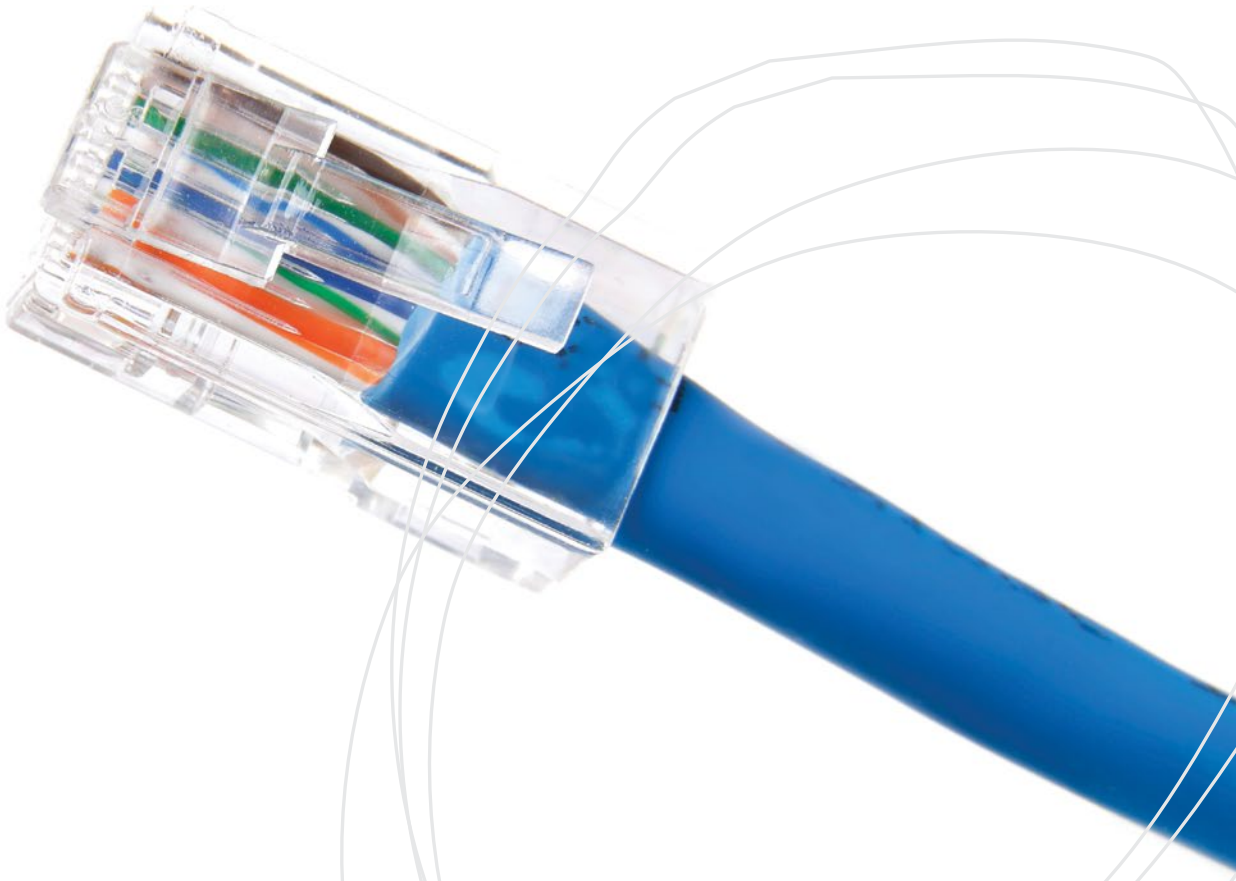
The Conference Board of Canada

Centre for the North

MAPPING THE LONG-TERM OPTIONS FOR CANADA'S NORTH

Telecommunications and Broadband Connectivity.



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The Conference Board of Canada

Mapping the Long-Term Options for Canada's North: Telecommunications and Broadband Connectivity
by *Adam Fiser*

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Preface

This report maps long-term options for Canada's Northern connectivity landscape. In 2013, the immediate concern for Northern stakeholders—both Aboriginal and non-Aboriginal—is to develop critical connectivity infrastructure that is reliable, scalable, and supportive of locally affordable services. In going forward, careful attention must equally be paid to developing multi-stakeholder partnerships that will mature and endure beyond immediate infrastructure concerns.

The report first orients the reader by benchmarking the high costs that residents pay for personal telecommunications and high-speed Internet services across Canada's North. Sharp contrasts appear between Canada's inhabited Arctic and boreal forest regions, particularly between satellite-dependent communities and markets where fibre optic networks are available. The report then explores two regional case studies that foreground the disparate drivers and challenges shaping critical connectivity infrastructure in Canada's inhabited Arctic and boreal forest regions, and a third case study examines the unique connectivity requirements of Canada's growing presence and responsibilities in the circumpolar North. It concludes with a series of lessons and recommendations to enhance Canada's Northern connectivity landscape and improve the multi-stakeholder partnerships it depends on.

Contents

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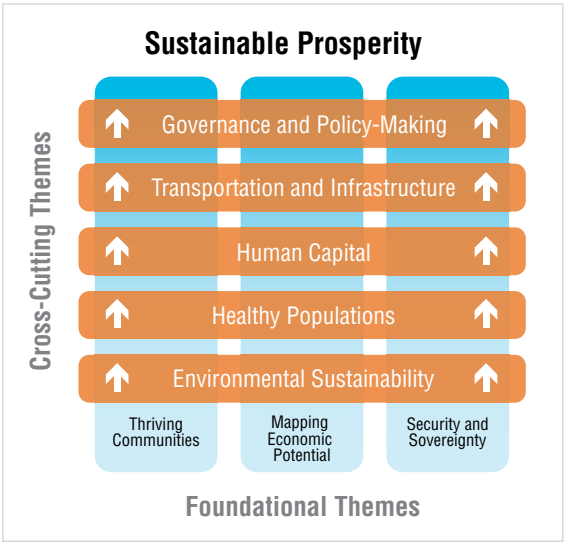
The Centre for the North is a major research initiative of The Conference Board of Canada. The Centre brings Aboriginal leaders, businesses, governments, and community advocates together to identify challenges and opportunities, and to decide how those challenges can be met. Working with Northern stakeholders and some 50 roundtable members, the Centre delivers cutting-edge research and provides a vibrant forum for discussion on issues facing Canada's North.

Vision: Toward a shared vision of sustainable prosperity in Canada's North.
Mission: Through research and dialogue, develop new insights that strengthen the foundation for informed decision-making.

The Centre examines issues from a Northern perspective, seeks to maximize Northern engagement, and prioritizes Northern interests. The Centre looks at issues and opportunities across the North—a vast region that includes the three Northern territories, as well as the northern portions of seven provinces.

To date, the Centre has published a number of foundational and issue-specific reports related to the underlying themes of thriving communities, economic development, and security and sovereignty. The Centre's research agenda is based on a strategic interdisciplinary framework, as illustrated in the exhibit "Sustainable Prosperity."



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Executive Summary

Telecommunications and Broadband Connectivity: Mapping the Long-Term Options for Canada's North

At a Glance

- The immediate concern for Northerners—both Aboriginal and non-Aboriginal—is to develop critical connectivity infrastructure that is reliable, scalable, and supportive of locally affordable services.
- The high cost of personal telecommunications and high-speed Internet access is constraining consumer uptake of knowledge-based services and new media and limiting the ability of regional economies to diversify.
- Stakeholders must work together to ensure that development goals and network efficiencies are achievable despite policy differences, cultures, and business approaches.
- This report profiles advertised services for personal communications and high-speed Internet services across Northern regions, explores a set of regional case studies, and ends with a series of recommendations.

In the information age, communications infrastructure is a critical enabler of both economic opportunity and social cohesion. This report provides an overview of connectivity in Canada's North, including regional trends in personal telecommunications and high-speed Internet access. In 2013, the immediate concern for Northerners—both Aboriginal and non-Aboriginal—is to develop critical connectivity infrastructure that is reliable, scalable, and supportive of locally affordable services. Northerners' access, however, varies widely by region and type of location, is often vulnerable to bottlenecks and service disruptions, and can be limited by price, income, and available technologies.

Broad industry adoption of the Internet Protocol has set a path for next-generation networks in Canada, including its Northern regions, but the most modern standard of service continues to elude most Northern communities. This limits the ability of regional economies to diversify through investments in sectors such as knowledge-based services and new media production. At the very least, enhanced connectivity would permit new efficiencies and growth across established economic bases. Such diversification and connectivity, however, presuppose a reliable, scalable, and affordable connectivity infrastructure that can support service delivery and applications development.

Affordability is particularly important from a local consumer standpoint. Northern consumers pay more than their counterparts in Canada's major cities for personal telecommunications and high-speed Internet access. This constrains their ability to take advantage of knowledge-based services and new media, particularly in remote and rural areas where even plain old telephony and other basic services such as low-speed dial-up Internet have required ongoing subsidies to maintain

affordability. In these high-cost areas, the diffusion of new information and communications technologies such as mobile telephony and high-speed Internet has also depended on targeted government funding and investment partnerships between the public and private sectors. Because the immediate need of Northerners for improved critical connectivity infrastructure is evident, it forms the primary focus of this report.

Chapter 2 profiles advertised services for personal telecommunications and high-speed Internet access in Canada's Northern regions. It compares residential wireline and basic long-distance plans, cellular voice (with/without a 1 gigabyte data plan), and residential high-speed Internet access based on the Industry Canada standard (1,500/384 kilobits [Kbits] per second) and the Canadian Radio-television and Telecommunications Commission's aspirational goal (5,000/1,000 Kbps by 2015). The high cost of serving the far-flung communities of Canada's North leads to high prices for residential wireline, long distance, cellular voice/data, and residential high-speed Internet. Our benchmarking exercise finds that an average Northern Canadian consumer pays $139 per month for a basic basket of services, including a basic cell phone plan (~200 local anytime calling minutes), a home phone with long distance (~400 North American minutes), and high-speed Internet access (≥ 1,500/384 Kbps). By comparison, an average consumer in Nunavut pays $171 per month for a similar basket of services.

One of the primary causes of concern behind this affordability gap is the high cost of Northern data backbone and backhaul services, particularly among satellite-dependent communities and entire regions such as Nunavut. The recent attention paid to territorial communications, due to NorthwesTel and its 2013 modernization plan, appears to have triggered service improvement efforts for residents in Yukon, the Northwest Territories, and Nunavut, particularly in terms of mobile data services and high-speed Internet plans. High Throughput Satellite services may be closing the gaps between what terrestrial and satellite-based service providers claim to offer consumers, but our profile finds that, so far, their Northern presence is limited to provincial communities, particularly in Manitoba, Alberta, and British Columbia. Moreover, these services are not necessarily compatible with the local access infrastructure in Northern communities—such as cable, copper wireline, or radio. For many Northern service providers, the ideal next-generation backbone and backhaul solutions are fibre optic systems.

Chapters 3 and 4 of the report drill down from the Northern connectivity profile to explore a set of regional case studies that foreground the disparate drivers and challenges shaping critical connectivity infrastructure in Canada's inhabited Arctic and Northern boreal forest regions. A third case study then examines the special and unique connectivity requirements of Canada's growing presence and responsibilities in the circumpolar North. Qualitative scenarios are used to introduce the different environments and their focal issues. Five major lessons emerge from the research behind the regional case studies:

1. Next-generation networks and new media introduce threats and opportunities for stakeholders in the Northern connectivity landscape.
2. Canada's regulatory framework and basic service objectives for Northern telecommunications must adapt to the challenges of next-generation networks.
3. Northern stakeholders should investigate options for shared network infrastructure and shared information technology (IT) services in high-cost areas. Infrastructure models that place too much stress on the obligations of incumbent carriers, or too much hope in the salutary effects of nascent competition, can stall innovation. Shared—open access—infrastructure can help distribute the cost of deploying next-generation backhaul, and promote fair and transparent pricing.
4. Aboriginal participation in network development and IT services deserves encouragement and support. Not all Aboriginal communities and organizations are ready to host or manage network services, and not all Aboriginal governments and businesses are prepared to invest in network infrastructure. A one-size-fits-all approach to Aboriginal inclusion is thus insufficient and may be counterproductive. Aboriginal stakeholders and non-Aboriginal partners need to frame immediate and near-term opportunities for participation in terms of multigenerational targets and long-term development goals.

5. Telecommunications is critical Northern infrastructure around which multiple systems of governance co-exist, overlap, and potentially conflict. Stakeholders must work together to ensure that mutual development goals, common objectives, and network efficiencies are achievable despite local policy differences, cultures, and business approaches. The required inter- and intra-governmental relationships could be formal, informal, or a combination of each. What is critical is that governments (Aboriginal and non-Aboriginal), their departments, and related agencies have the ability to productively cross boundaries, to achieve common objectives decisively and within reasonable time frames.

Addressing the connectivity needs of Northern communities, businesses, and consumers in a world of rapidly evolving technologies will be a complex process. There is a clear need for increased capital investment, both to build up-to-date infrastructure and to improve reliability through redundancy. This investment will have to be supported by governments. Money alone will not suffice—the ability to maintain both infrastructure and devices also will depend on training, attracting, and retaining sufficient IT professionals and technicians. Ensuring access in high-cost regions where many families have below-average incomes will require relentless attention to affordability. This in turn will depend on careful regulation of investment decisions, service plans, and subsidy requests from service providers. And to make sure that Northerners are able to get the most out of these investments, improvements in capacity and access will need to be accompanied by more Northern and Aboriginal content and greater support for digital literacy.

In 2013, the technology solutions and economics have improved for many Northern service providers and their consumers, but improvements have not eliminated all trade-offs from resource conflicts and legacy infrastructure. Conflict and complementarity continue to go hand in hand in shaping the Northern connectivity landscape.

Chapter 1

Introduction

Chapter Summary

- Near the end of the 20th century, Internet technologies introduced radical ways to combine digital text, video, and voice over wired and wireless connections. For resident Northerners, the Internet first became available through the mixed efforts of amateur technologists, inspired entrepreneurs, civic groups, and local community networks, bolstered and amplified by targeted government funding and industry partnerships.
- Canada's Northern residents want ubiquitous broadband connectivity—yet, in this regard, Canada's Northern communications infrastructure is vulnerable to bottlenecks and service disruptions.
- Compared with their Southern metropolitan counterparts, Northern consumers pay more for personal telecommunications and high-speed Internet services, notwithstanding the support that Northern service providers may receive from targeted government funding or regulatory subsidy.

In the 20th century, the communications facilities of telephone, radio, and television revolutionized how Northerners meet, exchange, and socialize. These facilities developed gradually in Northern communities, and often to satisfy the needs of public services, industrial development, and military operations first.[1] In this context, remote Aboriginal communities were among the last to benefit from new communications facilities while they adapted the technologies they could acquire to suit their members' local needs and cultural exigencies.[2] Near the end of the 20th century, Internet technologies introduced radical ways to combine digital text, video, and voice over wired and wireless connections. For resident Northerners, the Internet first became available through the mixed efforts of amateur technologists, inspired entrepreneurs, civic groups, and local community networks. Their grassroots efforts were then bolstered and amplified by industry partnerships such as the Stentor Alliance, and through government policies such as the federal Connecting Canadians Agenda (circa 1994–2004).[3] However, for many remote communities in Northern regions such as Nunavut, Nunavik (Northern Que.), Nishnawbe Aski Nation (Ont.), and elsewhere, Internet access was not available until the turn of the 21st century when special federal initiatives such as the C-band Public Benefit and National Satellite Initiative (NSI) developed. In the first decade of the new millennium, such initiatives gave Northern

1 Fiser and Luke, "Between the Clinic and the Community."

2 Cf. the role of Native communications societies in establishing community media and trail radio across Northern Canada. Mohr, "To Tell the People."

3 Academic and government research centres also played important supporting roles. Cf. the Communications Research Centre's technology trials.

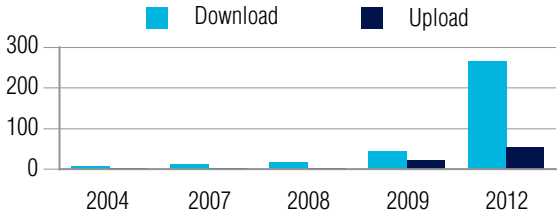
residents a taste of what the Internet could offer, but, apart from carefully managed public demonstrations, bandwidth cost constraints and traffic management techniques limited available throughput to a slow-speed consumer experience.

In 2013, Internet-based voice, video, and smart mobile devices have amplified consumer throughput requirements and expectations. Canada's Northern residents want ubiquitous broadband connectivity—yet, in this regard, Canada's Northern communications infrastructure is vulnerable to bottlenecks and service disruptions. Many Northern residents, particularly in the more densely populated regional hubs, now have access to high-speed Internet advertised at ≥ 1,500 kilobits per second (Kbps) down, but constraints on affordable bandwidth translate into higher prices, particularly for satellite-based services. (See Chapter 2 for a detailed analysis.) Compared with their Southern metropolitan counterparts, Northern consumers pay more for personal telecommunications and high-speed Internet services, notwithstanding the support that Northern service providers may receive from targeted government funding or regulatory subsidy.

Canada's Northern residents have a growing appetite for Internet applications, whether they are in the high Arctic or in boreal forest regions such as Ontario–Manitoba's Little North.[4] For example, Canada's youngest territory, Nunavut, passed the federally subsidized Qiniq network's 2,000th subscriber mark in only nine months, rather than over the nine-year planning horizon that federal managers had expected when they first allocated NSI funding to the network in 2005.

In Nunavik, the Kativik Regional Government owns a satellite-backhauled Internet Service Provider (ISP) called Tamaani, which serves 14 remote Inuit communities. As Chart 1 indicates, since Tamaani began delivering residential Internet services in 2004, it has charted steady growth in its satellite backbone requirements. Tamaani, like Qiniq, has also depended on NSI funding to make satellite backhaul, and thus consumer

Chart 1
Tamaani's Satellite Backbone Network Growth
(megabits per second)



Source: Kativik Regional Government.

rates, relatively affordable. For both networks this critical funding base expires in 2016, and no apparent federal renewal is on the horizon.

Opportunities to acquire fibre optic infrastructure are potential game changers for Northern connectivity. In Northwestern Ontario, First Nation members of the Kuh-Keh-Nah network (K-Net), their incumbent Bell Aliant, and provincial/federal partners in the Northwestern Ontario Broadband Expansion Initiative are replacing microwave and satellite backhaul links with fibre optics. The upgrades will expand the "information highways" running to each participating community from T-1 carrier circuits capable of 1,500 Kbps to 10,000 Kbps and 100,000 Kbps Ethernet connections over fibre. As of January 2013, 4 of 26 First Nations have converted over to fibre optic links.

In Canada and throughout the Organisation for Economic and Co-Operative Development (OECD) group of nations, high-speed Internet is now an increasingly multi-megabit service that enables an abundance of data, information, and sociability.[5] Many Northerners now have options to conduct electronic banking and e-commerce to acquire goods and services online. Northern capitals such as Whitehorse and Yellowknife have improved infrastructure to support smart mobile devices. In addition to accessing e-mail and web pages, residents who can afford premium Internet services and smart mobile devices can potentially explore media-rich

4 Berger and Terry, *Canoe Atlas of the Little North*.

5 This is not to discount the potential for computer malware and viruses, misinformation, online social conflicts, and so forth.

maps and virtual worlds, join in videoconferencing, and subscribe to video-on-demand. However, this is far from a uniformly enjoyed experience—there are significant dead spots beyond the regional population centres of the North (including important highway corridors), and real-user experiences may vary significantly from what service providers advertise.

Canada's Northern residents have a growing appetite for Internet applications, whether they are in the high Arctic or in boreal forest regions.

This report explores these challenges, recognizing that Northern residents, governments, and industries coexist in regions and as communities—both virtual and geospatial. These distinct stakeholders also co-invest in various kinds of non-governmental, not-for-profit, and related civil society associations to promote social ideals, technological innovation, and socio-political change. Thus, by their interactions, they co-create opportunities for new lifestyles, products and services, and modes of governance to develop.

Taking a multi-stakeholder perspective, this report examines some of the key opportunities for understanding and solving Northern connectivity challenges. Some solutions are merely possible, even imaginary, while others are currently probable, if not already under development (though possibly inadequate long term). To understand the challenges of Northern connectivity and assess the available opportunities, our research examines the strategic choices of residents, governments and public agencies, industries, and civil society. This is not an attempt to reduce technology solutions (e.g., their physical and engineering constraints) into purely social or political problems. It is a way of revealing how solutions to Northern connectivity challenges are as contingent on the strategic choices of a multi-stakeholder society as they are on the constraints of climate, geography, and physics. In focusing on the strategic context of Northern connectivity, our research assesses how the intersecting choices of residents, governments and public agencies, industries, and civil society shape available solutions.

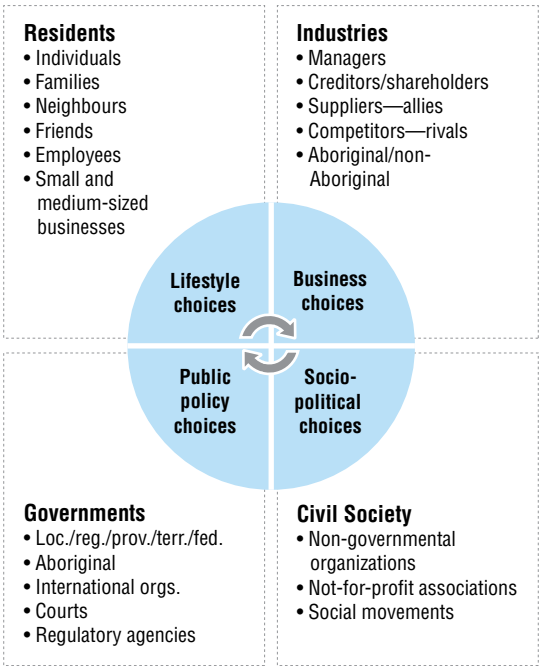
In broad strokes, our holistic research approach analyzes the multi-stakeholder society in terms of four intersecting domains:

1. Northern residents make lifestyle choices that drive consumer demand in remote communities and in the regional population centres those communities interact with (e.g., demand for high-speed Internet and 4G mobility, social media, and media-rich applications). As technology users and developers, they are individuals, families, neighbours, and friends. They are also employees and small and medium-sized business owners.
2. Governments and public agencies make policy choices that drive investment in Northern infrastructure, information communications technologies (ICTs), and services (e.g., from the federal government's current position on Arctic sovereignty, polar research, and public safety, to local, regional, provincial, territorial, and federal government initiatives to connect with citizens and Aboriginal constituents via e-services). International governing bodies may also take part in relevant governance matters, particularly in the context of circumpolar activities.
3. Industry players make business choices that drive investment and development in Northern technologies and services (e.g., demands for improved Arctic shipping routes, new technologies to uncover remote resources, and better ways to train and retain workers in remote environments). Industry players include Aboriginal and non-Aboriginal firms. Alongside mining and forestry companies, we find telecommunications carriers and technology vendors, cooperatives, and regional Inuit and First Nations development corporations.
4. Non-governmental organizations (NGOs), not-for-profit associations, and other civil society groups, including Aboriginal societies, function as community intermediaries between Northern residents, governments, and industries to shape social and political choices about community relationships and the equitable distribution of resources—both tangible and intangible. At the interstices of civil society we find, for example, not-for-profit tribal councils providing mobile services and software applications to member First Nations and charitable organizations refurbishing computers for schools or managing public telecottages. Here we also find not-for-profit

associations acting as community champions that disburse public funding to private sector service providers on behalf of government programs.[6] Exhibit 1 graphically depicts the intersection of these strategic choices and lists some examples of roles taken on by residents, governments, industries, and civil society.

The dominant buzzwords around connectivity in the North continue to be broadband, infrastructure, and bandwidth. Applications and appetites are changing rapidly in this net-centric age, particularly as next-generation mobile and fixed-access devices loom over the horizon. Yet it can be hard for Canada's Northern innovators to keep up with Southern urban trends. The following chapters of this report focus on prevailing challenges to innovation in Canada's Northern connectivity landscape—including affordability, scalability, reliability, Aboriginal participation, and so forth. Such challenges can be complex. They may mean different things to different stakeholders and may take on new meanings over time. In this historical, multi-stakeholder context, we reflect on how solutions to overcome connectivity challenges enable and affect relationships among the relevant stakeholders.

Exhibit 1
Northern Connectivity as a Multi-Stakeholder Problem of Strategic Choices



Source: The Conference Board of Canada.

METHODOLOGY

As a methodological approach, the multi-stakeholder perspective helps us compare Northern connectivity challenges and opportunities. Our comparative approach is national in context but regional in focus. In the time frame of 2013–16 and beyond, regional, provincial, and territorial projects are under way to address fundamental Northern connectivity challenges. We achieve this analysis through two main approaches: a Northern connectivity profile of residential high-speed Internet access and personal telecommunications options; and three regional case studies prefaced by qualitative scenarios.

CONNECTIVITY PROFILE

The objective of the Northern connectivity profile is to compare and contrast personal telecommunications services and high-speed Internet availability for Canada's Northern residents based on advertised pricing and product information (e.g., download/upload speeds, and caps). This exercise integrates data from federal departments such as Industry Canada and Aboriginal Affairs and Northern Development Canada (AANDC) and captures available data sets from service providers and other groups involved in Northern connectivity services. Our guiding research questions for this analysis included:

- How do Northern regions differ in terms of the availability of high-speed Internet service to residents?
- Are there significant differences in the connectivity profiles of Aboriginal and non-Aboriginal communities—or provinces and territories?

6 Federal examples of the community champion model include Industry Canada's Broadband for Rural and Northern Development Program (BRAND: $84 million from 2002–07) and the NSI under Infrastructure Canada (e.g., $155 million from 2003–07).

- How do differences in available backhaul options translate to differences in residential high-speed Internet service options (e.g., fixed wireless or fibre optic versus Ka-band or C-band satellite)?
- How do advertised prices differ across Northern regions and communities and where is affordability a possible challenge for Northern residents?

REGIONAL CASE STUDY ANALYSIS AND QUALITATIVE SCENARIOS

Between September 2012 and March 2013, we also engaged Northern stakeholders to probe their knowledge of regional connectivity issues. Our discussions with stakeholders included representatives from Labrador, Nunavik (Northern Que.), Northeastern and Northwestern Ontario, Manitoba, Saskatchewan, Alberta, Nunavut, the Northwest Territories, Yukon, and Northern British Columbia.

Our guiding research questions during this information-gathering phase included:

- What are the key challenges in accessing and using broadband ICTs, for Northern residents, industries, and governments?
- Are there some Northern communities or regions that are more at a disadvantage than others when it comes to accessing and adopting broadband ICTs?

We also asked Northern stakeholders to identify current projects to develop critical connectivity infrastructure in their regions. The purpose of these discussions was to learn about specific project details regarding regional connectivity initiatives, including funding options and business models, Aboriginal inclusion, and the important challenge of project sustainability. Our guiding research questions included:

- What key Northern initiatives have improved Northern connectivity and accessibility?
- How have these initiatives made a difference to Aboriginal and non-Aboriginal Northerners and Northern organizations?
- What factors were critical to the development and implementation of these initiatives?
- What were the key challenges to these initiatives and how were they overcome?
- Who were the key partners that made these initiatives possible and what were their roles? How did they work together? What challenges did their partnerships have to overcome?
- Were there key partnership factors that made these initiatives sustainable? In cases where initiatives have been abandoned, why did partnerships dissolve?

We engaged Northern stakeholders to probe their knowledge of regional connectivity issues, and to identify projects to develop critical connectivity infrastructure.

Finally, we asked stakeholders to provide key lessons learned about past and present issues and initiatives to help future connectivity projects. These lessons form the basis for concluding remarks and actionable insights.To help readers orient themselves within the complex landscape of Northern connectivity and information technology (IT) issues, we introduce the regional case studies by way of three qualitative scenarios. Each scenario tells a story using characters based on our research team's real-life encounters with Northern stakeholders. The scenarios represent opportunities and challenges to Northern individuals, living today and in the near future. These scenarios are presented to distinguish clusters of regions, as well as to encapsulate patterns and challenges that endure across regions. The use of qualitative scenarios for planning has a long tradition in the strategic policy and business worlds. Scenarios also come in several distinct flavours. In this report, we adapt a narrative-based approach associated with the Royal Dutch/Shell company, which has conducted scenario-based planning and analysis since the early 1970s. In its guide to scenario planning,[7] the Shell team describes a scenario as a "story that describes a possible future":

> [A scenario] identifies some significant events, the main actors and their motivations, and it conveys how the world functions. Building and using scenarios can help people explore what the future might look like and the likely challenges of living in it.

7 Shell International BV, *Scenarios: An Explorer's Guide*, 8.

Each of the scenarios presented in this report encapsulates one of three dominant geopolitical situations that we encountered in our study of Canada's Northern connectivity landscape. These are situations in which complex conditions such as geography, society, ethnicity, politics, economy, history, and technology co-define portions of the whole Northern connectivity landscape. At the basis of our first scenario, Charlie the Inuk media artist, is *Canada's inhabited Arctic.* In our second scenario, Tim the miner, it is the *boreal forest zone*. In our third scenario, Sandy the coast guard, it is a *circumpolar world* of the near future that binds our inhabited Arctic and boreal forest regions to an international and dynamically shifting geopolitical context.

Chapter 2

A National Connectivity Profile for Canada's North

Chapter Summary

- Northern connectivity varies considerably by region and type of location.
- Satellite-backhauled connectivity is the only option for 36 per cent of communities in the Northern connectivity profile. Among subgroups, this constraint encompasses 85 per cent of Inuit communities (versus 43 per cent of First Nation/Métis settlements, 39 per cent of First Nation reserves, and 18 per cent of non-Aboriginal settlements).
- In mid-2013, the Canadian Radio-Television and Telecommunications Commission (CRTC) target of 5,000 Kbps down/1,000 Kbps up continues to elude most Northern communities.
- Based on advertised rates, the Broadband Canada target of 1,500 Kbps down/384 Kbps up was available to 86 per cent of non-Aboriginal communities and 78 per cent of Aboriginal communities in the Northern connectivity profile. This benchmark more accurately represents the status quo in Northern regions (as of mid-2013).
- Service availability does not imply affordability. Northern Aboriginal communities also have unique socio-economic characteristics that may affect their adoption of ICTs.

While it is fairly clear to consumers what a basic telephone service or long-distance calling plan encompasses, the definition of data services such as high-speed Internet and its cognate term broadband occupy a potentially frustrating range of possible meanings and moving targets. Semantic slippage and confusing terminology also exist among mobile data services. For many consumers, it is not entirely clear what the actual differences are between 3G, 3.5G, and 4G, or between "smart" and "super" phones. For its part, Canada's national regulator has offered moderate guidance[1]; however, in 2011 CRTC set an aspirational goal for Canadians to have residential Internet access capable of supporting download speeds of at least 5,000 Kbps and upload speeds of at least 1,000 Kbps by 2015.[2] Since 2009, Canada's federal government has taken steps to impose a narrower target for Northern and rural service providers. High-speed Internet services funded under Industry Canada's Broadband Canada program are required to support residential download speeds of at least 1,500 Kbps and upload speeds of at least 384 Kbps. This particular standard carries over from an older benchmark that Canada's National Broadband Taskforce (NBTF) introduced in 2001 with its report *The New National Dream: Networking the Nation for Broadband*

1 For example, in a 2010 decision, CRTC accepted the argument that mobile Internet could be an adequate substitute for fixed-access technologies such as asymetric digital subscriber line (ADSL). CRTC, *Telecom Decision CRTC 2010-805*.

2 CRTC, *Telecom Regulatory Policy CRTC 2011-291*.

Access.[3] The NBTF standard was in turn based on research that Industry Canada's Communications Research Centre (CRC) had conducted in the 1990s.

In this chapter, we present a Northern connectivity profile to assess how close Canada's Northern regions may have come to acquiring Internet services that meet or exceed Broadband Canada's target of 1,500 Kbps down/384 Kbps up, as well as CRTC's target of 5,000 Kbps down/1,000 Kbps up. The research behind the Northern connectivity profile triangulated multiple sources. The most important sources are the regional and national telecommunications carriers and ISPs. All of the large telecommunications carriers to Northern regions provide mobile broadband coverage maps and databases of communities served by fixed-access technologies. Whenever possible, we validated coverage using address ranges. The availability and quality of data varied per provider. Carriers such as TELUS, Bell/Bell Aliant, MTS Inc., and SaskTel provided service availability data down to the level of address ranges, as did the satellite service provider Xplornet. Other providers such as the territorial incumbent NorthwesTel, or the larger cable companies Rogers, Shaw, and Eastlink, furnished data based on community listings and/or postal code information. Smaller providers, including regional ISPs, the greatest number of which appeared in Alberta, sometimes provided only a static coverage map or a list of community names. When there was reasonable doubt, we tried to contact a service provider for verification. Our initial environmental scan and data validation process took approximately four months. Data collection began in September 2012. A review and update phase was undertaken between March and July 2013 to incorporate new service plans. In particular, we have focused on NorthwesTel's introduction of new mobile and high-speed Internet services under its modernization plan (as of July 13, 2013).[4] In 2013, the Northern connectivity landscape has been considerably fluid. The territories, in particular, have become focal points of market change. For example, NorthwesTel initiated a multi-year process of spending an estimated $233 million on infrastructure and service upgrades across its serving area—with an emphasis on improving cellular and high-speed Internet service offerings. Meanwhile, SSi Micro, NorthwesTel's primary competitor in the high-speed Internet market, has set out to enter the voice/telephony market, while new entrants such as Ice Wireless and Lynx Mobility have been rolling out competitive mobile services in select communities. Our Northern connectivity profile thus captures developments in progress.

In 2013, the Northern connectivity landscape has been considerably fluid. The territories, in particular, have become focal points of market change.

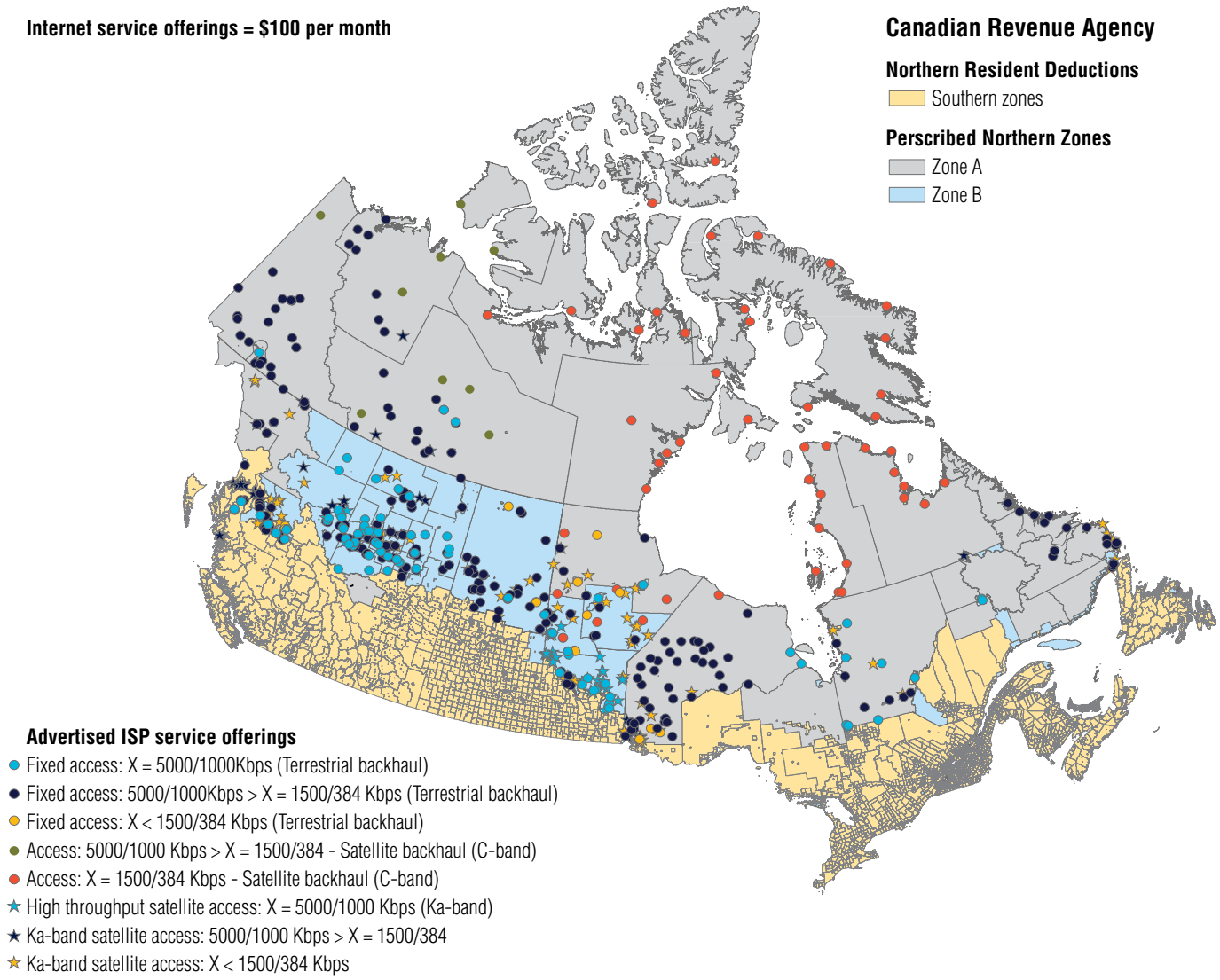
Exhibit 2 provides a visual representation of our profile of Northern high-speed and mobile Internet access in the provinces and territories. The profile's geodemographic structure is overlaid atop the Canada Revenue Agency's definition of Northern zones. Zone A (in light violet) includes locations eligible for full Northern deductions, while Zone B locations (in dark violet) are eligible for half deductions. We compiled our initial list of target communities from Statistics Canada's Geosuite 2011 database of provincial/territorial census divisions, census subdivisions, and designated places. We then organized our target communities, the census subdivisions and designated places, in terms of non-Aboriginal and Aboriginal settlements (including Inuit, First Nation, and Métis). The resulting list is described in Table 1.

The Northern connectivity profile distinguishes several types of high-speed and mobile Internet access. Because satellite services are available virtually across Canada (notwithstanding local obstacles such as tree cover or the potential remoteness of customers), we distinguish between services that are dependent on satellite backhaul from those that use terrestrial backhaul. Although satellite-backhauled services can be considerably more expensive (and restrictive) than terrestrial-backhauled services at comparable speeds, in 2013 virtually all Northern satellite-based service providers include a package advertising 1,500/384 Kbps. (See Table 2.)

3 National Broadband Task Force, *The New National Dream.*

4 The plan is ongoing as of this writing.

Exhibit 2
Northern Connectivity Profile, 2013



Source: Canada Revenue Agency.

The Northern connectivity profile then differentiates terrestrially served communities into those with advertised services that claim to meet or exceed the CRTC target of 5,000/1,000 Kbps from those where advertised services fall short of that target but meet or exceed 1,500/384 Kbps. The profile also identifies mobile broadband access ≥ 1,500/384 Kbps.

When interpreting the profile, it is important to consider the limitations of our working data set. Due to constraints on data collection, we focused our efforts on residential high-speed Internet access and did not include a separate profile for enterprise services. Moreover, because the access data largely depend on the service providers' claims and marketing information, it is more appropriate to treat them as ceiling estimates rather than indicators of actual service performance. Until more robust speed-testing methods are conducted across Canada's Northern regions, data such as these may be the best proxy indicators of what Northern residents have available.

Table 1
Northern Connectivity Profile—Number of Target Communities

Province/territory	Non-Aboriginal	Inuit	First Nation/Métis	
			Reserves	Settlements
Labrador (27)	20	5	2	0
Quebec (33)	9	14	0	10
Ontario (62)	16	0	43	3
Manitoba (112)	27	0	49	36
Saskatchewan (49)	5	0	23	21
Alberta (116)	72	0	36	8
British Columbia (116)	41	0	66	9
Yukon (25)	12	0	0	13
Northwest Territories (33)	6	5	1	21
Nunavut (25)	0	25	0	0

Source: The Conference Board of Canada.

Turning to questions of affordability, we also explore a subset of the Northern connectivity profile that includes pricing information for lowest-cost high-speed Internet service offerings ≥ 1,500/384 Kbps. This data set includes additional information about personal telecommunications services to Northern communities based on a basic basket of services that includes a voice-only cell phone plan (~200 local anytime calling minutes), a home phone with long distance (~400 North American minutes), and the aforementioned high-speed Internet service (≥ 1,500/384 Kbps). This data set also includes a comparison between the basic cellular service offerings and higher-tier cellular service offerings that include 1 Gigabyte (GB) of mobile data.

In general, the Northern connectivity profile suggests that in mid-2013 Northern access defined strictly in terms of market availability falls well short of the CRTC aspirational goal, with 16 per cent coverage for Aboriginal communities versus 36 per cent coverage for non-Aboriginal. By contrast, the profile indicates that the Industry Canada target of 1,500/384 Kbps has diffused more successfully as a standard for Northern connectivity, with 78 per cent coverage for Aboriginal communities versus 86 per cent coverage for non-Aboriginal. Apart from an ongoing need to ground truth the service providers' claims—and test the de facto standard against evolving user demands—we also need to better understand if Northern access is affordable for Northern residents, whether Aboriginal or non-Aboriginal. The former challenges are beyond the scope of this report. However, we explore the issue of affordability further on in this chapter by comparing relevant Northern research, census data, and results from AANDC's Community Well-Being (CWB) Index.

NORTHERN CANADA'S SATELLITE DEPENDENCY

Based on the Northern connectivity profile, three main issues emerge with regard to Northern Canada's satellite dependency. These include:

- 46 per cent of Aboriginal locations and 18 per cent of non-Aboriginal locations depend on satellite backhaul.
- 35 per cent of provincial locations and 45 per cent of territorial locations depend on satellite backhaul.
- High throughput satellite (HTS) services have increased data transfer rates and reduced consumer costs for some satellite-dependent communities, but availability is currently limited in Northern regions. In the Northern connectivity profile, HTS services were most frequently available in Manitoba, Alberta, and British Columbia.

The issue of affordability is particularly acute for satellite-dependent communities in the North, as satellite packages often require a substantial upfront equipment/installation fee and a commitment to multiple terms. (See Table 2.) Almost half of Aboriginal communities in the Northern connectivity profile depend on satellite backhaul, and this increases to 85 per cent for Inuit communities versus 43 per cent for First Nation/Métis settlements, 39 per cent for First Nation reserves, and 18 per cent for non-Aboriginal settlements. In the provinces, satellite-dependent communities have options such as Xplornet or Galaxy Broadband, which primarily focus on Ka-band technology. Xplornet was among the first in Canada to deploy HTS. (See Table 2.) By comparison, the Kativik Regional Government of Nunavik (Northern Que.)—a predominantly Inuit region—delivers Tamaani, a wireless Internet service, using C-band satellite backhaul. This arrangement is similar to

Table 2
Satellite-Based Services for Northern Residents

Internet Service Provider (contract term)	Satellite carrier (frequency)	Download/upload	Caps on service	Monthly fee (install)
Xplornet (3-year term)	Telesat (Ka-band)	3,000/128 Kbps	75/7.5 MB per hour	$67.99 ($299)
Xplornet 4G (3-year term)	Viasat-1 (Ka-band)	5,000/1,000 Kbps	20 GB per month	$64.99 ($99)
Galaxy Broadband (3-year term)	Telesat (Ka-Band)	1,500/384 Kbps	350 MB per day	$59.99 ($349)
Netkaster	Telesat (Ka-Band)	1,000/256 Kbps	55 MB per hour	$99.95 ($499)
NorthwesTel	Telesat (C-Band) with ADSL access	1,500/384 Kbps	15 GB per month	$99.95 ($49.95)
Airware (N.W.T. only)	Telesat (C-Band) with mobile wireless access	768 Kbps	6 GB per month	$79.95 ($150)
Qiniq (Nunavut only)	Telesat (C-Band) with mobile wireless access	1,500/384 Kbps	10 GB per month	$80 ($125)
Tamaani (Nunavik, Que.)	Telesat (C-Band) with mobile wireless access	, Kbps	30 GB per month	$80 ($100)

ADSL = assymetric digital subscriber line; Kbps = kilobits per second; MB = megabyte; GB = gigabyte
Source: The Conference Board of Canada.

Internet services that First Nations in Northern Ontario and Manitoba deliver under the Northern Indigenous Community Satellite Network (NICSN). It is also comparable to what SSi Micro delivers to Nunavut over the Qiniq brand. Also in Nunavut, the incumbent NorthwesTel depends on Ka- and C-band satellite backhaul. Currently, in the largest Nunavut communities of Iqaluit, Cambridge Bay, and Rankin Inlet, the company offers high-speed Internet access via ADSL[5] and C-band satellite backhaul. (See Table 2.)

With the launch of Viasat-1 in 2011, Xplornet's new 4G satellite offerings appear to have made considerable improvements over its non-HTS services. Compared with Xplornet's more prevalent Northern service offering of 3,000/128 Kbps (over Telesat/Ka-band), where its 4G service is available, consumers may pay $3 less per month and $200 less per install, for 2,000 Kbps more per download and 872 Kbps more per upload (based on advertised rates). The 4G service also comes with significantly improved data caps (20 GB per month versus ~75 MB per hour). As Table 3 indicates, the Northern connectivity profile identified the availability of HTS services in limited regions of Manitoba, Alberta, and British Columbia.

The issue of affordability is particularly acute for satellite-dependent communities in the North.

In the Arctic, the most prevalent satellite offerings are NorthwesTel's services (via Ka-band or ADSL/C-band satellite backhaul) versus SSi Micro's Qiniq and Airware products (mobile wireless over C-band satellite backhaul). In Nunavut, SSi Micro recently benefited from Broadband Canada's contribution of $10.6 million to support upgrades to the Qiniq network and the delivery of satellite capacity until 2016.[6] This enabled

5 ADSL = asymmetric digital subscriber line, which delivers high-speed Internet over copper telephone lines.

6 Zarate, "Qiniq Promises True Broadband for Nunavut."

Qiniq to offer residents up to 1,500/384 Kbps for $80 per month. By comparison, NorthwesTel's Nunavut 1 service to Iqaluit, Cambridge Bay, and Rankin Inlet provides a 1,500/384 Kbps ADSL service over C-band satellite backhaul for $99.95 per month. Government funding for satellite infrastructure has been a major catalyst for lower consumer prices in the Arctic: SSi Micro's Airware brand offers an unsubsidized service package of 2,000 Kbps down to residents in the N.W.T. at $499.95 per month. By comparison, its Qiniq brand offers a subsidized package of 2,000 Kbps to Nunavut residents for $129.95 per month. NorthwesTel's Ka-band Netkaster offering of 2,000 Kbps is located close to the middle of this price range. In 2012, NorthwesTel also began to offer a 2,000 Kbps down Ka-band satellite Internet service for $109.95 per month. The plan is limited to the Nunavut communities of Arviat, Baker Lake, Gjoa Haven, Kugluktuk, Cambridge Bay, and Rankin Inlet.[7]

Northern satellite service providers have taken different approaches to limiting consumer data usage. For Qiniq's current 1,500/384 Kbps satellite-based service (wireless over C-band), SSi Micro caps data usage at 10 GB per month. By comparison, NorthwesTel's 1,500/384 Kbps Nunavut 1 service offering caps data usage at 15 GB per month. Qiniq's policy has been to throttle services once usage caps are exceeded, while NorthwesTel charges an overage fee of $17.50 per GB (compared with $5 per GB for cable and ADSL services on its terrestrial-backhauled networks). Territorial government and civil society stakeholders have expressed concern about Northern data caps and overage fees. According to CRTC's 2012 Communications Monitoring Report,[8] it would take approximately 13 hours of High Definition Youtube video footage (running at 1,500/17 Kbps) to exhaust a 20 GB usage cap. By comparison, a Skype audio-only conversation (running at 42/42 Kbps) would exhaust 20 GB in approximately 563 hours. Obviously, how rapidly a user exhausts his or her data cap can individually vary, yet there is reason to believe that 10 and 15 GB caps are inadequate for the average Canadian consumer. In its 2012 report, CRTC noted that an average Canadian consumer downloaded 17.9 GB of data per month, based on a weighted mean of data from Canada's five largest high-speed Internet service providers.

Satellite services continue to evolve. In February 2012, Telesat announced a $40-million contingent commitment to improve Arctic communications over satellite, with implications for 3G mobile and videoconferencing services. The company submitted a proposal to upgrade its Arctic satellite infrastructure based on a public-private partnership with the federal government that would cost approximately $160 million.[9] It is currently unclear at what stage this proposal may be in, particularly as Northern policy stakeholders focus on terrestrial backhaul solutions and the potential for undersea Arctic fibre optic deployments. Telesat's conspicuous absence from CRTC's 2013 review of NorthwesTel's Modernization plan—where the high cost of satellite backhaul figured prominently—suggests the company may be waiting to see how the landscape evolves. Meanwhile, observers hope that Xplornet's 4G satellite rollout over Viasat-1 will reach more Northern communities in the coming months with a promise of higher speeds, improved caps, and lower prices.

NORTHERN RESIDENTIAL ACCESS: ABORIGINAL VERSUS NON-ABORIGINAL COMMUNITIES

Tables 3 and 4 break down our findings on Northern access in the provinces and territories, respectively.

Regional geodemographic contrasts are evident. With the exception of Alberta, all of the provinces in the Northern connectivity profile have substantially higher percentages of Aboriginal communities versus non-Aboriginal (≥ 65 per cent). In terms of the greatest number of communities overall, British Columbia, Alberta, and Manitoba top the list of locations in the Northern connectivity profile.

7 NorthwesTel, *NorthwesTel Launches New Broadband Service in Nunavut.*

8 CRTC, *CRTC Communications Monitoring Report 2012,* Table 4.5.2.

9 CBC News, *Telesat to Spend $40 Million;* Telesat, *Telesat Proposes $40 Million Investment.*

Table 3
Internet Access Conditions in Northern Provincial Locations, Aboriginal Versus Non-Aboriginal

Province (number of locations)	Per cent of locations		Per cent of locations with mobile broadband ≥ 1.5/0.384 Mbps (no.)		Per cent of locations with access ≥ 5/1 Mbps including fixed access and (HTS) service (no.)		Per cent of locations dependent on satellite (no.)	
	Ab.	Non-Ab.	Ab.	Non-Ab.	Ab.	Non-Ab.	Ab.	Non-Ab.
Labrador (27)	74	26	14 (1)	40 (8)	0	10 (2)	0	35 (7)
Quebec (33)	73	27	29 (7)	67 (6)	8 (2)	67 (6)	79 (19)	0
Ontario (62)	74	26	28 (13)	94 (15)	4 (2)	0	26 (12)	31 (5)
Manitoba (112)	76	24	33 (28)	41 (11)	16 (Terr. = 14) 27 (HTS = 23)	11 (Terr. = 3) 37 (HTS = 10)	64 (54)	63 (17)
Saskatchewan (49)	90	10	59 (26)	100 (5)	2 (1)	60 (3)	14 (6)	20 (1)
Alberta (116)	38	62	89 (39)	97 (70)	18 (Terr. = 8) 7 (HTS = 3)	42 (Terr. = 30) 3 (HTS = 2)	30 (13)	4 (3)
British Columbia (116)	65	35	47 (35)	88 (36)	7 (Terr. = 5) 3 (HTS = 2)	39 (Terr. = 16) 2 (HTS = 1)	51 (38)	10 (4)

Terr. = Terrestrial backhaul; HTS = High Throughput Satellite
Source: The Confence Board of Canada.

Table 4
Internet Access Conditions in Territorial Locations, Aboriginal Versus Non-Aboriginal

Territories (number of locations)	Per cent of locations		Per cent of locations with mobile broadband ≥ 1.5/0.384 Mbps		Per cent of locations with access ≥ 5/1 Mbps		Per cent of locations dependent on satellite	
	Ab.	Non-Ab.	Ab.	Non-Ab.	Ab.	Non-Ab.	Ab.	Non-Ab.
Y.T. (25)	48	52	8	33	0	8	15	0
N.W.T. (33)	82	18	41	83	7	17	41	0
Nun. (25)	100	0	0	0	0	0	100	n.a.

n.a. = not available
Source: The Conference Board of Canada.

The distinction between Aboriginal and non-Aboriginal appears to correlate with differences in access, but there is no uniform pattern across the provinces. Overall, Alberta has the highest availability of mobile broadband to both Aboriginal and non-Aboriginal locations. It also has the highest penetration of services ≥ 5,000/1,000 Kbps and the lowest percentage of satellite-dependent communities among the three regions with the greatest number of locations. By comparison, British Columbia and Manitoba have the highest frequency of satellite-dependent communities (the majority of which are Aboriginal). Manitoba also has the greatest availability of HTS.

Geographic factors such as regional population densities and a community's locational distance from urban centres have an important influence on access. Quebec's Inuit communities and Manitoba's Northern First Nations can be considerably distant from urban centres, which may explain their Northern regions' greater

satellite dependence compared with those of the other provinces. Stakeholders in these regions have noted the high cost of backbone connectivity infrastructure to their remote communities. Northern British Columbia's mountainous terrain also presents a challenging environment for terrestrial connectivity infrastructure. Many, primarily Aboriginal communities, in this region are dependent on satellite-backhauled Internet services.

Government interventions and multi-stakeholder partnerships also have an important influence on the Northern connectivity profile, which we explore further in our case studies. For example, Northern Alberta's leading profile overall has benefited from the province's investment in the Alberta SuperNet fibre optic backbone network. Saskatchewan's Community-Net initiative, under its incumbent SaskTel, may provide a similar story for explaining its Northern region's low dependence on satellite. In terms of satellite-dependent communities, federal programs such as the NSI and Broadband Canada have helped service providers introduce more affordable residential services. In terms of improving terrestrial backbone connectivity, multi-stakeholder partnerships are also currently under development. In Northwestern Ontario, a new fibre optic backbone network is emerging thanks to a partnership between Bell Aliant, area First Nations, Ontario, and Industry Canada. It promises to leap-frog the communities' prevailing service conditions, which have depended on a mixture of satellite and aging microwave backhaul solutions.

Among the territories, Nunavut is currently entirely dependent on satellite backhaul, although service providers have devised a range of access solutions, including mobile wireless and assymetric digital subscriber line (ADSL). (See Table 4.)

That any of the territories can meet or exceed the CRTC benchmark of 5,000/1,000 Kbps is due to their incumbent NorthwesTel's terrestrial connectivity infrastructure, which enables ADSL and cable services in the larger urban centres such as Whitehorse and Yellowknife. NorthwesTel currently advertises a 5,000/512 Kbps high-speed Internet service to all of its terrestrially served communities in Yukon and the Northwest Territories. In 2013, the incumbent began its $233-million network modernization plan, which sets out to establish Internet services that would eventually exceed the CRTC benchmark in all of its 58 terrestrially served communities. The incumbent's plan is expected to include a 15,000 Kbps (down) package to its ADSL-served communities, and 50,000 to 100,000 Kbps (down) packages to its several cable-served communities.

Mobile broadband has also penetrated parts of Yukon and Northwest Territories, and continues to evolve. Through its joint investment in a shared national network with TELUS, Bell Canada (which owns and competes with NorthwesTel) first enabled mobile Internet for consumers in and around the larger population centres of Yukon and the Northwest Territories. This has included a deployment of Long Term Evolution (LTE) services in locations such as Whitehorse, Yellowknife, and Inuvik (with download speeds advertised at around 12 to 25 megabits per second [Mbps]). In Yukon, NorthwesTel's joint venture with the Dakwakada Development Corporation, Latitude Wireless, delivers cellular services to 19 communities (as of mid-2013), of which 4 have access to High Speed Packet Access Plus (HSPA+). In N.W.T., Bell Mobility and Northwestel provide HSPA+ or higher services to 17 of 33 communities. NorthwesTel's partnership with Falcon Communications Ltd promises to deliver HSPA+ to N.W.T.'s 10 satellite-dependent communities in 2014. In mid-2013, the incumbent also provides cellular services in 9 Nunavut communities, of which 5 have access to 3G mobile data (Evolution-Data Optimized [EVDO]).. At this time, Lynx Mobility, an Aboriginal-owned satellite-based cellular service provider, also operates in several Nunavut communities (where NorthwesTel does not currently offer cellular services). It has yet to deploy mobile Internet in the region, though it has devised 3G solutions for customers in Northern Quebec, including Nunavik, under a joint venture with the Inuit Makivik Corporation.

Table 5
Community Well-Being Index for Northern Communities, 2006 Census

Location type	Median CWB score	Median income score	Median education score	Median housing score	Median labour score
Non-Aboriginal	80	86	53	92	87
Inuit	60	66	29	59	75
First Nation/Métis settlement	64	66	28	63	72
First Nation reserve	51	46	17	54	63

Source: Aboriginal Affairs and Northern Development Canada.

THE SOCIO-ECONOMIC CONTEXT BEHIND NORTHERN CONNECTIVITY

Canada's resident Northerners value their small town pace, close-knit communities, and proximity to nature; however, as social surveys have observed, they are also wary of geographic remoteness, the high cost of living, and social isolation.[10] The deleterious effects of geographic remoteness and social isolation in the North can be especially hard on the elderly and youth, and particularly among Aboriginal communities.[11] With respect to mitigating these effects, an international network of Northern indigenous communities and circumpolar health researchers has identified social cohesion as an important indicator of personal health and community well-being.[12] This body of knowledge resonates with what First Nations in provincial Northern regions have also experienced,[13] particularly in the aftermath of federal residential school policies.[14] More broadly, researchers have observed how social cohesion is deeply impressed by a society's cultural environment and the affordances it provides for interpersonal communication[15] and social networking. For the gregarious and convivial, there are numerous benefits from interacting and transacting with the world beyond one's home, including contributions to personal growth, cross-cultural enrichment, and socio-economic prosperity. Yet, interpersonal communication may also involve perceived risks and potential dangers, particularly if encounters across cultural, socio-economic, and political divides amplify feelings of mistrust, misunderstanding, and exclusion.[16] In this regard, the historical interaction of peoples and regions weighs in, as do the technological affordances that transform and amplify human creativity and sentiment. Beyond the personal we find communication in all facets of societal development.

The issue of affordability, particularly regarding satellite services, becomes accentuated given the census characteristics of Northern communities. As a basis for further comparative investigation, we draw upon the Community Well-Being (CWB) index that AANDC created from 2006 Census data.[17] This index ranks communities on a scale from 0 to 100, which integrates and balances four component measures of income, education, housing (quantity and quality), and labour force activity (all compiled from 2006 Census subdivisions—there is no index currently available from the 2011 Census). Table 5 summarizes the available CWB index scores for 373 census subdivisions in the Northern connectivity profile. In this subset, comprising 62 per cent of the overall connectivity profile, the median Northern First Nation reserve scores near the centre of the CWB

10 Centre for Indigenous Peoples' Nutrition and Environment, *Inuit Health Survey 2007–2008*.

11 Curtis, Kvernmo, and Bjerregaard, "Changing Living Conditions, Lifestyle and Health."

12 Duhaime and others, "Social Cohesion and Living Conditions in the Canadian Arctic."

13 Carpenter and others, *How Women in Remote and Rural First Nations Communities*.

14 Archibald, *Final Report of the Aboriginal Healing Foundation*.

15 Wellman, Boase, and Chen, "The Networked Nature."

16 Archibald, *Final Report of the Aboriginal Healing Foundation*.

17 See AANDC's *Measuring Well-Being* for an introduction and *The Community Well-Being (CWB) Index* for methodological considerations.

Table 6
Community Well-Being Index Scores for Five Census Units* and Three Major Southern Metropolian Areas

Location	CWB score	Income score	Education score	Housing score	Labour score
Grande Prairie	85	100	52	95	92
Whitehorse	85	92	64	93	90
Fort St. John	83	90	56	96	91
Kenora	82	89	56	95	87
Yellowknife	88	100	67	93	92
Toronto	84	92	66	91	86
Vancouver	85	91	69	93	86
Montréal	80	83	62	92	84

*based on the Northern Connectivity Profile
Source: Aboriginal Affairs and Northern Development Canada.

scale (at 51 points). By comparison, the median Inuit and First Nation/Métis settlements respectively score 9 and 13 points higher, while the median non-Aboriginal settlement scores 29 points higher.

For points of reference in interpreting the CWB index, we include comparable scores for the five most populous census units in the Northern connectivity profile, alongside index scores for the three largest metropolitan areas in Southern Canada (Toronto, Montréal, and Vancouver). (See Table 6.)

In terms of which of the four socio-economic components within the CWB may best express inter-group differences in the Northern connectivity profile, a simple Kruskall-Wallis[18] test suggests that the most significant differences between reserves, Inuit settlements, First Nation/Métis settlements, and non-Aboriginal settlements can be found in income, followed by housing. In terms of theory-building, Statistics Canada's Internet Use Survey[19] of 2010 has revealed a significant positive correlation between low-income scores and low Internet use. We do not have the necessary data to link this hypothesis with the Northern connectivity profile,[20] but it warrants further investigation. Moreover, inter-group differences are significant for all four CWB component measures[21] and warrant further exploration for their possible compound effects on ICT access and adoption. The low median education scores for the profile's Aboriginal communities, and particularly for Northern reserves, are especially concerning in light of how ICT adoption may be predicated on earlier skills development and exposure to formal educational programming.[22] However, before drawing any definite conclusions about these patterns, one must also consider the methodological challenge that many remote First Nations have resisted participating in the census and related Statistics Canada initiatives. In this light, more participatory community-based research initiatives may present opportunities for improving our understanding of the Northern connectivity landscape's socio-economic context.[23]

BENCHMARKING AFFORDABILITY

Our analysis in this benchmarking section integrates data collected from several national and regional sources, including Industry Canada's Broadband

18 The non-parametric Kruskal-Wallis test evaluates whether the mean ranks of scores on each CWB Index component (our dependent variables) are the same across all types of Northern communities (our independent or grouping variable).

19 Statistics Canada, *Canadian Internet Use Survey*.

20 Statistics Canada, "Individual Internet Use and E-Commerce."

21 Income: X^2 (3,N=373)=189.1, $p < 0.001$; Housing: X^2 (3,N=372)=174.6, $p < 0.001$; Education: X^2 (3,N=372)=169.9, $p < 0.001$; and Labour: X2 (3,N=372)=148.5, $p < 0.001$.

22 Statistics Canada, *Internet Use by Individuals*.

23 O'Donnell and others, "How the Washaho Cree at Fort Severn."

Canada program, the CRTC Communications Monitoring Reports, and the Northern Communications and Information Systems (NCIS) Working Group's Arctic Communications Infrastructure Assessment (ACIA) report.[24] We also sought updated product information from Northern telecommunications carriers and ISPs (current to July 13, 2013). To establish a comparative framework for benchmarking affordability, we compiled a list of Canadian locations from the larger Northern connectivity profile[25] discussed in the previous section. Our research units for this benchmarking analysis consist of three components, based on advertised price ranges for a residential wireline service with/without long distance, cellular voice with/without a 1 GB data plan, and residential high-speed Internet access ≥ 1,500/384 Kbps. Each component is defined in the following sections. The result of our data gathering is a database of basic service baskets for 399 Northern census units ranging from tiny hamlets to villages, towns, and cities. The basic service basket for each census unit tallies costs for a residential wireline service with long distance, a basic cellular voice plan, and a residential high-speed Internet plan ≥ 1,500/384 Kbps. For 82 per cent of the database we also compare higher-tier service baskets that include cellular voice with a 1 GB data plan. Table 7 summarizes the distribution of our final purposive sample for this benchmarking exercise.

Table 7
Frequency of Northern Canadian Benchmarking Data Set Locations by Province and Territory

Province/territory (no. of locations)	No. of locations	Per cent	Cumulative per cent
Labrador	11	2.8	2.8
Quebec	19	4.8	7.5
Ontario	50	12.5	20.1
Manitoba	51	12.8	32.8
Saskatchewan	31	7.8	40.6
Alberta	111	27.8	68.4
British Columbia	77	19.3	87.7
Yukon	19	4.8	92.5
Northwest Territories	19	4.8	97.2
Nunavut	11	2.8	100.0
Total	399	100.0	0.0

Source: The Conference Board of Canada.

The result of our data gathering is a database of basic service baskets for 399 Northern census units ranging from tiny hamlets to villages, towns, and cities.

Residential Wireline Service

The residential wireline service component consists of tariffed rates for single-line service (residential) and non-tariffed rates for North America-wide long-distance calling plans. We have endeavoured to verify that the pricing of single-line residential services includes other recurring charges such as network access fees. This rate does not include extra calling features such as call display or voicemail. In our analysis, we have also omitted non-recurring service charges, such as installation or activation fees. We have also omitted temporary promotions, bundles, or price discounts that service providers may offer at their discretion. Our objective has been to compile a benchmarking data set that is broadly comparable across the territories and other Northern Canadian regions. The rates captured reflect data collected as of July 13, 2013.

Although CRTC opened territorial wireline markets to long-distance competition in 2000,[26] followed by local competition in 2012,[27] local and long-distance competition is relatively nascent across the territories. For benchmarking in the territories, we thus focus on a broadly comparable NorthwesTel long-distance service.

We do not include Voice over Internet Protocol (VoIP) alternatives in this wireline analysis because they rely on a high-speed Internet service. Despite recent excitement around new entrants in the territories, it appears that limitations on current Internet access technologies may impact consumer uptake of commercial VoIP systems to varying degrees. One example is the absence

24 Imaituk Inc., *A Matter of Survival.*

25 Canada Revenue Agency, *Northern Residents Deductions.*

26 CRTC, *Decision CRTC 2000-746.*

27 CRTC, *Telecom Regulatory Policy CRTC 2011-771.*

of a so-called "dry loop" digital subscriber line (DSL) option for consumers on the NorthwesTel wireline network. At this time, a consumer must lease a residential single-line service from NorthwesTel to acquire high-speed Internet via ADSL. We provide some further analysis of a commercial VoIP solution for territorial consumers in the final subsection of this benchmarking exercise—after accounting for comparative costs (based on cable versus ADSL high-speed Internet components).

Cellular Voice With/Without a ≥3G Data Plan

The cellular communications component compares advertised pricing for basic voice (200 to 250 local minutes) as well as voice bundled with 1 GB of data (available to communities in 82 per cent of our database). To simplify our exploratory analysis, we do not include the additional cost of mobile long-distance service charges or plans. We define the 1 GB data plan in terms of average data transfer rates greater than 200 Kbps (following the IMT-2000 standard). More colloquially we will call this a ≥ 3G voice and data plan. In the territories, this definition would include NorthwesTel and Latitude's rollout of EVDO[28] as well as their more recent and ongoing rollout of the UMTS[29] standard under NorthwesTel's modernization plan (e.g., HSPA+). Bell Canada's national UMTS network rollout (with TELUS) had initially made HSPA available in more densely populated Northern locations, such as Whitehorse and Yellowknife. Services now extend as far North as Tuktoyaktuk, and Bell Canada's UMTS network has since upgraded to support HSPA+ (e.g., a data downlink speed[30] of 7 to 14 Mbps) on a path to the Long Term Evolution (LTE) standard (available in limited cases as of 2013). Following industry convention, Bell Canada/NorthwesTel and other carriers, such as TELUS, have chosen to label HSPA services 4G, alongside their early implementations of the LTE standard (e.g., a data downlink speed of 12 to 25 Mbps). The International Telecommunication Union Radiocommunication (ITU-R) standards body introduced a stricter technical definition for 4G in ITU-R M.1645, based on peak (theoretical) data rates of 1 Gbps for low-mobility situations (e.g., pedestrian access) and 100 Mbps for high-mobility situations (e.g., vehicular access).[31] However, in 2010, under pressure from telecommunications service providers, such as T-Mobile in the United States, ITU-R acknowledged that telecom industry use of 4G for current technologies, such as HSPA+, WiMax, LTE, and other evolved 3G services, had established a de facto standard that consumers were familiar with. The standards body thus relaxed its definition of 4G, to the dismay of some market observers[32] who had hoped the stricter definition would spur innovation. The gaps between standards, market offerings, and actual user experiences can be a source of confusion and potential consumer dissatisfaction. Rather than become mired in the controversy of 3G versus 4G, in this benchmarking exercise we examine mobile data plans that are at minimum 3G, and identify the technologies and average estimated data downlink speeds to provide a basis for comparison.

Residential High-Speed Internet (≥ 1,500/384 Kbps)

The residential high-speed Internet component compares prices for ADSL, cable, Ka-band satellite, and wireless Internet services advertised[33] as capable of supporting data transfer rates ≥ 1,500/384 Kbps. This is the Industry Canada standard under the Broadband Canada program (circa 2009–12), and it applies to Northern Internet services that have benefited from federal program funding under Industry Canada and related departments (such as NorthwesTel's partnership with Falcon Communications or SSi Micro's partnership with the Nunavut Broadband Development Corporation). Our analysis concentrates on advertised monthly service pricing and does not include additional set-up fees, hardware costs, bundles, or non-recurring promotional discounts.

28 Evolution-Data Optimized is an evolution of the Code Division Multiple Access 2000 (CDMA2000) standard.

29 Universal Mobile Telecommunications System is a standard based on Global System for Mobile (GSM) that uses W-CDMA radio access technology.

30 By data downlink we mean an inbound data transfer rate, also known as "download speed."

31 3G Americas, *Defining 4G*.

32 Lawson, "ITU Softens."

33 The obvious limitation of relying on advertised rates is not being able to test actual consumer experiences of service standards and quality.

Table 8
Average Northern Residential Single-Line Rates and Long-Distance Plans

Location	Residential single-line rate (monthly)	Long-distance plans (monthly)
Northern Canadian average	28.79[1]	◆ Average limited plan was $28.71 for 814 North American long-distance minutes[2] ◆ 56% of locations had unlimited North American calling for less than $30
Pan-provincial average	28.28[3]	◆ $27.63 for 983 North America[4] long-distance minutes ◆ 65% of locations had unlimited North American calling for less than $30
Pan-territorial average: ◆ Yukon average ◆ Northwest Territories average ◆ Nunavut average	32.37[5]	◆ NorthwesTel Freedom 400 package offered 400 North American long-distance minutes for $22.95

1 Based on a sample of 399 Northern locations.
2 Based on a sample of 171 Northern locations where unlimited long-distance calling was not an identifiable consumer option.
3 Based on a sample of 350 pan-provincial locations.
4 Based on a sample of 122 pan-provincial locations where unlimited long-distance calling was not an identifiable consumer option.
5 Based on a sample of 49 pan-territorial locations.
Source: The Conference Board of Canada.

Residential Wireline Service: Benchmarks

Table 8 indicates that territorial incumbent NorthwesTel's monthly single-line rate for residential local calling exceeded the Northern pan-provincial average by $4.09. For a long-distance benchmark for the territories, we use the incumbent's Freedom 400 plan, which offered 400 North America-wide long-distance minutes for a monthly fee of $22.95. Compared with NorthwesTel's Freedom 400 plan, 65 per cent of Northern pan-provincial locations had access to unlimited North America calling for less than $30 per month. The average for Northern Canadian locations without unlimited North America plans was 814 minutes at $28.71 per month. Pan-provincially, this average price decreased by $1.08, while the average minutes increased by 169 (to 983).

Cellular Voice With/Without a 1 GB Mobile Data Plan: Benchmarks

Table 9 indicates a pan-territorial average of $31.53 per month for basic cellular voice plans (200 to 250 anytime local calling minutes). The Yukon average was $30, while the N.W.T. average was $0.79 more due to a $45 per month service charge where Ice Wireless was the sole provider. By comparison, the Nunavut average was $35.45 per month due to a $60 per month service charge where the satellite-based Lynx Mobility was the sole provider. In terms of 1 GB mobile voice/data plans, ≥ HSPA, Yukon and N.W.T. averages were at least 1,100 Kbps faster than the pan-provincial average (for $0.94 less per month). The best 1 GB voice/data plan, ≥ HSPA, for Yukon and N.W.T., was from Bell Mobility and included unlimited local anytime calling minutes. In sharp contrast, Nunavut's 3G consumer experience was limited to EVDO-based technology (≤ 2,000 Kbps), and its cheapest plan ≥ 1 GB of monthly data cost $5 more than the Yukon and N.W.T. averages ($70 versus $65 per month). Altogether, the Northern Canadian average was $33.63 per month for basic voice and $65.87 per month for voice and 1 GB data with an average 5,300 Kbps data downlink speed.

Lowest-Cost Residential High-Speed Internet Package (≥ 1,500/384 Kbps): Benchmarks

Table 10 summarizes the lowest-cost residential high-speed Internet packages available to Northern residents and advertised at ≥ 1,500/384 Kbps. In Yukon and N.W.T., subscribers with cable access had twice the

Table 9
Average Northern Cellular Services: Basic Voice Versus Voice With 1 GB Data Plans

Location	Basic voice (200–250 anytime local minutes)	Voice and 1 GB data (average data downlink/average price)
Northern Canadian average	$33.63[1]	◆ 5,300 Kbps for $65.87[2] per month
Pan-provincial average	$32.78[3]	◆ 5,200 Kbps for $65.94 per month[4]
Pan-territorial average	$31.53[5]	◆ 5,300 Kbps for $66 per month[6]
Yukon average	$30[7]	◆ 6,400 Kbps for $65 per month[8] ◆ $65 Bell Mobility plan includes unlimited local anytime minutes
Northwest Territories average	$30.79[9]	◆ 6,300 Kbps for $65[10] per month ◆ $65 Bell Mobility plan includes unlimited local anytime minutes with 1 GB data
Nunavut average	$35.45[11]	◆ ≤ 2,000 Kbps for $70 per month12 ◆ $70 NorthwesTel Smart Plus plan includes 400 local anytime minutes with unlimited data usage and text messaging

1 Based on a sample of 399 Northern locations.
2 Based on a sample of 322 Northern locations where ≥3G mobile data service was an identifiable consumer option.
3 Based on a sample of 350 pan-provincial locations.
4 Based on a sample of 302 pan-provincial locations where ≥HSPA mobile data service was an identifiable consumer option.
5 Based on a sample of 49 pan-territorial locations.
6 Based on a sample of 20 pan-territorial locations where ≥HSPA mobile data service was an identifiable consumer option.
7 Based on a sample of 19 Yukon locations.
8 Based on a sample of 5 Yukon locations where ≥HSPA mobile data service was an identifiable consumer option.
9 Based on a sample of 19 N.W.T. locations.
10 Based on a sample of 15 N.W.T. locations where ≥HSPA mobile data service was an identifiable consumer option.
11 Based on a sample of 11 Nunavut locations.
12 Based on a sample of 5 Nunavut locations where EVDO was an identifiable data standard for available mobile data plans.
EVDO = Evolution-Data Optimized; HSPA = High Speed Packet Access
Source: The Conference Board of Canada.

advertised data download speed than those on ADSL, the second-fastest service available (5,000 versus 2,500 Kbps). These were Whitehorse and Carcross in Yukon and Yellowknife, Fort Smith, and Norman Wells in the Northwest Territories. The greater availability of cable in N.W.T. communities also explains its higher average data download rate (2,900 Kbps), compared with Yukon (2,800 Kbps) and Nunavut (1,500 Kbps). The pan-provincial average outperformed the N.W.T. average on upload speed by over 200 Kbps, but was 100 Kbps slower on downloads (2,800/590 versus 2,900/384 Kbps), at an average price that was $10 less per month. Altogether, the Northern Canadian average was 2,800/565 Kbps for $57 per month.

Combined Costs for Personal Telecommunications and High-Speed Internet: Service Baskets

Table 11 combines the costs explored in the previous sections into two service baskets distinguished by whether a basic voice or voice with 1 GB data plan is chosen for the cellular service component. All three territories registered higher-cost baskets than the pan-provincial average on both cellular service benchmarks. compared with the pan-provincial average, Yukon paid $13 more on average for the basket with basic voice and $15 more on average for the voice/1 GB data basket.[34] By comparison, N.W.T. paid $13 more on average

34 Based on ≥ HSPA technology.

Table 10
Average Northern Lowest-Cost Residential High-Speed Internet Services (≥ 1,500/384 Kbps)

Location	Data transfer rate	Monthly price
Northern Canadian average[1]	2,800/565 Kbps	$57 (average)
Pan-provincial average[2]	2,800/590 Kbps	$55 (average)
Pan-territorial average[3]	2,500/384 Kbps	$68 (average)
Yukon average[4]	2,800/384 Kbps	$65 (average)
Northwest Territories average[5]	2,900/384 Kbps	$65 (average)
Nunavut average[6]	1,500/384 Kbps	$80 (average)

1 Based on a sample of 399 Northern Canadian locations.
2 Based on a sample of 350 pan-provincial locations.
3 Based on a sample of 49 pan-territorial locations.
4 Based on a sample of 19 Yukon locations.
5 Based on a sample of 19 N.W.T. locations.
6 Based on a sample of 11 Nunavut locations.
Source: The Conference Board of Canada.

Table 11
Combined Costs for Personal Telecommunications and High-Speed Internet (Basic Cellular Voice Versus Cellular Voice/1 GB Data)

Location	Residential single-line rate with a limited North America plan, basic cellular voice, and high-speed Internet	Residential single-line rate with a limited North America plan, cellular voice/1 GB data, and high-speed Internet
Northern Canadian average	$139 per month	$171 per month
Pan-provincial average	$137 per month	$170 per month
Pan-territorial average	$155 per month	$188 per month
Yukon average	$150 per month	$185 per month
Northwest Territories average	$150 per month	$184 per month
Nunavut average	$171 per month	$205 per month

Source: The Confence Board of Canada.

for the basic voice basket and $14 more on average for the voice/1 GB data[35] basket. The highest-cost region for consumers was Nunavut, where a basic voice basket cost, on average, $34 more per month than the pan-provincial average, while a voice/1 GB data[36] basket cost, on average, $35 more per month. Altogether, the Northern Canadian average was $139 per month for the basic voice basket and $171 per month for the voice/1 GB data basket.

35 Based on ≥ HSPA technology.

36 Based on EVDO technology, which has lower capacity than HSPA.

Table 12
Comparison of Commercial VoIP Versus NorthwesTel Freedom 400 Long-Distance Calling Plan

Location	High-speed Internet	Residential line rate (ADSL)	VoIP bundle	VoIP total	NorthwesTel calling plan total
Yukon/N.W.T.	$64.95 (ADSL)	$32.37	$29.95	$127.27	$118.27
Nunavut	$99.95 (ADSL)	$32.37	$29.95	$162.27	$118.27
Yukon/N.W.T.	$62.95 (Cable)	n.a.	$29.95	$92.90	$118.27

Source: The Conference Board of Canada.

Benchmarking Case Study: Viability of VoIP Substitution for Territorial Consumers

To help illustrate how costs may constrain consumer choice and market innovation, we use our benchmarking data to explore the question of VoIP substitution for residential wireline services in the territories. Our analysis concentrates on cable- and ADSL-serviced locations in Yukon, N.W.T., and Nunavut. Table 12 assesses the situation of commercial VoIP substitution, using data from Iristel, a recent entrant to the pan-territorial market. In our example, a mid-level package from Iristel[37] retailed at $29.95 per month and included unlimited North America calling. Our exploratory analysis does not include the extra cost of hardware or additional calling features.

Table 12 provides a cost comparison with the NorthwesTel Freedom 400 long-distance calling plan examined previously in Table 8. For cable subscribers in Whitehorse, Carcross, Yellowknife, Fort Smith, and Norman Wells, there was a monthly cost savings of $25.37 in favour of Iristel. Iristel's featured plan includes unlimited calling to Canada and the U.S., which may lead to further cost savings when compared with the NorthwesTel 400 plan, depending on a consumer's particular calling habits. For ADSL subscribers in Yukon and N.W.T., NorthwesTel's plan was $9 less than Iristel's plan, but the added value of Iristel's unlimited North America calling might outweigh the switching cost.

However, for ADSL subscribers in select Nunavut communities such as Iqaluit, the switching cost increases to $44 per month (based on 1,500/384 Kbps, the Nunavut Internet 1 plan retailed at $99.95). For further comparison, if an Iqaluit resident had chosen SSi Micro's $80 per month wireless service instead of NorthwesTel's ADSL option, the combined commercial VoIP solution would save about $8.32 (based on a 1,500/384 Kbps, Qiniq plan and Iristel's $29.95 VoIP plan). In this case, there are other factors to consider, such as Nunavut's current dependence on satellite backhaul, which may raise questions about the technical requirements of VoIP substitution (particularly if Internet services are best-effort). Iristel has thus far limited its Nunavut presence to Iqaluit.

In mid-2013, there thus appears to be some disincentive for ADSL subscribers in the territories to adopt a commercial VoIP solution such as Iristel, particularly in Nunavut. On the other hand, NorthwesTel representatives have indicated that at least 60 per cent of the population in their serving area have access to cable or another technology where a home phone is not required. Moreover, it is worth considering that many flavours of VoIP are available to Internet subscribers, including free software versions of the well-known Skype and Google Talk applications. From NorthwesTel's perspective as a territorial incumbent, the potential incursion of VoIP in 60 per cent or more of its market also means the potential erosion of internal cross-subsidies to support its higher cost serving areas. (See our discussion in Chapter 4.)

37 Iristel, *Switching Is Easy.*

Canada's North is subject to the vicissitudes of high-cost serving areas. In terms of telecommunications services, this condition means high prices for residential wireline, long distance, cellular voice/data, and residential high-speed Internet. Our benchmarking analysis of a subset of the Northern connectivity profile finds that an average Northern Canadian consumer pays $139 per month for a basic cell phone plan, home phone with long distance, and high-speed Internet access. Some Northern regions are higher-cost areas than others. The average territorial consumer pays more than the average Northern provincial consumer for a similar basic basket of services. At the upper extreme, a resident of Nunavut may pay over $20 more per month than residents of Yukon or the Northwest Territories.

Finally, the question of whether new Internet-based services can adequately substitute for plain old telephone service (POTS) does not have a simple answer. In our analysis, the cost of commercial VoIP substitution worked favourably for Yukon and N.W.T. cable subscribers, but potentially unfavourably for ADSL subscribers—especially in Nunavut. ADSL subscribers on the NorthwesTel network must currently lease a telephone line to acquire their residential high-speed Internet service. In this case, our conclusions on the subject of substitution are regionally focused and provisional, and are certainly not the final word. Northern consumers will have to study their options closely to discover the best possible solutions for their needs, which may include supporting their incumbent or local competition, or finding alternative applications such as Skype or GoogleTalk.

Chapter 3

Northern Connectivity Scenarios and Case Studies

Chapter Summary

- This chapter presents three scenarios to encapsulate patterns and challenges that endure within and across Canada's Arctic, boreal forest regions, and the circumpolar North.
- Each scenario tells a story using characters based on our research team's real-life encounters with Northern stakeholders. Meet Charlie the Inuk media artist, in *Canada's inhabited Arctic*; Tim the miner, in the *boreal forest zone*; and Sandy the coast guard, in the *circumpolar world* of the near future. Each scenario represents opportunities and challenges to Northern individuals, living today and in the near future.
- The scenarios help to present the data gathered through interviews with regional stakeholders across Canada's North.

To help orientate readers within the complex landscape of Northern connectivity and IT issues, this chapter presents three qualitative scenarios. Each scenario tells a story using characters based on our research team's real-life encounters with Northern stakeholders. The scenarios represent opportunities and challenges to Northern individuals, living today and in the near future. These scenarios are presented to encapsulate patterns and challenges that endure within and across Canada's Arctic, boreal forest regions, and the circumpolar North.

The data used to develop these scenarios were gathered between September 2012 and March 2013 through interviews with regional stakeholders from Labrador, Nunavik (Northern Quebec), Northeastern and Northwestern Ontario, Manitoba, Saskatchewan, Alberta, Nunavut, the N.W.T., Yukon, and Northern British Columbia. These stakeholders provided their diverse knowledge and perspectives regarding regional connectivity issues. Particular emphasis was placed on collecting data related to the key challenges that Northern residents, industries, and governments face in accessing and using broadband ICTs, as well as gaining a deeper understanding of the reality that some Northern communities and regions are at more of a disadvantage than others when it comes to meeting these challenges. We also asked regional stakeholders to identify current projects to develop critical connectivity infrastructure in their regions. The purpose of these discussions was to learn about specific project details regarding regional connectivity initiatives, including financing options, Aboriginal inclusion, and the important challenge of project sustainability.

The three scenarios presented in this chapter, therefore, help to present these data by distinguishing clusters of regions, as well encapsulating patterns and challenges that endure across regions. Each of the three scenarios

also represents one of three dominant geopolitical situations in Canada's Northern connectivity landscape. At the basis of our first scenario, Charlie the Inuk media artist, it is *Canada's inhabited Arctic*. In our second scenario, Tim the miner, it is the *boreal forest zone*. And in our third scenario, Sandy the coast guard, it is part of a *circumpolar world* of the near future that binds our inhabited Arctic and boreal forest regions to an international and dynamically shifting geopolitical context.

SCENARIO 1: CHARLIE THE INUIT ARTIST AND PRODUCER LIVES AND WORKS IN THE ARCTIC

Meet Charlie, an Inuk in his early 20s who lives in a medium-sized community in the remote territory of Nunavut. Charlie has been up late putting the finishing touches on a sound mix for a public service announcement (PSA). He has an ear for beats, and in his spare time produces electro and hip hop in his bedroom studio (e.g., a laptop with digital audio workstation (DAW) software, some comfortable headphones). A small Winnipeg production company is producing the PSA to promote a federal anti-smoking campaign for the territories. One company producer had found Charlie's work on SoundCloud[1] (a global network of over 20 million users that amateur and professional musicians use as a platform to distribute their music). She found his unique style compelling and invited him to bid on the contract. The Winnipeg company relies on a fibre-to-the-premises connection, but Charlie's wireless connection depends on C-band satellite backhaul.

Two to three years ago it would have been practically impossible for Charlie to send his 100-megabyte (MB) sound file to Winnipeg. Today he can, thanks to Qfile,[2] an innovative Industry Canada-funded application that caches large data files to local servers across Nunavut, while prioritizing file transfers via dedicated satellite bandwidth. Caching is beneficial for Charlie, who was able to share pieces of the sound track with several collaborators across Nunavut: One friend sent him a drum loop and baseline, while another contributed a recording of her aunt's throat singing. Charlie and several friends in his community jointly pay $145 a month to be able to upload 10 GB per month and maintain 50 GB of storage. Without the file-sharing app, the Winnipeg production company that contracted Charlie would have had to courier his work by air, which means it likely wouldn't have given him or his collaborators a chance to bid on the contract. Beyond that, Charlie would have had little opportunity to promote his music and production skills outside his 800-person community.

Two to three years ago it would have been practically impossible for Charlie to send his 100-megabyte sound file to Winnipeg. Today he can, thanks to Qfile.

Charlie dreams of one day building a production network like his heroes at Piksuk Media[3] and IsumaTV.[4] But he understands how fragile connectivity can be in his world. His cousin Margaret manages the local Community Service Provider (CSP) where Charlie and other subscribers go to purchase modems and pay their monthly subscriptions. News from the latest gathering of CSPs across Nunavut is that satellite bandwidth will become a lot more expensive—perhaps unaffordable—if federal, territorial, and industry partners fail to negotiate new infrastructure funding agreements by 2016. There is also excitement about competition in the North, with new cell phone services and incumbent high-speed Internet packages coming out, but new cell phones and higher speeds have typically come at higher prices. (See our analysis under Benchmarking Affordability in Chapter 2.) In this regard, the possibility of an undersea fibre optic backbone to replace satellite backhaul has got people hoping that prices could eventually decline. As Charlie checks his laptop to confirm the file transfer, a plane rumbles overhead in the direction of Nunavut's newest mine. People are

1 SoundCloud, *Hear the World's Sounds.*

2 Qiniq, *Qfile.*

3 Piksuk Media, *About Us.*

4 Isuma.tv, *Authentic Web TV.*

talking about employment opportunities in the coming months and years. He could use extra income to help pay for new sound gear and his ever-increasing bandwidth consumption. Even with new media, being an artist in the Arctic means having to wear many hats—sometimes even a hardhat.

SCENARIO 2: TIM IS AN ITINERANT MINING TECHNOLOGIST IN CANADA'S "RING OF FIRE"

Tim is a migrant worker in Northern Ontario's Ring of Fire. His family lives in New Brunswick. A few years ago he was living in the territories, but an industry downturn convinced him to find work elsewhere. After going back to college for Geographic Information System (GIS) certification, Tim now works for a junior mining company mapping potentially lucrative geological formations. Tim misses his wife and young daughter, and depends on the communications facilities that mining camps provide. Service quality may vary tremendously between the larger and smaller ventures. In the N.W.T., several senior mining companies partnered with NorthwesTel, the territory's local incumbent exchange carrier, to develop a microwave network that now serves several diamond mines northeast of Yellowknife.[5] This allowed the companies to manage logistics and process data more efficiently and let workers like Tim Skype with their distant families and friends.

In Northern Ontario, the Ring of Fire provides a different landscape from the tundra, rock, and ice Tim was used to. Here it is a mixture of taiga (swampy wetlands and small trees) with thick boreal forest, lakes, and winding rivers—where snow can be heavy in the winter. It is a formidable combination that challenges efforts to deploy terrestrial communications infrastructure. This region also has a significant risk of forest fires during the summer, which has set emergency responders on high alert in the past few years. In 2011, nearly 3,600 residents of remote Northwestern Ontario First Nations had to be evacuated[6] to Southern emergency shelters in the Ottawa area. Moreover, in the Northeast, along the James Bay coast, First Nations are vulnerable to other natural hazards such as severe seasonal flooding, which causes first responders to implement emergency measures and evacuate communities.[7] Without adequate personal communications, such natural catastrophes can place additional stress on families and friends.

While visiting one of the Northeastern hub towns, Tim learned about Five Nations Energy Inc., a First Nations-owned power company that ran fibre optic cables to member reserves (Attawapiskat, Fort Albany, and Kashechewan), some 200 kilometres away from their point of origin in Moosonee.[8] The First Nation company also delivers power and fibre optic infrastructure to the DeBeer's Victor diamond mine, a partnership that sparked interest in the broader community connectivity project.[9] Several hundred kilometres west of town, a gold mine and surrounding First Nations have recently acquired fibre optic backhaul thanks to a larger project, the Northwestern Ontario Broadband Expansion Initiative, which partners the Ontario and federal governments with the regional incumbent Bell Aliant.

Tim has noticed that more First Nations people are carrying cell phones. Keewaytinook Mobile, a tribal council-led First Nation technology initiative from the Sioux Lookout district of Northwestern Ontario, now allows remote communities (as far east as Attawapiskat) to access their own Northern mobile services over locally managed community networks. The tribal council, Keewaytinook Okimakanak, also recently completed roaming agreements with a major Southern carrier (though it was too late to help customers during the 2011 fires). Tim learned the news from a young

5 The project replaced satellite communications with a terrestrial microwave radio system for the BHP Ekati, Diavik/Rio Tinto, and DeBeers Snap Lake diamond mines northeast of Yellowknife. NorthwesTel, *NorthwesTel Year in Review 2008*.

6 Knet Media, *Over [a] Hundred Forest Fires*.

7 CBC News, *2 Ontario First Nations*.

8 The $8-million project received funding from the Northern Ontario Heritage Fund Corporation, Industry Canada FedNor, Health Canada, and the Mushkegowuk Tribal Council. Wawatay News Online, *High-Speed Internet*.

9 Five Nations Energy Inc., *Five Nations Energy Inc. Celebrates Five Years*.

First Nation man who travels many kilometres in a year to climb towers, repair radios, and splice fibre as an employee of the tribal council. The examples are exciting, but network coverage is also uneven, and some communities in the Central North region have yet to benefit from any fibre or mobile initiatives. Observers may also wonder if a not-for-profit tribal council and small remote communities have the resources and capabilities to manage their own broadband and mobile communications services.

In Northern Ontario, the Ring of Fire landscape of taiga, thick boreal forest, lakes, and rivers challenges efforts to deploy terrestrial communications infrastructure.

For its part, Keewaytinook Okimakanak has been delivering not-for-profit technology solutions to remote First Nations since 1994 when it began as a regional electronic Bulletin Board System (BBS) over dial-up and DirecPC satellite. Members and partners trust in its capabilities.

As for primary sector industries in the region, with the exception of a few examples such as DeBeers' partnership with Five Nations Energy Inc., for the most part they procure telecom services directly from their regional incumbent or from a satellite service provider. Unlike the tribal council, these businesses are headquartered beyond the regions they serve, and their interests in the North may not be in harmony with those Aboriginal residents whose ancestral roots run deep.

SCENARIO 3: SANDY IS A COAST GUARD OFFICER IN THE CIRCUMPOLAR NORTH

It is 2020. Sandy lives and works out of Halifax but spends much of her time thinking about search and rescue (SAR) operations along the Arctic coasts. Two years earlier, she was helping to train the Nunavik SAR teams in Northern Quebec. Today, she's on Arctic waters and her crew is escorting a research vessel to pick up a team of biologists from the Canadian High Arctic Research Station[10] in Cambridge Bay, Nunavut. Sandy's work defines the frontier of Canada's Arctic presence. She often worries about future ice and weather patterns, and her team relies on a sophisticated network of remote sensing and weather-monitoring systems to maintain what the military calls "situational awareness."

Foremost among these systems is Canada's $975-million-plus Radarsat Constellation, a project that the Canadian corporation Macdonald, Dettwiler and Associates Ltd. (MDA) built and currently manages on behalf of the Canadian Space Agency (CSA) and federal government departments.[11] In planning and development since 2005 and launched in 2018, the Radarsat constellation's three-satellite configuration now provides comprehensive surveillance of Canada's lands and oceans "offering an average daily revisit, as well as daily access to 95% of the world to Canadian and International users."[12] For Sandy's patrol and other Arctic vessels, Radarsat can provide near real-time imaging data[13] of changing ice flows along important Northern sea routes.

As Sandy's patrol ship cuts through the icy waters, she notices a group of Canadian Rangers[14] on manœuvre near the port of Nanisivik, their distinct red sweatshirts recognizable from offshore. For the Inuit who form Canada's enduring presence along this Arctic front, situational awareness has come at a price—including forced relocations of Inuit settlements and tons of garbage and toxic waste left from spent military infrastructure.

10 Aboriginal Affairs and Northern Development Canada, *Backgrounder*.

11 Including the Department of National Defence, Fisheries and Oceans Canada, Agriculture and Agri-Food Canada, Environment Canada, Natural Resources Canada, and Public Safety Canada.

12 Canadian Space Agency, *RADARSAT Constellation*.

13 On the order of 15 minutes or less.

14 The Canadian Rangers are a volunteer force of the Canadian Forces reserve made up of Inuit, First Nation, Métis, and non-Aboriginal peoples. Formally established in 1947, their primary duty is to conduct surveillance or sovereignty patrols (SOV PATS) in Canada's sparsely populated remote, Northern, and coastal regions.

While Canada has not consistently honoured the political culture and development goals of its Northernmost indigenous inhabitants, Inuit leaders have tried to find positive spillovers from a Canadian military presence in their Arctic homeland. In testimony before the Standing Committee on National Security and Defence, Charlie Lyall, former President and CEO of Kitikmeot Corporation, put it this way: "For Inuit, an active military presence in the Arctic is vital and provides strong partnerships for its major projects."[15]

Among the larger-scale opportunities are information-communications infrastructure projects. While Sandy's team mostly comprises non-Inuit military personnel, Inuit Development Corporations (IDCs) and local indigenous labour have played critical roles in maintaining ground-based radar stations across Canada's Arctic front. (See discussion below.)

Inuit have also been integral in cleaning up the remains of past military systems. The most prominent example to date was the cold war era Distant Early Warning system or DEW line, which left a toxic legacy of waste—from abandoned shelters exposing lead and polychlorinated biphenyls (PCBs), to mercury and other heavy metals seeping from used equipment, to soil saturated with old petroleum products and battery acid. Cape Dyer, one of the largest former DEW line sites, at 23,388 acres, contained more than 6,500 metric tons of contaminated soil and demolition debris.[16] Yet, undaunted by the challenge, Inuit teams under Qikiqtaaluk Logistics worked with scientists and engineers, including Queen's University's Analytical Services Unit, to undertake the remediation effort. A project of this magnitude can employ over 100 workers from around Nunavut.[17]

With this kind of practical expertise, the IDCs are equipped to bid on other environmental remediation projects in the region, but they also have an indigenous workforce that can provide maintenance and support services for other military and civilian facilities, including the critical telecommunications infrastructure that supports Canada's circumpolar presence.

CANADA'S INHABITED ARCTIC: A CLOSER LOOK AT THE BASIS OF CHARLIE'S WORLD

The inhabited Arctic is a world defined by the historic settlement patterns of Inuit, Gwich'in, Dene, Cree, Innu, and other indigenous societies in interaction with each other and the later settlement patterns of non-Aboriginal Canadians. Demographic data models indicate that Aboriginal societies will continue to constitute majority populations in Nunavut (84 per cent[18]) and in the N.W.T. (51 per cent[19]), while comprising over a fifth of the Yukon Territory's total population.[20] Further east, the regions of Nunavik in Arctic Quebec and Nunatsiavut in Northeastern Labrador will also retain substantial, primarily Inuit, Aboriginal majorities akin to Nunavut.

As discussed in Chapter 2, these societies have unique needs and socio-economic characteristics. Their adoption of IT is but one facet of a more complex wave of cultural and socio-economic changes that Canada's Aboriginal peoples have experienced post-contact, including the boom and bust of staple economies, the impact of reserves and residential schooling, and the development of territorial agreements and primary sector industries on traditional Aboriginal lands. Early research suggests that the networks and ICT practices developing among Canada's Aboriginal communities—in the Far and Near North—reflect not only Southern media contents and values, but more importantly, Northern perspectives, traditions, and values.[21] Yet, fundamentally, the technologies available to Northerners also constrain the extent and intensity of their net-

15 Standing Senate Committee on National Security and Defence, *Sovereignty & Security in Canada's Arctic*; Evalik and Lyall, *Canadian Sovereignty, the Military, and Infrastructure Development*.

16 Northern News Services Online, "Cleaning Up 'Our Land.'"

17 Qikiqtaaluk Corporation, *Qikiqtaaluk Logistics Awarded Cape Dyer*.

18 Nunavut Bureau of Statistics, *Population Estimates*.

19 Government of the Northwest Territories, *Community Population Estimates*.

20 Yukon Bureau of Statistics, *Aboriginal Data*.

21 O'Donnell and others, "How the Washaho Cree at Fort Severn"; Gauvin and Lorthiosis, *Internet Usage in Northern First Nation Communities*.

working, media production, and related ICT practices. For the inhabited Arctic, the greatest technological constraints currently involve access to network transport backbones and satellite backhaul.

COMPARATIVE SATELLITE DEPENDENCE IN THE INHABITED ARCTIC AND LITTLE NORTH

In Chapter 2, under Benchmarking Affordability, we examined some of the costs and limitations of current satellite-based personal communications across Canada's North. While Ka-band HTS technologies have begun to improve Internet services at lower costs than previous offerings, in 2013 they have yet to penetrate Canada's Arctic markets. Prevailing models—built over the past decade—currently revolve around Telesat Canada's Anik F satellite fleet (F2, F3, and F1R) and the economic contributions of federal infrastructure funding and partnerships. In the N.W.T. and Nunavut, this constellation of interests, needs, and technology developed into a regional duopoly between the incumbent, NorthwesTel (including its various affiliates, particularly Ardicom), and the Industry Canada/Infrastructure Canada-funded SSi Micro. By contrast, Yukon has only one satellite-dependent community, the Gwich'in settlement of Old Crow, under NorthwesTel.

Satellite network design has been a challenge for NorthwesTel and SSi Micro. Up until 2012, both competitors had exclusively used Anik F2, and their dishes all pointed at the same antenna on F2's A-pole, a design constraint that led to bandwidth scarcity despite the availability of additional C-band capacity on F2's B-pole.[22] Moreover, the unfortunate circumstance of co-habiting on Anik F2, as opposed to exploiting the availability of Anik F3 and/or F1R (which were not available when SSi Micro and NorthwesTel-Ardicom developed services in the early 2000s), left Nunavut, Old Crow (Y.T.), and the N.W.T.'s 10 satellite-dependent communities without a redundant backhaul connection. Thus, when a technical anomaly on Anik F2 dropped voice and data connections on October 6, 2011, these 36 communities had no other telecommunications option. By contrast, Nunavut's Southern neighbours in Nunavik (Northern Que.) and Ontario-Manitoba's Little North benefited from having redundancy between Anik F2, which supports their incumbent Bell Aliant's voice network, and F3, which carries their NSI-funded Northern Indigenous Community Satellite Network (NICSN). For NICSN's remote Ontario First Nations, the added redundancy of Anik F3 allowed them to use e-mail and IP telephony to smoothly relay polling station results during the October 6 provincial election.[23]

For the inhabited Arctic, the greatest technological constraints currently involve access to network transport backbones and satellite backhaul.

In the wake of a concerted territorial and federal effort to improve Arctic communications, SSi Micro began to work with Telesat in establishing diversity over Anik F3 in 2012.[24] While the cost of repositioning dishes would have proved insurmountable for either SSi Micro or NorthwesTel, the former was able to leverage Broadband Canada funding and contracts it had acquired from the governments of Nunavut and the N.W.T. to manage their C-band Public Benefit satellite transponder space, which Telesat had allocated to Anik F3 in 2010. This C-band Public Benefit was the result of an arrangement Telesat had made with Industry Canada to acquire strategic orbital space[25] at 118.7°W (where Anik F3 currently resides). Since 2003, the Government of the Northwest Territories (GNWT) has had free access to 5 megahertz (Mhz) (valued at $7.5 million) and the Government of Nunavut has had access to 12.5 Mhz (valued at $15.7 million), through to 2022.[26] Similarly, the NICSN consortium operating in Nunavik and the Little North has collectively benefited from around 25 Mhz under the C-band Public Benefit. The GNWT has stated that without this special arrangement it would be unable to deploy enterprise services such as school connectivity and

22 See Telesat's technical explanation in Imaituk Inc., *A Matter of Survival*, 87.

23 McMahon, "Northern Voices Heard."

24 SSi Micro, "Inclusion for All."

25 Industry Canada, *Conditions of Approval*.

26 Imaituk Inc., *A Matter of Survival*, 92.

telehealth across its 33 communities,[27] due to the estimated commercial cost of its transponder requirements (approximately $400,000 per year in 2012). More broadly, policy discussions behind the C-band Public Benefit paved the way for Infrastructure Canada's NSI, which provided multi-year funding for networks such as Qiniq (Nun.), NICSN (Que., Ont., Man.), and the First Nations Emergency Services Society (FNESS) (B.C.), through to 2016. Proponents of the NSI model consider it to be a form of infrastructure lease rather than a strict telecommunications subsidy. Somewhat similar to sponsoring a condominium tenancy agreement, Infrastructure Canada contributed upfront block funding to cover the lease of Telesat's transponders. In addition, Telesat offered in-kind contributions of transponder space to extend lease agreements. Moreover, the carrier held competitive bids for the available transponder space, which allowed groups such as NICSN (Que., Ont., Man.) to pool their bids and acquire better rates per Mhz based on multi-year contracts. The satellite industry's varying price per Mhz has been a source of uncertainty in this public-private market space where the declared value of C-band Public Benefits, NSI-funded transponder space, and commercial spectrum has ranged from $2,500 per Mhz to as high as $8,500 per Mhz. Without the advantage that bulk purchasing consortia, multi-year funding, and shared service approaches offer, more narrowly focused regional operators and enterprise networks (such as telemedicine) can end up paying considerably more per Mhz. For example, bandwidth to serve a telemedicine network in Nunavik (Que.) has cost $4,000 per Mhz, while the Kativik Regional Government (KRG), which administers Nunavik, benefited from rates as low as $2,500 under the NICSN partnership agreement. Nevertheless, if the federal government decides to forego another round or variation of the NSI beyond 2016, satellite-based networks such as Qiniq and NICSN will all face considerable hardship. In February 2012, Telesat estimated it would require approximately $160 million in new infrastructure investments to meet the inhabited Arctic's evolving needs until 2022. The company pledged $40 million, but has yet to receive confirmation of possible partnership contributions from the federal government or other stakeholders. Telesat claimed its Arctic Infrastructure Initiative would "more than double the communications capacity serving the Arctic, provide urgently needed network redundancy in every Northern community, and put in place the long term funding required to [… sustain the network …] for at least the next 10 years."[28]

Observers have noted that Telesat is not the only satellite carrier serving the Arctic. New entrants to the Nunavut mobile telephony market, Juch-Tech and Ice Wireless, demonstrated in 2012 the feasibility of deploying services over SES's AMC-9 satellite.[29] Yet, it remains to be seen whether alternative satellite backhaul will have a real economic impact on service innovation in the inhabited Arctic. Established service providers such as NorthwesTel and SSi Micro have thus far only taken tentative steps in this direction.

MARKET PLAYERS, GOVERNMENTS, AND FUTURE BACKBONE CONNECTIVITY

A spirited rivalry exists between the territories' two main operators, with NorthwesTel currently dominant in Yukon and SSi Micro prevailing over a strong user base in Nunavut thanks to pent-up demand and the Nunavut Broadband Development Corporation (NBDC)'s efforts to engage local constituencies under the Qiniq brand. Regional observers have described the N.W.T. as a battleground, predominantly under NorthwesTel's market power, where SSi Micro has a presence in 26 communities,[30] despite operating there without any significant government funding (e.g., through federal initiatives such as NSI or Broadband Canada). Yet, relative to the incumbent's local ADSL and cable infrastructure, SSi Micro's innovative 2.5-Ghz mobile wireless access network can be rapidly deployed under scenarios where the economics of backhaul render services feasible. In fact, users of the Qiniq

27 Government of the Northwest Territories, "Response to Consultation."

28 CBC News, *Telesat to Spend $40 Million.*

29 Juch-Tech, *Press Release: A New Source of Bandwidth in Iqaluit!*

30 Lemay-Yates Associates, Inc., *Yukon Telecommunications Development.*

network can take their portable modems and roam wherever SSi Micro's access points are available across Nunavut and the Northwest Territories.[31]

Presently, to reach the global Internet and inter-exchange services with carriers other than NorthwesTel, SSi Micro's only economic option is to procure terrestrial backbone connectivity services from the incumbent. In 2011, SSi Micro filed a complaint with CRTC against NorthwesTel's non-tariffed backbone connectivity services,[32] submitting that "NorthwesTel, as both a retail competitor in the Internet service market and the only wholesale supplier of terrestrial backbone connectivity in its territory, is in a position to thwart competition."[33] Though CRTC ruled in favour of SSi Micro's request for NorthwesTel to establish a tariff for backbone connectivity services, the issue is ongoing and will be subject to further public and regulatory scrutiny.[34] In recent years (2011–13), the governments of Yukon and N.W.T. have both investigated projects to diversify backbone connectivity in their respective regions, including the possibility of a joint network connecting along the Mackenzie Valley and Dempster highway routes. Yukon has also investigated backbone connections to networks in Juneau and Anchorage Alaska.[35] In a similar attempt to diversify backbone connectivity, although particularly with regards to finding alternatives to satellite backhaul, NBDC and stakeholders have investigated the feasibility of undersea fibre optic networks.[36] The Government of Nunavut has also looked to fibre for municipal area solutions, and in 2011 contracted Ledcor to install "fibre optic cables between local government offices, schools, emergency response centres, fisheries, research centres and medical facilities" in its 25 communities.[37]

While NorthwesTel has been a party to policy discussions about the potential for fibre optic deployments in all three territories, government stakeholders have not ruled out the possibility of retaining ownership of any future backbone infrastructure they come to majority invest in (e.g., in models similar to the Alberta SuperNet). Pan-territorial visions have also appeared to tantalize the imaginations of Arctic stakeholders. In 2010, the Arctic Cable Company, based in Anchorage, proposed Arctic Link, a transoceanic fibre optic system between Asia, North America, and Europe. Discussions around Arctic Link identified two routing options through Canada's Arctic: a northerly route through the McClure Strait, and a southerly route past Cambridge Bay then north to serve Resolute Bay and communities on the Eastern shore of Baffin Island. The venture has since dissolved. More recently, an Ontario company, Arctic Fibre Inc., has proposed an alternative Europe to Asia crossing. In 2012, Arctic Fibre generated considerable buzz and press[38] with an ambitious proposal to solve most of Nunavut's backhaul challenges. Proponents proposed that the transoceanic cabling venture could be equity financed—at an estimated cost of $600 million—through an ownership structure that would include "Canadian insurance companies, pension funds and First Nations developmental agencies, as well as a mix of foreign carriers from China, Japan, the United States and the United Kingdom."[39] Furthermore, they proposed that a secondary fibre optic backbone network for Nunavut could be achieved through an estimated domestic contribution of $161 million from federal, territorial, and other potential stakeholders. Detractors of the project have suggested that figures in between $161 million and $600 million are too conservative an estimate, pointing to the NBDC's feasibility study, which provided a risk-adjusted estimate north of $1 billion.[40] Yet, until actual attempts are made to engineer such a project in Canada's Arctic waters, hopeful Nunavummiut are holding out for more information. In 2013, the company has maintained that it will have its backbone ready for service by November

31 SSi Micro, *Roaming*.

32 CRTC, *SSi Micro Ltd.*

33 CRTC, *Telecom Decision 2012-4*.

34 CRTC, *CRTC Invites Canadians to Comment*.

35 Yukon Economic Development, "Technology and Telecommunications Development Report."

36 Nunavut Broadband Development Corporation, *Nunavut Fiber Optic Feasibility Study*.

37 Ledcor Group, *Project Profile*.

38 Trichur, "Shrinking Arctic Ice and a Golden Fibre Optic Opportunity."

39 Arctic Fibre Inc., *Who We Are*.

40 Salter Global Consulting Incorporated, *Nunavut Fibre Optic Feasibility Study*, 8.

2015.[41] Yet current developments of the transoceanic venture remain uncertain and limited information is available about Arctic Fibre's international stakeholders in Asia and Europe. The excitement surrounding the project has nevertheless raised Northern stakeholders' expectations of what the inhabited Arctic needs in terms of quality broadband connectivity infrastructure.

In terms of strictly regional projects, NorthwesTel has proposed several versions of festoon cabling to improve backhaul for Nunavut. Territorial and federal stakeholders have also looked to Greenland, Nunavut's eastern neighbour, for inspiration. In 2009, TELE Greenland implemented a fibre optic link from Nuuk (Greenland) to Milton (N.L.) as part of a system that extends to Iceland, and on to the Faroe Islands and the United Kingdom.

Arctic Fibre has generated considerable buzz and press with an ambitious proposal to solve most of Nunavut's backhaul challenges.

Beyond the territorial situation, smaller regions of Canada's inhabited Arctic have ended up with different monopoly situations. Churchill, Manitoba, which provides an important deep-sea port on Hudson Bay, acquired improved telecommunications services to support facilities growth, residential requirements, and local economic development in the mid-2000s. In 2005, the Manitoba incumbent, MTS Inc., and Manitoba Hydro partnered to use the latter Crown corporation's fibre optic backbone and deploy MTS Inc's high-speed Internet services to the community. Further east in Nunavik (Northern Que.), the regional players depend on Telesat and federal contributions, such as NSI and Broadband Canada; however, unlike in Nunavut or N.W.T., their business model is based on centralized government ownership under the Kativik Regional Government (KRG), a Quebec Regional County Municipality (RCM) that exercises additional powers with respect to Aboriginal self-government. Meanwhile, in Nunatsiavut, the self-governing region of Newfoundland and Labrador, market forces and the influence of federal and provincial partners have let the incumbent, Bell Aliant, and its competitors, such as Eastlink, lead development efforts. The Government of Newfoundland and Labrador had entertained the possibility of a festoon fibre optic cable along the coast of Labrador, but the prospect of funding such a project did not align with federal partners. In 2011, however, the Government of Newfoundland and Labrador ($3 million), the federal Atlantic Canada Opportunities Agency ($3 million), Nalcor Energy ($8.3 million), and Smart Labrador partnered with incumbent Bell Aliant ($9.7 million) to "construct a new pole line with an attached 48-fibre communications cable between Labrador West and Happy Valley-Goose Bay."[42] According to government stakeholders, this $24-million project will lay "the backbone of Labrador's long-term broadband infrastructure" in addition to improving services for residents and businesses in Happy Valley-Goose Bay, Churchill Falls, Labrador City, and Wabush. Through the not-for-profit Smart Labrador and its predecessors, this region has had a long-standing tradition of community-based IT projects, such as telecottages and community access sites in the 1990s, and a federally funded Smart demonstration project in the early 2000s. Proponents of the community-based approach in Labrador worry that the incumbent may have too much control over their critical connectivity infrastructure, citing that opportunities for local economic development and competitive services, particularly in Aboriginal areas, might better flourish if communities and governments had a greater ownership stake.

HISTORICAL TRAJECTORY OF PARTNERSHIPS AND BUSINESS MODELS

To get where they are today, the operators in Canada's inhabited Arctic have relied on federal government partnerships to deploy and manage communications services. Territorial and provincial governments have also contributed matching funds or initiated partnerships on their own. In this section, we provide a comparative historical examination of some of the more relevant partnerships and discuss some of the dominant business models that have resulted.

41 CRTC, *Transcript of Proceeding.*

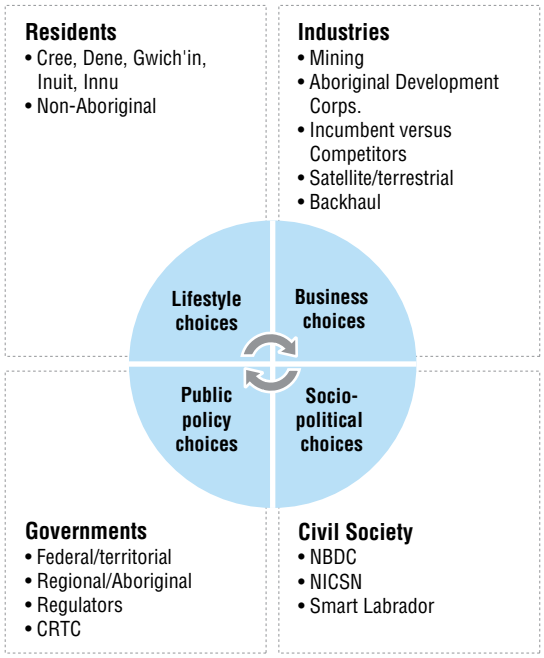
42 Government of Newfoundland and Labrador, *Invest to Increase Broadband Services in Labrador.*

Since the early 2000s, the multi-stakeholder environment of the inhabited Arctic's connectivity landscape has settled on the sometimes complementary and conflicting efforts of Canada's federal government, particularly Industry Canada, and CRTC, Canada's national telecommunications regulator.

CRTC is responsible for the traditional role of enforcing basic service objectives for telecommunications service across Canada. Since 1999, those basic service objectives have included local telephone access, directory assistance, and long-distance free dial-up Internet, among other features. When they first deliberated the role of a basic service objective for Canada,[43] the national regulator's commissioners heard from several parties, including representatives of the territories and Northern Aboriginal regions. Among these groups, governments and representatives of civil society argued for the inclusion of "broadband" high-speed Internet as a basic service objective. However, with mixed though mainly negative reactions from the incumbents, CRTC decided to adopt a position that promoted the role of governments in funding partnerships with private sector operators. Partnerships, CRTC proposed, would fund the necessary infrastructure improvements to Northern backbone connectivity and would help incentivize Northern operators to develop high-speed Internet services.

As it happened, CRTC's decision to not define broadband as a basic service objective coincided with the federal government's first major funding programs to promote broadband infrastructure developments in rural and remote communities. The Smart Communities Demonstration project (1999–2003) marked Canada's first holistic approach to funding broadband infrastructure and, in its $60-million budget, included support for community-based organizations, human resources development, and applications (such as videoconferencing, e-learning, and telemedicine). Several important Northern community-based IT organizations made great strides through this project, including Keewaytinook Okimakanak (Ont.), Smart Labrador (Nfld.), and the Keewatin Career Development Centre (Sask.). Yellowknife (N.W.T.) also participated as a Smart community. Several federal departments also collaborated through the resulting Smart initiatives, including AANDC, Human Resources and Skills Development Canada, and Health Canada. More narrowly focused infrastructure funds soon followed in the mid-2000s, including Broadband for Rural and Northern Development (BRAND) (2002–06) and the NSI (2003–07), which respectively contributed $105 million and $155 million in federal funds to develop rural and Northern community access and/or backhaul infrastructure. Beneficiaries included Nunavut, Nunavik, and sub-Arctic communities in the boreal forest zone such as the First Nations of Keewaytinook Okimakanak (Ont.) and the surrounding communities of La Ronge (Sask). BRAND funded individual rural and Northern projects based on a matching capital cost structure that included service providers, an appointed not-for-profit community champion responsible for managing contributions, as well as other governments, Aboriginal communities, and so forth. For example, among 59 projects that BRAND funded, to a total of around $78 million,

Exhibit 3
Multi-Stakeholder Society in Canada's Inhabited Arctic



Source: The Conference Board of Canada.

43 CRTC, *Telecom Public Notice CRTC 97-42.*

Table 13
Comparison of NSI Beneficiaries, Regions, and Contribution Values

Network and beneficiaries	Regions	Contribution values
Northern Indigenous Community Satellite Network—including Kewatin Tribal Council, Keewaytinook Okimakanak, and Kativik Regional Government	Manitoba, Ontario, Quebec[1] (44 communities)	◆ $20.6 million
Naskapi Imuun Inc. Broadband and partner Lynx Mobility (formerly Omniglobe)	Quebec[2] (5 communities)	◆ $4.7 million
Nunavut Broadband Development Corporation and partner SSi Micro	Nunavut[3] (25 communities)	◆ $7.8 million (phase 1) ◆ $21.6 million (phase 2)
Falcon Communications Ltd. and partner NorthwesTel (formerly SSi Micro)	Northwest Territories[4] (10 communities)	◆ $7 million (phase 1) ◆ $14.8 million (phase 2)
First Nations' Emergency Services Society and partner Norsat (formerly Omniglobe)	British Columbia[5] (17 communities)	◆ $7.9 million

1 National C-Band Benefit User Group, *Network Association Meeting January 20, 2005.*
2 PRWeb, *OmniGlobe Networks and Naskapi Imuun Partner.*
3 Nunavut Broadband Development Corporation, *Broadband Investment for Nunavut's Growth.*
4 NorthwesTel, *NorthwesTel and Falcon Complete Community Internet Project.*
5 First Nations', Emergency Services Society, *National Satellite Initiative.*
Source: The Conference Board of Canada.

matching funds contributed $96 million, of which service providers contributed 29 per cent,[44] followed by community champions at less than 9 per cent. As previously discussed, NSI's multi-year infrastructure approach provided satellite-served networks with the necessary funds needed to lease Telesat transponders. These targeted infrastructure funds would set the tone for federal investments in Northern communications infrastructure, and moved federal policy away from the holistic—shared services—approach of the Smart Communities Demonstration project. Table 13 provides a comparative breakdown of NSI's beneficiaries, target communities, and contribution values.

As Table 13 indicates, several NSI partnerships suffered setbacks and had to be refocused. In Quebec and British Columbia, the satellite service provider Omniglobe declared bankruptcy shortly after its partners received their NSI funding. In both cases, projects went ahead: Naskapi Imuun took control over Lynx Mobility (its joint venture with Omniglobe), while the First Nations Emergency Services Society (FNESS) found a new satellite service provider, Norsat. In the N.W.T., the Denendeh Development Corporation, an Aboriginal development corporation behind Falcon Communications Ltd., had initially partnered with SSi Micro, but disagreements over service obligations and policy led to a dissolution of their partnership. Falcon Communications Ltd. then approached NorthwesTel to carry on with expanding services to the territories' 10 satellite-dependent communities. NorthwesTel completed the infrastructure build phase of its project in 2012 and now delivers upgraded services. Currently, the partners have plans to complete a deployment of HSPA+ mobile services to the communities by 2014.

The federal government later followed up on BRAND and NSI with Broadband Canada, a $225-million targeted initiative (2009–12) that helped operators in rural and remote communities develop services, improve access, and address issues of affordability. SSi Micro (operating Qiniq) and the Kativik Regional Government (operating Tamaani), for example, used this program

44 Industry Canada, *Formative Evaluation of the Broadband.*

funding to develop and subsidize $80-per-month service offerings, advertised at Broadband Canada's minimum standard of 1.5 Mbps down.

At the same time as these federal initiatives developed, provincial and territorial governments contributed matching funds and/or undertook their own initiatives to enhance broadband connectivity. The Yukon government was one of the first out of the gate in a cost-sharing partnership with its incumbent NorthwesTel, with additional funding from the federal government. NorthwesTel had introduced Internet services to the major territorial centres in the late 1990s. With support from the Yukon government's Connect Yukon initiative, followed by Industry Canada's BRAND pilot program, it began delivering Internet to most Yukon communities by 2001 (at advertised download speeds ≥ 1.5 Mbps). The incumbent's extension of its high-speed Internet service to all Yukon communities required expanded infrastructure throughout the territory. For the first phase of Connect Yukon, the territorial government contributed over $10 million to improving rural Internet access, and Northwestel contributed $3 million.[45] In addition to playing a partner role in funding this infrastructure, the Yukon government acted as a critical anchor tenant to help sustain the economic feasibility of new rural network services going forward. For a brief period, Yukon was a leader in regional connectivity. In CRTC's 2001 *Report to the Governor in Council*, the territory came in second, behind Nova Scotia, for the highest percentage of communities connected.[46] However, in under a decade, Yukon government stakeholders declaimed the results of their government's past efforts, submitting that backbone connectivity was "unreliable and expensive" and based on older technology (frame relay) and that mobile ("cell") services were "outdated."[47] The Yukon government is now leading efforts, pan-territorially, to discover more durable and affordable solutions to the Arctic connectivity challenge.

While Northern expectations of broadband connectivity may be difficult to lock down, particularly given the rapid pace of technological evolution, there are a limited number of business models for developing the requisite infrastructure at any given time. In its 2001 communications monitoring report, CRTC noted several archetypical business models for developing and maintaining broadband connectivity. (See Table 14.) The Yukon government's past experience with Yukon Connect incorporates several of these archetypes, including providing investment commitments alongside the incumbent, and playing the role of an anchor tenant on NorthwesTel's private network. The GNWT has similarly played an anchor tenant role, due to the relative size of its enterprise requirements with respect to other network customers in the communities outside of Yellowknife. With 33 communities in total and 10 satellite-dependent communities in its purview, the GNWT has not been in a position to make the same broad commitment that Yukon made in the first decade of the 20th century. It has relied instead on the incumbent, on the competitive pressure of SSi Micro and other players, on Telesat's C-band Public Benefit, and on federal contributions (notably NSI) to spur innovation. In some respects, the forced option to wait for a more opportune moment to invest has not harmed the GNWT's position relative to its territorial counterparts. As discussed in Chapter 2, NorthwesTel has larger cable presence in the N.W.T. than in Yukon, and the incumbent's efforts to modernize infrastructure in 2013 are leading to improvements in residential Internet services, mobile communications, and government enterprise connections outside of Yellowknife. That said, backbone connectivity remains a major obstacle to network scalability and service evolution. Thus, in its first major network-related project, currently under development, the GNWT has plans for a $70-million fibre optic backbone along the Mackenzie Valley corridor between Inuvik and Fort Simpson (with possible extensions). This project is unique in Canada and North America for its potential to generate a substantial revenue stream from Inuvik's international satellite station facility (under management by Sweden's PrioraNet[48] in partnership with Natural Resources Canada and a

45 Kerr, "The Yukon's Online Debate."

46 CRTC, *Report to the Governor in Council.*

47 Lemay-Yates Associates, Inc., *Yukon Telecommunications Development.*

48 SSC Group, *Inuvik Satellite Station.*

Table 14
Comparison of Archetypical Business Models That Support Broadband Connectivity Requirements

Business model attributes	Description and/or examples
Private network with anchor tenant	A public sector organization, depending on its size, could consume sufficient telecommunications voice and data services to act as an anchor tenant on a new infrastructure build. An anchor tenant providing certainty of demand would facilitate funding of the infrastructure build.
Joint-built networks	A number of private and/or public organizations jointly plan and build a network that meets not only their needs but also those of others. Construction costs are shared, reducing the cost to all and making the project feasible.
Public network with private sector operators	Alberta SuperNet
Incumbent investment commitment	NorthwesTel modernization plan
Public seed funding for community-owned network	K'atl'odeeche First Nation

Source: CRTC.

dozen other federal, territorial, Aboriginal, and international partners[49]). The Inuvik facility began operating in 2010 and currently hosts a modest collection of two dishes, each from the Swedish and German space agencies. However, stakeholders believe that with proper backbone connectivity infrastructure the Inuvik facility could develop into a world-class satellite receiving station, comparable to established circumpolar space hubs, such as in Kiruna Sweden (where PrioraNet is headquartered). According to the Mackenzie Valley Fibre Link's (MVFL) proponents, a ground station located in Kiruna grossed an estimated $150 million of revenue in 2010.[50]

Given the estimated cost of the MVFL build, the GNWT will have to undertake some form of partnership, for which it has several business models available, as Table 14 indicates. The incumbent NorthwesTel has expressed interest in playing an ownership and/or operational role, as have alternative providers. For its part, the GNWT has also looked south to its provincial neighbour Alberta. NorthwesTel's backbone in the N.W.T. already connects to the province-wide Alberta SuperNet, in Meander River, Alberta. While the Province of Alberta owns SuperNet's rural backbone infrastructure, it has a network operator agreement in place with a private company, Axia (and an additional agreement with Bell Canada for high-speed switching in the metro core). Rather than procure enterprise services from its incumbent TELUS, Alberta chose to co-invest $193 million between 2001 and 2005, in partnership with Bell and Axia. Though observers have noted that SuperNet's governance is not entirely transparent, the Government of Alberta appears to benefit from significant cost savings, while Albertans across 402 rural communities have benefited from the presence of over 80 independent service providers that use SuperNet's backbone connectivity.[51]

Alberta's rural municipalities have also taken initiative to support operators in infrastructure partnership agreements (e.g., to build towers, expand service ranges, and subsidize customer premises equipment).[52] In some cases, municipal, cooperative, and First Nation

49 Natural Resources Canada, *Inuvik Satellite Station Facility*.

50 Canadian Chamber of Commerce, *Mackenzie Valley Fibre Link*.

51 Bly, *Connecting the Dots*.

52 Fiser, Bly, and Middleton. "Strategic Investment in Rural Communications Infrastructure."

organizations have developed their own service provider models—including utilities, public WiFi, and not-for-profit associations.[53] Olds, Alberta, for example, took the radical initiative to invest in local access infrastructure to support next-generation services over fibre-to-the-home for its residents. Whether such an investment will pay off in the long run is not a foregone conclusion at this time, but such SuperNet communities have received mandates from their constituents to explore new economic opportunities through digital infrastructure. In this regard, communities along the N.W.T.'s proposed MVFL would not be embarking on an entirely new trajectory if something like the Alberta SuperNet developed in the territory. With funding from the federal government (CanNor), the reserve of K'atl'odeeche First Nation, adjoining Hay River (N.W.T.), has built a community fibre network that connects local public services such as its school, health clinic, and band office.[54] Though south of Fort Simpson and not directly on the path of MVFL, with improved backbone connectivity (e.g., through NorthwesTel) and a possible southward link to Alberta SuperNet, this small community could become an example for future community networks in the territories. Most importantly, it is owned and operated by the First Nation, which undertook the community network build with local First Nation labour under an initiative that focused on developing technical expertise in the community. The community network's Dene proponents presently offer a WiFi service to residents and have plans to deploy next-generation services that would outclass current service offerings by NorthwesTel or SSi Micro in terms of pricing, speeds, and caps. They would also like to develop a regional centre of excellence to help propagate technical standards for fibre optic construction and train the next generation of Northern Aboriginal IT and networking professionals.

Among the alternatives featured in Table 14, the dominant partnerships that developed in the inhabited Arctic have mixed elements of the private network/anchor tenant, Incumbent Local Exchange Carrier (ILEC) investment commitment, and public seed funding models. The networks that developed indicate that such archetypes are not mutually exclusive but are in fact co-existent. Just as K'atl'odeeche First Nation's local community fibre network connects to the pan-territorial incumbent's physical network, so too do its partnerships and service model intersect with the incumbent's at a regional policy level. Thus, rather than offer the First Nation a one-way client relationship, or simply treat it as a competitor, NorthwesTel could equally become a customer of the community fibre network.

With improved backbone connectivity and a southward link, the K'atl'odeeche First Nation could become an example for future community networks in the territories.

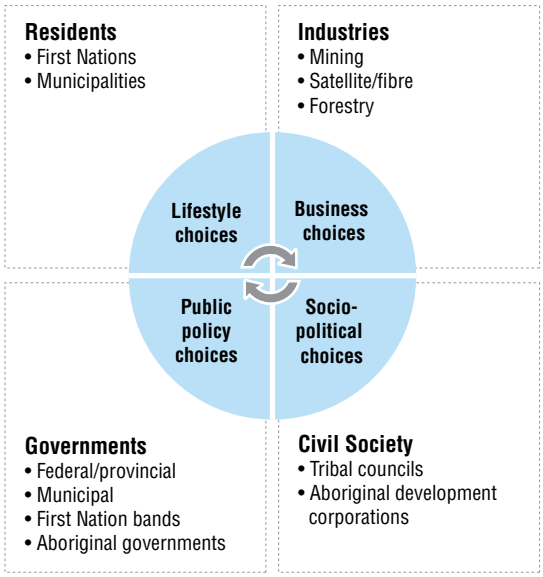
In Nunavut, it appears that the archetypes are inadequate to describe the prevailing service model, Qiniq. SSi Micro, a private operator, owns the network assets underlying Qiniq's operations in Nunavut, and the company initially took on a debt bond to match federal NSI funds. The company works with CSPs—local businesses in each Nunavut community—that act as sales agents, participate in the NBDC, and receive about 20 per cent of Qiniq's gross. Yet, to remain operationally feasible and relatively affordable, Qiniq requires the federal NSI to help pay for satellite transponder space on Telesat's Anik F2. This issue of sustainability is also common to the Kativik Regional Government's network Tamaani (Nunavik, Northern Que.), which employs its local agents directly, and to the other NICSN partners in Ontario and Manitoba, which manage or co-manage different local ISP configurations. Finally, the FNESS partnership with Norsat in British Columbia, which incorporates some aspects of local community ownership, will also face sustainability challenges when NSI ends.

With the impending dissolution of NSI in 2016, it appears that Qiniq could become more like a private network with anchor tenants. SSi Micro took over the Government of Nunavut's network services contract from NorthwesTel's subsidiary Ardicom in 2010. That extra injection of revenue may somewhat help SSi Micro continue to operate in Nunavut after 2016, particularly if alternative backhaul—such as undersea fibre

53 Fiser and Middleton, "Alberta's SuperNet."

54 Wohlberg, "K'atl'odeeche Dreams."

Exhibit 4
Multi-Stakeholder Society in Canada's Boreal Forest Zone



Source: The Conference Board of Canada.

optic arrangements—materializes in the near future. But the company and NBDC have warned stakeholders that new federal infrastructure agreements will be required to sustain affordable Internet services when NSI is over. Similarly, the Kativik Regional Government in Nunavik (Northern Que.) has warned federal stakeholders about the impact that 2016 will have on Tamaani's sustainability. It is also searching for alternatives to satellite backhaul. One interesting prospect for this network is to connect south in the boreal forest zone to its Cree neighbours which operate the Eeyou Communications Network (ECN), a wholesale fibre optic network in partnership with Hydro Québec.

As we shall discuss in the following section, the boreal forest zone has become a source of unique business models based on the leadership role of Aboriginal partners, similar to K'atl'odeeche First Nation but on a broader regional scale.

CANADA'S BOREAL FOREST ZONE: A CLOSER LOOK AT THE BASIS OF TIM'S WORLD

Canada's boreal forest zone encompasses a 1,000-kilometre band starting in the Yukon Territory and sweeping southeast to Newfoundland and Labrador.[55] Beyond the tree line to the north lies the Arctic tundra, while to the south of the boreal forests lie the "subalpine and montane forests of British Columbia, the grasslands of the Prairie Provinces, and the Great Lakes-St. Lawrence forests of Ontario and Quebec."[56] Though it may not capture the Canadian imagination as vividly as the stark frozen Arctic, this geographic context shapes the largest portion of the Northern connectivity landscape and dominates the Northern provincial context. (See Exhibit 4 and 5.)

Canada's boreal forest zone shapes the largest portion of the Northern connectivity landscape and dominates the Northern provincial context.

The physical characteristics of the boreal forest regions shape settlement patterns and prospects for primary sector industries. Substantial indigenous populations in Yukon, the Southern N.W.T., and in Northern provincial enclaves, such as Ontario-Manitoba's Little North, have identified with these forests for countless generations preceding European contact. Hunting, fishing, and seasonal harvesting continue to supplement incomes and mark a way of life for Aboriginal communities. The forests and their relative climatic conditions also condition the economics and appropriateness of communications technology solutions.

Increasingly, however, the connectivity landscape of the boreal forests has become acceptable for regional fibre optic backbone deployments. Some local community services and governments have also adopted

55 Natural Resources Canada, *The North.*

56 Natural Resources Canada, *Boreal Forest.*

Exhibit 5
Mapping North America's Boreal Forest Zone

Source: Natural Resources Canada.

a municipal fibre strategy to establish fibre optic networks between local hospitals/health clinics, schools, government offices, and other community institutions. Targeted funds from federal partners, notably Health Canada, have encouraged the deployment of fibre optics to support public enterprise services.

Some First Nations in these regions have also placed special emphasis on the potential for Aboriginal ownership and control. With the encouragement of national Aboriginal initiatives such as the Assembly of First Nations (AFN)'s E-community Strategy,[57] these First Nations have politicized local community ownership and control over network assets, enterprise services, and labour prospects as another "digital" dimension of their struggle for self-determination. Many First Nation proponents of digital self-determination argue for Aboriginal sovereignty over data created from interactions with their communities—including database records of their transactions with federal programs (e.g., Health Canada's First Nations and Inuit Health Branch [FNIHB], AANDC), the Census and related Statistics Canada studies, as well as research data collected by various academic and industry projects (e.g., social, environmental, health). The First Nations Information Governance Centre (FNIGC), responsible for the highly successful Regional Health Survey, which works with First Nation populations on reserve, promotes a set of principles called OCAP (Ownership, Control, Access,

57 Assembly of First Nations, *First Nations E-Commerce*.

and Possession) that has become influential among academic researchers and Aboriginal proponents of digital self-determination.[58]

At the back end of these discussions about OCAP are questions of what kinds of hardware, software, and local technical capabilities Aboriginal communities would require to implement varying degrees of digital self-determination. Apart from local area networks and small-scale server rooms (for local administrative, health, and school data systems), there is a question of whether Aboriginal data require exclusively Aboriginal networks and data management systems at regional and national scales. On the networking side, alternatives range from creating secure Virtual Private Networks (VPNs) over at least partially non-Aboriginal infrastructure, to requiring parallel backbone infrastructure that an Aboriginal entity would entirely own and control. Yet, regardless of the degree to which sovereignty claims are made over connectivity infrastructure and digital data, underlying most Aboriginal claims is a firm belief that networks and data services operating in relation to Aboriginal communities must respect their collective privacy and data security concerns, while supporting the development of Aboriginal businesses, labour capacities, media production capabilities, and so forth.

As Northern Aboriginal communities become increasingly active online, they expand their range of development possibilities and challenges, while intensifying their exposure to other world views and cultures. Non-Aboriginal stakeholders need to be mindful that new IT projects in Canada's North can be sources of socio-political and cultural conflict, beyond what their own non-Aboriginal value systems may recognize or understand. Yet, digital self-determination and related issues of identity and privacy are ongoing concerns for all contemporary networked societies—so there is also common ground to be shared (e.g., malware, e-mail phishing scams, privacy concerns over social media applications such as Facebook, and so on).

ISSUES OF OWNERSHIP AND CONTROL WITHIN MULTI-STAKEHOLDER PARTNERSHIPS

While exclusive First Nation ownership and control over physical network infrastructure is largely limited to local and community area networks, such as K'atl'odeeche First Nation's current fibre optic network in Southern N.W.T., it may include backhaul to and from a network's member communities and Network Operations Centre (NOC). The underlying network assets, in addition to various electronics and computing devices, may encompass a variety of media, including licensed spectrum, and copper, coaxial, or fibre optic cables. There are several prominent examples of First Nation-managed Wide Area Networks and Tier-2 Internet service providers in the boreal zone that specialize in First Nation networks and managed data systems. Across Northern Ontario, Keewaytinook Okimakanak's Kuh-Keh-Nah network (KO-K-Net) is the oldest, largest, and most thoroughly documented.[59] KO-K-Net has become emblematic of the AFN's E-Community Strategy. While its core team comprises First Nation and non-Aboriginal staff, KO-K-Net specializes in the delivery of managed network services to remote First Nation community networks. Other Northern First Nation service providers, such as Alberta's Technical Services Advisory Group (TSAG), Manitoba's Broadband Communications North, or Quebec's ECN, have cultivated similar principles of First Nation-owned network assets, First Nation-managed data systems, and local First Nation technical capabilities.

Such First Nation models have become successful on several dimensions, including:

- advancing the cause of First Nation self-governance (as encoded in AFN resolutions such as 16/2008 and 09/2011)

58 See the First Mile concept in McMahon and others, "Digital Divides and the 'First Mile'" and the OCAP concept in O'Donnell and others, "How the Washahoo Cree Nation at Fort Severn," which originated with the Steering Committee of the First Nations Regional Longitudinal Health Survey. Cf. Schnarch, "Ownership, Control, Access, and Possession (OCAP)."

59 Ramirez and Richardson, *PACTS Case Study*; Beaton and Fiddler, "Living Smart in Two Worlds"; Fiser, *First Nations SchoolNet Regional Management Organization (RMO) Backgrounder*; Ferreira, Ramirez, and Beaton, "Connectivity in Canada's Far North"; Fiser and Clement, "The K-Net Broadband Deployment Model"; O'Donnell and others, "How the Washahoo Cree Nation at Fort Severn."

- directing resources toward local First Nation employment and enterprise, including human resources development
- establishing a political, cultural, and academic discourse—more or less—around First Nation technology use and new media production

Yet, none of these First Nation models is fully self-sufficient. All depend on non-Aboriginal resource inputs—via federal and/or provincial/territorial governments—to initiate network build phases, train and retain staff, and sustain post-build network operations. A study of KO-K-Net's annual reports found that from 1998–2007,[60] 88 per cent of $11 million in capital funding for new network assets and community builds came from federal and provincial programs. Similarly, 88 per cent of almost $20 million in funding for network-related jobs and training came from federal and provincial program sources. During this same period, 76 per cent of the network's $11 million in operational funding for connectivity depended on the contributions of federal and provincial programs,[61] with AANDC and Health Canada being particularly dominant (given their fiduciary obligations to First Nation schools, administrators, public works, and Aboriginal health facilities across Canada).

Thus, regardless of the degrees to which they advocate for digital self-determination, the sustainability of First Nation network operators depends critically on the participation of non-Aboriginal government programs[62]—as project funders and long-term customers (i.e., so-called "anchor tenants"). As anchor tenants, non-Aboriginal government programs may also wield a considerable influence over the planning and operations of First Nation networks. Proponents of AFN's E-Community Strategy have noted that AANDC requires individual Band Council Resolutions (BCRs) and special land-use permits to be authorized before First Nation communities (and partners) can begin to engage in the construction of community fibre networks on reserve lands. In some cases, when the assent of AANDC regional staff was slow to come, remote network builds suffered unanticipated delays at additional cost.

The sustainability of First Nation network operators depends critically on the participation of non-Aboriginal government programs.

The feasibility of First Nation networks also depends on the non-Aboriginal telecommunications carriers that First Nations have to contend with when they lease terrestrial backbone connectivity or satellite backhaul to cross networks beyond their communities. The financial study of KO-K-Net from 1998–2007 found that approximately three-quarters of the First Nation network's annual revenues from terrestrial network services went to its regional incumbent for backbone connectivity services.[63] Partners may also turn out to be unreliable. For example, several Aboriginal communities in British Columbia, Quebec, and Ontario lost network services when their satellite service provider and private partner, Omniglobe Networks Inc., unexpectedly filed for bankruptcy in 2011[64]—only two years after Canada's National Research Council lauded the company for being a "Canadian Innovation Leader."[65] These communities had locally owned and controlled wireless access networks but lost all means for data traffic to flow beyond their borders until Infrastructure Canada and the satellite carrier Telesat stepped in to support alternate service provision.

When successful, connectivity projects that promote self-determination can be beneficial for Northern Aboriginal communities that have been too often marginalized. However, there is an underlying risk of isolating socio-economically vulnerable communities. In Alberta, for example, First Nation band councils neighbouring the rural municipality of Parkland County refused to partner with the municipality on a low-cost

60 Fiser, *The Kuh-Ke-Nah Broadband Governance Model.*

61 Ibid., 209.

62 Fiser, *The Kuh-Ke-Nah Broadband Governance Model.*

63 Ibid., 214–15.

64 Gorman, "Firm That Delivered Services to HRM Files for Bankruptcy."

65 National Research Council Canada, *Emerging Technologies Thrive in Canada.*

tower-sharing agreement despite the potential this had as a source of revenue for the councils, and for introducing competition and new services among rural wireless Internet providers. The First Nations instead chose a single vendor that had developed a relationship with them through joint projects under Health Canada's FNIHB. Yet, while they potentially locked themselves into a single-vendor relationship, Parkland County's strategy helped three competitors establish new services in the rural marketplace.

When Aboriginal regions are sparsely populated and socio-economically vulnerable (e.g., to boom/bust cycles in the primary sector, to political cycles in government program support), development strategies that exclude neighbours can create disunity among potential allies. In Northern Quebec, the KRG represents Nunavik's majority Inuit population. Among Nunavik's settlements are the adjoining sister communities of Kuujjuarapik and Whapmasgoostui—one Inuit, the other Cree. The former is a member of KRG, while the latter is a member of Eeyou Itschee with a separate government that maintains its own local Cree institutions and services. The communities share a complex history that includes periods of cooperation and conflict. Nevertheless, KRG's Tamaani Internet service is available to residents on both sides. Moreover, given the uncertainty that Inuit stakeholders face after the NSI ends in 2016, KRG has looked to Eeyou Itschee for a possible terrestrial backbone solution (in partnership with Hydro Québec). For their part, the Cree of Eeyou Itschee have had to cultivate important business relationships with neighbouring non-Aboriginal communities in order to develop their wholesale backbone service, the ECN. In addition to the Inuit and Cree of the region, the Naskapi Imuun further south has partnered with Inuit and Cree organizations to deliver its Lynx Mobility services through a sales model that enables local economic development.[66] These Aboriginal governments in the Northern Quebec region realize that self-determination and Aboriginal identity do not necessarily preclude business development and cooperation across the region.

Nevertheless, cooperation can be challenging. Northern communities sometimes struggle to co-participate in broader regional projects for reasons of historical, cultural, and local socio-political differences between neighbours. Unfortunately, the nature of federal and provincial funding does not always accommodate individual community plans, particularly in cases of large-scale infrastructure. In this regard, regional intermediaries such as business incubators, chambers of commerce, Aboriginal development corporations, tribal councils, and political territorial organizations are especially important in bringing disparate local interests together into a broader collective vision that federal, provincial, and large industry partners can more easily understand and support.

Currently, the Northwestern Ontario Broadband Expansion Initiative, slated for completion in 2014, provides some important lessons on how to navigate potentially sensitive areas. This $80-million-plus project has set out to deploy fibre optic backbone connectivity to some of Canada's most socio-economically vulnerable First Nations, in addition to Goldcorp's Musselwhite mine[67] located on traditional Aboriginal land. The region's incumbent, Bell Aliant, initially partnered with KO-K-Net on a proposal for Broadband Canada funding in 2009—to be matched by contributions from the incumbent, Health Canada, AANDC, the Northern Ontario Heritage Fund Corporation (NOHFC), and the Ontario Ministry of Agriculture and Rural Affairs (OMAFRA). Individual First Nations would also be tasked to invest in portions of the project that would improve local access infrastructure. Because this was a regional effort, federal stakeholders decided it would be more appropriate to replace KO-K-Net (which officially represented only five impacted First Nations) with Nishnawbe Aski Nation (NAN), the political territorial organization that represents the major treaty area where the project would develop (Treaty 9), including 49 First Nations (a population of roughly 45,000 people). In doing so, however, some stakeholders behind KO-K-Net believed that the decision for broad regional representation undermined the local sovereignty of its members' First Nation-owned

66 Lynx Mobility, *Partners*.

67 Goldcorp / Canada, *Musselwhite Mine*.

networks. It appeared that NAN was given an intermediary role bereft of any powers to shape Bell Aliant's engineering analysis and design decisions. NAN staff also did not possess the technical expertise that KO-K-Net had developed, nor were they as familiar with the different First Nation networks that KO-K-Net staff helped build since the mid-1990s. As a result, conflicts over network design began to test the coherence of the planned regional fibre optic network.

Regional intermediaries such as Aboriginal development corporations are important in bringing local interests together into a broader collective vision.

KO-K-Net's members, for example, wanted dark fibre to be included between Bell Aliant's new points-of-presence and the local assets they maintained, which would improve capacity for the mobile services they delivered and allow them to offer better services to their anchor tenants at Health Canada and AANDC—not to mention residents. They also feared that the incumbent might overly benefit from new infrastructure that could potentially be used to deploy competitive services in the future. The request for dark fibre and the separation of Bell Aliant's carrier services from each First Nation network's access services were items that KO-K-Net had initially included in its 2009 co-proposal with Bell Aliant, but with the transfer of Aboriginal oversight to NAN, a political organization that had few technical staff, these measures had to be renegotiated on a case-by-case basis.

As the project developed, more First Nations turned away from the incumbent's blanket agreement with NAN and demanded separate agreements. In some cases, the path of the emerging backbone network also had to be switched, to accommodate unforeseen geographic realities and culturally sensitive areas. To their credit, OMAFRA and NOHFC (the majority provincial funders) have worked with Bell Aliant, Health Canada, NAN, and KO-K-Net to respectfully accommodate the local First Nation stakeholders' individual needs. When fibre optic cabling was at risk of disrupting an ancestral spirit bog (somewhat akin to overturning a graveyard), they averted disaster and worked around it. When a large and fairly militant First Nation requested that workers help clear timber for an unrelated economic development project, the benefits of good will outweighed the risk of changing a project schedule. Provincial stakeholders also toured some of the remotest communities to observe construction developments and engage local leaders and residents. Nevertheless, as of 2013 the Northwestern Ontario Broadband Expansion Initiative has overrun its initial cost estimates and may have to bypass several Eastern communities, primarily Matawa First Nations, that were originally slated for improved connectivity. Such are the realities of economic development when Aboriginal self-determination is a concern, and stakeholders ignore them at their peril. But predicting all the potential obstacles can be very difficult for non-Aboriginal partners. This is why intermediaries need to combine aspects of cultural sensitivity, political competence, and technical understanding to be the greatest possible asset to their partners.

In terms of the largest concentration of Aboriginal ownership over physical communications infrastructure, cross-cultural partnership models have so far been more successful than ones that exclude neighbours. The ECN, for example, extends Aboriginal ownership over a regional fibre optic backbone (under a long-term arrangement with Hydro Québec). Yet, ECN's Cree leadership was only able to secure critical federal and provincial capital funding support for the project, on the condition that it would benefit non-Aboriginal Jamesian communities in addition to Eeyou Itschee's Cree communities. The network currently serves nine Cree and five Jamesian communities, which constitute an overall population of almost 30,000 people. Luck was also involved as ECN had few alternatives to build out a regional fibre optic network on its own. If not for Hydro Québec's decision to include an optical ground wire in its plans for a hydroelectric network, ECN would not have been feasible. The region's incumbent Telebec competes with local service providers and was not interested in a partnership to improve backbone connectivity services. With its core network build phase completed in 2011, at a cost of approximately $29 million (split between federal, provincial, and local public partners—see Table 15), ECN now delivers wholesale backbone connectivity to its customers, in partnership

Table 15
A Sample of Multi-Stakeholder Partnerships to Deploy Fibre in Rural/Remote Regions of Canada

Case	Extent	Provincial/territorial	Federal	Telecom service provider	Other partners
Alberta SuperNet	15,000 km (13,000 km of fibre, 2,000 km microwave)	Alberta Innovation ($193 millions)		Bell Canada (> $200 millions), Axia (~$30 million)	Municipal governments, 89+ Internet Service Providers
Northwestern Ontario Broadband Expansion Initiative	2,500 km of fibre	Ontario Ministry of Agriculture and Food ($28 million), Northern Ontario Heritage Fund ($5 million)	Industry Canada ($14.5 million), AANDC (~$6 million), Health Canada ($3 million)	Bell Aliant ($26 million)	Nishnawbe Aski Nation, 26 First Nations
Eeyou Communications Network	1,500 km of fibre	Quebec ($9.6 million)	Canada Economic Development for Quebec regions ($9.6 million)		Various local public partners including Cree and non-Aboriginal ($9.6 million)
Labrador West Fibre Route	490 km of fibre	Newfoundland and Labrador ($3 million)	Atlantic Canada Opportunities Agency ($3 million)	Bell Aliant ($9.7 million)	Nalcor Energy ($8.3 million)

Source: The Conference Board of Canada.

with Alcatel-Lucent, which maintains its virtual Network Operations Centre (NOC). ECN is therefore not in the business of providing Internet access to residents, though it does act as a Tier 2 Internet service for smaller Internet service providers in the region. As a managed network, ECN can also support critical data applications such as videoconferencing and telemedicine that require dedicated bandwidth and quality of service (QoS) beyond best-effort Internet service. Its core customer base includes 14 local councils, two regional governments (Cree Regional Authority, Conférence régionale des élus de la Baie James), two school commissions (Cree School Board and Commision Scolaire de la Baie-James), two regional health councils, and two hospitals.[68]

Similarly, in Manitoba, Broadband Communications North (BCN) has had a productive relationship with Manitoba Hydro in a model that provides another variation on the First Nation-led network. Where available, BCN leases backbone transport on Manitoba Hydro's fibre optic network, but it has not been able to acquire a long-term arrangement similar to ECN's in Quebec. Moreover, while ECN focuses on selling wholesale transport services to its customers, BCN focuses on delivering local Internet access as well as managed data services for videoconferencing, telemedicine, and other critical applications that require more security and reliability than a best-effort Internet service. In this regard, it is similar to KO-K-Net in Ontario or TSAG in Alberta. BCN's board of directors consists of First Nation and Métis organizations. Its mandate is to improve broadband connectivity for Manitoba's remote Aboriginal communities, but it has not shied away from connecting Northern non-Aboriginal communities along the way. Similar to ECN in Quebec, KO-K-Net in Ontario, and SSi Micro in Nunavut, BCN was motivated to improve services when the regional incumbent, MTS Inc., was slow to deliver reliable broadband connectivity to Northern Manitoba Aboriginal communities. Also, similar to KO-K-Net, or SSi Micro and Qiniq, BCN offers its partner communities the

68 Glustein and Loon, *The Eeyou Cree Network*.

opportunity to develop a local ISP. This could entail community ownership (via a band office) or the creation of a local enterprise. BCN technicians remain responsible for the head end in each community, while the partner manages sales, community accounts, and provides customer installations. BCN's lead stakeholder, Keewatin Tribal Council, is also a member of KO-K-Net and KRG's Northern Indigenous Community Satellite Network, which provides BCN with satellite backhaul for 16 remote community connections.

Another unique variation on the First Nation model is the First Nations (Alberta) Technical Services Advisory Group (TSAG). Alberta's TSAG is a not-for-profit organization established by the Chiefs of Alberta to provide technical support and training to First Nations in the treaty 6, 7, and 8 regions. Its programs include animal and human health, asset management, environmental management, fire prevention, and a circuit rider training program. TSAG became involved in connectivity and IT management after it partnered with Health Canada in a project to develop critical networking components to support First Nations telemedicine in Alberta. Under the partnership, a Health Canada employee with technical expertise and policy experience was seconded to TSAG to help develop its internal IT capacity and related management capabilities. Under his tutelage, TSAG managed a Health Canada-funded project to develop community fibre optic networks that connect to Alberta SuperNet points-of-presence on or near each First Nation. When the project was completed, each First Nation then became the owner of its own local fibre optic network. In a later development, TSAG acquired a regional ISP that had adapted a First Nations-focused Internet service based on an original partnership to deliver services to Health Canada facilities on reserves. TSAG then rebranded this business Arrow Technology Group, and it now delivers wireless Internet services and managed data applications to First Nations, Métis communities, and neighbouring non-Aboriginal communities.

Beyond the infrastructure models of Aboriginal ownership and control are various other possibilities for Aboriginal investment and participation. In British Columbia, the All Nations Trust Company, an Aboriginal-owned financial institution, manages Pathways to Technology, a $40.8-million-plus fund from provincial and Health Canada contributions. Portions of the fund go to developing First Nations IT capacity, while a core segment is reserved for funding service providers, such as the incumbent TELUS and smaller ISPs, for the purposes of improving Aboriginal connectivity. With funding from Pathways to Technology, TELUS, for example, expanded high-speed Internet service to the Northern First Nation of Doig River. While the All Nations Trust Company manages the funds, two other Aboriginal partners helped to shape and secure the funding agreements, including the First Nations Technology Council and First Nations Health Council. In Saskatchewan, the multi-faceted Keewatin Career Development Council (KCDC) works closely with its incumbent SaskTel on connectivity projects for Northern Saskatchewan's First Nations. KCDC managed Northern Saskatchewan's Smart Community Demonstration project in the early 2000s and like KO-K-Net (in Ont.) was a regional management organization for the federal First Nations SchoolNet program. In addition to providing advisory services, funding administration, advocacy, and human resources development in Saskatchewan's Aboriginal IT sector, KCDC provides managed services such as videoconference bridging for First Nation schools. The organization is currently working with Northern First Nations and SaskTel on a regional fibre optic deployment project to improve connectivity for schools and other public institutions.

FIBRE OPTIC BACKBONE SYSTEMS IN CANADA'S NORTH

Across Canada's Northern boreal forest regions, all-IP fibre optic networks are emerging to provide scalable transport services between carrier points-of-presence. This can be the result of incumbent carrier investments, as is the case in British Columbia (TELUS),[69]

69 TELUS, *TELUS Investing $3 Billion in B.C. Over Next Three Years.*

Saskatchewan (SaskTel—a Crown corporation),[70] and Manitoba (MTS Inc.).[71] NorthwesTel, for example, has over 4,000 km of long-haul fibre in place between Whitehorse, Edmonton, and Yellowknife. To mitigate the impact of fibre cuts occurring along its British Columbia and Alberta segments, the company invested $10 million to improve network diversity and redundancy. More predominantly, deployment can be the result of public-private partnerships that extend fibre optic transport to rural and/or remote areas, as was the case in Alberta,[72] and more recently in Northern Ontario[73] and Labrador.[74] (See Table 15.)

Across Canada's Northern boreal forest regions, all-IP fibre optic networks are emerging to provide scalable transport services.

When considering such partnerships to improve connectivity infrastructure, Northern businesses, governments, and regional organizations have to carefully decide how they want to govern infrastructure that the national regulator has left largely forborne from regulation (with the exception of NorthwesTel, as discussed in the previous section). Apart from having to meet minimal regulatory requirements, such as registering carrier status, whichever organization controls the infrastructure has considerable discretion to determine data transport pricing and services. In some cases, discretion is tempered through negotiated long-term contracts and access agreements (particularly between the largest government clients and the network operator). In other, particularly Northern cases, where there are limited resources available to support facilities-based competition, the owner of the network assets has a strategic advantage over its customers and competitors. In high-cost serving areas, monopoly owners of network infrastructure may also be reluctant to upgrade infrastructure beyond minimum standards of functionality. Under such circumstances, business models based on the ownership stake of majority public investors and Aboriginal stakeholders may have a revitalizing effect on service innovation.

70 SaskTel, *SaskTel Announces 2011 Network Investment.*

71 MTS Inc., *Introducing MTS's Fibre Optic Network.*

72 Service Alberta. *The Network (Technical Information).*

73 Government of Ontario, *Government Partners for New Fibre Optics Network.*

74 Government of Newfoundland and Labrador, *Governments of Canada and Newfoundland and Labrador Invest.*

CIRCUMPOLAR UNCERTAINTY: A CLOSER LOOK AT SANDY'S WORLD

This is a geopolitical region defined by Canada's evolving relationships with its indigenous Arctic populations, its circumpolar neighbours, and broader foreign interests. (See Exhibit 6.) It also contains a growing commercial space defined by climate change and prospects for natural resource exploration, fisheries, tourism, and intercontinental transport (marine and air). Canada's regional claim in this uncertain circumpolar world encompasses all of Nunavut, as well as parts of Yukon, the N.W.T., Manitoba, Ontario, Quebec, and Labrador. It includes zones of national interest and disputed international boundaries. As a result, aspects of this region are governed by international statutes, such as the United Nations Laws of the Sea and through governing bodies such as the International Maritime Organization (IMO). With respect to these international conditions, Canada's Arctic sovereignty implies certain duties and responsibilities—including support for maritime and aerial navigation and the provision of adequate SAR capabilities. Previously, we discussed the connectivity landscape of Canada's Arctic settlements and indigenous residents. In this section, we discuss the connectivity issues and initiatives pertaining to Canada's bilateral and international relationships in the Arctic—the kinds of relational challenges and opportunities that Canada's assertion of Arctic sovereignty will imply in the near future. (See Exhibit 6.) Voice and data communications are critical in shaping Canada's situational awareness of the Arctic, including the following domains of application:

- Canada's Arctic military presence and Coast Guard
  - border safety and security
  - maritime and aviation safety
  - cooperation with Inuit and other circumpolar stakeholders

- Arctic research
  - climate change and weather systems
  - cooperation with Inuit Traditional Ecological Knowledge (TEK) systems

CANADA'S ARCTIC MILITARY PRESENCE AND COAST GUARD

The Canadian Joint Operating Command (CJOC)[75] currently coordinates Canada's Arctic military presence through Joint Task Force North, one of CJOC's six regional joint task forces that address continental defence and related issues such as public safety and disaster response. Joint Task Force North (JTFN) is headquartered in Yellowknife, N.W.T., and has approximately 65 Regular Force, Reserve, and civilian personnel stationed year-round. Its mission is to "exercise sovereignty and contribute to safety, security, and defense operations in the Canadian North."[76] Each year, JTFN conducts several large-scale Northern operations, including four recurring missions. (See Table 16.)

Voice and data communications are critical in shaping Canada's situational awareness of the Arctic.

The majority of these missions—and NANOOK in particular—requires robust communications infrastructure to support JTFN's whole-of-government approach to safety, security, and defence operations.[77] This whole-of-government approach can place considerable strain on existing Northern communications systems, as was prominently exemplified in the "profound communications failure" that transpired during JTFN's Operation NANOOK in 2009.[78]

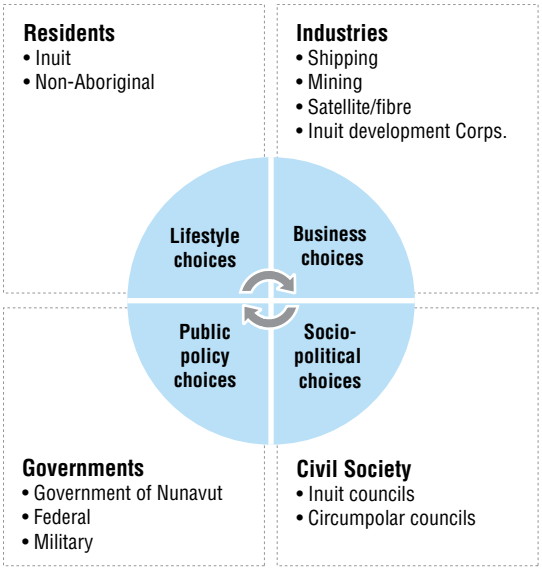
75 The federal government created CJOC in 2012 by merging three former operating commands—Canada Command, the Canadian Expeditionary Force Command, and the Canadian Operational Support Command. Canada Command was previously responsible for Northern defence issues.

76 National Defence and the Canadian Forces, "Operation Nanook: Below the Treeline."

77 National Defence and the Canadian Forces, *JTF North*.

78 "The influx of out-of-territory personnel arriving in one community overloaded the local cell phone and Internet network, and severely hampered the communication capabilities of the emergency responders conducting the operation." Quoted in Nunatsiaq Online, "A Failure to Communicate."

Exhibit 6
Multi-Stakeholder Society in Canada's Circumpolar Environment



Source: The Conference Board of Canada.

From a broader policy perspective—encompassing both military and civil society—the idea of a whole-of-government approach also conveys the importance of joint multi-jurisdictional responses to the challenge of establishing a shared critical infrastructure that will satisfy the disparate interests of federal, territorial, Aboriginal, municipal, and private sector parties. As a result of the Operation NANOOK failure in 2009, the federal government, in partnership with the territories, established a Northern Communications and Information Systems (NCIS) Working Group to oversee the renewal of Arctic communications infrastructure.[79] Presently, the Government of Yukon has taken leadership and directed the NCIS's efforts toward plotting a course for affordable Northern connectivity infrastructure capable of supporting civilian as well as military applications.

Several ongoing large-scale projects retain this implied broader meaning of the term "whole-of-government," including military partnerships with the Arctic's indigenous communities. We discuss several of the major communications infrastructure projects below.

79 Imaituk Inc., *A Matter of Survival*.

Table 16
Recurring JTFN Missions

Month	Operation	Description
April	NUNALIVUT[1]	Operation NUNALIVUT provides an opportunity for specialized groups such as RCAF search-and-rescue units, the RCN Combined Dive Team, and the Canadian Army's Arctic Response Company Group to work in the high Arctic, and to patrol with the Canadian Rangers. It also allows the Canadian Forces to provide meaningful support to scientific research in the Arctic, and to demonstrate interoperability in the high Arctic with military allies and other Canadian government institutions.
June	NEVUS[2]	Operation NEVUS is the annual deployment of a Canadian Forces technical team to Ellesmere Island to perform essential preventive and corrective maintenance on the High Arctic Data Communications System (HADCS).
July	NUNAKPUT[3]	NUNAKPUT is the Canadian Forces' contribution to whole-of-government exercises emphasizing aid to law enforcement in the North.
August	NANOOK[4]	Operation NANOOK is the Canadian Forces' annual engagement with international military and security partners to demonstrate interoperability in the Arctic. This aspect of the operation usually entails exercises using scenarios in which the Canadian Forces partner with other Canadian government departments and agencies, and with allied armed forces, to mount whole-of-government responses to security and environmental issues. Operation NANOOK typically involves simultaneous activities at sea, on land, and in the air, and all force-generators may be tasked to deploy personnel, capital equipment, and other resources. The number of soldiers, sailors, airmen, and airwomen deployed on Operation NANOOK has ranged from about 650 to more than 1,250.

1 National Defence and the Canadian Forces, *Operation NUNALIVUT*.
2 National Defence and the Canadian Forces, *Operation NEVUS*.
3 National Defence and the Canadian Forces, *Recurring Operations*.
4 National Defence and the Canadian Forces, *Operation NANOOK*.
Source: Joint Task Force North.

NORTH WARNING SYSTEM

Canada's contribution to the North American Aerospace Defense Command (NORAD) includes the North Warning System (NWS). The NWS provides limited aerospace surveillance of Canadian and U.S. Arctic territory. It is a massive radar network that spans over 4,800 kilometres to include 15 long-range and 39 short-range radar stations, from Alaska to Southern Labrador. The system's presence across Canada's Arctic front, from West to East, includes 47 unmanned sites. This largest portion of the network falls under the Regional Operations Control Centre of Canadian Forces Base (CFB) North Bay, Ontario, which processes signals and then passes information on to the NORAD Combat Operations Centre (COC) in Colorado Springs, Colorado.

This sophisticated network is of particular importance for Inuit labour across the Arctic. Pan Arctic Inuit Logistics (PAIL), a corporation formed in 1994 of Inuit Development Corporations from Inuvialuit, Nunavut, Nunavik, and Nunatsiavut, cooperates with Nasittuq, a joint venture with Atco Structures and Logistics, which maintains the unmanned NWS sites along Canada's frontier. (See the following chapter below for a discussion of this joint venture and its benefits to Aboriginal communities.)

NEW OPPORTUNITIES FOR ARCTIC TRANSPORT EXPOSE VULNERABILITIES IN CANADA'S NORTHERN INFORMATION COMMUNICATIONS INFRASTRUCTURE

In 2009, the Arctic Council published its Arctic Marine Shipping Assessment[80] (AMSA), which affirmed that the Northwest Passage is not likely to become a reliable trans-Arctic route before 2020. Nevertheless, Canada's Department of Fisheries and Oceans, Coast Guard, and other stakeholders expect regional shipping to increase within the Canadian Arctic, including for community resupply, natural resource development, and tourism. AMSA concluded that Canada and other circumpolar nations lack critical marine infrastructure, including important information services such as hydrographic, oceanographic, and meteorological data to support safe navigation. AMSA also highlighted a lack of emergency response capacity among circumpolar nations. The assessment noted fundamental limitations to marine communications in the Arctic and that information systems to monitor the movement of ships were also inadequate. Altogether, these shortcomings impair emergency response efforts in the Arctic's vast environment and undermine Canada's sovereignty. This conclusion has been subsequently echoed in reports from Canada's Auditor General[81] and the Standing Senate Committee on Fisheries and Oceans.[82]

CANADA'S 21ST CENTURY POLAR SURVEILLANCE STRATEGY

In the wake of the AMSA report and a more focused attention of international parties on the potential for increased Arctic traffic, Canada's federal government set out to advance its circumpolar monitoring capabilities. Foremost among its future systems is Canada's $975-million-plus Radarsat Constellation, a project that the Canadian corporation Macdonald, Dettwiler and Associates Ltd. is under contract to build for the Canadian Space Agency and federal government departments.[83] The project, in planning and development since 2005, is slated to launch in 2018. When fully implemented, the Radarsat constellation will include three satellites in a configuration that is expected to provide comprehensive surveillance of Canada's lands and oceans, "offering an average daily revisit, as well as daily access to 95% of the world to Canadian and International users."[84]

80 Arctic Council, *Arctic Marine Shipping Assessment 2009 Report*.

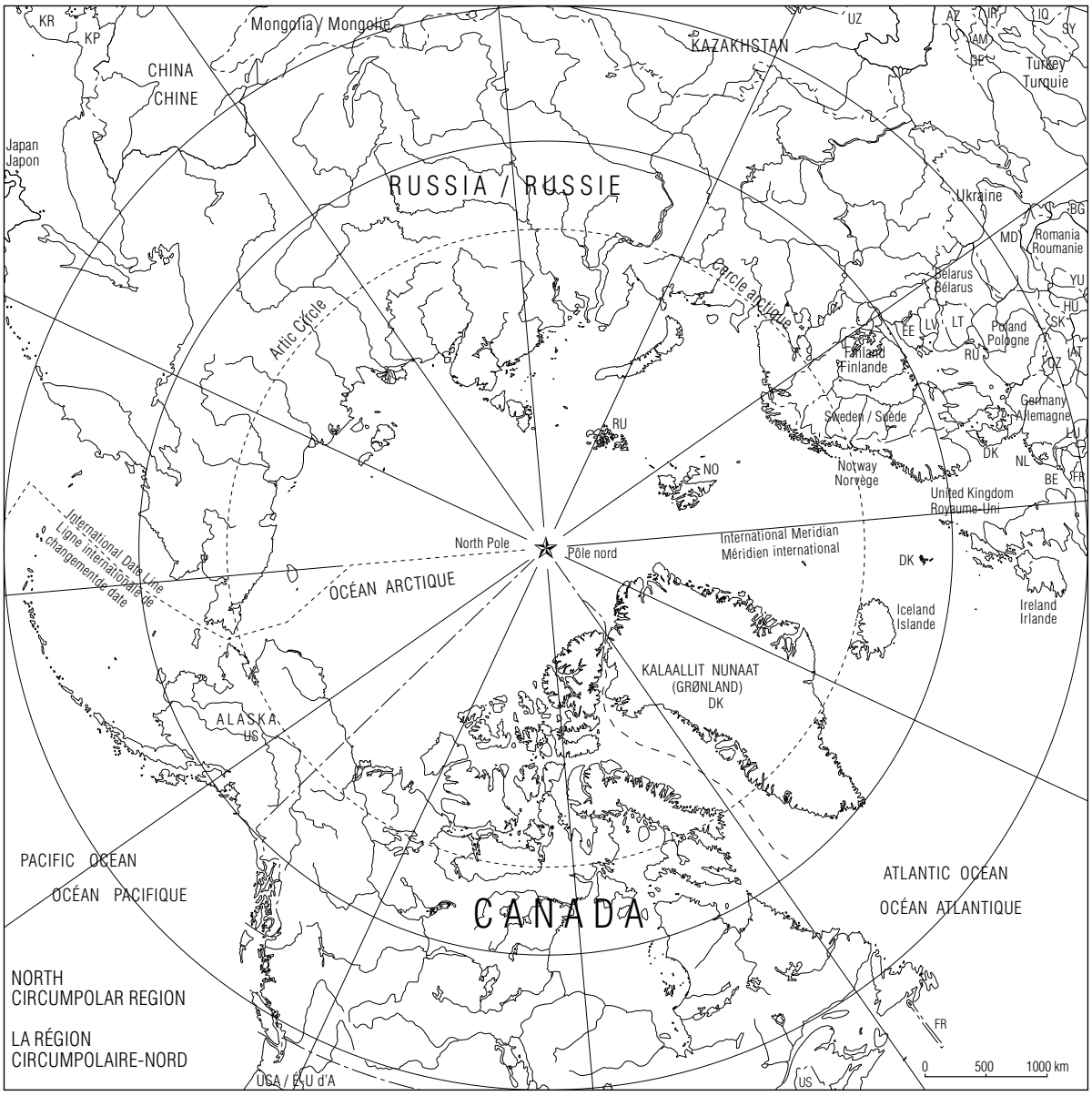
81 Varga, "Auditor General of Canada Urges Upgrades."

82 Standing Senate Committee on Fisheries and Oceans, *Controlling Canada's Arctic Waters*.

83 Including the Department of National Defence, Fisheries and Oceans Canada, Agriculture and Agri-Food Canada, Environment Canada, Natural Resources Canada, and Public Safety Canada.

84 Canadian Space Agency, *RADARSAT Constellation*.

Exhibit 7
Circumpolar Nations



Source: Natural Resources Canada.

Chapter 4

Comparative Analysis of Lessons Learned

Chapter Summary

- This chapter examines each of the five lessons learned from our multi-stakeholder research on the Northern connectivity landscape.
- The shifting Northern connectivity landscape introduces potential threats and opportunities for the incumbent, for competitors, and for consumers.
- The joint investments required to establish next-generation networks over the immediate to near term in Canada's Northern regions create opportunities for Northern businesses, governments, and communities.
- One of the challenges to developing a comprehensive national policy for telecommunications in Northern Canada is the diversity of Canada's North, which includes its inhabited Arctic, its boreal forest regions, and circumpolar presence.
- Cooperation between Aboriginal and non-Aboriginal entities is essential to help Northern regions and Northern Aboriginal governments pool resources and aggregate demand to support innovation.
- Multi-stakeholder partnerships continue to be crucial vehicles for investment across Canada's Northern connectivity landscape.

Our multi-stakeholder research perspective on the Northern connectivity landscape emphasizes relationships and the interdependence of strategic choices. Five major lessons can be gleaned from this research:

1. Next-generation networks and new media introduce threats and opportunities for stakeholders in the Northern connectivity landscape.
2. Canada's regulatory framework and basic service objectives for Northern telecommunications must adapt to the challenges of next-generation networks.
3. Northern stakeholders should investigate options for shared network infrastructure and shared IT services in high-cost areas. Infrastructure models that place too much stress on the obligations of incumbent carriers, or too much hope in the salutary effects of nascent competition, can stall innovation. Shared—open access—infrastructure can help to distribute the cost of deploying next generation backhaul. A shared approach can also help to ensure that critical backbone and backhaul linkages, between and across regions, are priced transparently and fairly. This may presuppose a more active role for governments and their representative agencies—both Aboriginal and non-Aboriginal—as brokers of long-term networking agreements, and as anchor tenants of connectivity infrastructure. Such entities may even benefit from taking an ownership stake in infrastructure partnerships.

4. Aboriginal participation in network development and IT services deserves encouragement and support. There are varieties of Aboriginal inclusion, from co-investment to co-management. Not all Aboriginal communities and organizations are ready to host or manage network services, and not all Aboriginal governments and businesses are prepared to invest in network infrastructure. A one-size-fits-all approach to Aboriginal inclusion is thus insufficient, and may be counterproductive if decision-makers ignore the socio-economic strengths and weaknesses of participating communities and regions. There are, however, numerous entry points for Aboriginal investors, businesses, and labour to participate in Northern telecom and IT sectors, including finance, infrastructure ownership, network operations and management, site/facilities management (operations and maintenance), training and technical support services, applications development, and so forth. Aboriginal stakeholders and non-Aboriginal partners need to frame immediate and near-term opportunities for participation in terms of multigenerational targets and long-term development goals.
5. Telecommunications is critical Northern infrastructure around which multiple systems of governance co-exist, overlap, and potentially conflict. A whole-of-government approach is required to ensure that mutual development goals, common objectives, and network efficiencies are achievable despite local policy differences, cultures, and business approaches. The required inter- and intra-governmental relationships could be formal, informal, or a combination of each. What is critical is that governments (Aboriginal and non-Aboriginal), their departments, and related agencies have the ability to productively cross boundaries, to achieve common objectives decisively and within reasonable time frames.

This chapter examines each of these five lessons more closely in the following analysis.

NEXT-GENERATION NETWORKS IN CANADA'S NORTH—THREATS AND OPPORTUNITIES

One of the most far-reaching changes to the Northern connectivity landscape is happening at the interface between regulation and technology. This is not simply a Northern issue, but is a broader reflection of evolving telecommunications services and related consumer habits. In Canada, as in other OECD nations, the telecommunications industry's investment in IP-based next-generation networks has come to a head, and blurred the boundaries between regulated public switched telephone networks (PSTNs) and the regulatory frontier of data services, the Internet, and whatever disruptive digital applications the future may bring.[1] One of the more uncertain implications of this evolution is what may happen to incumbent telecommunications carriers, and their regulated service obligations to rural and remote communities, if/when a critical mass of consumers substitutes unregulated Internet-based data applications for plain old telephony and other basic telecom services. Moreover, the joint investments required to establish next-generation networks over the immediate to near term in Canada's Northern regions creates opportunities for Northern businesses and governments, both Aboriginal and non-Aboriginal, to co-invest in next-generation networks. They may also seek to affirm ownership over the resulting connectivity infrastructure through alternatives to the incumbent carrier or facilities-based competition. One possible alternative involves the structural separation of wholesale network transport services (such as backhaul) from consumer network access services (such as residential Internet and voice services). Such regional networks as the Alberta SuperNet and the First Nation-owned fibre

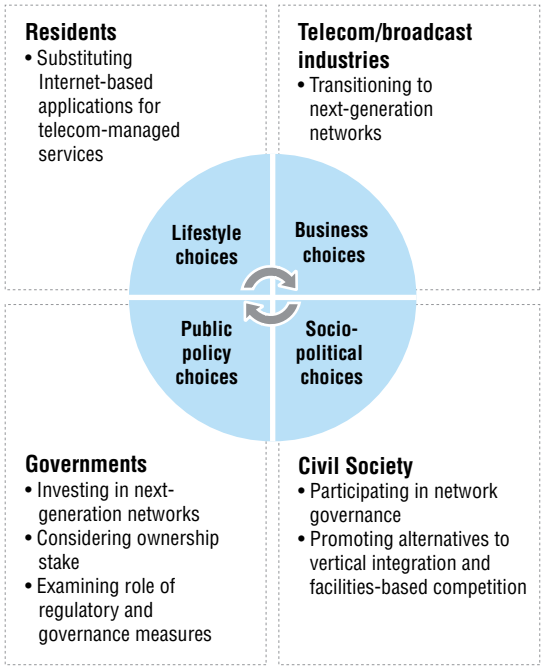
1 CRTC states: "In 1999, the CRTC studied the Internet and decided not to regulate it. Access to Internet services was competitive, and both creativity and innovation grew in an environment without regulation. While there was some broadcasting content being offered, most Internet services at the time were text based. CRTC concluded that the Internet was meeting the objectives of the *Broadcasting Act* and *Telecommunications Act*. CRTC periodically reviews its policies to ensure that the objectives continue to be met." CRTC, *Frequently Asked Questions*.

networks on the Quebec and Ontario sides of the James Bay coast provide working examples of structural separation in Canada's Northern connectivity landscape that enable competition for services and cooperation for backbone/backhaul.

This shifting landscape introduces potential threats and opportunities for the incumbent, for competitors, and for consumers.

The Internet has opened the floodgates for cheap Internet-based data applications that users can substitute for telecom-managed services. An average high-speed Internet connection in Canada now allows consumers to choose free VoIP applications, such as Skype or Google Talk, over long-distance telephone calls and related charges.[2] Such free services are best effort, but Skype, now a part of Microsoft, had over 600 million users in 2011[3] and its servers handled a peak of more than 45 million concurrent user sessions in October 2012.[4] The service is free, but generally robust, and service failures generally arise due to local bottlenecks at the customer access level (beyond Skype's control). Meanwhile, similar applications such as GoogleTalk or Apple FaceTime are available to anyone with a Google account or Apple device. Skype and similar applications provide a unified communications service that integrates voice and video with text-based communications, including instant messaging (IM) and e-mail. Such user-centred applications are now mainstream in the Internet marketplace and reflective of a sophisticated consumer mindset that expects interoperability of voice, video, and data services on top of ubiquitous and seamless connectivity between fixed and mobile devices. Similarly, popular social media applications such as Facebook are seeking to become the user's primary interface, whether at home, at work, or on the go.

Exhibit 8
Some Impacts of the Internet on Strategic Choices in the Northern Connectivity Landscape



Source: The Conference Board of Canada.

For their part, Canada's Northern Internet users are trying hard to keep up. In a 2011 report to CRTC, NorthwesTel, the incumbent local exchange carrier for Yukon, N.W.T., and Nunavut, estimated that aggregate VoIP traffic over its network (including free and commercial flavours) had grown from around 500,000 minutes per year in 2005 to over 20 million minutes per year in 2010.[5] Meanwhile, social research in Northern Ontario and Northern Quebec Cree communities has independently discovered a tremendous interest in social media, particularly Facebook.[6]

2 Skype, for example, recommends 100 Kbps (symmetrical) for voice and 300 Kbps (symmetrical) for video calls. Skype, *How Much Bandwidth?* According to CRTC, audio-only calls can be effective at 42 Kbps symmetrical.

3 Eaton, *Why Microsoft Is Buying Skype for $8.5 Billion.*

4 Lunden, *Skype Reaches a 45M Concurrent User Peak.*

5 NorthwesTel, *NorthwesTel Response to Interrogatory 02 August 2011 NWTel(SSI)07Jul11-9.*

6 O'Donnell and others, "How the Washaho Cree at Fort Severn"; Gauvin and Lorthiosis, *Internet Usage in Northern First Nation Communities.*

IP INTRODUCES NEW DEMANDS AND OPPORTUNITIES FOR NORTHERN IT SERVICES

Internet applications to replace traditional telephony services have matured significantly, in terms of functionality, reliability, affordability, and scalability, and technologies based on open standards, such as SIP and H.323, are available to all levels of enterprise, including small and medium-sized enterprises (SMEs). Nevertheless, to be more than best-effort solutions, these applications require dedicated IT support and management. The underlying make or buy decision will determine whether organizations choose to have a service provider at the helm of their Internet-based systems rather than dedicated internal IT staff, and this creates an opportunity for IT service providers to assert their expertise, whether they are specialized SMEs, the nationally competitive telecommunications service providers, or regional players somewhere in between. In Chapter 3, we encountered several such SMEs that provide managed IP-based enterprise services for governments and other clients in Northern Aboriginal communities. Prominent examples include not-for-profit organizations such as KO-K-Net in Ontario, BCN in Manitoba, KCDC in Saskatchewan, TSAG in Alberta, ECN and KRG in Quebec, as well as for-profit operators such as SSi Micro in Nunavut and the Northwest Territories.

Governments and businesses in Northern regions do not always recognize the competitive advantage these smaller organizations may possess. In Northwestern Ontario, the district court system contracts one of the big three national carriers to manage a regional telejustice network that connects several courts and potentially 24 remote First Nation communities by way of videoconferencing. Telejustice reduces travel requirements for all parties involved in the justice system. However, the big carrier requires significant prior notice to establish multi-party videoconference sessions. On several occasions when the courts needed an ad hoc multi-site connection to remote First Nations, they turned to the more agile KO-K-Net, which manages its own video bridge and can organize a multi-party videoconference at practically a moment's notice. The organization's agility, its connections to most of the region's First Nations, and its actual proximity to the district courts are unmatched by the big carrier. But KO-K-Net does not have a sales and marketing division that can compete for enterprise contracts with the same kind of formal business plan the big carriers offer. Its client base is largely constituted out of initial grants/pilot projects and informal personal relationships. Its small staff troubleshoots work as it comes.

Internet applications to replace traditional telephony services have matured significantly, in terms of functionality, reliability, affordability, and scalability.

While Northern regions may face recruitment challenges in the IT and telecommunications sectors, the broader trend in "cloud computing" and markets for "anything as a service" (XaaS) reflects a growing demand for sophisticated Internet applications based on a preference to outsource expertise and IT management responsibilities to specialized firms (often on project and pay-per-use bases). Thus, while consumer demand for IP services pushes telecommunications service providers to innovate, this demand creates new business opportunities and niche markets. TELUS, for example, has invested over $1 billion in its subsidiary TELUS Health over the past five years[7] (and in 2013 acquired Ontario's largest electronic medical records company). With the right network infrastructure in place, Northern regions can take advantage of the broader market trends in cloud services, perhaps for only the immediate to near terms as they develop their human resource bases and talent pools to gradually take over services and build regional economies for locally developed Internet applications. When capabilities are in place, however, agile Northern firms can also compete in the cloud. SSi Micro (based in N.W.T.) maintains an international roster of clients and collaborates with partners such as Cisco and McGill university. KO-K-Net (based in Northern Ont.) provides video-bridging services for universities, government partners, and private sector clients across Canada. Its young First Nation staff custom designed the network's video-booking software, in addition to other client applications for schools and community ISP management. Similarly, SSi Micro

7 The Windsor Star, "Telus Health Acquires Ontario's Largest Electronic Medical Records Company."

staff has engineered innovative solutions to deliver applications over satellite. These examples are hardly exhaustive of the potential for Northern businesses—whether Aboriginal or non-Aboriginal—to deliver innovative digital services to customers beyond the North.

BROADBAND CONVERGENCE

The Internet has not simply disrupted traditional telephone service, but has simultaneously facilitated the convergence of television, film, radio, and print media. In the broadcast domain, market incursions of so-called "over the top" (OTT) services such as Netflix, alongside free video-sharing applications such as YouTube, have pushed service providers to integrate what was conventionally a broadcast media experience, distinct from telecom, into a broadband user experience that can play out over multiple media, whether fixed home entertainment units, personal computers, video game consoles, or mobile devices. These incursions and transformations similarly play out with other media experiences. As newspapers join radio and television networks online to deliver applications for personal computers and mobile devices, the differences between their respective goods and services also blur. This is the era of new media production.[8] Many Northern media producers have seized this opportunity. Wawatay News, a newspaper, radio, and video production network that has served remote Northern Ontario First Nations since the 1970s, was an important early advocate for Northern connectivity in the 1990s and has steadily archived and embedded more of its print, radio, and video content online. More recent examples of new media production include Isuma TV, an online interactive network of Inuit and other indigenous artists that launched in 2008. In addition to an extensive online archive of indigenous video and multimedia projects, the network provides support for live webcasting, video on demand, content customization, and online marketing opportunities. Legendary Nunavut producer Zacharias Kunuk[9] co-founded the network with several collaborators.

Given their legacies, the large incumbent telecommunications service providers and Broadcast Distribution Undertakings (BDUs) (e.g., cable companies) want to capture value from all the new media contents—voice, video, and print—riding on their Internet-enabled distribution channels. The channels are the providers' digital networks—whether fixed wireless and satellite (especially in rural spaces), fibre optic/copper/cable systems to the node or home (especially in urban spaces), or mobile wireless systems for access on the go. In this context, we can better understand Bell Canada Enterprises (BCE)'s acquisition of CTV Globemedia in 2010 (for $1.3 billion) and CRTC's conditions on BCE's acquisition of Astral media in 2013.[10] Concentrated media ownership is a reality in many Northern regions. BCE's subsidiary, NorthwesTel, the incumbent for Yukon, N.W.T., and Nunavut, owns most of the territories' telephone, cable, and mobile access networks. In other Northern regions, there is little competition except between duopolies of telephone and cable operators.

As innovators, carriers need to either maintain revenue growth or acquire partnerships, subsidies, and targeted government funding to support further network evolution.

While consumers may want extra competition to discipline pricing, their demand for ubiquitous and seamless connectivity feeds off and into so-called triple and quadruple play services through which vertically integrated service providers bundle home entertainment, fixed voice, and mobile services. Yet, in order to provide these various services, whether through service bundles or diversified service providers, the market requires adequate access and core networks to support consumer demand and sustain service innovation. The Internet is also transforming these fundamental enablers of service provision, with implications for terrestrial and satellite carriers. But as innovators, carriers need to either maintain revenue growth or acquire partnerships, subsidies, and targeted government funding to support further network evolution.

8 Cf. Manovich, "New Media From Borges to HTML."

9 Kunuk directed *Atarnajuat: The Fast Runner,* Canada's top-grossing film release of 2002.

10 CRTC, *CRTC Denies BCE's Bid to Acquire Astral.*

CARRIERS ARE MIGRATING TO ALL IP BACKBONE NETWORKS

The telecom industry's development of IP-based next-generation networks is, in part, a business strategy to contain user options and capture more value from Internet applications. However, carriers have been migrating to IP not simply to keep up with, or shape, user demand for new media, but to discover new efficiencies and capabilities in fundamental network operations. Canada's Northern telecom industry is no exception. SSi Micro, the satellite-based service provider behind such brands as Qiniq (Nunavut) and Airware (N.W.T.), provides voice and videoconferencing over an all-IP-meshed network that reduces the number of satellite hops required for network peers to communicate. Here, IP forms the basis of a managed regional network—independent of the global Internet—that includes Quality of Service (QoS) guarantees for services, such as voice and video, beyond best effort. In its current modernization plan, NorthwesTel has indicated it will be migrating to a similar strategy for its telephone network.[11] Smaller regional networks such as BCN, KO-K-Net, ECN, and KRG's Tamaani offer similar managed capabilities over different IP network designs.

IP has become a driver for innovation in Northern mobile communications as well. In Northern Quebec, the Naskapi Imuun Nation and Nunavik's Makivik Corporation, as well as Nunavut communities such as Cape Dorset and the Eeyou Cree community of Whapmagoostui, have each partnered with Lynx Mobility and Telesat to deploy IP-based cellular services over satellite backhaul.[12] In Northwestern Ontario, the Keewaytinook Okimakanak Tribal Council and partner First Nations involved in KO-K-Net have integrated 3G IP mobility in their portfolio of community-managed broadband services, which includes high-speed Internet, videoconferencing, VoIP, and various other data applications for health care, education, and public administration.

While available knowledge and skills set the bar for applications development, the range of deployable applications is largely contingent on the availability and cost of network transport and backhaul. In 2011, Northwestern Ontario received a substantial boost, thanks to an $80-million-plus multi-stakeholder partnership between the Ontario and federal governments, the region's incumbent carrier Bell Aliant, and 26 First Nations. For the project—still under construction—Bell Aliant is deploying fibre optic transport systems to KO-K-Net's remote First Nations that, until recently, depended on bundled T1 circuits over microwave (at 1,500 Kbps each) and in other cases C-band satellite. Now, local community enterprise and government services have shared access to data rates of 10,000 and 100,000 Kbps (full duplex), based on a network architecture that can scale to meet future growth.

Fibre optic systems can be a significant game changer for Northern communities that have depended on microwave radio or satellite backhaul, though this is not simply an assessment of technological differences. The total cost of satellite deployment—which includes a ground and space segment—can be considerably higher than a regional fibre optic deployment, and it becomes a factor in the price of satellite bandwidth. Yet, as more spectrally efficient, cheaper-to-deploy HTS becomes available (particularly over Ka-band), the price of satellite bandwidth will diminish and may even compete with alternative fibre optic solutions.[13] Moreover, geographically remote communities, mines, and so forth may be too isolated from available terrestrial infrastructure to warrant a build-out of fibre optic or microwave backhaul systems. In other cases, coast guard, military, and SAR operations require mobile capabilities that only space systems can realistically support. Satellite thus plays an important complementary role in Northern network deployment strategies. However, satellite carriers such as Telesat require advance cooperation from prospective stakeholders given the significant upfront costs they face in developing and deploying new infrastructure, especially along the space segment. If governments and other potential customers in the Arctic

11 NorthwesTel, *NorthwesTel Modernization Plan*.

12 Lynx Mobility, *Partners*.

13 Companies such as Xplornet have begun to explore the potential of Ka-band spot beams in rural Canada.

wait for alternative backhaul options to come along, this may lead satellite carriers to focus innovation on regional market segments where demand is greater.

Terrestrial microwave systems are also evolving, particularly in supporting 3/4G mobile network design. However, in the context of Northern telecommunications there are several challenges, such as terrain and geography, as well as legacy microwave network designs that incumbents may have engineered to meet the requirements of regulated voice services rather than bandwidth-intensive unregulated IP data services. Canada's incumbent telecommunications carriers, such as NorthwesTel, continue to deploy terrestrial microwave backhaul systems because the related capital and operations and maintenance costs of these systems can be significantly cheaper than either present fibre optic or satellite backhaul solutions. Under careful management, such systems may meet growing consumer demands, but their ability to scale may be limited when compared with fibre optics.

REGULATING NORTHERN TELECOMMUNICATIONS IN AN ALL-IP WORLD

In terms of how the new telecommunications environment impacts the regulation of Northern incumbent carriers, the challenges for CRTC are perhaps best encapsulated in a 2012 statement by NorthwesTel:

> The challenge of continuing to provide Canadians living in remote Northern communities with access to comparable services to those available in other regions of the country continues to rely on a balance of reasonable rates, sustainable sources of implicit cross-subsidies, and access to the National subsidy mechanism. With the evolution of IP technologies and competitive pressures, risks to this delicate balance are now materializing. Advancements of IP technologies and networks, including the increased penetration of broadband access, are displacing traditional legacy services (e.g. long distance and digital private line service), and more importantly are eroding critical sources of internal cross-subsidies.[14]

NorthwesTel also noted that the federal government's targeted infrastructure funding programs, such as NSI, created the potential for duplicate networks in satellite-dependent communities. For example, the incumbent operates in Nunavut's three largest communities, while SSi Micro operates in all 25. According to NorthwesTel, sometimes even a duopoly may be too expensive to maintain, and competition in satellite-based communities has further eroded its ability to marshal internal cross-subsidies.[15] This has nevertheless not prevented the incumbent from ramping up higher speed services in SSi Micro's core markets.

Fibre optic systems can be a significant game changer for Northern communities that have depended on microwave radio or satellite backhaul.

The incumbent's position encapsulates the vertically integrated service provider's predicament—in the past it could provide basic telephone services to remote high-cost areas based on its ability to cross subsidize remote and rural communities with its monopoly over services in the more densely populated areas of its Northern territory. This tactic became enshrined in CRTC's national contribution framework, which taxed competitive carriers for the benefit of subsidizing vertically integrated incumbent services in high-cost areas. Now, with the evolution of new media services over next-generation networks, the incumbent seeks to maximize value by controlling the entire new media value chain—from content to distribution—even as its revenues from basic telephone services erode under the pressure of Internet-based substitution. How realistic an assumption this may be depends on the availability of alternative networks in Northern regions, on consumer satisfaction with Internet-based applications, and on what CRTC chooses to regulate. Our earlier

14 CRTC, *Telecom Notice of Consultation CRTC 2011-302*.

15 Ibid.

analysis of VoIP substitution, for example, discovered that by not offering a Dry DSL loop[16] to its customer base, NorthwesTel may have a competitive advantage over commercial VoIP providers such as Iristel. (See Benchmarking Affordability in Chapter 2.) Such an advantage may evaporate if customers are satisfied with free best-effort services such as Skype or Google Talk. NorthwesTel has also indicated that, while it does not offer an ADSL connection without its home phone service, 60 per cent of the population in its serving area has access to alternative Internet services such as cable.[17]

SHARED INFRASTRUCTURE FOR SHARED SERVICES

Recent debates and regulatory reviews across Canada's territories have focused on competition as an engine for innovation in telecommunications services.[18] Opponents of the vertically integrated incumbent telecommunications provider NorthwesTel have argued that competition in local exchange and high-speed Internet markets expands consumer choice. Supporters of the incumbent have argued that, thus far, new market entrants have relied on government "subsidies"—particularly in the form of targeted federal funds, such as Broadband Canada and the NSI—to establish their foothold in Northern markets. This latter notion of subsidy is distinct from the subsidies that an incumbent receives from CRTC-regulated mechanisms, which essentially tax telecommunications service providers to support the incumbent's obligations to high-cost serving areas. Instead, we are dealing with government departments that have presumably made strategic decisions to fund telecommunications services for broader policy goals such as economic development. This type of decision-making is generally project-based and program-related. Key proponents of this approach in the North include Industry Canada and Infrastructure Canada. More recent versions include CanNor and AANDC's First Nations Infrastructure Fund (FNIF).

In 2000, the federal government introduced a holistic funding strategy under the Smart Communities Demonstration project, which encouraged diverse departments, not-for-profit community champions, and service providers to collaborate in planning for infrastructure capacity, enterprise services, human resources development, and broader community economic development. But as narrower targeted funding approaches took centre stage in the mid-2000s, and as departments focused on their internal enterprise requirements, federal stakeholders and their Northern interlocutors had fewer opportunities to coordinate policies for shared IT infrastructure and services. With the creation of Shared Services Canada in 2011, the federal government may have returned to a more holistic approach for planning corporate IT requirements. One of the new agency's goals is to "move the Government of Canada to a single, shared telecommunications infrastructure."[19] Yet, at this stage in 2013, the organizational capacities of Shared Services Canada and related agencies do not appear to be robust enough to help coordinate a common federal, territorial, and Aboriginal strategy for next-generation public enterprise systems in the Arctic.

Though the Canadian military mainly funds communications infrastructure to support narrowly defined defence requirements, its whole-of-government approach has recently influenced a pan-territorial and interdepartmental review of connectivity infrastructure needs, via the Northern Communications and Information Systems (NCIS) Working Group. Through the NCIS, military decision-makers sit alongside policy-makers and staff from federal departments with Northern portfolios and their Yukon, N.W.T., and Nunavut counterparts. One early outcome of their collective engagement was the publication of an Arctic Communications Infrastructure Assessment in 2011,[20] which has helped to generate a holistic review of

16 The Dry loop arrangement entails a customer purchasing a functioning ADSL service without the underlying single-line residential phone service.

17 Paul Flaherty (President and CEO NorthwesTel). Letter to Siomonn Pulla and Adam Fiser, June 17, 2013.

18 CRTC, *Transcript—Hearing 4 October 2011*.

19 Government of Canada, *Shared Services Canada*.

20 Imaituk Inc., *A Matter of Survival*.

funding opportunities and co-investment strategies for next-generation connectivity infrastructure in the territories.

Government investments could stand to place a greater strategic emphasis on government entities as long-term anchor tenants (and possibly controlling interests) of shared connectivity infrastructure. Some strong versions of this approach, such as the Alberta SuperNet, also attempt to reconfigure the struggle of vertically integrated facilities-based competitors into a structurally separated network of shared network backbone/backhaul and multiple competing service providers. The Alberta government owns SuperNet's extended area network across rural and Northern Alberta. Its provincial ministry, Service Alberta—one of the first shared service models in Canada—is responsible for overseeing the provincial government's contract with its network operator Axia. Moreover, Service Alberta is tasked by its government to enforce service-quality features and the equitable pricing of rural backhaul. Other smaller-scale regional models are also available, such as the ECN in Northern Quebec that wholesales network transport services to regional and local service providers on a not-for-profit basis.

VARIETIES OF ABORIGINAL INCLUSION

A critical element of the Northern connectivity landscape is the inclusion of Aboriginal communities in all aspects of development. Here, inclusion is a multi-dimensional concept. It can mean personal and collective access to such affordances as new IT and related applications such as online social media. It can mean access to support and training for the adoption of new technologies, practices, and related professions. It can mean participation in service delivery, or even applications development and network design. It can also mean participation in background policy, financial agreements, and so forth. NorthwesTel, for example, has several joint ventures with Aboriginal stakeholders including Ardicom Digital Communications, Latitude Wireless, Tundra Communications, Borealis Communications, Waterways Communications, and Tahltan River Communications, as well as partnerships with Falcon Communications and British Columbia's All Nations Trust Company.

While the role of Aboriginal labour is sometimes limited, such ventures and partnerships provide important vehicles for Aboriginal economic development. Currently, some aspects of inclusion are more practical than others, in the near term, while other aspects may be more appropriate as long-term policy goals that will require careful multi-stakeholder planning and considerable efforts to become achievable. Some Northern Aboriginal stakeholders have also pursued Aboriginal ownership and control over networks and data services as a dimension of their broader struggle for political economic self-determination.

While many small Northern Aboriginal communities may encounter challenges in trying to staff a network management service or software development shop from their local membership, in Chapter 3 and in previous sections of Chapter 4, we have discussed important cases that policy-makers and investors need to understand. Moreover, some aspects of the IT and telecommunications ecosystem are more accessible to Aboriginal communities and can be immediately served by Northern Aboriginal organizations and local labour.

A critical element of the Northern connectivity landscape is the inclusion of Aboriginal communities in all aspects of development.

One of the largest and longest-running partnerships to include Aboriginal organizations and local labour in a Northern ICT project has been the North Warning System (NWS). While the NWS radar stations are unmanned, site maintenance and logistical support are of critical importance. For Inuit, whose traditional territories adjoin the radar network, from Inuvialuit (N.W.T.), to Nunavut, Nunavik (Northern Que.), and Nunatsiavut (N.L.), it became important to identify economic opportunities and partnership prospects in the long-term military presence. The NWS is actually part of a legacy of Arctic military operations that dates back to the DEW line that joint American and Canadian forces built in the 1950s. When the DEW line became obsolete in the 1980s, it left a toxic residue that reflected the environmental standards of its day. The NWS contract, originally awarded in 1988 to ATCO

Frontec, and further renewed in 1994 to ATCO Frontec and Pan Arctic Inuit Logistics (PAIL), includes the management, operation, and maintenance of 47 radar sites and five logistics support sites across Canada's North.

An enhanced training program under Nasittuq, the ATCO joint venture with PAIL, is designed to benefit Inuit labour from across Labrador, Nunavik, Nunavut, and the Inuvialuit Settlement Regions. The program has a development/apprenticeship focus on skills and professional certification. "Our ultimate goal is to have 50 per cent of the 225 positions filled by Inuit employees," said Ivan Wawryk, President of Nasittuq Corporation. In Labrador, for example, the Labrador Inuit Development Corporation owns a 19 per cent stake in PAIL, while the Labrador Inuit Association (LIA) has had 27 members complete various training positions, of which 12 remain employed by PAIL and 15 have moved on to other employment opportunities thanks to PAIL.[21]

In a similar model, ATCO Frontec has partnered with NASCo, a joint venture comprising the following Aboriginal business groups: the Inuvialuit Development Corp, Nunasi Corp., Denendeh Development Corp., and Yukon Indian Development Corp. ATCO Frontec and NASCo have an agreement for the operation and maintenance of facilities, towers, and power-generating systems at 157 NorthwesTel microwave sites in the N.W.T., Yukon, and Northern British Columbia.

NorthwesTel in turn has an estimated workforce of 600 employees, 11 to 12 per cent of whom self-identify as Aboriginal.[22] In a 2012 presentation to Nunavut stakeholders, NorthwesTel Vice President Mark Walker discussed the realities and challenges of recruiting and retaining Aboriginal staff. In Nunavut, for example, NorthwesTel has 48 staff located in 23 communities. In 2010, their combined wages contributed $3.2 million to the Nunavut economy. Yet, more broadly, Walker stated that the company needs to work on improving its organizational capacity to nurture Aboriginal executives and engineers.[23]

21 Torngait Services Inc., *The Labrador Inuit Development Corporation.*

22 NorthwesTel, *Building ICT Capacity in Nunavut, in Nunavummiut…*

23 Ibid., 9.

GOVERNANCE

One of the challenges to developing a comprehensive national policy for telecommunications in Northern Canada is the diversity of Canada's North, which includes its inhabited Arctic, boreal forest regions, and circumpolar presence. Even as neighbouring regions may share dissatisfaction with the status quo of a common telecommunications market, they may not have the institutions in place to define and enforce a pan-regional communications policy. Thus, for example, while Yukon, the N.W.T., and Nunavut share a common carrier, NorthwesTel, their disparate geographies, distinct—though sometimes overlapping—Aboriginal societies, and separate government policies have created divergent paths for development.

One of the challenges to developing a comprehensive national policy for telecommunications in Northern Canada is the diversity of Canada's North.

As for the provincial Northern regions, they are politically disadvantaged by the southward focus of each province's majority population and dominant centres of government. Moreover, as high-cost serving areas for their incumbent carriers (and the CRTC), the provincial Northern regions have struggled to define an autonomous position with respect to telecommunications policy governance. That there is typically not one cohesive Northern regional government in the provinces, but a plurality of First Nations, municipalities, and agencies (federal, provincial, and regional), does not help their cause.

There are also multiple overlapping systems of governance surrounding Northern telecommunications and connectivity initiatives. And internally, government programs at various levels pursue their own policies to promote electronic services in public safety, health, education, public administration, and so forth. Within the federal, provincial, and territorial governments, multiple departments or ministries pursue distinct internal IT policies independent of their governmental peers.

Governance is a growing concern for Canada's Northern Aboriginal communities, particularly as they come to negotiate greater independence in their relationships with federal, provincial, and territorial partners. Indigenous populations are substantial in the Northern regions. Yet, even as part of Canada's total Aboriginal population these societies are minorities within the country's total population (e.g., approximately 4 per cent in 2011). The divergence between regional indigenous policy goals and the political inertia of national policy-setting activities may result in conflict or, worse, inactivity at the national level—especially if Southern issues overcrowd Northern indigenous priorities. Similarly, the Arctic and Northern Aboriginal populations are only a small fraction of their incumbent telecommunications carriers' market share (particularly if one frames NorthwesTel in the context of its larger parent organization BCE). In light of this challenge, cooperation between Aboriginal and non-Aboriginal entities is essential to help Northern regions and Northern Aboriginal governments pool resources and aggregate demand.

COMPLEMENTARY NEEDS SHAPE THE NORTHERN CONNECTIVITY LANDSCAPE

As consumers of telecommunications, Canada's Northern residents, governments, and industries have distinct yet complementary needs. Service providers and regulators have long recognized the importance of complementarities. There are the traditional tactics of telecommunications carriers to cross-subsidize high-cost areas with revenues from metropolitan areas, residential lines from business lines, and so forth.[24] There are also regulatory measures to foster service standards, such as CRTC's National Contribution Fund,[25] which obliges service providers to subsidize basic telephone services to Canada's high-cost areas. In these cases, the objective is to exploit complementary market segments and distribute the economic burden of high-cost services.

Complementary needs also drive innovation in Canada's Northern connectivity landscape. Take, for example, the dominance of multi-stakeholder partnership agreements in the funding of remote and rural broadband infrastructure. Through such partnerships, Canada's federal, provincial, territorial, Aboriginal, and municipal governments have co-invested with regional carriers and operators to enable infrastructure for faster Internet access, media-rich applications, and other largely unregulated telecommunications services. Here, largely government investments create incentives for innovation to occur in high-cost areas where carriers have been reluctant to invest on their own. In addition, some form of non-governmental and not-for-profit association may intermediate between public and private partners to manage the government contributions, represent consumers, and even develop applications. Under such circumstances, complex relationships may develop between partners, sometimes leading to disagreements (and passionate debates) over partner roles and responsibilities. Challenges notwithstanding, these multi-stakeholder partnerships continue to be crucial vehicles for investment across Canada's Northern connectivity landscape. They also project Canada's Northern connectivity profile on an international level, as evidenced by current and anticipated telecommunications projects to support Arctic research, public safety/emergency response off Arctic shores, and joint military operations in the circumpolar region. However, while the partnerships thus far have largely targeted infrastructure development, they may have fallen short of achieving a concomitant focus on collaborative long-term planning. Northern stakeholders not only need funding for next-generation networks, they also need a shared policy vision and roadmaps to assess expectations and strategic outcomes.

HIGH COSTS HAVE FORCED TRADE-OFFS BETWEEN NORTHERN NEEDS

While the complementary needs of Northern residents, governments, and industries can harbour critical economic synergies, they may also run afoul of resource conflicts. Under the economic circumstances of Northern regions, where small remote communities interact with a larger population base concentrated in

24 International Telecommunication Union, *ICT Regulation Toolkit*.

25 CRTC, *Procedures for the Operation of the National Contribution Fund*.

a few hub towns or cities—with primary industries, such as mining and forestry camps, interspersed in the vicinity—the communications needs of remote residents, governments, and industries have bottlenecks to contend with. Under such circumstances, the primary challenge for service providers is to acquire sufficient backhaul—whether by satellite, fixed microwave, or fibre optic systems—to transport regional customer traffic along a North-South axis (where gateways to the global Internet reside), but also increasingly along a Northwest-Northeast axis (to enable more efficient regional communications).

With limited backhaul available, service providers in many Northern regions have had to prioritize customer needs and make trade-offs between services. In remote Northern regions, carrier backhaul costs have compelled service providers to selectively satisfy customer demands. In some cases (such as Tamaani in Nunavik (Northern Que.), this meant that residents had Internet access but extremely limited capabilities to engage in multimedia applications. The effect has been delayed or localized deployment of media-rich services such as telemedicine and videoconferencing.[26] In other cases (such as KO-K-Net (Northern Ont.), the trade-offs have meant diminished residential Internet access but a demonstrable array of multimedia systems to support video and other media-rich applications in regional schools and health clinics. As backhaul systems improve, such trade-offs may recede.

Faced with the prospect of inadequate backhaul, primary sector industries have regularly commissioned private networks to support critical data applications and staff communications. Military and non-Aboriginal government units have also resorted to special networks for their applications and staff, sometimes for necessary security reasons, but other times due to narrow perspectives on shared IT services and the potential benefits of demand aggregation. The absence of shared infrastructure may indicate missed opportunities for Northern stakeholders to pool resources and co-invest in facilities that could better serve their collective requirements. More generally, constraints on affordable backhaul have squeezed remote residents the most, particularly those in sparsely populated, geographically vast Aboriginal areas, where local governments depend on federal transfers, and possibly Impact Benefit Agreements (IBAs), where local businesses are small, and where personal and household income rates may be well below national averages. (See Chapter 2 for a closer examination of these concerns.) In 2013, the technology solutions and economics may have improved for Northern service providers, but improvements have not eliminated all trade-offs from resource conflicts. Conflict and complementarity continue to go hand in hand in shaping regional connectivity solutions.

With limited backhaul available, service providers in many Northern regions have had to prioritize customer needs and make trade-offs between services.

It is clear that there is no single-best technology solution for Canada's North. Although broadband connectivity defined in terms of fibre to the node or premises (FTTx) has become a popular talking point in government conferences and industry trade shows, the challenges of technology deployment are still such that, in sparsely populated regions where a few urban hubs are surrounded by small, increasingly remote communities, diverse technology solutions are better than any single one on its own. At the access network level, this is a practical necessity when consumers want fixed access to the home and mobile access on the go. But it is also significant at wide-area-network levels where a reliance on any single satellite, fibre, or fixed wireless backhaul solution creates single points of failure and diminished disaster management capabilities. Past network outages across Yukon, N.W.T., and Nunavut are testament to this claim.[27]

26 Here, the contrast is between networks such as Qiniq or Tamaani (residential Internet) and K-Net/BCN (public services).

27 Imaituk Inc., *A Matter of Survival.*

Chapter 5

Final Observations and Recommendations

Chapter Summary

- Multi-stakeholder partnerships have been, and will continue to be, crucial for enabling remote community access, but more emphasis needs to be placed on planning for sustainable innovation, shared services, and common long-term development goals. Northern governments (Aboriginal and non-Aboriginal) should lead by example with support from federal counterparts.
- Access to broadband ICTs may introduce substantial benefits to Northerners and Northern organizations. However, critical infrastructure required to support broadband and even basic telecommunications in many regions of the North requires renewal and reinvestment.
- The Northern connectivity landscape is complex and regionally variegated. When examined from a multiple stakeholder perspective, it is clear that one technology solution or business model does not fit all.
- Seven recommendations conclude the chapter.

Governments and businesses are seeking improved broadband connectivity to meet their needs, and the needs of the Northern stakeholders they answer to. There is no single best solution for everyone. Solutions for Northern cities and towns may not be what Inuit communities or Northern First Nations require. For some Northern communities, the right solution is a business model that supports local community development under municipal or other local community management. For others, the right solution may be more arm's length, whether public or private, turnkey, or custom-designed. Meeting resource industries' communication infrastructure requirements in remote Northern regions also depends on the context of where particular operations are located. Some industry players may have access limited to satellite services or may be able to collaborate with telecommunications carriers to establish microwave or fibre optic networks. In some cases, the mutual interests of resource companies and surrounding communities can be served by shared infrastructure, joint ventures, or other types of co-investment strategies. In many cases, however, the potential for shared infrastructure and services is left unexplored.

The broadband convergence of data, voice, and video has the potential to transform communications in the North. Whether it manifests in terms of personal social networks, home entertainment, cultural creativity, business development, and beyond, the transformative potential of next-generation networks and Internet applications is as hopeful as it is unpredictable.

Governments in the North should lead by example. Northern schools and hospitals can supplement remote Northern communities' limited access to teachers

and health care service providers with applications for e-learning and e-health. To that end, critical connectivity infrastructure must be available, reliable, and affordable, just as prospective users must be willing and able to adopt electronic services.[1] Moreover, governments serving the North may improve their interface with regional offices and with other levels of government if they have access to reliable broadband ICTs. They may also better serve Northern communities and businesses online. But their constituents and clients must have the right tools and appropriate technical support.

In the realm of public safety and security, emergency operators also need access to reliable broadband ICTs to better respond to disasters and to improve recovery operations. As the recent federal allocation of 700 Mhz spectrum for public safety broadband use indicates, public authorities across Canada recognize that broadband ICTs are now an essential element of effective and timely emergency response operations.[2] Canada's military, coast guard, and other public safety agencies, in concert with provincial and territorial search and rescue facilities across Canada's North, are undertaking a transformation of capabilities that is closely associated with next-generation broadband technologies and the situational awareness they can provide. Indeed, how Canada and other circumpolar nations define their share of the Arctic depends to no small extent on the capabilities of next-generation satellites and high-bandwidth data visualization applications for surveilling the Arctic environment and tracking human activities.[3] This context includes immediate safety and security applications as well as the longitudinal scientific monitoring of climate change, geological processes, and Northern ecosystems. From a practical community perspective, such new technologies could be of great benefit to individuals and families living on the land, provided they blend harmoniously with Northern perspectives and cultural values.

While Northern residents and public services have a clear stake in the Northern connectivity landscape, their needs are part of a broader continuum of demand that includes industries operating in the North. With broadband ICTs, the Northern operations of major corporations in mining, forestry, fisheries, and oil and gas can better communicate with head offices and manage their logistics. As new Arctic shipping routes become available, next-generation information systems for tracking and identifying shipments will be integral for assurance purposes and provide another interface between industry and public safety.[4] On a more personal but no less global scale, the local businesses of Northern residents may also expand their economic opportunities and resource bases by using broadband ICTs to access suppliers and customers from other regions. Northern artists and craftspeople also have the creative potential to benefit from new media production techniques and online marketing strategies.

While Northern residents and public services have a clear stake in the Northern connectivity landscape, their needs are part of a broader continuum of demand.

Overall, access to broadband ICTs may introduce substantial benefits to Northerners and Northern organizations. However, critical infrastructure required to support broadband and even basic telecommunications in many regions of the North requires renewal and reinvestment. The Arctic in particular, from Yukon to Nunavik, has experienced multiple systemic failures in critical 21st-century communications infrastructure,[5] including terrestrial and satellite facilities. Faced with the prospect of sinking hundreds of millions of dollars[6]

1 Some of the first pilot projects to demonstrate broadband in Northern Canadian regions focused on the potential of these applications. Cf. Industry Canada's Smart Communities Demonstration project and First Nations SchoolNet, and Health Canada's Merlin project circa 1998–2003.

2 Lucente, *700MHz Spectrum Requirements*.

3 Standing Senate Committee on Fisheries and Oceans, *Controlling Canada's Arctic Waters*.

4 Cf. Long-Range Identification and Tracking—LRIT; Machine to Machine over Satellite—M2M-SAT, etc.

5 Yukon: Yahoo News Canada, Yukon Phone, Internet Services Partly Restored; Marowits, "Service Being Restored;" George, "Lousy Telephone Service Puts Nunavik at Risk."

6 NBDC, Bell Aliant, James Bay Cree, MVFL, etc.

in new regional infrastructure, government, industry, and community stakeholders must cooperate to create new investment strategies and solutions. In the early 21st century, targeted government funding and multi-stakeholder partnerships have shaped investment in the Northern connectivity landscape. But investments in Northern connectivity infrastructure can be risky,[7] and not every business model is appropriate for every region of the North.

A survey of the landscape reveals numerous regional contrasts. For example, in Nunavik and along the James Bay coast of Quebec, the KRG and Grand Council of the Crees have internalized management of satellite and fibre optic backhaul via their respective organizations, Taamani and the ECN. This is in sharp contrast to their Eastern neighbours in Labrador/Nunatsiavut that rely on their incumbent local exchange carrier, Bell Aliant, competitors such as Eastlink, and satellite operators, such as Xplornet. KRG delivers Internet access through its subsidiary Tamaani, while the Cree's ECN is a wholesale broadband network that serves local providers in their communities in neighbouring Jamesian municipalities and in the surrounding region. On the Ontario side of the James Bay coast, it is a mixture of Aboriginal and non-Aboriginal ISPs that deliver services to First Nations such as Fort Albany and Attawapiskat, while a regional First Nations utility company provides their fibre optic backhaul. Further west, in Northwestern Ontario and Manitoba's Treaty 5 region, remote First Nations have chosen not-for-profit organizations, such as tribal councils, to lead Internet service and related applications development. In both regions, incumbent local exchange carriers—Bell Aliant and MTS Inc.—continue to extend the Northern reach of fibre optic transport networks, whether through internal projects or in partnership with governments and industry. The First Nations have also engineered backhaul solutions with public support, using microwave and satellite technologies to enable Internet access and develop e-services such as telemedicine and distance education.

In Northern Saskatchewan, the remote First Nations and Northern communities have relied on their incumbent SaskTel, a Crown corporation, to deliver Internet services to residents, businesses, and public facilities. Present initiatives are focusing on regional fibre optic transport and 3G/4G mobile network deployments. In neighbouring Alberta, Northern communities have a unique connectivity situation thanks to their provincial government's co-investment in Alberta SuperNet, a province-wide multi-gigabit fibre optic transport network that reaches 402 rural communities. Alberta is also home to the largest regional deployment of 3G/4G mobile broadband thanks to competition between its incumbent, TELUS, and competitors such as Rogers and Bell Mobility.[8] (See Chapter 2 for further analysis.) Bell and TELUS's joint investment in 3G/4G has created a national mobile Internet network that extends into Yellowknife (N.W.T.), Whitehorse (Y.T.), and even as far as Tuktoyaktuk (N.W.T.). In Nunavut and the N.W.T., as well as in Northern British Columbia, targeted federal funding has been crucial for enabling remote community access, and introducing competition in services (albeit on a limited basis). Governments have chosen a variety of "champions" to fund, whether that means the incumbent local exchange carrier(s), not-for-profit community groups, or local entrepreneurs.[9] In some cases, particularly in the Arctic, passionate debates have surfaced around which type of champion is better for each region. For its part, Yukon is largely dependent on its incumbent local exchange carrier, NorthwesTel (also a subject of passionate debate[10]), though alternative services are available through independent commercial satellite operators, as they are in most of the other Northern regions. As this non-exhaustive summary illustrates, the Northern connectivity landscape is complex and regionally variegated. One technology solution or business model does not fit all.

7 For example, Omniglobe, NSI.

8 Bell has a network-sharing agreement with TELUS on 3G/4G mobile network deployments.

9 Cf. NorthwesTel/Falcon Communications, SSiMicro/Nunavut Broadband Development Corporation, and Norsat/First Nations Emergency Services Society.

10 For example, see Kerr, "Competitors Pan NorthwesTel's Modernization Plan."

Moreover, Northerners are not all positioned to benefit equally from available and future communications services. Government, military, and industry forces can more easily mobilize resources to acquire the communications facilities and services their personnel require. As their economic presence looms large over the Northern connectivity landscape, they sometimes risk crowding out the needs and interests of local residents, and remote Aboriginal communities in particular. Real efforts have to be made to include local Aboriginal populations, which comprise majorities in many Northern regions despite being minorities with respect to Canada's Southern metropolitan populations.

The concern for Northerners today—both Aboriginal and non-Aboriginal—is to develop critical connectivity infrastructure that is scalable, locally affordable, and reliable.

In addition, the regulatory context is also evolving, and Canada's CRTC has increasingly had to pass judgment over issues of broadband service quality—including a review of a Northern incumbent's monopoly over critical backbone infrastructure and related services.[11] Some observers believe that the time is ripe for Canada to follow other OECD nations in establishing basic service objectives for broadband access services nationwide.

In this context, the immediate concern for Northerners today—both Aboriginal and non-Aboriginal—is to develop critical connectivity infrastructure that is scalable, locally affordable, and reliable. Concomitant with that concern is the challenge of designing multi-stakeholder partnerships to manage and maintain broadband communications services capable of meeting the needs of remote communities. Although the long-term societal implications of broadband connectivity, for good or ill, may be unpredictable, given a myriad of intervening factors such as the macro-economy, complex cultural changes, and demographic shifts, the immediate needs of Northerners for improved critical connectivity infrastructure are evident.

A number of Northern initiatives by communities, governments, and businesses are addressing the gaps in broadband technologies. Community-based First Nation networks in the Northern regions of Ontario, Manitoba, Quebec, and Saskatchewan provide Internet-based voice, data, and video applications to support telemedicine, e-learning, and other community applications. Modelled after the Kuh-Keh-Nah Network, a First Nations ICT leader in Northwestern Ontario, they are reaching out to youth, adults, and Elders alike. Northern Ontario's Keewaytinook Internet High School, for example, offers a full roster of Internet-based high school courses to Aboriginal youth and adults who need their GED,[12] each developed by local teachers and cultural content providers. These networks employ local technicians and support staff to help participating communities with technology issues, in schools, health clinics, and community centres. They open their planning and development cycles to members of the communities to have their say. Their members are determined to demonstrate what's possible when Northern Aboriginal communities harness the potential of broadband ICTs.

The sustainability of such initiatives can be challenging. Once local champions gain experience and expertise in broadband ICTs, they may find new opportunities to leave their Northern communities. Critical human resource development systems need to be in place if initiatives are to successfully impart hard-earned knowledge and expertise to future generations. However, government support for such initiatives has generally been project-based and unpredictable, and this has caused many of the "softer" human capital dimensions of Northern connectivity funding to become contingent on the harder physical capital dimensions. As a result, local disillusionment may set in when available support and technology fail to keep up with evolving community needs.

11 See Northwestel V-Connect service in CRTC, *Telecom Decision CRTC 2012-4* and CRTC, *Telecom Decision CRTC 2012-644*.

12 General Education Development.

RECOMMENDATIONS

1. **Increased capital investment:** Increased capital investment into connectivity is clearly required in Canada's North. Governments need to lead by example, as Northern populations and economic activity are small, remote, and dispersed throughout a large geographic expanse. Targeted government funding and multi-stakeholder partnerships have become prominent vehicles for attracting the necessary investments and distributing risk between government and industry. However, ongoing government support—and a public ownership stake—may be required to sustain innovation. Public programs associated with Northern broadband communications do not always maintain the budgets required and there are too often only one-time government financial commitments available that cannot keep pace with the evolution of community needs and broadband ICTs. Governments also have a responsibility to consider whether taking an ownership stake in infrastructure can help discipline service providers that would otherwise have discretion over the pricing and management of critical connectivity services.
2. **Reducing IT capacity constraints:** There are scarce IT professionals in Canada's North to manage next-generation Internet services and develop applications. This limits the development and application of broadband ICTs in Northern regions. Attracting and retaining these professionals is an ongoing challenge. Finding solutions such as remote service delivery or local training becomes essential. There is also a planning gap in terms of available data about human resource development and careers in the Northern IT professions. Even basic longitudinal NAICS[13] data for Northern regions are presently hard to come by.
3. **Access to functioning and capable devices:** In addition to critical connectivity infrastructure, Northerners need access to functioning and capable devices that can benefit from next-generation connectivity infrastructure. Once they have the equipment, there is a need to maintain it. However, there are often inadequate funds and not enough skilled people in Northern communities to maintain critical IT supply chains.
4. **Improvements to network diversity and redundancy:** The design of Northern network backbones can have a negative impact on service reliability. Single points of failure along a backbone, coupled with non-redundant links between communities, can bring down an entire region's communications infrastructure. In Chapter 3, we discussed the regional communications breakdown that occurred with the failure of Telesat's Anik F2 satellite. Diversity is also an important consideration in terrestrial infrastructure design. When a power failure in Whitehorse, Yukon, disrupted operations at NorthwesTel's central office in September 2012, the event disabled the incumbent's cellular and landline telephone services, as well as its Internet services, across Yukon and the Inuvik area of the Northwest Territories.[14] The failure in Whitehorse also disrupted NorthwesTel's cellular and Internet services in Iqaluit, Nunavut. Network diversity is an abiding, albeit potentially costly, concern. In its 2011 ACIA report, the Northern Communications and Information Systems (NCIS) Working Group identified several instances of fibre breaks along non-redundant links and their negative impacts on territorial services. To mitigate the problem, in 2011 NorthwesTel added an important redundant network link between N.W.T. and British Columbia.[15] Observers noted that service providers in Canada's other Northern regions have similar investment decisions to make.
5. **Increased efforts to improve affordability:** Northern regions are typically high-cost areas for personal telecommunications and high-speed Internet services, where geographic challenges are compounded by low population densities and small dispersed economies. Most Northern families have earnings below the national average while the cost of living is much higher in the North than in the South. If Canadian social policy is serious about developing a Northern knowledge-based economy, it should

13 North American Industry Classification System.

14 CBC News North, *Yukon Phone, Internet Services Partly Restored.*

15 NorthwesTel, *NorthwesTel Completes New Fibre Link.*

investigate the relevance of a Northern subsidy for residential broadband services—including personal telecommunications and high-speed Internet access.

6. **Careful regulation of investment decisions, service plans, and subsidy requests of Northern service providers to ensure their Northern customers receive adequate service:** Northern telecommunications occupies a special regulatory context. Apart from regional census metropolitan areas, most Northern communities in the provinces are designated as High Cost Serving Areas by the CRTC. Incumbent carriers to these High Cost Serving Areas, such as Bell Aliant, MTS Inc., SaskTel, and TELUS, are obliged to provide affected communities with services such as touchtone dialing, 911, and directory listings, as well as long-distance free dial-up Internet. They have no obligation to provide communities with high-speed Internet or broadband-related services. Even certain features of a modern telephone system, such as enhanced 911, are not available everywhere there is telephone access. In the Arctic territories, the incumbent NorthwesTel has its own unique regulatory context—an acknowledgment that its costs are higher than the provincial incumbent carriers. In the furthest reaches of Nunavut, for example, there is no 911 calling service.[16] In this context, the introduction of competitive services may benefit some areas, but it may also undermine the potential for cross-subsidies to spur innovation. CRTC must carefully consider its potential influence on how incumbent carriers and their competitors invest in next-generation networks across the North.
7. **Increased Northern and Aboriginal content development, relevant delivery channels, and appropriate support for digital literacy:** Having affordable and reliable broadband ICTs is a necessary but not a sufficient condition for Northerners and Northern organizations to use them. Northerners, especially Aboriginal communities, need the Internet and next-generation networks to deliver relevant Northern content. Having access to only Southern content will not benefit them in the same way as having information that also reflects their unique realities and needs. Furthermore, the technical advantages of having e-learning systems to deliver educational curricula and vocational training must not overshadow the continuing need for culturally relevant teaching modalities that work for Northerners and Aboriginal youth. New media aptitudes such as digital literacy are crucially important for Northerners and Aboriginal youth. Just as the Internet and social media provide endless creative possibilities and real economic potential, they introduce new concerns about social identity, privacy, and security.

16 CRTC, *911 Services*.

Appendix A

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