From the First Mile to Outer Space:
Tamaani Satellite Internet in Northern Quebec

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Abstract: Across Canada, discrepancies of access to broadband exist between urban centres and rural and remote Aboriginal communities. Government, public and private sector organizations are partnering to address these digital divides. Some employ a 'First Mile' approach that foregrounds how community-based institutions are driving development. This article provides a First Mile case study from the Inuit territory of Nunavik. We describe the cultural, social and political contexts the people of Nunavik and their government navigated to establish broadband in the region's 14 northern villages. The Kativik Regional Government is building and administering infrastructure that delivers public services and encourages economic development, balancing centralized efficiencies with the needs of residents in villages like Ivujivik.

Introduction

Across Canada, discrepancies of access to broadband systems exist between urban centres and rural and remote Aboriginal communities. In recent years, governments and public and private sector organizations have been partnering to address these digital access divides. In the historic and ongoing context of colonialism, Aboriginal peoples and their respective governments are engaging with these development processes to support their digital self-determination in the emergent network society (McMahon, 2011). Some of these projects employ a 'First Mile' approach that foregrounds how community-based institutions and Aboriginal governments are driving broadband development (McMahon, O'Donnell, Smith, Walmark, Beaton, & Woodman Simmonds, 2011; O'Donnell, Kakekaspan, Beaton, Walmark, & Gibson, 2011). These projects offer examples of the 'effective use' of ICTs by Aboriginal governments in the delivery of public and community services (Gurstein, 2012). This process situates Aboriginal broadband infrastructure development in terms of community-driven control, management, and capacity-building (Alexander, 2009; Bredin, 2001; Carpenter, 2010; Fiser, 2010; Mignone & Henley, 2009; O'Donnell, Milliken, Chong, Walmark, 2010; Ramirez, 2007; Whiteduck, 2010). Reflecting broader concerns over self-determination, many Aboriginal governments and organizations

involved in these projects stress community engagement and autonomy over broadband systems design (O'Donnell, Perley, Walmark, Burton, Beaton, & Sark, 2009; Whiteduck, Beaton, Burton, & O'Donnell, 2012). This aligns with a long history of communications infrastructure development undertaken by Aboriginal peoples in areas like print, radio, and television media (Alia, 2010; Roth, 2005).

Most existing First Mile research describes work undertaken by First Nations communities and organizations (McMahon, O'Donnell, Smith, Woodman Simmonds, & Walmark, 2010). This article provides an example from the Inuit territory of Nunavik. We describe the cultural, social, economic and political contexts that the people of Nunavik – the Nunavummiut[1] – and their regional government navigated to establish broadband infrastructure in the region's 14 northern villages. Focusing on First Mile development processes, we organize our paper in three thematic sections, and highlight a case study from the village of Ivujivik. In telling this story, we draw on policy documents, 'grey' literature (meeting minutes, websites and media reports), interviews, and our personal experiences and observations. One of the authors lives in Ivujivik and draws from his knowledge and experiences. The other author visited two Nunavik communities (Kuujjuaq and Ivujivik) over three weeks in summer 2012.

Nunavik: Political, Social, Economic and Cultural Contexts

First Mile broadband development projects reflect the specificity of the places they emerge from. In the last 50 years, people in Nunavik experienced tremendous political, social, economic, technological, and cultural changes alongside their commitment to Inuit culture (McMillan & Yellowhorn, 2004; Jacobs, 2001). For example, Chabot (2003) found that despite the increasing availability of consumer products and wage-based employment, Nunavummiut continue to manage resources like *niqituinnaq* (country food) according to values such as reciprocity and sharing. Inuttitut speakers reflect some of the highest Aboriginal language retention rates in Canada, thanks in part to the work of regional organizations like the Avataq Cultural Institute, local schools, and community radio stations (Papillon, 2008). Inuit cultural values are also reflected in regional economic development initiatives. For example, in 1967 Nunavik's membership-based co-op stores united in the *Fédération des coopératives du Nouveau-Quebec* (FCNQ), which provides various services to residents of the region, including banking, post offices, and cable TV (Tulugak & Murdoch, 2007). These examples reflect the strong focus of Nunavummiut in driving various development projects themselves.

Nunavummiut face challenging conditions that reflect the uneven distribution of resources and opportunities among individuals, communities, and regions in Canada. Nunavik's northern villages include some of the country's most remote communities. A population of some 11,000 people is distributed across 14 villages that range in size from 200 (Aupaluk) to 2,300 (Kuujjuaq). Like other remote Aboriginal peoples, Nunaviummiut experience the historic and ongoing impacts of colonialism and externally-imposed 'development' agendas. Their region is

rich in natural resources which government and corporate entities target for industries such as mining and hydroelectricity development. Many Nunaviummiut feel they do not equitably benefit from these activities, which also often result in long-term negative environmental and socio-economic consequences. Research demonstrates that residents of Nunavik face challenges in securing equal access to economic development opportunities and public services common elsewhere in Canada (Rodon, 2012). While conditions have improved since the 1970s, a 2006 Statistics Canada report described housing conditions as among the worst in Canada, with little improvement since 1996 (Jacobs et al, 2009). Statistics from the Institute for Research on Public Policy point to high levels of unemployment and household poverty (Papillon, 2008). Dr. Gerard Duhaime at Laval University provides ongoing reports on these conditions through the *Nunivaat Statistics Program* website (http://www.nunivaat.org/). Nunaviummiut also lack equitable access to transportation, electrical, and communications infrastructures available elsewhere in Canada.

Nunavummiut must also contend with the overlapping and contested administrative relationships associated with the region's governance. Until 1912, Nunavik was part of the District of Ungava of the Northwest Territories. That year, the *Quebec Boundaries Extension Act* gave Quebec responsibility for the territory and its Aboriginal inhabitants (Martin, 2008a).[2] However, the provincial government played little active role in the territory until the 1960s. The Government of Canada similarly ignored the region, although it stationed federal agents in all 14 communities after World War Two (Drummond, 2001). In 1975, the Inuit of Nunavik and the James Bay Cree signed a major land claim, the *James Bay and Northern Quebec Agreement* (JBNQA). At that time the Aboriginal groups lacked formal political structures and the provincial government did not recognize their claims to the land (Wera & Martin, 2008). However, the Cree and Inuit parties united to block a provincial hydroelectric development project, a process that culminated in the signing of the JBQNA. Through the land claim agreement, the Nunavummiut received some $90 million, ownership of land (nearly 9,000 square kilometres), and hunting, fishing, and trapping rights.

While some observers and residents of the territory critiqued the JBNQA as a 'colonial treaty' (see Martin, 2008a), Nunavummiut also used it to support various regional and community-based development projects. [3] For example, the Nunavik land claims corporation Makavik leveraged the resources provided through the *Agreement* to set up several organizations such as Air Inuit, the Avataq Cultural Institute, and Taqramiut Nipingat Inc. (TNI). The JBNQA also created the Kativik Regional Government (KRG) to administer public services such as policing, transportation, and communications.[4] KRG can exercise various municipal rights, including raising taxes and setting bylaws. It presently receives the majority of its funding from the Government of Quebec, with remaining revenues coming from the Government of Canada, municipal taxes, and royalties from natural resource projects. The JBNQA also created the Kativik School Board (KSB) and the Nunavik Regional Board of Health and Social Services (NRBHSS). KSB was the first Inuit-controlled school board in Canada. It develops and delivers

culturally-appropriate and Inuttitut-language educational services. The NRBHSS oversees the region's hospitals in Kuujjuaq and Puvirnituk, and nursing stations in the 12 other villages. Both organizations work to adapt health care and educational services to regional contexts, support local capacity building, and ensure public services remain under community control (Lavoie, 2001). These regional institutions play an important role in the First Mile orientation of broadband development in Nunavik. They also demonstrate how residents of the region are working to gain access to public services, build local capacity, and secure autonomy over various aspects of their lives.

The involvement of Nunavummiut in development projects is also reflected in the region's communications infrastructures and organizations. Much of this work is guided by TNI, a non-profit organization founded in 1975. In the 1970s, TNI staff built local radio stations in several villages, and now every Nunavik municipality manages a community FM station. Community engagement remains high: telephone lines ring as announcers discuss politics and broadcast music, news and announcements in Inuttitut, English and French. These radio stations reflect Nunavik's strong history of regional and local political participation: what Martin (2008b) describes as an 'Inuit Agora'. TNI is also involved in television production and distribution in the region. Nunavimmiut initially resisted satellite TV given their lack of control over the service and because it lacked Inuttitut-language content (Roth, 2005; Soukup, 2006). Once they appropriated this new technology, the residents of Nunavik began shaping it to meet their needs. Cable TV is now available through satellite and TNI produces an Inuttitut-language series called *Nunavimmiut* for the Aboriginal Peoples' Television Network, though in the past decade the program suffered funding reductions (KRG, 2012a). These media development processes demonstrate the strong focus of Nunavimmiut on building infrastructure and associated institutions to support their self-determined goals.

Access and Broadband Infrastructure Development in Nunavik

This First Mile focus on self-determined infrastructure development is further reflected in the ways Nunavummiut and their regional government bridged the access divides that separated them from the emergent network society (Castells, 2010). Similar to radio and television development, broadband projects in Nunavik reflect the efforts of regional institutions and residents. Nunavik's remote location and small, dispersed population failed to attract profit-oriented telecom investors, and so residents made several attempts to network the region themselves. For example, in the 1980s people in Kuujjuaq set up a local telephone system that connected houses with one another, though long distance interconnections were unavailable. Once the CRTC established its universal service requirements for telecommunications, the regional ILEC, Bell Canada (now Bell Aliant) began offering analogue services, but as of 2012 moderately-priced digital services remained unavailable (KRG, 2012a). Cellular service is available in larger villages through Nunacell (a joint venture between Makavik and Lynx Mobility).

Starting in the 1990s, regional institutions undertook several First Mile oriented broadband infrastructure development projects. Early experiments interconnected adult education centres in Kuujjuaq, Puvirnituq, Salluit and Kuujjuarptik through Bell Canada's 110-baud Envoy 100 email system (KRG, 2002). In 1994, the Inuit Broadcasting Corporation's *Connecting the North Symposium* in Iqaluit linked 400 participants (including representatives from Nunavik) with Aborigines in Australia over a video link. Inspired by the event, two years later TNI partnered with Makavik and Industry Canada's Community Access Program to set up Nunavik Net. The project established public access sites in the region's three largest villages (Salluit, Puvirnituq, and Kuujjuaq), utilizing Bell Canada's telephone infrastructure to interconnect over a long-distance dial-up satellite link to ISPs in Montreal. The project faced high long distance bills and a small customer base, and as a result ended just one year after it launched (Blair Christensen, 2003). Nunavik Net demonstrated the limitations of existing infrastructure and technologies, but also introduced the Internet to Nunavummiut, many of whom began asking their government to develop the service as a public good.

After Nunavik Net's demise, the regional government began exploring how it might support connectivity. KRG had jurisdiction over communication development through the *Provincial Act Respecting the Kativik Regional Government and the Northern Villages*. Along with addressing growing demand for Internet access among its constituents, the government required a high-speed data network to support its own operations. In the late 1990s, several public institutions, including KRG, KSB, and NRBHSS, all began relocating their head offices from Montreal to Kuujjuaq, further decentralizing their administrative functions to the 14 villages. This transition was part of a long-term goal to bring the institutions involved in Nunavik's self-government closer to the region's population.

As a result of this transition, KRG began planning a broadband network to interconnect offices across the region. This project was funded by Economic Development Canada and the Government of Quebec's *Villages Branches* program. KRG worked with SSi Micro, a Yellowknife-based satellite service provider that connected remote communities across the Arctic through C-Band satellite. The project enjoyed internal support and was endorsed by residents of the region, but lacked financial resources and faced competition from another Nunavik-based project. The federation of cooperatives (FCNQ) wanted to expand their digital cable TV network to provide Internet services. After two years of negotiations, the competition between the two regional institutions was settled in 2002 when a technical study and survey of user groups concluded that KRG's project provided more opportunities for intra-regional communication and greater potential for advanced digital services such as videoconferencing. While the FCNQ's network was cheaper to install and operate, it only provided Internet access, and expansion required costly upgrades (KRG, 2002). The needs assessment found the majority of demand came from regional public services (health and education), which FCNQ's network was unable to provide without significant investment. These goals reflected KRG's focus on bridging the

region's access divide in ways that not only provided Internet connectivity for consumers, but also a First Mile orientation towards fostering collaboration among regional institutions to support broadband-enabled public services. In short, KRG's plan better reflected Nunavummiut's aspirations towards self-government.

In 2002-2003, KRG received $5M from federal and provincial funders. By 2004, the government completed installation of 4.3m satellite dishes in all 14 villages. Local networks consisted of licensed wireless spectrum (2.5GHz) leased from the Inukshuk Corporation. With this ground infrastructure in place, KRG began looking for ways to access expensive satellite space segment. They partnered with two other Aboriginal technology organizations (Keewaytinook Okimakanak in Ontario and Keewaytin Tribal Council in Manitoba) to form the Northern Indigenous Community Satellite Network (NISCN). In spite of their differences, the three partners shared a First Mile orientation towards developing regional and local capacity, and retaining a measure of control and ownership of broadband infrastructure.[5] An opportunity for the NICSN partners to secure satellite bandwidth became available in the early 2000s, when Telesat Canada applied for an orbital slot to launch their Anik F3 satellite. As a condition of their orbital license, Industry Canada required the company to set aside 'Public Benefit' space segment for non-profit and public institutions. The NICSN partners gained access to this space segment, and through the subsequent National Satellite Initiative (NSI), used it to support public service applications and Internet access in their respective regions.

In Nunavik, KRG set up Tamaani Internet Services to manage their portion of the Public Benefit Transponder. Through Tamaani (which means 'here' in Inuttitot), KRG aimed to balance its needs as a public administrator with its mandate to supply universal coverage throughout the region. In December 2004, Tamaani was launched as a not-for-profit cooperative network, housed as a department inside KRG. In its first two weeks of operation, staff completed 120 installations, and villages quickly ran out of modems. The network became a victim of its own success: demand outstripped available capacity. An opportunity to secure additional space segment arose in 2006, when the federal government announced the second round of NSI funding. The three partners consolidated in a formal Joint Venture and applied for funding under this program (KRG, 2008). During two years of complex negotiations, Tamaani suffered human resource and technical challenges, and users became frustrated with the slow, congested, and unreliable network. Public service providers like the Nunavik Board of Health and Social Services remained skeptical about Tamaani's capacity, which threatened the network's long-term viability.

In 2008, KRG finally received its NSI Round two funding. The government improved ground infrastructure in the villages, upgraded their network management centre, and hired additional staff, including two field technicians. In 2009, KRG received additional provincial funding to install videoconferencing equipment in the 14 villages. Every community's KRG office or Northern Village Town Hall now houses a fixed videoconferencing unit. In 2010, a further

infrastructure boost came through Industry Canada's *Broadband Canada* program, which provided funding for two transponders, and further local upgrades. In February 2012, Tamaani doubled its minimum Internet access speeds (from 128Kbs to 256Kbs) (KRG, 2011). 'Tamaani 2.0' launched with a redesigned website, social media, and new tagline: "still remote, but no longer isolated". As of 2012, the network offered over 459 points of service to businesses and organizations, and had 2,142 residential subscribers (KRG, 2012b).

As of mid-2013, regional competition for Internet access is available through Xplornet, a commercial satellite operator. Local competition exists only in Kuujjuaq, where an entrepreneur set up Nunavik Communications in 2006. Nunavik Communications faces challenges given the high cost of commercial satellite bandwidth and low customer base, and recently began leasing space segment backhaul from KRG. Despite these developments, Nunavik continues to face a digital divide vis-a-vis Southern Canada, and KRG continues to advocate for funding to improve and build infrastructure. Tamaani's history reflects the strong focus of KRG and its constituents on shaping broadband infrastructure to not only address the region's access divides, but also to support the Nunavummiut's efforts to assert their autonomy and self-determination in the development process.

Institutional Development and Politics

This First Mile orientation towards broadband development in Nunavik is further reflected in the institutional structures and political activities associated with Tamaani. Compared to some other First Mile projects, Tamaani's network management reflects a more centralized approach. This is partly due to the self-government arrangements established through the JBNQA. KRG's NICSN partner KO-KNET blends centralized network operations with a strong role for locally-owned and operated ISPs (Fiser & Clement, 2012). This partly reflects KO-KNET's role as part of a federated Tribal Council composed of politically autonomous First Nations. In contrast, the situation in Nunavik reflects a different context. A regional government owns and operates Tamaani's infrastructure, centrally managing it from Kuujjuaq (with help from local agents). While locally-elected representatives drive KRG's decision-making, the government centralizes regional public service institutions (including broadband providers) in the regional hub, Kuujjuaq. While most of Tamaani's services are centrally managed from this network operations centre, the regional government engages residents of the villages by training and employing technicians (on a part-time basis). These local agents sign up new customers, manage accounts, and assist with minor repairs. In exchange for this work, they receive free Internet services, a small commission, and an hourly wage for special projects.[6] KRG chose this approach given the lack of capacity in the villages (some of which consist of only a few hundred people) and its centralized approach to network management. Over the long term, this arrangement aims to build capacity and engagement among communities by supporting local broadband champions. However, Tamaani's centrally-managed structure may limit the involvement of these individuals in technical, financial, and administrative decisions.

As part of KRG's Administration Department, Tamaani is directly accountable to the government's Regional Council and Executive Committee. The Executive Committee mandated Tamaani to deliver equitable access to all 14 communities, and to this end staff work out regional efficiencies and cross-subsidize between customer types (smaller residential and commercial customers and larger public service anchor tenants) to manage their limited satellite space segment. Working with its NICSN partners, Tamaani pools revenues and shares operations and maintenance costs. Tamaani staff also devised a strict Fair Access Policy: until 2012, all users were subject to a daily download limit of 250MB (for Basic Service) or 500MB (for Power Users). Improvements made possible through NSI Round Two and *Broadband Canada* allowed Tamaani to drop residential prices, provide faster speeds, and increase download capacity, but download limits remain necessary, given limited satellite space segment.

Tamaani's governance arrangement reflects the decisions of elected representatives drawn from Nunavik's 14 villages. Staff must secure the Executive Committee's authorization for all major decisions. Although they work together, in the past the Committee has criticized some of Tamaani's development work. For example, representatives expressed disappointment about the network's performance during the challenging years between 2007-2009.

Although Tamaani operates with an independent budget, it is financially and organizationally housed inside the regional government. Annual revenues presently cover network operations and maintenance costs, with surplus funds reinvested in the network.[7] The organization also accesses external support from other governments, and staff are engaged in efforts to identify funders to support the network's development and long-term sustainability. Funding agreements for satellite space segment are presently scheduled to expire in 2016 and 2019, with no new funding announced as of early 2013. Faced with this situation, KRG is working to advocate with the Government of Quebec and the federal government to secure additional support for space segment, or alternative infrastructure. The regional government wants to ensure that telecommunications development associated with natural resource projects in Nunavik will not only provision companies, but also benefit communities. To this end KRG and Makavik released *Parnasimautik: Plan Nunavik*, which lays out their vision for the region, including the importance of regional broadband infrastructure (including a 25-year plan culminating in a fibre optic backbone) (KRG, 2012a).

In this section, we demonstrated how Tamaani's governance structure engages Nunavummiut in the network's development and ongoing operations. Through its relationship with the Executive Committee and support for local agents, Tamaani's organizational structure is grounded in the specific circumstances of a decentralized model of self-government in Nunavik. These links between broadband development and self-government are further reflected in the regional government's advocacy efforts on behalf of Nunavummiut. These processes and

relationships reflect some shortcomings and challenges, including a tendency towards regional centralization in Kujjuuaq, the lack of a substantive role for local technicians, and uncertainty regarding long-term access to the publicly-subsidized space segment that the network relies on. However, they also reflect a clear example of First Mile oriented governance.

Broadband Applications

In this final thematic section we describe how Tamaani's development process reflects First Mile approaches to the development and delivery of broadband-enabled public services in Nunavik. This demonstrates how it articulates with the self-government aspirations of Nunavummiut. Given Nunavik's remote location and lack of infrastructure, service providers must employ innovative ways to deliver health and education services to the region's population. To this end, KRG works closely with the Kativik School Board and the Nunavik Board of Health and Social Services, both of which relocated to Kuujjuaq from Montreal in the late 1990s. These two institutions offer justification and funding support for Tamaani, and view connectivity as essential to their provision of broadband-enabled services.

KSB signed on as an early Tamaani anchor user and supported several funding applications. Through this partnership, KRG could access matching funds from the Government of Quebec's *Villages Branches* program, which provides connectivity funding to schools and municipalities in the province. After Tamaani completed service upgrades through *Broadband Canada*, KSB signed an additional agreement to secure more bandwidth and advanced services. Starting in 2013, KSB's head office will receive a 6 Mbps connection, and all schools will receive 3 Mbps connections. Now that infrastructure is in place, KSB is using videoconferencing equipment for meetings and teacher-training. It is also looking into using the system to deliver online courses.

The regional health provider in Nunavik also recognizes the importance of connectivity. Before Tamaani, NRBHSS accessed a health network funded by the provincial government (called the *Reseau de Telecommunications Sociosanitaire*) in the 1990s (KRG, 2002). In 1999, the two hospitals (in Kuujjuaq and Puvirnituq) connected to Montreal over a 640Kbps bi-directional link, while nursing stations accessed the Internet over 56Kbps links. As demand increased, the NRBHSS lobbied for more connectivity support, and in 2005 began discussions with KRG regarding the potential to sign on as an additional Tamaani anchor user. When the provincial government expressed skepticism over the network's capacity, the regional health organization argued in favour of Tamaani, in part due to its ties to the region. In 2010, after Tamaani's network stabilized following the NSI Round 2 upgrades, the provincial government approved the service contract, and KRG set up a dedicated 3Mbps connection for the hospitals in Kuujjuaq and Puvirnituq, and 512Kbps bi-directional links in the 12 nursing stations (KRG, 2008). Additional funding from the provincial government supported the Nunavik Telecommunications Network, a virtual private network that runs on Tamaani's infrastructure and interconnects 30 health sites, including hospitals and nursing stations. Connectivity costs are provided by the

Centre de services partagés du Québec (CSPQ), which contracts directly with Tamaani and works with NRBHSS for service delivery.[8] Tamaani and the NRBHSS are now working with the CSPQ and provincial Ministry of Health on a regional e-health vision to develop future applications. Medical staff use the health Network for remote diagnosis, training, tele-psychiatry, administrative meetings, and sharing of electronic health records. When several Nunavik villages suffered a tuberculosis outbreak in summer 2012, nursing staff used the network to digitally transfer X-Rays to hospitals in southern Quebec.

The interrelated development patterns of Tamaani, NRBHSS, and KSB reflect the close relationships between several institutions associated with self-government in Nunavik. They demonstrate how a First Mile orientation can support the co-construction of broadband-enabled public and community services, and infrastructure development. Without these two core anchor tenants, it is unlikely that Tamaani could generate the level of infrastructure and connectivity services presently available in Nunavik. At the same time, without Tamaani, the shaping and delivery of health and education applications by regional service providers would look much different. In short, these First Mile development processes locate the platform of delivery for education and health services both geographically and 'virtually' in Nunavik.

Case Study: The First Mile in Ivujivik

To this point, we have focused on how regional organizations in Nunavik build, manage, and utilize Tamaani's broadband infrastructure. We now turn to a short case study of First Mile broadband in one of Nunavik's villages. Ivujivik, which means "place where ice accumulates because of strong currents", is the northernmost village in Quebec. The community of 340 people is only accessible by air and by sea barge, and receives electricity by means of a diesel generator. It is home to a radio station, school, nursing station, co-op store, Northern Village Town Hall, daycare, and youth centre. Several businesses are based in the village, including artists and an Information Technology (IT) company. Along with their 'day jobs', many residents continue to live off the land, gathering *murre appak* eggs and hunting animals such as beluga whales and walruses. The town is proud of Lydia Angiyou, who was recognized by the Governor General of Canada in 2006 for saving local children from a polar bear attack. Ivujivik is one of the villages in Nunavik that did not sign the JBNQA in 1975, but it is still represented by KRG.

Thomassie Mangiok grew up in Ivujivik. He remembers when access to the Internet arrived in the village. It was a great addition to services that would ultimately allow Nunavummiut to easily and freely access previously unavailable information. In the past information was mainly available through local organizations, and although finding books, videos, music and other media was possible, it was difficult and expensive. Internet access was a boost for the people of Nunavik, who were ready to absorb and contribute data throughout the world. Mangiok asks readers to imagine living in one of the most isolated areas in Canada, still adapting to living conditions introduced by governments and by consumerist values publicized through external

media like television and radio. These one-way broadcasts did not give audiences control over content. He describes this arrangement as comparable to parents talking to their children, who are not yet able to ask questions. For Mangiok, Tamaani's success and high traffic proved that Nunavummiut are hungry to absorb the content that its connection to the world offered. Many people now use the Internet to debate issues on forums like Qanuuk.com and social media like Facebook. Recently, they used these platforms to discuss a major referendum on regional self-government.

Nunavummiut also use broadband to support economic development. Thomassie founded Pirnoma Technologies, an IT support, graphic design, and web development company based in Ivujivik and dependent on Tamaani. Working with two friends from Akulivik and Inukjuak, Thomassie set up Nunavik's only Inuit-owned and operated IT services company. Thomassie grew up as a gamer with a keen interest in programming. As a teenager, his family did not own a computer, but he remembers accessing the Internet through the school's dial-up connection. Connectivity has improved since then: Pirnoma staff working in different villages share files and information over email, use online storage tools, and hold meetings with instant messenger. Pirnoma also does graphic design work, and created the Tamaani logo, which is an igloo made up of 14 blocks of ice that represent the Nunavik villages.

Pirnoma is now working on translating the Ubuntu open source operating system into Inuttitut, for which staff are looking to secure funding. Between 2007 and 2011, Pirnoma staff also taught IT Troubleshooting courses (leading to Microsoft A+ and Cisco N+ certification). Graduates work in regional organizations such as the FCNQ and KRG. The courses are funded by KRG and administered through KSB for delivery at local schools or adult education centres. Pironoma could not function effectively without being able to send and receive information, access remote services, or download support software through the Internet. When Tamaani became unreliable, Pirnoma used another service provider for a time. Xplornet provided more bandwidth with less technical problems and more reliable Internet access, although it lacked Tamaani's portable modems. After NSI Round 2 and Broadband Canada, Tamaani was reborn with reliable and better service, and Pirnoma started using Tamaani's services again. Pirnoma offers one example of how a competitive local IT organization can be created and thrive despite the challenges of connectivity in Ivujivik.

Two local agents manage Tamaani customers in Ivujivik. They sign up new customers and maintain the local earth station. Both agents, Aulla Qaunnaaluk and Mosusie Audlaluk, became interested in the job for the free Internet and because of their personal interest in technology. They received training through Pirnoma (subsidized by KRG) in the late 2000s, and spoke with pride about acquiring the knowledge and skills to become "real technicians". However, both noted the position does not require a high degree of expertise, and rely on KRG field technicians for major problems.

Ivujivik's school, which includes elementary and secondary classes, used both Tamaani and Xplornet for a time, until the regional network's service improved. Until June 2012 all classrooms shared a single connection, which made the Internet painfully slow. The school does not have a local technician on staff, so a volunteer with a background in IT manages the network and troubleshoots problems. KSB staff recently set up a dedicated videoconference link provided by Tamaani primarily for use in teacher-training from the Université du Québec en Abitibi-Témiscamingue. Users experienced challenges setting up the system and scheduling meetings, but quickly picked up the technology. Staff who remember when computers first arrived in classrooms are now using Smart Boards.

The local nursing station uses Tamaani's network to schedule telemedicine appointments with physicians in Montreal. Nurses use a portable videoconferencing unit's stethoscope and camera for remote diagnosis. They also use the Internet to provide information on health and wellness, and use videoconferencing for administrative meetings and training. These activities help with cost-savings, lessen travel requirements, and improve access to health care.

Despite their successes and energy, people in Ivujivik face considerable challenges in using Tamaani's services. In part this is due to the village's remote location: it is difficult and expensive to purchase new equipment and undertake repairs. The village's small population also limits its technical capacity. That said, Ivujivik offers a vibrant example of how people living in a remote village in Canada are using the broadband infrastructure shaped by their regional government to support various local initiatives, including access to public services and as a platform for economic development. Their story shows how Nunavummiut are employing a First Mile approach to broadband development. As Thomassie writes, Tamaani is as essential to Nunavik as our mouth and hands are to our being.

Conclusion

This paper has focused on how people and organizations in Nunavik have worked to secure digital self-determination in the development of broadband infrastructure and associated institutions and applications. We have argued that given its strong ties to local and regional institutions, as well as its efforts to establish broadband infrastructure from the ground up in a region that otherwise lacked connectivity options, Tamaani reflects a First Mile development pattern. We situated these processes in the specificities of how Aboriginal self-government is shaped in Nunavik, as associated with the JBNQA. As such, we demonstrated how First Mile projects emerge as endogenous development patterns situated in diverse contexts, and undertaken by a variety of groups. We also highlighted some of the challenges faced by Nunavik's First Mile project. Our goal is not to evaluate Tamaani's development path, but rather to demonstrate how it reflects challenges alongside successes. We contend that this history provides examples of how a regional broadband development project helped build local

capacity, encourage community engagement, and foster autonomy and self-government among Nunavummiut.

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[1] Our use of the term "Nunavummiut" refers to someone who lives in Nunavik. While most of Nunavik's residents are Inuit people, the term also includes non-Aboriginal people.

[2] While First Nations have relations with the federal government through the *Indian Act*, Inuit in Nunavik do not have Indian status and so have direct relations with the provincial government.

[3] Support among Cree and Inuit people was divided and not every community ratified the treaty.

[4] KRG is a territorial rather than an ethnic government, which means non-Aboriginal residents can vote in elections, and each village is governed by a municipal government that remains in Inuit control only as long as they maintain a population majority.

[5] KO-KNET already operated a multi-point satellite network from its hub in Sioux Lookout, Ontario. In this venture, the organization invited partners to act as regional Internet service providers. This arrangement was structured as a co-operative: the members all benefitted from shared economies of scale and knowledge exchange. As a partner in this co-op, KRG pays KO-KNET a monthly network management fee (for the operation of the gateway and the network hub, and associated interconnection costs). As of 2013, this fee was set at $1,275 per month for each of the 14 villages in Nunavik. This fee includes a $400 discount per community that KRG receives because it manages bandwidth distribution. The revenue generated from this arrangement goes back into the co-op, either to support operations and maintenance, or towards a shared NICSN Public Benefit Fund.

[6] This model is different from the Nunavut Broadband Development Corporation (NBDC) model, which is a non-profit intermediary between the commercial network service provider (SSi Micro) and community users. SSi Micro operates the Qiniq satellite network on a for-profit basis. The company shares a portion of its profits with local agents, who are paid a commission for their work.

[7] Since 2004 Tamaani has generated a small financial reserve, less than 10% of total revenue.

[8] CSPQ and the provincial Ministry of Health provide funding to purchase 21MHz of dedicated bandwidth from Telesat (at commercial rates) to support health services in Nunavik.

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