

Digital Technology Adoption in Northern and Remote Indigenous Communities in Canada

Prepared for Innovation, Science and Economic Development Canada (ISED)



First Mile Connectivity Consortium (FMCC)

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The First Mile Connectivity Consortium (FMCC) is a registered national non-profit organization in Canada. The FMCC membership includes First Nation and Inuit community-based telecommunications associations and organizations serving remote and rural communities. FMCC research associates include experts on the topic of broadband infrastructure and digital technology adoption in remote and rural communities. The FMCC is primarily engaged in developing evidence-based policy related to broadband infrastructure, digital services and technology adoption in remote and rural communities. **Website:** <http://firstmile.ca>

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1 Executive Summary

This report addresses research on digital technology adoption in remote and northern First Nation and Inuit communities. It summarizes the major elements of our project, including the literature review, identification of primary and secondary data sources, methodologies, strategies and research questions, and recommendations from our research. It includes six comprehensive appendices that are linked to the appropriate report sections and are available online.

There are more than 50 nations or cultural groups and 50 Indigenous languages in Canada. First Nations peoples live in communities in the Northwest Territories and Yukon as well as in isolated communities in the northern regions of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Newfoundland and Labrador. Inuit peoples live in 53 communities across Inuit Nunangat ("the place where Inuit live") in four regions: Inuvialuit (NWT and YT), Nunavut, Nunavik (Quebec) and Nunatsiavut (Labrador). Using Geographic Information System (GIS) software, the First Mile Connectivity Consortium (FMCC) created a map of these regions that can be adapted to present statistical data for illustrative purposes (see Appendix 2).

Due to the short time (3.5 months) and funding resources available for this project, innovative strategies using digital technologies were used to conduct the research. These strategies meant travel time and costs were avoided, creating different opportunities for local engagement and participation in the research completed. We reviewed several options for research conducted remotely, and piloted two different methodologies in two remote or rural First Nations, one in northern BC and the second in Quebec. Our partnership with the SSHRC-funded First Nations Innovation (FNI) research project is supporting the participation of a third First Nation in northern Ontario using a third planned research method that will be implemented in summer 2016.

Formal protocols for regional and community approval as well as requirements for a license for field research in the territories made conducting research in the territories impossible in the time frame. To include Inuit information in the project, the research team consulted by teleconference and email with regional Inuit organization representatives. Their significant contributions are included throughout the report. One of the project recommendations is to expand the research into Inuit Nunangat in the next phase of the project.

Many authors have highlighted the vital role of the "community" in Indigenous community and economic development projects, in particular in small remote and northern communities. The literature suggests digital technology adoption and effective use is a multi-faceted process shaped by many factors. Based on the research on digital technologies in remote and northern Indigenous communities, in this report we propose and use a "whole-community" analytical approach with three levels of factors that shape digital technology adoption:

1. Community members / household factors (top level)
2. Community and community organization-level factors (middle level)
3. Local and transport infrastructure supporting individual and community adoption (base level)

The literature review is the most comprehensive review and analysis to date about the adoption and use of digital technologies in remote and northern Indigenous communities in Canada. This review

includes a summary of policies and programs designed to support digital technology adoption in Indigenous communities. It examines the literature under ten thematic categories:

1. Digital technology for healthcare, telehealth, and health education
2. Digital technology for economic development, business and entrepreneurship
3. Digital technology in education and distance education
4. Digital technology for Indigenous government and governance
5. Digital technology for justice, public safety and emergency communications
6. Social media for community interconnection and interdependency
7. Digital content about Indigenous culture and identity
8. Commercial entertainment online
9. Indigenous resurgence, self-determination and activism online
10. Digital technology to support land-based activities and environmental sustainability

Our field research was guided by the First Nations principles of “OCAP” – Ownership, Control, Access and Possession – or self-determination applied to research. As university-based researchers, we were also required to follow the federal government’s Tri-council Guidelines for doing research with Indigenous peoples that specify meaningful collaboration with the communities in all aspects of the research. These principles and guidelines aim to make research a capacity-building activity that not only supports communities to do their own research but also enables them to use research processes, data and findings produced in partnership with university-based researchers for their own development initiatives. Research methodologies must take into consideration the varying cultural, linguistic, and socio-economic contexts of northern Indigenous communities. The methods and protocols outlined in our report demonstrate a collaborative approach to research that can engage local community groups and their regional intermediary organizations in planning their own digital services.

We pilot tested two different research methodologies to collect information about digital technology adoption in two small, rural First Nations – Timiskaming in Quebec and Iskut in northern BC. We also developed a participatory research process in collaboration with a third remote First Nation, Poplar Hill in northern Ontario. These three First Nation research partners were identified based on their affiliation with three First Nation intermediary organizations associated with this project: the First Nations Education Council in Quebec, the First Nations Technology Council in British Columbia and Keewaytinook Okimakanak in Ontario. These regional partners made the appropriate introductions to local leadership and collaborators who facilitated the research.

Key research findings identified in the pilot studies and the consultation with Inuit organizations as well as in the literature review include:

- Indigenous residents in northern communities are using digital technologies for a wide range of personal and organizational purposes, including contact with family and friends through social networking, email, online banking and bill paying, online shopping, payroll and other administrative services, access to online government services, submitting proposals and reports, and education - both in-school and distance education.
- Tablets and smartphones are increasingly popular for personal Internet access, with smartphone access via Wi-Fi when mobile data service is not available locally.

- Communities have websites, but Facebook is the most popular means of online information sharing by individuals and local organizations, including job postings and local news.
- Some innovative applications include local online buy-and-sell, online fundraising, and software for learning Indigenous languages.
- Residents generally learn to use digital technologies on their own, from coworkers and family members. However, local training is required to help some residents develop basic digital literacies and assist others in applications such as ecommerce and online marketing for local entrepreneurship and local content development.
- Affordability remains a major constraint with numerous participants stating that surcharges for exceeding usage caps made it difficult to take full advantage of Internet access. Basic monthly subscription charges are beyond the means of low income households.
- Community access to the Internet including public Wi-Fi hot-spots is sometimes made available at band offices and community centres. Limited staffing limits public access for residents at schools or school-operated libraries in some communities.
- Quality of service (QoS) poses major constraints where local terrestrial and satellite networks do not have sufficient bandwidth and reliability for applications such as videoconferencing for telehealth and professional development for teachers and online videos or webinars in schools for continuing education and classroom instruction.
- In many cases remote and rural communities are left without mobile services because their isolation and small populations are seen as not having a business case by the incumbent telcos; however alternative mobile services (such as Keewaytinook Mobile and Ice Wireless) have been successful in these environments.
- Regional broadband networks using legacy microwave and satellite equipment lack the transport capacity or cost too much (for example, the high cost of satellite bandwidth) to support increased data usage in these communities.
- Aging digital technologies and networks require ongoing maintenance and upgrades to provide the bandwidth and quality of service that northern communities require.
- Regional fixed network incumbent providers often upgrade their facilities only if communities can help raise the funds required or if other subsidies are available to complete construction projects.

Recommendations

This project included an extensive literature review, an identification of primary and secondary data sources, two completed pilot studies conducted using telecommunications, and a plan for conducting an in-person pilot study in the coming months. Based on this work, we present recommendations in two parts: 1) conducting research: methods and approaches, and 2) addressing constraints and barriers to digital technology adoption. These are listed below and discussed in detail in the recommendations section of the report.

1 Conducting research on digital technology adoption in remote and northern Indigenous communities

1.1 More research is needed: data and information about digital technology adoption in northern and remote Indigenous communities is significantly limited compared to that from other communities in Canada.

1.2 Plan the research to represent and distinguish among Inuit, First Nation, and Métis nations and communities. Given that the current project conducted pilot studies with First Nations, we recommend working with an Inuit community for the next phase of the project.

1.3 Respect and follow the appropriate research ethics and data governance protocols.

1.4 Partner with regional Indigenous organizations that can act as intermediaries between researchers and involved Indigenous communities.

1.5 Develop a strong working relationship with each unique Indigenous community involved in the research.

1.6 Online or virtual research conducted remotely can be appropriate and cost-effective under the conditions outlined in the previous recommendations.

1.7 Research projects on this topic should use an appropriate mix of three methodological approaches: 1) online or virtual research conducted remotely by trained researchers; 2) in-person research with visiting researchers, and 3) capacity-building to train and support local community researchers.

1.8 Research projects on this topic should use the three-level analytical approach to develop their research instruments and data analysis.

2 Addressing constraints and barriers to digital technology adoption in these communities

2.1 Review existing mechanisms for funding digital network infrastructure development in remote and northern regions and assess the resulting costs and benefits to Indigenous communities.

2.2 Support approaches for developing digital infrastructure in northern and remote regions that ensure equity, adaptability, accessibility, affordability and sustainability.

2.3 Support the regional community intermediary organizations that provide technical expertise with the resources required to upgrade, operate and maintain the digital infrastructure in remote and northern Indigenous communities.

2.4 Ensure every Indigenous community has local technical support available.

2.5 Recognize the need for training, skills development and capacity-building in the community, at all levels from residents interested in skills and applications for use at home and work to community technicians.

2.6 Support local and regional efforts to produce digital content in Indigenous languages.

2 Introduction

Our project produced a better understanding of the state of digital technology adoption and use by Indigenous communities in remote and northern regions of Canada, provided a recommended analytical framework for understanding digital technology adoption in these communities, and piloted methodologies for remotely conducting appropriate, cost-effective research on this topic in partnership with involved communities.

According to Indigenous and Northern Affairs Canada, there are 618 First Nation communities in all the provinces and two territories (NWT and YT), representing more than 50 nations or cultural groups and 50 Indigenous languages. Many of these rural and remote First Nations are located in the northern regions of the provinces and in the three northern territories. Many are remote, accessible only by plane or winter roads for two months each year. Inuit peoples live in 53 communities across Inuit Nunangat, "the place where Inuit live", in four regions: Inuvialuit (NWT and YT), Nunavut, Nunavik (Quebec) and Nunatsiavut (Labrador).

The CRTC's 2015 *Communications Monitoring Report* lacks accurate information about digital technology adoption in the Indigenous communities located in these regions. Similarly, Statistic Canada's *National Household Survey* is missing the data from the three territories and many of the remote First Nations. Our project begins to address this knowledge gap.

We developed and pilot tested two different research methodologies to collect information about digital technology adoption in two small, rural First Nations. We also developed a participatory research process in collaboration with a third remote First Nation that will be piloted in the summer of 2016. We acknowledge that the project's three pilot studies do not represent the situation in Inuit communities; one of the project recommendations is to expand the research into Inuit Nunangat in the next phase of the project. There are established requirements for conducting research in northern communities in each of the territories. In the northern territories, researchers must first work with the community to develop a research protocol that is endorsed by the community leadership and obtain a license before conducting research in the community or anywhere in the region.

A major consideration for this project was to conduct the research appropriately. The researchers were guided by the First Nations principles of "OCAP" – Ownership, Control, Access and Possession – or self-determination applied to research. As university-based researchers, we were also required to follow the federal government's Tri-council Guidelines for doing research with Indigenous peoples that specify meaningful collaboration with the communities in all aspects of the research. OCAP and the Tri-council Guidelines aim to make research a capacity-building activity that not only supports communities to do their own research but also enables them to use research processes, data and findings produced in partnership with university-based researchers to support sustainable development in their communities.

This report summarizes the major elements of our project, including the literature review, identification of primary and secondary data sources, methodologies, strategies and research questions, and recommendations from our research. The report includes six comprehensive appendices that are linked to the appropriate report sections and are available online.

In this report and the accompanying appendices we use the specific terms defined below.

Adoption: We define “adoption” as encompassing *access, affordability and effective use*. Many northern and remote communities may have digital technology **ACCESS**, meaning that some broadband connectivity exists in the community. However, there may be limited bandwidth availability and/or a lack of certain kinds of infrastructure required for local distribution (such as optical fibre, fixed wireless or mobile wireless). **AFFORDABILITY** can be a challenge for community members, households and the community organizations providing essential services through digital technologies. In addition, digital technologies may not reflect **EFFECTIVE USE**; appropriate supports are still required including training for community members to leverage these tools to meet their self-determined needs.

Connectivity: Describes the means by which individual terminals, computers, mobile devices, and local area networks connect to the global Internet. The different types of local and backbone connections (ADSL, wireless, fibre, microwave, satellite, etc.) available in Indigenous communities depend on many factors discussed throughout this report. These types of connections influence the adoption of various digital technologies, making it possible to support the use of some devices and applications while other devices cannot be used effectively (for example, cellular / mobile devices or videoconferencing equipment for telemedicine applications).

Digital Literacies: The range of knowledge, skills, and behaviours used with digital devices such as smartphones, tablets, laptops and desktop computers. This term includes the ability to locate, organize, understand, evaluate, and analyze information using digital technology. It involves a working knowledge of current digital technologies and an understanding of how they can be used effectively.

Digital Technologies: Tools, devices, resources and infrastructure used to effectively find, analyze, create, communicate, and use data and information in a digital context. They encompass hardware such as computers, smart phones and other mobile and electronic devices; web 2.0 tools, digital media tools, programming tools and software applications; and the digital networks required to support their effective use. “Digital technology adoption” refers to how digital technologies are accessed and used.

Indigenous Digital Technology Intermediary Organizations: Refers to regional Indigenous organizations established and managed by remote and northern Indigenous communities to provide technical advice, support and services to member communities. The history and evolution of these organizations are discussed in the literature review.

Northern / Remote Indigenous communities: First Nation and Inuit communities in northern regions (north of 60) as well as remote Indigenous communities south of 60 that are geographically remote from urban centres and accessed most of the year by plane, boat or lengthy road journeys (the communities at the end of the road).

3 Analytical Framework and Research Approach

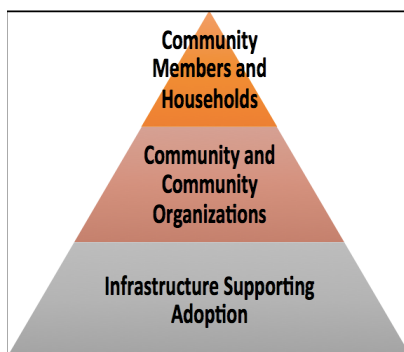
Researchers have used numerous methods and approaches to study and understand digital technology adoption. Most models focus on individual and household adoption and ignore the wider social and community processes involved. One theory that encompasses all elements is community informatics: an approach that stresses technology in itself will not support community development if the collective capacity is not available to use it effectively.

Many authors have highlighted the vital role of the “community” in Indigenous communities in Canada, in particular in small remote and northern communities. The literature suggests that there is a link between the use of digital technologies in Indigenous communities, social capital, and community economic development. Digital technology adoption and effective use of digital technology is a multi-faceted process shaped by many factors, many outside the control of any one individual. Based on the research on digital technologies in remote and northern Indigenous communities, we propose a “whole-community” analytical approach with three levels of factors that shape digital technology adoption:

- Community members / household factors (top level)
- Community and community organization-level factors (middle level)
- Local and transport infrastructure supporting individual and community adoption (base level)

The whole-community approach to understanding technology adoption in northern and remote Indigenous communities includes the three levels illustrated in the diagram to the left. All three need to be considered when conducting research on this topic. Adoption by Indigenous community members and their households is the top level. Many factors are involved in a decision by community members and household to adopt a digital technology. Adoption within and by communities is the middle level. The community level includes how digital technologies are adopted by both community organizations and the regional organizations that support community adoption. The base level is the infrastructure supporting digital technology adoption. Infrastructure issues such as availability, price, quality of service and/or experience, interoperability, ownership and accessibility are factors in

digital technology adoption. Infrastructure also includes the middle mile and backhaul layer that affects bandwidth, price and quality of service.



4 Demographic Characteristics of Northern and Remote Indigenous Communities

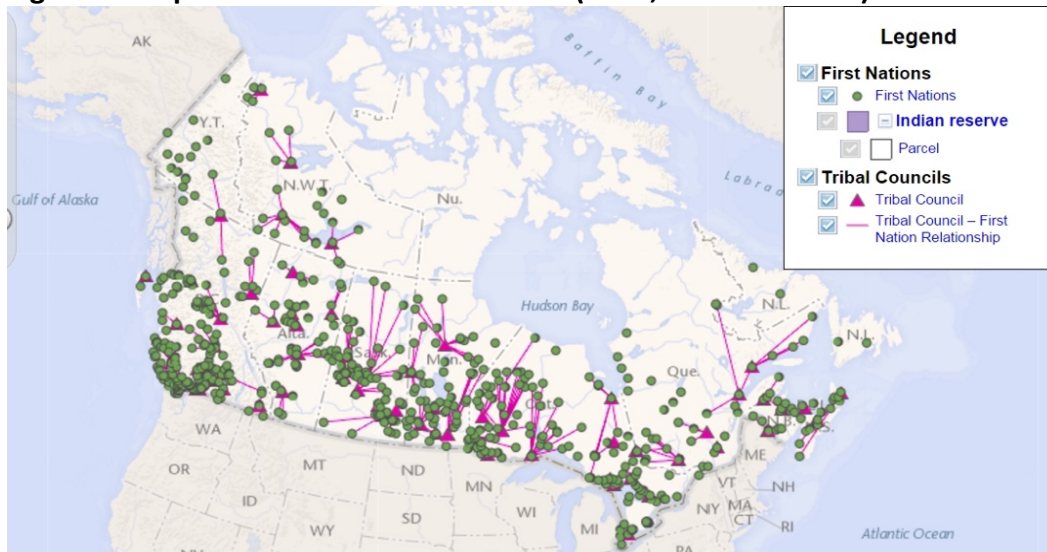
Three-quarters of Inuit live in 53 communities across the northern regions of Canada in Inuit Nunangat (pop. 43,455), in four regions: Inuvialuit (NWT and Yukon, pop. 3,310), Nunavut (pop. 27,070), Nunavik (Northern Quebec, pop. 10,750) and Nunatsiavut (Labrador, pop. 2,325)” (INAC, 2016). Statistics Canada (2011) lists 28 hamlets and settlements across Nunavut.

Figure 1: Map of Inuit communities (INAC, retrieved 2016)



Figure 2 below is the map of 618 First Nation communities, which represent more than 50 nations or cultural groups and 50 Aboriginal languages. According to the 2011 *National Household Survey*, more than 1.4 million people in Canada (or 4% of the population) identify themselves as an Aboriginal person, of which 50% percent are registered Indians (INAC, 2016). First Nation and Métis peoples live in communities in the Northwest Territories and Yukon as well as in isolated or remote communities in the northern regions of BC, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Labrador. Our research project included these communities and identifies the regions we consider in our report in Northern and Intermediate shaded areas on the map in Section 7 below.

Figure 2: Map of First Nation communities (INAC, retrieved 2016)



5 Profile: History of Digital Technology Adoption in a Remote Community

Fort Severn Washaho Cree Nation is the most northern community in Ontario, located on the shore of Hudson Bay. Fort Severn's transition to digital and broadband services and infrastructures is an example of how remote and northern Indigenous communities can adopt digital technologies - when the proper financial and organizational supports are available. Without road access for most of the year, Fort Severn community members have always found innovative and useful ways to communicate and share information over long distances and in challenging conditions. Their story of how they moved from analogue to digital technology is captured on a website, the Fort Severn First Nation technology showcase: http://fortsevern.firstnation.ca/tech_showcase and in publications discussed in the literature review (Gibson et al., 2012; Kakekaspan et al., 2014; O'Donnell et al., 2011).

Fort Severn First Nation along with several other remote communities established the Keewaytinook Okimakanak (KO) First Nations tribal council to develop and deliver shared support services for their local education, health, infrastructure, governance, justice, economic development, and telecommunication needs and priorities. In 1999, the community met with their KO technology resource people to plan their future telecom requirements. The workshop and the findings are available online at <http://smart.knet.ca/archive/fsworkshop/index.html>.

In 2000, KO became Industry Canada's only Aboriginal Smart Communities Demonstration project. This four-year project supported Fort Severn to construct a cable network connecting all the buildings to their C-Band satellite earth-station. This locally owned and operated system distributes the internet and television throughout the community. The community hired three full-time staff to provide technical and training support so all the residents could use these new online technologies, much like any institution, government office, corporation or IT service available in urban centres. They created and supported innovative digital applications expanding local education and health services and constructed and supported a public access facility for training, meetings, digital technology access, and secure headend network management operations, along with other uses. With the right support funding in place, this demonstration program was a recognized success (Carpenter, 2010).

In late 2009, Fort Severn switched on their community-owned cellular service, Keewaytinook Mobile. The community is currently planning to upgrade this system to provide 3G service. Each of the regional broadband-enabled public service applications employed in Fort Severn also continues to deliver their digital services to the community today. However, Fort Severn now struggles to pay for their local technician, operate and maintain aging equipment and infrastructure, pay the ongoing costs for the local facilities, and subsidize online services for low income households. These are similar challenges that telecom providers cite when they request public funds to build and maintain digital infrastructure in these 'high cost service areas'. Regardless of these business model deployed, telecommunications developments in these regions can only move forward with government help to mitigate the risks.

Community-driven models such as that deployed in Fort Severn provide increased community economic development opportunities associated with the adoption of digital technologies by people living in remote Indigenous communities. New strategies are needed to support and sustain the kind of innovative and community-centered approach to digital technology adoption seen in northern communities such as Fort Severn.

6 Literature Review and References

We conducted the most comprehensive review and analysis to date of the adoption and use of digital technologies in remote and northern Indigenous communities in Canada. The paper, included as **Appendix 1**, has been accepted for presentation at the Annual Conference of the Canadian Sociological Association in June 2016. It is based primarily on a literature review, supplemented by personal communications with key informants and the authors' knowledge from extensive research and professional experience in the topic area.

The whole-community approach discussed earlier guided our review and analysis. Included in our review are more than 200 publications, representing the latest research and knowledge on the topic. Our review indicates that Indigenous community members have repeatedly expressed their enthusiasm and desire to adopt digital technologies, despite many challenges, in particular lack of adequate, affordable digital infrastructure and services.

Despite the constraints, today in northern and remote Indigenous communities across Canada, community members are accessing and using digital technologies in their homes, the homes of friends and family members, community schools, and other community spaces. Those working in community health centres, local government offices, schools, public works buildings, airports, water treatment centres, and other community services are using digital technologies in many different ways to work and communicate. They are using a range of devices from smartphones to tablets, laptops and videoconferencing units. Their adoption and use of technologies and infrastructure is often supported by a regional Indigenous community intermediary staffed with skilled technicians who have built up capacities over the years to keep all the equipment and facilities operating reliably.

Our literature review looks at how remote and northern Indigenous communities are adopting and using digital technologies in 10 thematic categories:

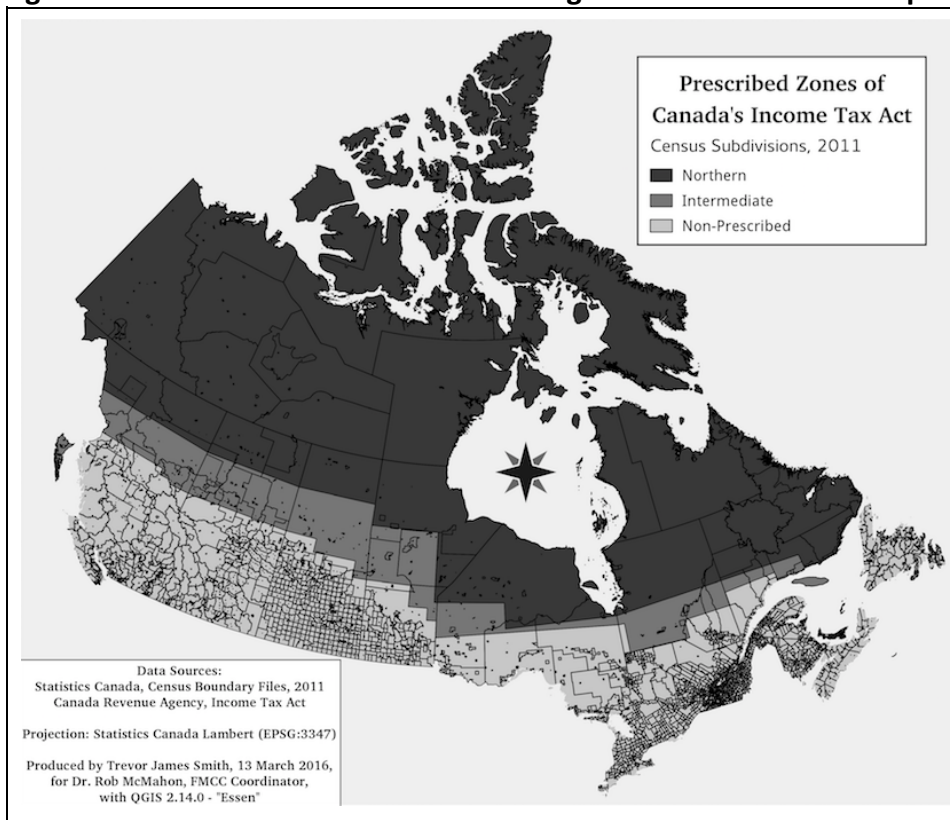
1. Digital technology for healthcare, telehealth, and health education
2. Digital technology for economic development, business and entrepreneurship
3. Digital technology in education and distance education
4. Digital technology for Indigenous government and governance
5. Digital technology for justice, public safety and emergency communications
6. Social media for community interconnection and interdependency
7. Digital content about Indigenous culture and identity
8. Commercial entertainment online
9. Indigenous resurgence, self-determination and activism online
10. Digital technology to support land-based activities and environmental sustainability

Our review includes literature on policies and programs to support digital technology adoption in Indigenous communities. The conclusion highlights the main challenges to digital technology adoption in these unique environments. See **Appendix 1** for the complete literature review.

7 Identification of Primary and Secondary Data Sources

We consulted a variety of primary and secondary data sources on digital technology adoption in Northern Indigenous communities. To develop our geographic area of interest, we defined Northern and remote Indigenous regions as including both territories and the northern regions of the provinces. Using Geographic Information System (GIS) software, we created a map (Figure 3, below) of these regions that can be adapted to present statistical data for illustrative purposes. Our review of primary and secondary data sources confirms the lack of available information about community and household technology adoption and use in these regions. We identified the need for additional data collection and analysis on this topic for Indigenous communities. For a more detailed review and discussion of the data sources we identified, including short descriptions and URL links, see **Appendix 2**.

Figure 3: The Northern and Intermediate regions considered in this report



Individual and household factors include socio-economic variables such as cost, education, income, age and ethnicity. This information for the provinces is available through government statistical bureaus such as the *Canadian Socio-Economic Information Management System* (CANSIM). The Statistics Canada and CRTC *Internet Monitoring Reports* lack this information for the three territories and many remote First Nations. Some data sets do specifically apply to northern communities and regions, including those provided by territorial and regional governments. We also reviewed online resources that provide socioeconomic data specific to Indigenous communities, including information on economic development, employment and education. Little information is available about attitudes, perceptions and beliefs about digital technologies and the Internet. Finally, we identified data sources from

government agencies and third-party researchers associated with digital technology adoption (number of devices owned; household spending on digital technologies; etc.).

Community-level factors such as local leadership and coordinated technology planning are from sources including northern Indigenous regional broadband organizations. While regional information is available, further research is required examining locally-owned networks. The First Mile Connectivity Consortium recently reviewed past and existing federal funding programs for broadband and is presently finalizing a report for release in Spring 2016. This report clearly illustrates the complex and fragmented nature of funding for broadband infrastructure and services in rural, remote and Northern communities. Funding initiatives are also often challenging for community-based organizations to access and utilize for a number of reasons that we identify in the report. Data on training (skills and jobs) in Canada's ICT sector provide only a general overview: additional research is required to illustrate specific data related to northern regions and Indigenous populations. Finally, we identified several examples of how digital technologies are used by public and community services, such as health, education, justice, public works and emergency management. Available data sources about the infrastructure required to support adoption include availability, price, quality of service, and interoperability are included in **Appendix 2**.

8 Summary of Methodologies, Research Strategies, Research Questions

Given the ethical and logistical requirements of doing research with Indigenous communities, we selected potential community research collaborators based on their affiliation with the three First Nation community intermediary organizations involved in this project: the First Nations Education Council in Quebec, the First Nations Technology Council in British Columbia and Keewaytinook Okimakanak in Ontario. The potential communities were approached by these intermediary organization partners, who made the appropriate introductions to and validation of the researchers and the research project.

As noted earlier, our research with these First Nations does not represent Inuit communities. We did approach Inuit organizations to discuss the project and the requirements for doing research with Inuit communities, including consultation and licence agreements. All agreed that doing this research appropriately would take many months of preparation, and was not possible in the short timeframe of this project. One of our recommendations is to conduct research with an Inuit community in the next phase of the project.

We considered several methodologies to test for our research on adoption of digital technologies in remote Indigenous communities including surveys of community members, focus groups, key informant interviews, and a survey of school students. For each, we considered various means to collect the data including in-person in the communities, videoconference, telephone, and email. **Appendix 3** provides more details about the research methods, strategies and questions.

The research requirements, timeframe and financial restrictions made it impossible for the researchers to visit the communities in person to carry out the research. We concluded that it would also require more time and resources than were available to provide training and supervision of local interviewers remotely. Because videoconferencing facilities have been installed in Indigenous communities in northern Ontario and northern Quebec, we decided to test focus groups via videoconferencing in a community in this region.

It is difficult to obtain enough reliable telephone numbers to carry out residential community telephone surveys, especially because many residents now have mobile phones with numbers from a different location such as a city, rather than landlines. Also, it is difficult to obtain email addresses for the general population, and email surveys would leave out those who do not use email. School students in senior grades could be asked to complete a questionnaire about use of digital technologies in their households, but it can be difficult to obtain permission to do research in schools. However, through directories and websites as well as referrals and verification with the community contact persons, it is possible to obtain telephone contacts for key informants such as employees of local governments, non-profit organizations, education and health care, and businesses. We therefore chose key informant interviews by telephone for our second field trial. More information is available in **Appendix 3**.

To address the agreed-upon research questions, the researchers collected information on digital technologies used by respondents; applications used in administration, online banking, e-government services, ecommerce, social media, distance education, telehealth, etc.; community access; availability of training and technical support; local and Indigenous content and applications; perceived benefits of digital technologies for the community; and perceived barriers to adoption or utilization. We used material from several sources to design our interview protocols, including the StatsCan Survey of Digital Technology and Internet Use, the Canadian Internet Use Survey, questionnaires from other field research in Canada, and questions from interview protocols used in other studies by the research team. As well, the researchers followed the whole-community three-level methodological approach described earlier and considered the tools, and the methods and data sources listed above to develop the research questions.

For the third pilot study, the researchers partnered the ISED research project with the ongoing First Nations Innovation (FNI) research project (<http://firstmile.ca>) based at the University of New Brunswick. This study will develop a Community Asset Inventory survey instrument in partnership with the Keewaytinook Okimakanak Research Institute (KORI) and Poplar Hill First Nation in Ontario. The research will be conducted in the community in June, 2016.

9 Summary of Videoconference Focus Group in Timiskaming First Nation, QC

Our first pilot study was an online focus group with Timiskaming First Nation (TFN), an Algonquin community located 510 kilometres northwest of Ottawa. This rural community of 584 people is adjacent to the municipality of Notre-Dame-du-Nord, Quebec. It is accessible by paved road. Local services include a health centre and school (grades K-8). The nearest town with banking and commercial services is New Liskeard, Ontario, 29 km away, while the nearest town with provincial government services is Rouyn, Quebec, 108 km distant.

TFN has Télébec (a Bell Canada subsidiary) fibre transport connecting directly to a few community organizations on a private network operated by the First Nations Education Council. Residential services are available through Télébec ADSL and Parolink Wireless (an Internet provider in New Liskeard, Ontario). The First Nations Education Council (FNEC) works with the TFN community to provide connectivity and infrastructure support, expand fibre optic links, and manage the connections with Télébec.

We chose to pilot a remotely-managed focus group using videoconferencing technology to gather research information. With on-site support from TFN staff, the researchers conducted a 90-minute focus group held at the Band Office with 10 residents of TFN. The session received technical support through FNEC staff in Wendake First Nation, Quebec. Participation in the focus group highlighted the need to identify and support community benefits and outcomes in any research. Key enabling factors for this methodology included a pre-existing research relationship with TFN; a comprehensive plan and resources to promote, manage and conduct the event remotely; an on-site research coordinator from TFN; support from the regional intermediary organization; and adequate videoconferencing facilities and connectivity. For more details on this research methodology and research results, see **Appendix 4**.

The research questions focused on individual, household and organizational use of digital networks and technologies in TFN. Briefly, TFN residents use the Internet for a variety of applications, ranging from staying in touch with family and friends, to entertainment, information-seeking, online shopping and bill-paying. Mobile devices such as tablets and smartphones are popular means of accessing the Internet; several also mentioned game consoles. Facebook is popular for sharing local news and announcements. Participants were unaware of any online activity for local marketing or entrepreneurship. People use the Internet both at home and at work. They also go online at community access points such as the library and band office. Residents rely on each other as there is no local technical support or digital training, and a community learning centre was shut down.

Affordability is the main barrier to adoption, with fixed income and expensive data overages and service bundles cited as specific challenges; some mentioned concerns about security for online banking and shopping. Participants thought that pricing should be “fair,” and that user subsidies or discounts should be available for low income or fixed income residents. Nonetheless, participants pointed to examples of digital innovation, such as a locally-developed Algonquin language app used in school and available for public download. Key findings from this study are presented in **Appendix 4**.

10 Summary of Findings from Key Informant Telephone Interviews in Iskut First Nation, BC

Iskut First Nation is a Tahltan community in the Stikine region of north central BC, with a population of about 320. Although located on a paved highway, Iskut is very isolated. The nearest high school and doctor are 87 kilometres away. The nearest hospital, commercial airport, and bank and other major services are in Terrace, 500 kilometres or six and a half hours away by car. There is no mobile phone service. Internet service is provided over an ADSL network which was installed with funds that the band obtained from the First Nations Infrastructure Fund. The facilities are owned and operated by Northwestel. Technical support for the band’s equipment and local network is provided by a firm based in Terrace.

To gather information in Iskut, we used a methodology of telephone interviews with key informants from institutions including the band office, education, health care, and local businesses. Since the research team had not previously conducted research with Iskut, it took time for relationship-building. Following our community contact’s advice and our team’s ethical commitment to community-engaged research, we contacted residents and staff directly only after we had the community’s consent. The process was delayed by the many responsibilities and commitments of the leadership. When the research team was

able to contact the chief of Iskut First Nation directly, she responded very quickly and approved our research.

Key digital applications for the band are email, payroll, online banking and accounts payable, and filing reports for government and tribal grants. The tourist lodge uses an Xplornet satellite link for email, reservations, and access to government services, including paying taxes. Public access to computers and connectivity is available but limited, with Wi-Fi at the band office and community hall. The school's facilities are not available to community residents. The tourist lodge runs an Internet café during the tourist season. The band saves time and money with online banking and filing reports online. The Iskut band and the Tahltan Central Government have websites, but Facebook is the most popular means of sharing information on jobs and other community information. The tourist lodge uses its website for marketing and reservations. There is little evidence of formal training for digital technologies being provided locally. Respondents stated that people learn on their own and help each other.

Although connectivity seemed adequate for basic business and organizational tasks, users believe additional bandwidth is required for some applications. Teachers in the local school access the Internet to find material for classes, but service quality and bandwidth are insufficient to stream videos for classroom use. The health centre is unable to use the telehealth videoconferencing equipment that was installed by Health Canada because of the lack of bandwidth and inadequate quality of service. The local teachers and health centre employees are unable to participate in webinars or other online professional development activities. The education manager pointed out that a teacher would have to miss a week of class to drive and then fly to meetings in Vancouver. Some residents have taken distance education courses online from various BC institutions. One respondent completed a Bachelor of Commerce degree online.

Respondents generally think the internet is important to Iskut and remote communities. One informant stated: "People are 'power users' compared to people in cities. They don't have local shops – they shop online. Their whole life is online." Another stated "Technology is a benefit for isolated communities," and added "Technology has taken over everybody's lives." For more details on this research methodology and research results, see **Appendix 5**.

11 Summary of Community Asset Inventory Tool for Poplar Hill First Nation, ON

Our third pilot study is the participatory development of a community asset inventory survey instrument and participatory process to collect information in collaboration with a remote First Nation community in Ontario. The survey will use the whole-community approach developed by this project. Local assets and capacity including resources such as physical infrastructures, facilities, equipment, as well as human and financial resources, will be included in collecting information about the effective use of digital technologies by individuals, households, and organizations in the community.

The leadership of Poplar Hill First Nation, a remote community in northwestern Ontario, agreed to work with the project researchers to create the tool with the understanding that the local survey will be conducted in the summer of 2016. We are now making plans for a researcher to work with community members to complete the survey. After the survey is complete, we will work together to analyze and present the information and findings in a format suitable for the community. The goal is that the

information gathered will support the community's work in planning economic and social development initiatives by identifying local priorities and capacities. **Appendix 6** contains more details about Poplar Hill's extensive history of digital technology adoption along with the research methodology and the proposed survey.

Poplar Hill First Nation, with reserve status established in 1978, is a remote community with an on-reserve population of 587. Most community members speak Ojibway as their first language, including the young people. Air transportation is available year-round with connections to Sioux Lookout, Red Lake and Winnipeg. A winter road is available for approximately two months each year for hauling fuel and supplies into the community. Education and health services are managed locally with a new school presently under construction and a new health centre being planned. The local roads, water, waste water and diesel-power electrical grid are owned, operated and maintained by the band administration. Similarly, the local coaxial cable network delivering internet connections to every building in the community is band owned and maintained. The community leadership directs and accesses various regional services in partnership with other treaty member First Nations across northwestern Ontario. Public safety services are delivered by the Nishnawbe Aski Police Services. Secondary-level support services in health, education, telecommunications, public works, housing, training, economic development, etc. are provided by the community's First Nation council, Keewaytinook Okimakanak.

As early adopters of communication technology, Poplar Hill is exploring strategies to continue building and upgrading their infrastructure and capacity to support the adoption of these new tools and applications. The opportunity to undertake a Community Asset Inventory survey builds on previous research and will contribute to community planning. Poplar Hill currently operates a comprehensive lands and resource mapping system for their traditional lands. This tool is now being used to digitize all aspects of the community infrastructure including buildings, roads, electrical, cable, water, waste water, housing, etc. This asset inventory is also intended to support local strategies for economic and social development as identified by community members. The household and organization survey on digital technologies will assist in identifying training and capacity requirements working with local expertise in their first language. Working with local researchers who have a strong connection to their traditional lands and resources and their first language is important for supporting appropriate research and building community research capacity. For more details on this research methodology, see **Appendix 6**.

12 Conclusion

This report summarizes and highlights the work undertaken by the FMCC team over the past four months. We hope this report will support further investment and engagement in research with northern Indigenous communities. Our findings from the literature review, review of primary and secondary data, and pilot study research all highlight an expanding, multi-faceted digital divide between urban environments and remote, rural and northern rural Indigenous communities in Canada. Our report both outlines the contours of this divide and points to recommendations that highlight the role that future community-engaged research can play in addressing it.

The First Mile Connectivity Consortium (FMCC) team worked with many people and organizations to produce this report. Our approach was to use community-engaged research and to acknowledge that a 'one-size-fits-all' approach is inappropriate for research on digital technology adoption in northern and

remote Indigenous communities. We pilot tested two different research methodologies that illustrated an approach for remotely-managed data collection and analysis, plus the third pilot study that will involve researchers working in-person in a remote community. Our report describes the processes, relationships and tools required to develop and implement these methodologies in partnership with both local communities and their regional intermediary organizations. Our method underscores the relationship-building and collaborative work required to conduct effective, ethical work in partnership with northern Indigenous peoples.

This journey challenged each member of the project team. We struggled to find an effective way to conduct research with remote communities that was respectful and useful for them, while also adhering to tight deadlines and resource constraints. We experienced the importance of recognizing local and regional research protocols established to protect Indigenous knowledge and ensure the correct information is being gathered and presented. The federal government's Tri-Council guidelines for ethical research in Indigenous communities provide clear requirements for researchers working in these environments. The research methodologies, the questions, the information collected, and the outcomes must all meet the requirements of the involved communities as well as their regional intermediary organizations.

While choosing to pilot-test remotely-managed methodologies in studies in three First Nation communities, we also wanted to ensure that our project was informed by perspectives from different organizations representing Inuit communities. In our ongoing consultations with representatives from these regional governments and northern-based non-profit associations, it became obvious that their research protocols required considerable more time and resources to ensure engagement in primary data collection at both the regional and community level. Therefore, working with the recommendation from one of the Inuit representatives, the FMCC team shared our findings, consulted with the representatives, and received additional information and recommendations that we include in this report.

We recognize that our pilot studies do not include an Inuit community. However the literature review (Appendix 1) includes a review of existing research with Inuit communities, including a prior study by one of the FMCC researchers in the Nunavik community of Ivujivik (McMahon & Mangiok, 2014). We are encouraged that the Kativik Regional Government is currently funding a study to obtain individual and household survey information that will include expenses for digital technology, online activities, and connectivity. This information, expected to be completed later this year, will add considerably to the information presented in this report.

Some of the research findings identified in the pilot studies and the consultation with Inuit organizations as well as in the literature review include:

- Indigenous residents in northern communities are using digital technologies including the Internet for a wide range of personal and organizational purposes, including contact with family and friends through social networking, email, online banking and bill-paying, online shopping, payroll and other administrative services, access to online government services, submitting proposals and reports, and distance education.

- Some innovative local applications include local online buy-and-sell, fundraising, and software for learning Indigenous languages.
- Training is required in the communities to help some residents to acquire basic digital literacies and to assist others in applications such as ecommerce and local content development.
- Affordability remains a major constraint with numerous participants stating that usage caps made it difficult to take full advantage of Internet access and that basic monthly charges were not affordable for people on fixed incomes.
- Quality of service (QoS) poses major constraints where local terrestrial and satellite networks do not have sufficient bandwidth and reliability to do videoconferencing for telehealth and professional development for teachers, and to use online videos or webinars in schools.
- Remote and rural communities may be left without mobile services when the incumbent telcos do not see the business case for it; however alternative mobile services (such as Keewaytinook Mobile and Ice Wireless) have been successful in these environments.
- Aging digital technologies and networks require ongoing maintenance and upgrades to provide the bandwidth and quality of service that northern communities require.
- Telecommunication providers may upgrade their facilities only if communities can raise the funds required, or other subsidies are available.
- Individual, family and community benefits of being able to participate effectively in the online environment required by government, financial institutions, businesses and many parts of our society are elusive for people living in remote and rural Indigenous communities.

Indigenous communities are finding innovative strategies and partnerships to address the challenges associated with this growing digital gap across Canada. Research literature and examples such as highlighted in the Poplar Hill study (Appendix 6) demonstrate how these communities are establishing local and regional businesses and organizations with the capacity to build, maintain and support the effective use of the digital technologies and services required by their community members.

Through the different processes and methodologies discussed and tested in this report, we illustrated some of the ways that university-based and community-based researchers can collaborate to create new knowledge about digital technology adoption and use in isolated Northern communities. The methods and protocols outlined in our report demonstrate how to use a collaborative approach to support and engage community organizations in planning for their own digital services.

13 Recommendations

Based on the literature review, pilot studies and other work described in this report, we present our recommendations in two parts: 1) conducting research: methods and approaches, and 2) addressing constraints and barriers to digital technology adoption.

13.1 Conducting research on digital technology adoption in remote and northern Indigenous communities

1.1 More research is needed: data and information about digital technology adoption in remote and northern Indigenous communities is significantly limited compared to that from other communities in Canada.

Our review of primary and secondary data sources illustrated that while some information exists about digital technology adoption in these communities, it is far more limited than that available from other communities in Canada. The literature review confirmed that more research is required to understand both the levels of adoption of digital technologies and their uses in Indigenous communities.

1.2 Plan the research to represent and distinguish among Inuit, First Nation, and Métis nations and communities. Given that the current project conducted pilot studies with First Nations, the next phase of the project should include an Inuit community.

Research must clearly distinguish between Inuit, First Nation, and Métis communities and contexts. Our Inuit informants indicated that too often, programs and projects that originate in far-off metropolitan centres try to include all Indigenous groups under a single ‘one-size-fits-all’ umbrella. Our focus on pilot studies with three First Nation communities identified some of the methodological factors that researchers working with remote and northern communities must consider in their work. Through these studies, we documented the unique languages, cultural contexts, land use practices, organizational policies and requirements, geographic considerations, installed base of infrastructure, service delivery organizations, cost factors, funding opportunities, local human resource capacities, partnership with local institutions and leadership, and community development requirements.

1.3 Respect and follow the appropriate research ethics and data governance protocols.

Local ownership and control of the information collected is an important requirement for many Indigenous communities, and there are protocols in place to support researchers and Indigenous communities to do this appropriately. The First Nations Information Governance Centre (FNIGC) Regional Health Survey follows the principles of OCAP (ownership, control, access and possession) in all its research work with First Nations. In the past, communities refused to participate in Statistics Canada’s surveys because they understood the information was going to be collected and used by others, without their informed consent. The First Nation principles of OCAP are important requirements for conducting respectful research in Indigenous communities. The federal government’s Tri-Council TCPS2 research ethics requirements (2014) provide important guidelines to be followed when working with any Indigenous community. Some individual communities, nations or regions also have research ethics protocols.

1.4 Partner with regional Indigenous organizations that can act as intermediaries with the Indigenous communities in the research.

Our experience with the current project confirmed what we have learned from our long-term First Nations Innovation research project, and from other long-term projects such as the Kativik Regional Government-Université Laval partnership: successful research with Indigenous communities requires collaboration with regional Indigenous intermediary organizations. Regional Inuit and First Nation organizations will support, facilitate, and guide research in the Indigenous communities they work with on an ongoing basis. The engagement of researchers with regional Indigenous organizations ensures community involvement and support for the work being undertaken, which we identified as a key success factor in our pilot studies. Remote and rural communities have established these regional community intermediary organizations to represent their interests and support their work. Given the lack of the large-scale governance organizations that exist in large population, well-resourced urban centres, rural and remote communities set up these regional entities to take on similar responsibilities. Too often, these intermediary organizations are by-passed by well-intentioned researchers, who instead directly contact over-burdened and under-resourced community leaders. We suggest that this challenge might be addressed by researchers working in partnership with the regional community intermediary organizations set up to support local governments in these isolated and unique areas of Canada.

1.5 Develop a strong working relationship with each unique Indigenous community involved in the research.

Research on the adoption of digital technologies in Indigenous communities can use standardized research protocols but may require some modifications for different cultural and geographical contexts. Developing a strong working relationship with the community that respects regional and local cultural, political and research protocols is an essential initial step in working with Indigenous peoples living in remote and rural communities. The research requires a focus on the benefits to communities that must be clearly stated and understood by everyone involved in the work; for example, identifying the data that the communities want presented to policy-makers.

A community engagement approach brings a sensitivity about regional and local requirements that helps to ensure reliable data collection in regions where professional researchers cannot visit in person. As illustrated in our pilot studies, and in other methodologies such as that used by the First Nations Information Governance Centre's Regional Health Survey, a good working relationship with community leadership and the participation of local data collection teams is essential when collecting data at this level (see <http://fnigc.ca/our-work/regional-health-survey/about-rhs.html>).

1.6 Online or virtual research conducted remotely can be cost-effective and appropriate under the conditions outlined in the previous recommendations.

In research with remote and isolated communities, researchers must consider innovative approaches to data collection. Online or virtual research methods can help address challenges associated with the cost and time constraints of conducting research with northern Indigenous communities. The literature review found examples of valuable data collected via online surveys that were conducted appropriately with community research partners, following the research protocols recommended above.

The two pilot studies conducted for this project used 1) a focus group conducted by videoconference, and 2) key informant interviews conducted by telephone. Both were successful in gathering community

data on digital technology adoption. As pilot studies, they should be considered as examples of what could be done in a more comprehensive research project. For example, in social science research, good practice for focus groups generally involves doing multiple focus groups until data saturation is achieved. In a small remote community of 300 people or less, this could potentially involve eight to 10 focus groups, each with eight to 10 community members. For individual community interviews, it may be appropriate to conduct upwards of 20 interviews per community. For example, for the in-person research conducted in Fort Severn First Nation with the First Nations Innovation project, 42 interviews were conducted with community members. It would likely take considerable time to conduct this level of research remotely; however our pilot studies demonstrate that such an approach is possible.

Through the research methodologies piloted by this research project, the researchers demonstrated how to work with regional and local organizations to identify and facilitate community involvement in remotely-managed data collection in northern Indigenous communities. We stress that this participatory process requires strong and trusting relationships. The videoconference for the focus group could only take place because of relationships with Timiskaming First Nation and the community intermediary organization (FNEC). These Indigenous organizations facilitated the social and technical connections and resources that the remotely-located researchers utilized during the 1.5-hour focus group session. The key informant interviews in Iskut were similarly completed through the facilitation and connections provided by the community intermediary organization (FNTC), as well as local and regional leadership including members of the Tahltan Central Government and the Iskut Band Council.

Clearly, adequate resources and time are required to complete any research initiative in Indigenous communities in Canada's northern regions. It is challenging to do research engaging community and regional organizations over a very short period. One example mentioned by an Inuit organization representative is the household survey research in the 14 Inuit communities in Nunavik led by Dr. Gerard Duhaime, Université Laval. This multi-year, \$500,000 project, funded and managed by the regional Kativik Regional Government (KRG), will result in data collected in-person in the communities and managed and presented online using KRG's/Laval's data presentation software. This research project began in early 2015 and is still ongoing today.

1.7 Ideally, research projects on this topic should use an appropriate mix of three methodological approaches: 1) online or virtual research conducted remotely by trained researchers; 2) in-person research with visiting researchers, and 3) capacity-building to train and support local community researchers.

Each of these three approaches has opportunities and challenges, and different associated costs and resource implications. These should be factored in at the research design stage so that the appropriate mix of methodologies and approaches is included. The project's experiences with virtual research were discussed in the previous recommendation. Following the OECD approach, research projects on this topic should be ongoing and updated to reflect changing trends and technologies (OECD, 2015, referenced in Appendix 6.)

Regarding costs, in the long run, the most cost-effective approach for long-term and regular data collection would probably be to build community capacity and train and support local community researchers. This is the approach utilized by the First Nations Regional Health Survey discussed earlier. Online or virtual research conducted remotely by trained researchers has costs associated with

professional services and local coordination, but avoids expenses associated with travel and time. In-person research is generally the most expensive to conduct appropriately, given the protocols and relationship-building required. For example, over five years the First Nations Innovation project based at the University of New Brunswick conducted in-person research with 12 First Nations at an approximate average cost of \$36,700 per community. The Université Laval research with partner Kativik Regional Government is presently conducting research with 14 Inuit communities at an approximate average cost of \$37,700 per community. However, we note possible additional outcomes of in-person research, including increased opportunities for local training and capacity-building for community researchers, more sustained relationship-building activities, and increased public outreach activities regarding research methods, goals and outcomes.

1.8 Research projects on this topic should use the three-level analytical approach for their research instruments and data analysis.

The “whole-community” analytical approach is described in section 2 of this report. It includes three levels of factors that shape digital technology adoption:

- Community members / household factors (top level)
- Community and community organization-level factors (middle level)
- Local and transport infrastructure supporting individual and community adoption (base level)

Based on our review of the literature and pilot studies, we believe this is the most appropriate approach for research on digital technology adoption in remote and northern Indigenous communities.

13.2 Addressing constraints and barriers to digital technology adoption in these communities

2.1 Review existing mechanisms for funding for digital network infrastructure development in remote and northern regions and assess the resulting costs and benefits to Indigenous communities.

The literature review and pilot studies identified that despite significant public funding for digital infrastructure development, the costs of access and use of digital technologies in many remote and northern regions is still very high. We identified challenges with existing funding mechanisms and the need for mechanisms that enable communities to hold telecom providers to account. There are ongoing quality of service (QOS), accountability, and affordability issues in these communities, demonstrating a need for ongoing oversight, monitoring by funders, and possibly regulatory intervention. While findings from our pilot studies are difficult to generalize across all northern communities and regions of Canada, the researchers are hearing similar anecdotal evidence through our work with FMCC.

Significant new investments will be needed to increase broadband capacity to support adoption in northern and remote Indigenous communities. However, before these investments are made, the funders should be confident that the funding mechanisms are the right ones, and the accountability and benefits to communities will be guaranteed. The choice of broadband technology will also be crucial. According to the latest analysis from the OECD (2014), fibre is the only ‘future proof’ technology that is certain to offer greater capacity than wireless networks, which are continually evolving to offer better performance in addition to the benefits of mobility and flexible deployment. Rolling out fibre could also generate new and interesting possibilities for innovation and technical development in isolated, low-population communities that currently lack a diverse economic base. New engineering and technical solutions are needed to reduce these and related infrastructure costs.

2.2 Support approaches for developing digital infrastructure in northern and remote regions that ensure equity, adaptability, accessibility, affordability and sustainability.

The lack of accessible and affordable digital infrastructure is the major barrier to more effective use of digital technologies for education, health services and community and economic development in remote and northern Indigenous communities. The price of connectivity in northern and remote communities is high, particularly considering the charges for exceeding data caps, which are highest in satellite-served communities. The costs of adopting digital technologies will continue to be a constraint or a barrier to technology adoption as long as services are not affordable for fixed income residents and those dependent on subsistence activities and seasonal employment.

The need for affordable infrastructure that supports the provision of essential services in Indigenous communities was highlighted in the literature review and was a message heard during both our team's consultations with the Inuit organizations and the pilot study research with the First Nation communities. The literature review completed for this project includes all the completed studies (Nunavut, Nunavik, etc.) and successful projects (northwestern Ontario fibre network) demonstrating how fibre networks can be constructed to deliver required connections in every Indigenous community in Canada.

The lack of ongoing and sustainable partnerships among governments, Indigenous communities and service providers to make these developments happen was identified by many research studies referenced in the literature review. Our pilot studies similarly highlighted the high cost to connect public buildings in Timiskaming, and the inadequate service available in Iskut - despite each community raising considerable funds to develop their Internet connection infrastructure. Funding frameworks can be shaped to incorporate increased partnership development opportunities and accountability mechanisms to avoid these kinds of outcomes.

2.3 Support the regional community intermediary organizations that provide technical expertise and the resources required to upgrade and maintain the digital infrastructure in remote and northern Indigenous communities.

The literature and our pilot studies highlighted the important role of the regional community intermediary organizations that support infrastructure development and digital technology adoption in Indigenous communities. These organizations require sustainable funding rather than project-based funding that favours short-term benefit over long-term sustainability.

2.4 Ensure every Indigenous community has local technical support available.

Remote Indigenous communities require a local technical team to provide ongoing support for the communications infrastructure, rather than relying on distant telecommunications providers. This helps address the challenges of quality of service, accessibility, and affordability outlined in this report. Currently these resources are very challenging to find or retain for many Indigenous communities. Examples of Indigenous owned and managed digital technologies applications and networks discussed in the literature review highlight how some of these challenges are being addressed by Indigenous communities.

2.5 Recognize the need for training, skills development and capacity-building at all levels in the community, including for community technicians.

Many programs designed to support digital technology adoption in Indigenous communities underemphasize the importance of training, skills development and capacity-building within the community. This is a key factor determining whether or not the potential of digital technologies in Indigenous communities will be realized. We recommend a train-the-trainer model for digital training in Indigenous communities. We recommend an approach that focuses on training northern youth and Elders to be technical and digital leaders in their communities. Such an approach involves researchers partnering with communities to facilitate the resources and capacities that will produce community technical resources appropriate for regional as well as linguistic and cultural contexts.

2.6 Support local and regional efforts to produce digital content in Indigenous languages.

Language will be a challenge for the community members and households more comfortable in Indigenous languages than in Canada's two official languages. The Internet and associated technologies may contribute to the disappearance of Indigenous languages even as the communities strive to preserve them, although there are examples of Indigenous language applications and content. The literature highlights the importance of providing community members with access to localized online resources catered to community-specific needs to help maintain Indigenous control over their knowledge, language, and culture.

Appendix 1: Literature Review and References**Appendix 2: Identification of Primary and Secondary Data Sources****Appendix 3: Methodologies, Research Strategies and Research Questions****Appendix 4: Online Focus Group: Timiskaming First Nation, QC****Appendix 5: Key Informant Interviews: Iskut First Nation, BC****Appendix 6: Community Asset Mapping Tool: Poplar Hill First Nation, ON**