit. The flying distance from Toronto to Fort Severn is 1,495 kilometres. A return flight from most Canadian cities to Sioux Lookout costs more than \$1,000. The follow-on return flight from Sioux Lookout to Fort Severn costs about the same, making the total return airfare cost to Fort Severn about \$2,000.

Good communication links and infrastructure are important for all First Nations and particularly so for very isolated communities like Fort Severn. Even before bringing digital infrastructure and communications into their community, Fort Severn as a collective demonstrated its leadership by developing and implementing a community radio station in the 1980s and a community cable TV service in the early 1990s (Fort Severn First Nation, 2011, Gibson et al., 2012). Local telephone services are delivered by Bell Aliant using a Telesat satellite C-Band service.

In early 1999, Fort Severn's tribal council, Keewaytinook Okimakanak (KO), commissioned a study of the telecommunications needs of the KO communities (Keewaytinook Okimakanak, 1999). The consultants reported that data communications were severely limited in Fort Severn. Like other KO communities, the primary local bottleneck for dial-in Internet was the MSAT outbound connection that was installed as part of the First Nations SchoolNet effort to connect all First Nation schools to the Internet.

In the consultation process, Fort Severn community members identified several key priorities for network services: building a network to connect all of the communities; making Internet more accessible; and videoconferencing. Community priorities for health and education were: bringing more education services into the communities; supporting the health service for people who are sick; and mental health and health services. Later that year, Fort Severn hosted a workshop for community members to discuss a planned satellite upgrade and what they would like to do with the increased

⁵ The following section is adapted from O'Donnell et al., 2011a.

bandwidth. The community identified governance, education and health as the three main areas for development.

In May 2000, the Kuhkenah SMART First Nations Demonstration project was selected as Industry Canada's Aboriginal SMART demonstration project. As a partner in this project, Fort Severn developed many broadband applications to support the community and its residents. In that year, KO-KNET, with funding from Industry Canada (FedNor) installed a hub C-Band earth station in Sioux Lookout and in Fort Severn. Fort Severn was part of the community network to share the bandwidth, available for 128kbps Internet and 512kbps on-demand video. In the summer of 2001, the Fort Severn community worked with KO-KNET to use the existing community TV cable network to add a cable modem service to households. In early 2002, the connectivity was upgraded to support medical quality videoconferencing and X-Ray transfer (Kakekaspan, 2002).

The SMART project and increased bandwidth in the community opened up a plethora of possibilities for Fort Severn residents, who could now access more services and a wider range of information online. Fort Severn set up a community E-Centre for residents without home Internet access. They set up a Keewaytinook Internet High School (KiHS) classroom to enable students to study for their high school education in the community (prior to this, young adolescents would be required to leave their community and travel to an urban centre for their high school education). The community worked with KO Telemedicine (KOTM) to establish their telemedicine service and increase the range of health options offered via videoconference to residents. Underpinning many of these service areas is their IP videoconferencing services, which continues to play a growing role in several service areas, including health and government.

Soon after, Fort Severn became one of the communities in the Northern Indigenous Community Satellite Network. NICSN is a jointly-managed, inter-provincial partnership between First Nations and Inuit communities in northern Quebec, Ontario and Manitoba. NICSN has demonstrated that a satellite network can be locally and regionally owned, managed, operated and maintained. In 2007, the NICSN group successfully secured additional satellite bandwidth for the existing single transponder that is in place for the life of the Telesat satellite (Anik F3) by purchasing 2 additional transponders for 11 years (2008 – 2019), with 100 per cent of costs covered by the federal government (Infrastructure Canada and Industry Canada) with an in-kind contribution from Telesat to support this initiative.

Several years later, Fort Severn leadership worked with their tribal council Keewaytinook Okimakanak (KO) to develop the community-owned and managed cell service, Keewaytinook Mobile (KM). A recent publication about the KM service in Fort Severn discusses how the service has quickly become essential to supporting lands and resources and many other activities in the community (O'Donnell et al, 2011b).

These developments and best practices are possible because the Fort Severn IP network established in partnership with Keewaytinook Okimakanak's Kuhkenah Network (KO-KNET) is operating on a privately managed wide-area network service. Online network management tools such as the coax cable management tool, the videoconferencing bandwidth booking tool and the local bandwidth management tool support the effective use of the Fort Severn IP network. Each of these tools require regular and sustained maintenance of the network by the local Fort Severn ICT technician to ensure proper operation. The equipment (computers, routers, satellite equipment, modems, videoconferencing units, phones, and so on) along with the cabling throughout the community also requires consistent and sustained maintenance and upgrading by the community.

Overall, the community leadership and community services staff members interviewed believe that their service delivery enabled by technology is meeting community needs. The youth in elementary school and KiHS are perceived to be major beneficiaries of the technology in the community. One community

leader explained: *"The kids in the schools... they're picking it right up. They're picking it up early and they're learning more about it and like they're doing stuff that I don't even know."* On the other hand interview respondents also identified the need to reach out more to community members, especially the youth, to make sure that the content and services developed speak to their needs and that they feel a sense of ownership over them.

Fort Severn leadership is working closely with its tribal council KO and telecommunications division KO-KNET to effectively manage the content, traffic and services on their local network. The community clearly requires more IT support and development capacity to more effectively deliver education services and community government in particular. The Washaho School needs more IT equipment, resources and support. The band would like to expand its use of ICT for government and community administration - for example, they would like to complete land-use planning and land-use studies using GPS and mapping technology - but will require more staff, technical and related resources to do it.

When the SMART Communities project was taking place, Fort Severn was able to create and fill three IT-related positions, including a multi-media person who looked after the website among other duties. Now that SMART is finished, the First Nation has just enough funds for one IT position – the e-Centre manager, who also provides IT support to the band and community members who subscribe to the community ICT services, including the community Internet, community cable TV, and Keewaytinook Mobile.

Professional development and training of staff working on service delivery is a big challenge for the Fort Severn community. Many of its service areas still require budgets for training new staff. One band staff member explained that many of the people they hire in health and education require both more experience and training to be in the position but they are the best candidates available. The public funds provided for the staff position often do not cover training, so even if distance education is available for that person, they are challenged pay for it.

The health services staff believes that some community members need more support to ensure that they can effectively use the broadband-enabled health services the community is delivering. This includes ensuring that the Internet connections in all community homes is hooked up and community members have access to IT support services when they have computer problems, so they can more effectively use their broadband connections.

The Fort Severn leadership clearly recognizes the community's ownership and control of many aspects of the technical infrastructure used to deliver services in the community - such as their C-band satellite equipment. Those delivering the services using the broadband delivered by the satellite are often generally unaware of who owns and manages the satellite and the broadband.

The community leadership also recognizes the community's ownership of and control over the services, at least to a point. Staff delivering community services had mixed views about community ownership of the services enabled by broadband. Fort Severn First Nation, like most First Nations across the country, is constantly negotiating with governments for sufficient resources to run the services in a holistic way to meet community needs. Having access to adequate funding is always a challenge and until there is more control over the funding situation, First Nations like Fort Severn will likely not feel fully in control of the services relying on that funding.

The Role of Sovereignty, Community Informatics and Designing and Delivering Service "At the End of the Road"

As one comes to learn of the astonishing level of technical development and more importantly of technologically enabled service delivery literally at "the end of the road" in Fort Severn or perhaps given

the depth of isolation of the community, at many steps beyond "the end of the road" one begins to ask the obvious question of how was this possible.

As discussed earlier, Fort Severn is a community of about 400 persons with a long history of making communications technologies work to meet their needs (Fort Severn First Nation, 2011; Gibson et al., 2012). Cree people have been living in the Hudson Bay area for thousands of years. Even before the first European explorers with the help of the local Cree people constructed one of the first fur trading forts near the mouth of the Severn River more than 400 years ago, the people living there have been communicating and sharing their stories and information in unique ways. The land and the waterways always provided for the people and continues to support the people who are still practicing their traditional hunting, trapping, fishing and harvesting skills in this special, fragile but harsh environment.

Fort Severn community members have a history of tailoring its use of new technologies to suit the needs of community members – whether canoes, boats, snowshoes or ski-doo's and videoconferencing. When new ICT tools were first introduced to Fort Severn, the community shaped the digital tools and networks to meet their needs. They were quickly embraced and accepted as yet another way to develop and shape their community so young people could continue to live and survive in Fort Severn. Everyone recognized the need for choices for new business opportunities, how to attend school or for accessing health care services. Since those early days of ICT development where Fort Severn community members were using the original Bulletin Board System on 300bps modems on a dial-up satellite service that would constantly drop the connection, the people have developed their own content, programs, services and infrastructure.

Community members with very little background in telecommunications or IT took advantage of training programs and support systems that their regional organization (Keewaytinook Okimakanak) was able to deliver both in their community and online. The people upgraded their skills and knowledge to manage and control both the telecom infrastructure and the applications that they identified as required for their future economic and social well-being. What are the precipitating factors for understanding and celebrating this level and complexity of development? And equally as one examines the development and range and depth of services and technology initiatives of KO-KNET in a similarly challenging (from a technology perspective environment) one is forced to ask the question what made this possible.

A first answer to these questions must be the unique funding and jurisdictional environment in which Fort Severn, KO-KNET and other similar communities in the area have found themselves. On the one hand in contrast to many other similar size communities they recognize as a foundation condition that they (meaning here themselves as First Nations) have a degree of autonomy for development which may not be as visible to other non-First Nations communities. While other communities are embedded in a very wide range of institutional, jurisdictional, political linkages with wider municipal and ultimately provincial or federal authorities these First Nations lack many of those connections and those that do exist (as for example with the Federal Department of Aboriginal and Northern Affairs) are seen as alien and distant and lacking in legitimacy at the local level.

Meanwhile, local authorities have the requirement to provide services to the local population who recognize the need for such services and as well the nature of equivalent services available elsewhere. As well, when the proper resources are available the local authorities sometimes have access to funds for the delivery of such services locally whether by purchase from outsiders or by other means. Of course, in most instances the easiest option is to purchase service from outsiders however, in the case of telecommunications the potential suppliers have consistently indicated that without very deep subsidy advanced services would be uneconomic locally and thus have been extremely reluctant to become locally active. And as well, given the degree of isolation of these communities the possible role of ICT enabled services as an alternative means for service provision is a quite obvious option. The old

adage applies: those most in need of these services are the last to be served within existing corporate business models based on serving customers in populated centres for maximum profits.

The step of moving from this position of being service receivers to a community informatics⁶ enabled position of taking where the local communities are taking responsibility for building, managing, delivering a local ICT infrastructure and then based on this infrastructure using the opportunity for service redesign and redevelopment to respond to local conditions and requirements is well within the range of possibility. The circumstance, as in these instances, is one where the oft stated principle of the Internet that the intelligence resides at the edge of the network (in this case at the end of the road) is given a most interesting verification while equally suggesting certain of the pre-conditions and limitations on a broad acceptance of these principles. The role of the perception of the opportunity (or requirement) for autonomous development, the availability of financial resources to support such development, the lack of interest or extension of external networks and service delivery capacity into the local environment and overall a well developed recognition of the community needs that must be fulfilled are among those pre-conditions. Recognition must be given to the inherent plasticity of the technology as a platform for, enabler, and integral element of community oriented services in the post-Internet era. The element and possibility for virtualization of services in the form of electronically delivered education, health care, justice, administration and governance provides an enormously liberating context for local and community creativity and enterprise where other of the above noted pre-conditions exist.

The opportunity for a true *community informatics* where the community defines the needs and the design, development and deployment parameters of ICT enabled services and where it uses community processes as the building blocks and means for on-going social and economic sustainability of these services is realized and realizable within these communities and can provide a model for similar developments elsewhere.

Concluding Comments

To a degree the discussion above has highlighted the uniqueness of the background to the highly original developments among the First Nations of northwestern Ontario. However, on closer examination this uniqueness can be seen to in part disappear. While, as we have argued, a foundational element of these developments has been the sense of autonomy that derives in large part from the jurisdictional authority which First Nations in Canada enjoy under the Canadian Constitution, in fact there is little in our description or in the reality of these developments that are built directly on this jurisdictional status. In no sense is the development of the KO-KNET telecommunications/ICT platform or its local manifestations in communities such as Fort Severn built directly on or as a result of this jurisdictional status. Rather the jurisdictional status has given these First Nations a sense of a possible autonomy and to a degree a jurisdictional isolation from which the above noted innovations have sprung.

There is little or no reason that other communities could not internally develop a similar sense of autonomy and a willed capacity for the development of locally controlled ICT infrastructures should they so choose. In fact of course there are many and increasing instances of local communities (as for example in municipal broadband development) recognizing the opportunities that ICTs present for local development and particularly local economic development that responds directly to local conditions and requirements. Of course, these are fiercely resisted by those who are threatened by competition or by arecognition that developments at the periphery are both possible and desirable and even potentially profitable. Equally the benefits of local cooperation, the use of public authority to realize local public

⁶ cf. Gurstein, M. (2007), What is Community Informatics (and Why Does It Matter?), Polimetrica

benefits may in certain instances be seen as an ideological challenge to those who have no tolerance for the development and delivery of services outside of market mechanisms.

However, the type of developments that we have presented in the above may be a source of inspiration and direction particularly in those wide swaths of the world and within even the most developed countries where the promise and opportunity of ICTs have not been realized and where the conditions for such a realization seem to be becoming rather less favourable over time rather than more favourable.

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