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Manitoba and a Digital-First Future:

The Implications of Connectivity for Equity and Education

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Preface

ICTC is a national center of expertise on the digital economy. With over 25 years of experience in research and program development related to technology, ICTC has the vision of strengthening Canada's digital advantage in the global economy. Through forward-looking research, evidence-based policy advice, and creative capacity building programs, ICTC fosters innovative and globally competitive Canadian industries, empowered by a talented and diverse workforce.

Tech Manitoba represents the province's growing tech sector. Tech Manitoba is an industry-led association that helps companies thrive and grow through collaboration, education, and promotion. Tech Manitoba brings people together to share skills, explore ideas, and build a strong community. Through programming, events, and building connections at a local, national, and international level, Tech Manitoba aims to stimulate economic growth in Manitoba, be the trusted voice of Manitoba's tech sector, and foster a culture where members thrive and grow.

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Glossary of Key Terms

This glossary presents an overview of terminology used but not fully expanded upon within the text.

Bandwidth: the maximum capacity of an internet connection; it is different from the actual speed at any given moment.

Dark Fiber (or Unlit Fiber): refers to unused optical fibre lines, available for use in fibre-optic communication. Often, companies install more lines than are needed for current demand to allow for future expansion and to provide network redundancy without having to reincur the significant engineering costs for further installation. This excess capacity is often leased to individuals or other companies as an additional revenue stream.

Download Speed: the speed, typically measured in megabits per second (Mbps), at which data can be pulled from a server to the local computer. Most systems are designed to have higher download speeds than upload speeds since a large proportion of online interactions—browsing websites and social media, accessing emails and shared files, streaming audio and video, etc.—involve fetching and receiving data from servers.

Fiber to the x (FTTx): a catch-all term for broadband network layouts that use optical fiber cables to provide all or part of a last mile telecommunications network. FTTx can refer to various configurations of fiber deployment, which fall into two groups: FTTH/B/P (fiber to the home/building/premises), where the fiber optic cable is laid all the way to the end user, and FTTC/N (fiber to the cabinet/node), where copper wires complete the final leg of the connection from the intermediate node to the end user.

Jitter: the variation in time between data packets arriving. Typically measured in milliseconds (ms), jitter is caused by network congestion or route changes. High jitter can increase latency and result in packet loss, affecting internet performance, and video and audio call quality.

Latency: the amount of time it takes for a bit of data to travel to its destination and back (for example, a ping from a home computer traveling to the internet service provider's server and back to the home computer). Latency is affected by the software and hardware used to access a network and by the utilisation level of the network. Sometimes referred to as the ping, ping time, or ping rate, it is typically measured in milliseconds (ms).

Glossary of Key Terms

Packet Loss: the number of transmitted packets of data that fail to reach an intended destination, usually represented as a % of total packets sent.

Ping: a request sent to a server.

Ping Rate: the time it takes to send a request to a server and to receive the response; another way of describing latency.

Managed Network: a type of communication network that is built, operated, secured, monitored, and maintained by a third-party service provider. Managed networks may provide hardware such as servers, routers, and switches, as well as operating system and firewall software to run and secure backend infrastructure and data storage.

Streaming: a method of transmitting or receiving data (especially audio or video content) over a computer network as a steady, continuous flow, allowing playback to start while the rest of the data is still being received.

Upload Speed: the speed, typically measured in Mbps, at which data can be sent from the local computer to a server, through the network. Activities such as sending email, online gaming, and video and audio calls require data to be sent from the local computer to external servers. The quality of these interactions depends on the upload speed of the network connection.

Executive Summary

Broadband internet is an indispensable service in modern society. Access to reliable, affordable, high-speed broadband internet services is becoming vital to the economic and social welfare of communities across Canada. Broadband internet benefits rural and remote communities by bringing them, among other things, educational resources, better health services, and greater economic opportunities.[1] However, a digital divide persists in Canada—several rural, remote, and low-income areas still receive inadequate internet services, or none at all.

The recent COVID-19 pandemic has further served to highlight this divide and the importance of digital equity in providing improved access to education, healthcare, employment, and other social and economic opportunities. This study explores broadband connectivity and its impact on educational equity in Manitoba, highlighting how a lack of reliable and affordable high-speed internet is particularly detrimental to learners. This issue is compounded by the increasing number of educational resources and experiences that rely on access to technology.

Issues such as bandwidth availability, connectivity speeds, cost of services, usage caps, and infrastructure needs currently impact digital equity in Manitoba, particularly among populations living in rural and remote locations. While there has been an improvement in the quality of internet services in the province in recent years, several infrastructure and service gaps remain. This study also highlights relevant international best practices to motivate further research towards addressing these gaps and improving educational equality in Manitoba. By analyzing case studies from regions that face similar challenges—expansive and rugged terrain, remote and isolated settlements, sparse populations, and systemically disadvantaged communities—this report provides a useful framework for the continued development of innovative, multifaceted strategies to help close Manitoba's digital divide.

1. Ruimy, Dan, "Broadband Connectivity in Rural Canada: Overcoming the Digital Divide," House of Commons Canada, April 2018, www.ourcommons.ca/Content/Committee/421/INDU/Reports/RP9711342/indurp11/indurp11-e.pdf

Introduction

Issues of digital equity continue to present themselves across Canada. An investigation of digital equity can include questions related to connectivity, access, location, cost, and the experience of those from rural and remote communities. Most recently, COVID-19 has highlighted the importance of digital access and equity by suggesting that the future will see many more digitally accessible economic and labour market opportunities.[2]

At the time of this report, lockdowns and stay-at-home orders are encouraging Canadians to remain indoors as much as possible and stay out of public areas. Educational institutions and students, among many others, have had to adapt to this new reality by pivoting to methods of teaching and learning online. As a result, blended and remote learning concepts and practices have become commonplace, and for those living in what are deemed "COVID-19 hot spots," online learning is part of daily life. Bandwidth availability, connectivity speeds, cost of services, usage caps, and infrastructure needs are a few of the considerations currently impacting digital equity in Manitoba, particularly among populations living in rural and remote locations.

To better understand the concept of digital equity and its manifestation in Manitoba, this paper considers the following five dimensions of digital equity[3]:

- Access to hardware, software, and connectivity to the internet
- Access to meaningful, high-quality, culturally relevant content in local languages
- Access to creating, sharing, and exchanging digital content
- Access to educators who know how to use digital tools and resources
- Access to high-quality research on the application of digital technologies to enhance learning

Although this is a list requiring extensive research in several areas related to technology, education, and policy, the focus of this study is to primarily explore connectivity and its impacts on educational equity. This study investigates the current state of broadband connectivity and access across Manitoba, while examining best practices via international case studies from regions facing similar challenges. This includes countries with geographic, educational, and economic similarities to Canada and Manitoba in particular.

2. Ivus, Maryna; Kotak, Akshay; McLaughlin, Ryan, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022," Information and Communications Technology Council, August 2020, www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf

3. Resta P., Lafrerriere T., "Issues and Challenges Related to Digital Equity," International Handbook of Information Technology in Primary and Secondary Education, 2008, link.springer.com/chapter/10.1007/978-0-387-73315-9_44

"A lack of digital access is a lack of access to education, period."

Terry Godwaldt, Director of Programming,
The Center for Global Education, Canada

"5 Things Every Educator Should Know About Digital Equity", International Society for Technology in Education (ISTE), April 12, 2017, www.iste.org/explore/Lead-the-way/5-things-every-educator-should-know-about-digital-equity

DIGITAL EQUITY IN CANADA

Internet access is a key component of everyday Canadian life. It impacts our ability to communicate with friends and family, access online entertainment and news content, attend a virtual doctor's appointment, and engage in online learning. Taking into account ongoing trends in digitization and the impact of COVID-19 in accelerating the importance of digital adoption,[4] the need for internet access for all Canadians is as pressing as ever. In April 2020, 3.4 million Canadians began working from home.[5] While this number has decreased in the months since (many workers began returning to the office, at least occasionally, when lockdowns lifted in the summer), there were still twice as many Canadians working from home in September 2020 than in the pre-COVID period.[6] However, the pathway to remote work is not without challenges. Particularly, students and workers without sufficient internet access can face challenges acclimating to the new realities of remote working and learning.[7]

4. Ivus, Maryna; Kotak, Akshay; McLaughlin, Ryan, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022," Information and Communications Technology Council, August 2020, www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf

5. "Labour Force Survey, August 2020," September 4th, 2020, Statistics Canada, www150.statcan.gc.ca/n1/daily-quotidien/200904/dq200904a-eng.htm

6. "Labour Force Survey, September 2020," October 9th, 2020, Statistics Canada, www150.statcan.gc.ca/n1/daily-quotidien/201009/dq201009a-eng.htm

7. Ian Froese, "Lack of computers, internet access exposes shortfall of at-home learning in Manitoba," April 14, 2020, CBC News, www.cbc.ca/news/canada/manitoba/lack-computers-internet-shortfall-at-home-learning-manitoba-winnipeg-1.5531100

Canadians use the internet in diverse ways. In 2018, 94% of Canadians had access to the internet at home. Of those, more than half (53%) had an internet-connected smart home device, such as a smart television (41%) or a smart speaker (15%).[8] In addition, 88% of users reported accessing the internet on a smartphone, and 23% had done some telework.[9] With the growth in at-home internet activity in recent years, the overall quality of the internet in Canada had also climbed. The median download speed in Canada has increased 46% from 2019 to 2020, going from 15.42 Mbps to 22.58 Mbps. Upload speeds have seen a similar rise, going from a national median of 5.79 Mbps in 2019 to 8.16 Mbps in 2020.[10] Provincial median download speeds range from 51.95 Mbps in Ontario to 5.64 Mbps in Newfoundland, while Ontario, British Columbia, and New Brunswick have the highest upload speeds.[11]

Figure 1: How do Canadians use the Internet? Statistics Canada, 2019[12]

Beyond enabling the smaller details of modern life, internet access also helps individuals access critical services, such as education,[13] government services,[14] and, increasingly, healthcare,[15] including mental health and psychiatry services.[16] As with teleworking and remote learning, COVID-19 has increased the prevalence of, and need for, telehealth,[17]

8. Statistics Canada, "Canadian Internet Use Survey," Statistics Canada, October 29, 2019, www150.statcan.gc.ca/n1/daily-quotidien/191029/dq191029a-eng.htm

9. Ibid.

10. CIRA, "Canada's Internet Factbook 2020," Canadian Internet Registration Authority, 2020, www.cira.ca/resources/factbook/canadas-internet-factbook-2020

11. Ibid.

12. Statistics Canada, "Canadian Internet Use Survey," Statistics Canada, October 29, 2019, www150.statcan.gc.ca/n1/daily-quotidien/191029/dq191029a-eng.htm

13. Johnson, Nicole, "Tracking Online Education in Canadian universities and Colleges: National Survey of Online and Digital Learning 2019 National Report," Canadian Digital Learning Research Association, 2020, www.cdlra-acrfl.ca/wp-content/uploads/2020/07/2019_national_en.pdf

14. "Service Canada," Government of Canada, 2020, www.canada.ca/en/employment-social-development/corporate/portfolio/service-canada.html

15. "2015 Canadian Telehealth Report," COACH: Canada's Health Informatics Association, 2015, livecare.ca/sites/default/files/2015%20TeleHealth-Public-eBook-Final-10-9-15-secured.pdf

16. Letto, Aimee; Ryan, Michelle, & Bornstein, Stephen, "Rural Psychiatry Practices and Models: A Canadian Jurisdictional Scan," Newfoundland and Labrador Centre for Applied Health Research, April 2018, www.nlcahr.mun.ca/CHRSP/Rural_Psychiatry_April2018_.pdf

17. George-Cash, David, "Canada's Telehealth Boom in 'Early Innings' as COVID Stokes Demand," BNN Bloomberg, October 15 2020, www.bnnbloomberg.ca/canada-s-telehealth-boom-in-the-early-innings-as-covid-19-stokes-demand-1.1507993

telepsychiatry,[18] and other digital health services in Canada.[19,20] These services can range from online doctor's appointments and lab requisitions to accessing support for home recovery from illness or injury, such as physiotherapy, dietary requirements, or medication information.[21]

Looking beyond digitally enabled healthcare services, recent research by the ACORN Institute has shown that internet access is also related to the social determinants of good health—the conditions in which people are born, grow, live, work, and age. These determinants inform Canadians' abilities to participate in the ever-growing digital-based economy. For example, internet access is important in assisting Canadians in their search for employment (e.g., searching for jobs, working from home), as well as related tasks like accessing banking and financial services, and maintaining social connections.[22]

A study on internet adoption in France[23] found that improvements to broadband adoption and quality also improved mean household income and reduced income inequality. The study analyzed data from over 5,000 French towns from 2009 to 2013 and found that broadband adoption contributed to 34% of the increase in average household income in this period, and 80% of the reduction in inequality, as measured by the Gini Index.[24] Improvement to the quality of broadband service, as measured by median download speed, was found to account for 6% of income growth and 20% of inequality reduction. The authors suggest that income equality is improved because broadband adoption and improvements to quality have a relatively greater impact on lower-income households. In addition, the study found that improvements to income equality were greater in regions of previously low internet penetration and in regions where education levels are higher or where there is less inequality in education. This would suggest that broadband diffusion policies should be complemented with access to education.[25]

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18. Centre for Addiction and Mental Health, "CAMH Enhances Virtual Capacity to Respond to Demand for Mental Health Services," Centre for Addiction and Mental Health, May 4 2020, www.camh.ca/en/camh-news-and-stories/camh-enhances-virtual-capacity

19. Ryan McLaughlin, "Telehealth: From Good Idea to Indispensable Public Policy," September 15, 2020, medium.com/digitalthinktankictc/telehealth-from-good-idea-to-indispensable-public-policy-c171ee44457a

20. Avis Favaro, et al., "Ontario implements virtual medical visits in bid to keep doctors, patients safe amid COVID-19," CTV News, March 14, 2020, www.ctvnews.ca/health/coronavirus/ontario-implements-virtual-medical-visits-in-bid-to-keep-doctors-patients-safe-amidcovid-19-1.4853436

21. Ibid.

22. ACORN Institute Canada, "Access to the Digital Economy and Health," ACORN Institute Canada, acorncanada.org/sites/default/files/Digital%20Economy%20Report%20Final.pdf

23. Houngbonon, Georges Vivien & Liang, Julienne, "Broadband Internet and Income Inequality," HAL Archives, 2017, hal.archives-ouvertes.fr/hal-01653815/document

24. The Gini Index, a co-efficient of statistical dispersion in a distribution, is often used to measure the inequality of income across a population

25. Ibid

The Digital Divide

The "digital divide" is a term used to reference the differences in access to technology across different regions or populations. In this context, devices like laptops, mobile phones, and computers are included, in addition to services like broadband internet. Differences in technology access tend to occur between groups with different levels of income and between groups located in rural and urban areas. Telecommunications services require relatively large up-front investments in physical infrastructure, followed by regular maintenance of that infrastructure.[26] Largely due to this cost, as well as challenging terrain in Canada and in countries with similar geography,[27] the quality of internet access has historically been lower in rural and remote areas.

"The digital divide—a term that refers to the gaps in access to information and communication technology (ICT)—threatens the ICT have-nots, whether individuals, groups, or entire countries. Education and learning lie at the heart of these issues and their solutions. The gaps that define the learning digital divide are thus as important as the more obvious gaps in access to the technology itself."

Organization for Economic Cooperation and Development

"Bridging the Digital Divide", OECD: Schooling for Tomorrow Knowledge Base, www.oecd.org/site/schoolingfortomorrowknowledgebase/themes/ict/bridgingthedigitaldivide.htm

26. Elvidge, A.M., Martucci, J. Telecommunications Network Total Cost of Ownership and Return on Investment Modelling. BT Technology Journal 21, 184–190 (2003). doi.org/10.1023/A:1024467706446

27. Park, Sora, et al., "The Multi-Layers of Digital Exclusion in Rural Australia," University of Canberra, 2015, researchprofiles.canberra.edu.au/en/publications/the-multi-layers-of-digital-exclusion-in-rural-australia

In the Canadian context, the digital divide is most salient for youth in rural areas.[28] These individuals are less likely to have access to computers in the home, spend less time on the computer, and tend to report lower levels of competency with respect to computer skills.[29] Internet infrastructure and affordability in rural areas play a large role in this trend. A 2018 study conducted by the Pew Research Institute found that only two-thirds of Americans in rural areas have access to broadband, positioning them well behind their urban and sub-urban counterparts in the adoption of at-home internet, smartphone and tablet usage, and the ownership of hardware (desktops and laptops).[30]

A similar gap in service availability and quality exists in Canada. A study conducted by the Canadian Internet Registration Authority (CIRA) in 2020 showed that "rural download speeds were measured at 3.78 Mbps, compared to 44.09 Mbps in urban Canada."[31] The same study showed that on average, upload speeds in urban areas are ten times faster than upload speeds in rural settings. Fast upload speeds are necessary for video conferencing, cloud storage, and educational tools, especially as more Canadians work and study from home due to COVID-19.[32] Of course, download and upload speeds only comprise a part of service quality and performance. A holistic approach to bridging the digital divide must also consider other metrics such as latency, redundancy, frequency and duration of service outages, affordability, and digital literacy.[33]

Canada's Universal Service Objective

In December 2016, the Canadian Radio-Television and Telecommunications Commission (CRTC) declared high-speed internet access to be a "basic telecom service" in Canada.[34] The CRTC also extended the definition of "basic telecom service" to include unlimited data

28. Looker, Dianne E. & Thiessen, Victor, "The digital divide in Canadian schools: factors affecting student access to and use of information technology," Research Data Centres, 2003, www150.statcan.gc.ca/n1/en/pub/81-597-x/81-597-x2003001-eng.pdf?st=qeW2VbmD

29. Ibid.

30. Perrin, Andrew, "Digital gap between rural and nonrural America persists," Pew Research Centre, 2019, www.pewresearch.org/fact-tank/2019/05/31/digital-gap-between-rural-and-nonrural-america-persists/

31. CIRA, "New Internet Performance Data Shows the Staggering Scale of Canada's Urban-Rural Digital Divide," CIRA, 2020, www.cira.ca/newsroom/new-internet-performance-data-shows-staggering-scale-canadas-urban-rural-digital-divide

32. Ibid.

33. Ruimy, Dan, "Broadband Connectivity in Rural Canada: Overcoming the Digital Divide," House of Commons Canada, April 2018, www.ourcommons.ca/Content/Committee/421/INDU/Reports/RP9711342/indurp11/indurp11-e.pdf

34. Canadian Radio-Television and Telecommunications Commission, "Telecom Regulatory Policy CRTC 2016-496," Government of Canada, December 21, 2016, crtc.gc.ca/eng/archive/2016/2016-496.htm

options—for urban and rural customers—and set the target download and upload speeds to at least 50 Mbps and 10 Mbps, respectively.[35] The CRTC also reported that while 82% of Canadians already had access to those speeds, this level of service was not currently available as in rural and Northern communities.

When announcing the new universal service objective, the CRTC referred to these targets "ambitious, but realistic," noting that it chose those goals based on similar targets set by Canada's trading partners.[36] Agencies in the US and Australia had set target speeds at 25 Mbps, Europe generally at 30 Mbps, and Germany at 50 Mbps. The CRTC said it expects services that meet the target speeds to be available to 90% of households by the end of 2021 and to the remaining 10% within the following 10 to 15 years.[37]

As mentioned earlier, 82% of Canadian households have 50/10 Mbps internet access, but in rural communities, only 37% do.[38] Testing conducted in early 2020 by CIRA shows the contrast between rural and urban internet speeds:

	Urban (median)	**Rural** (median)
Download Speeds	34.13 Mbps	6.05 Mbps
Upload Speeds	10.25 Mbps	1.19 Mbps
Jitter	25.99 ms	31.95 ms
Latency	11 ms	FR4
Packet Loss	2.20%	5.50%

Table 1: Rural vs. Urban Internet speeds. Canadian Internet Registration Authority, 2020.[39]
Median values are used as they are less distorted by the small number of outliers with extremely high speeds and are therefore more representative of the sample.

Fully closing the digital divide between urban and remote communities will come with upgrades to existing infrastructure and the deployment of new infrastructure across Canada. This is a significant capital investment that will require the combined effort of various stakeholders, including government, communities, and industry.[40] To aid this

35. Dobby, Christina, "CRTC Rules High-Speed internet a Basic Service, Sets Target," The Globe and Mail, December 21, 2016, www.theglobeandmail.com/report-on-business/crtc-rules-high-speed-internet-a-basic-telecom-service/article33405960/

36. Ibid.

37. Ibid.

38. Government of Canada, "High-Speed Access For All: Canada's Connectivity Strategy," Innovation, Science and Economic Development Canada, July 16, 2019, www.ic.gc.ca/eic/site/139.nsf/eng/h_00002.html

39. CIRA, "Canada's Internet Factbook 2020," Canadian Internet Registration Authority, 2020, www.cira.ca/resources/factbook/canadas-internet-factbook-2020

40. Canadian Radio-Television and Telecommunications Commission, "Broadband Fund | About the Fund," Government of Canada, October 29, 2019, crtc.gc.ca/eng/internet/fnds.htm

journey, the CRTC has established the Broadband Fund—a $750 million fund that, over five years, will finance investments to improve internet access in remote areas.[41] Another program, the Connect to Innovate program, was established to bring broadband services to remote and rural communities by 2023.[42]

First Nations Communities

Many First Nations communities are considered to be unserved or underserved in the context of internet access. A 2018 report by the Auditor General of Canada found that many rural and remote regions in Canada, including numerous First Nations communities, lack access to broadband high-speed internet.[43] Recent data from the CRTC show that only 31.3% of First Nations reserves in Canada have access to internet services at 50/10 Mbps speeds: on First Nations reserves in Manitoba, that coverage fraction drops to just 1.8%.[44]

Although there are several public funding programs designed to target unserved and underserved communities, barriers exist that can prevent communities from applying for these programs. ConnectIN,[45] a two-year pilot study in British Columbia, Alberta, and Manitoba, brought to light some of these challenges. This project ran from 2018 to 2020 and was led by three First Nations' regional technology organizations, with financial support from CIRA, and additional support from Cybera and the University of Alberta. The report[46] highlighted key issues affecting internet accessibility for First Nations communities in these provinces:

- Infrastructure funding from the Broadband Fund is earmarked for projects serving areas that are either identified as being underserved, or those with proven lower speeds than universal service targets. Regions are broken into hexagonal tracts, 25 km in radius, and assigned with an "adequate" or "inadequate" classification.

41. Dobby, Christina, "CRTC Rules High-Speed internet a Basic Service, Sets Target," The Globe and Mail, December 21, 2016, www.theglobeandmail.com/report-on-business/crtc-rules-high-speed-internet-a-basic-telecom-service/article33405960/

42. Government of Canada, "Connect to Innovate," Innovation, Science and Economic Development Canada, May 29, 2020, www.ic.gc.ca/eic/site/119.nsf/eng/home

43. Auditor General of Canada, "Report 1- Connectivity in Rural and Remote Areas," Office of the Auditor General of Canada, 2018, www.oag-bvg.gc.ca/internet/English/att__e_43221.html

44. Canadian Radio-Television and Telecommunications Commission, "Communications Monitoring Report 2019," Government of Canada, 2020, crtc.gc.ca/eng/publications/reports/policymonitoring/2019/cmr9.htm

45. "ConnectIN: Testing the Gaps in First Nation's Internet Connectivity," Cybera, October 4, 2018, www.cybera.ca/connectin/

46. "Research Proves the Connectvity barriers Faced by Indigenous Communities are Very Real, and Very Limiting," Cybera, March 30, 2020, www.cybera.ca/research-proves-the-connectivity-barriers-faced-by-indigenous-communities-are-very-real-and-very-limiting/

This means that even if just one household within the hexagon has adequate access, the entire tract is deemed to be adequately served, irrespective of the connectivity of others within the hexagon.

- Some remote communities cannot test their connectivity speeds using online testing tools; their speeds are sometimes too low to support the tools. This necessitates the use of specially programmed hardware for speed testing, which is not easily available to all communities, and requires additional investment of time and money. Similarly, remote communities that do not use postal codes (which many First Nations communities do not, but which are required for online speed testing) cannot easily get speed test results that are correctly correlated to their locations.

These technical issues make it difficult for communities to adequately prove that they are underserved and eligible for infrastructure funding. The ConnectIN project also helped conduct speed testing in some First Nations communities using physical devices installed in public buildings. Of the 20+ communities tested, less than half achieved average upload speeds greater than the minimum of 10 Mbps, and only a quarter achieved average download speeds greater than the minimum of 50 Mbps. Connectivity also fluctuated at different points in the day, to the extent that several communities that nominally met the upload/download minimums only did so at impractical times like 4 to 5 a.m. More than half the communities fell entirely below the minimum target speeds of 10 Mbps up/50 Mbps down.[47]

Low-Income Neighbourhoods

While the universal service target is a laudable objective with broad support, it remains difficult to measure actual speeds and service quality, as illustrated above. The CRTC often uses data provided by internet service providers (ISPs) to assess broadband availability and speeds.[48] These microdata are usually not shared publicly as network operators consider them to be strategic intelligence. This lack of open, public domain measurement data limits meaningful evaluation, comparison, and analysis of service delivery across Canada.[49]

47. "Research Proves the Connectvity barriers Faced by Indigenous Communities are Very Real, and Very Limiting," Cybera, March 30, 2020, www.cybera.ca/research-proves-the-connectivity-barriers-faced-by-indigenous-communities-are-very-real-and-very-limiting/

48. Canadian Radio-Television Telecommunications Council, "Broadband Service Availability: Methodology," Government of Canada, 2020, crtc.gc.ca/eng/publications/reports/policymonitoring/2019/cmr9.htm#a5.4

49. Canadian Internet Registration Authority, "Telecom Notice of Consultation CRTC 2019-406: Call for Comments Regarding Potential Barriers to the Deployment of Broadband-Capable Networks in Underserved Areas in Canada," CIRA, May 7, 2020, www.cira.ca/sites/default/files/2020-05/CRTC%202019-406%20CIRA%20Submission.pdf

Furthermore, as shown in a recent study,[50] framing the digital divide as primarily an urban or rural issue can be problematic. Using public data from the M-Lab Network Diagnostic Test,[51] the study found that even within urban areas, usually considered to be well served, average internet speeds can vary by neighbourhood due to variations in infrastructure. Even in the Greater Toronto and Hamilton Area (GTHA)—Canada's most populous metropolitan area—older, lower-income neighbourhoods can still have average speeds under 10 Mbps.[52] Apart from a few areas in the downtown and business cores of the large cities within this region and some higher-income suburbs, average speeds across the GTHA were less than half of the CRTC's target of 50 Mbps.[53]

Internet Affordability

In addition to geographic barriers, there is a clear gap in internet access based on income. According to the CRTC's latest Communications Monitoring Report,[54] only 69% of Canadians in the lowest-income quintile (annual earnings less than $33,000) had internet access at home in 2017, compared to 94.5% in the highest quintile (annual earnings over $132,909). Hardware access shows a similar trend: only 63% of those in the lowest-income quintile had access to a working home computer, compared to 95% of those in the highest quintile. Low-income Canadians spend 9.1% of their income on communication services such as mobile or landline fees, internet, and television. On average, Canadians spend $233 per month on these services, with $155 going towards mobile and internet services.[55]

Low-income Canadians spend 9.1% of their income on communication services such as mobile or landline fees, internet, and television.

50. Rajabiun, Reza & McKelvey, Fenwisk, "Complementary Realities: Public Domain Internet Measurements in the Development of Canada's Universal Access Policies," The Information Society, 2019, www.davidellis.ca/wp-content/uploads/2019/05/RajabiunMcKelvey-InfoSoc2019.pdf

51. Measurement Lab, "NDT (Network Diagnostic Tool)," MLab, 2015, www.measurementlab.net/tests/ndt/

52. Rajabiun, Reza & McKelvey, Fenwisk, "Complementary Realities: Public Domain Internet Measurements in the Development of Canada's Universal Access Policies," The Information Society, 2019, www.davidellis.ca/wp-content/uploads/2019/05/RajabiunMcKelvey-InfoSoc2019.pdf

53. Ibid.

54. Canadian Radio-Television and Telecommunications Commission, "Communications Monitoring Report 2019," Government of Canada, 2020, crtc.gc.ca/pubs/cmr2019-en.pdf

55. Ibid.

Canadian Broadband Policy: A History

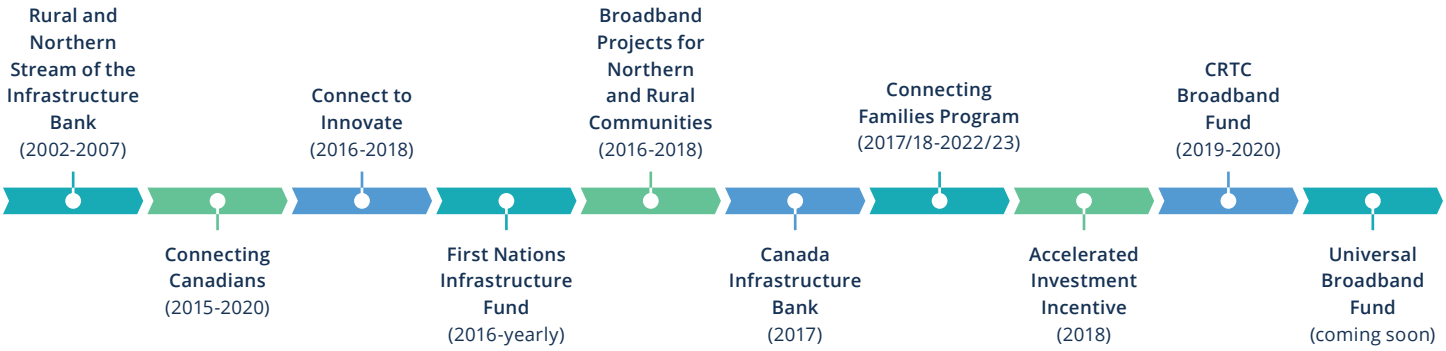

Figure 2: Canadian Broadband Policy (2002–present)

Over the years, the Government of Canada has initiated many programs to try to bring broadband access to all areas of the country—including Manitoba. Those in rural and remote areas, especially those in First Nations communities, have limited to no broadband access. Households on First Nations reserves have only 24% coverage for broadband at 50/10 Mbps, and even at the lower speed of 1.5 Mbps the coverage is only 90.8%.[56] The programs and initiatives discussed below were set up, at various points in time, with the aim of bringing broadband access to unserved and underserved areas.

The Rural and Northern Stream of the Investing in Canada Infrastructure Program ran from 2002 to 2007. This program was given $2 billion to provide infrastructure for broadband access to northern rural communities.[57] The Government also allocated $2 billion to be spent over the next decade for infrastructure projects, including broadband and telecommunications, in northern and rural communities as part of its Investing in Canada Plan, set up in 2017.[58] Similarly, the First Nations Infrastructure Fund was created to address infrastructure gaps on reserves.[59] These funds are designed for infrastructure projects, including those focused on connectivity, that are identified, reviewed, and selected by Indigenous Services Canada (ISC) as part of their annual First Nations Infrastructure Investment Plan (FNIIP) assessments.[60]

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56. Government of Canada, "High-Speed Access For All: Canada's Connectivity Strategy", Innovation, Science and Economic Development Canada, July 16, 2019, http://www.ic.gc.ca/eic/site/139.nsf/eng/h_00002.html; Canadian Radio-Television and Telecommunications Commission, "Communications Monitoring Report 2019," Government of Canada, January, 2020, crtc.gc.ca/pubs/cmr2019-en.pdf

57. Government of Canada, "High-Speed Access For All: Canada's Connectivity Strategy," Innovation, Science and Economic Development Canada, July 16, 2019, www.ic.gc.ca/eic/site/139.nsf/eng/h_00002.html

58. Infrastructure Canada, "Rural and Northern Communities Infrastructure," Government of Canada, September 20, 2018, www.infrastructure.gc.ca/plan/rnc-crn-eng.html

59. Government of Canada, "First Nations Infrastructure Fund," Indigenous Services Canada, June 13, 2017, www.sac-isc.gc.ca/eng/1100100010656/1533645154710

60. Ibid.

The Connecting Canadians program,[61] initiated in 2015, earmarked $500 million to help provide high-speed internet to households in rural and remote communities, and to enable them to participate in the digital economy. The five-year program has already funded over 80 projects across Canada that are expected to provide up to 300,000 households with improved internet connectivity.[62]

A program similar to Connecting Canadians is the Connect to Innovate project, which began in 2016 and aims to bring high-speed internet access to 975 rural and remote communities, including 190 Indigenous communities.[63] From 2016–2018, the government of Canada provided $585 million to Connect to Innovate to provide "backbone" infrastructure in rural and remote Canadian communities including fiber-optic cable, satellite, and microwave services.[64]

The Connecting Families Program intends to invest $13.2 million over five years (starting in 2017–2018) to help struggling Canadian families gain access to the internet. The program will distribute up to 50,000 computers to eligible households (those who make $30,000 a year or less) to allow families and youth access the tools they need via the internet.[65]

The Government of Canada created the Accelerated Investment Incentive to encourage businesses to invest in land, buildings, and equipment, and to encourage telecommunications firms to invest in fiber connectivity, wireless services, and broadband infrastructure.[66] Since the introduction of the incentive in 2018, many telecommunications service providers have announced that they will be expanding their services to cover rural and remote areas, including along major roads.[67] The Canada Infrastructure Bank (starting June 22, 2017) is also supporting connectivity projects through private investments, with the intention to extend the reach and durability of public funds.[68] The Infrastructure Bank has designated $1 billion for funding tools such as loans, equity, and loan guarantees, and seeks to leverage $2 billion in private investments.[69]

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61. Government of Canada, "Connecting Canadians Digital Canada 150," Connecting Canadians, August 20, 2020, www.ic.gc.ca/eic/site/028.nsf/eng/h_00587.html

62. Connecting Canadians, "Announced Connecting Canadians Projects," Government of Canada, December 19, 2019, www.ic.gc.ca/eic/site/028.nsf/eng/50044.html

63. Government of Canada, "Connect to Innovate," Innovation, Science and Economic Development Canada, May 29, 2020, www.ic.gc.ca/eic/site/119.nsf/eng/home

64. Ibid.

65. Government of Canada, "Connecting Families," Innovation, Science and Economic Development Canada, November 11, 2019, www.ic.gc.ca/eic/site/111.nsf/eng/home

66. Government of Canada, "High-Speed Access For All: Canada's Connectivity Strategy," Innovation, Science and Economic Development Canada, July 16, 2019, www.ic.gc.ca/eic/site/139.nsf/eng/h_00002.html

67. Ibid.

68. Ibid.

69. Ibid.

The CRTC created the Broadband Fund in 2016, earmarking $750 million to provide unserved and underserved communities in Canada with broadband internet and mobile wireless services.[70] This will be supplemented with the Universal Broadband Fund,[71] which is scheduled to be launched soon and is being designed to meet the needs of rural and remote Canadian communities by providing broadband services to fit their unique needs. The Universal Broadband Fund is part of the federal government's new, coordinated plan to meet its universal service objective, High Speed Access for All: Canada's Connectivity Strategy.[72] The plan aims to deliver up to $6 billion in investments in rural broadband projects over the next decade.

The goal for all these initiatives is to provide Canadians in rural and remote communities with broadband of at least 50/10 Mbps. This level of broadband speed is needed for the stable functioning of cloud-based software and for online learning and telehealth services.[73] Achieving this ambitious goal will need billions of dollars in public and private investment to activate current dark fibre and to lay down new fibre and other infrastructure.[74] The lack of connectivity in these communities has created a national connectivity gap where only 37% of rural households and 24% of households in Indigenous communities have access to 50/10 Mbps, compared to 97% of urban homes.[75] The goal of the Government of Canada's latest connectivity plan is to achieve the broadband target for all Canadians by 2030.[76] Collectively, the projects funded by the initiatives discussed above will be laying over 20,000 km of fibre-optic cable across Canada.[77] This will enhance connectivity to over 380,000 households and 1,100 anchor institutions (like schools, libraries, and hospitals). In addition to opportunities for online education and healthcare, improvements to broadband connectivity should increase employment opportunities across Canada.[78]

Canada is an expansive country with many topographical features such as hills, mountains, valleys, and muskegs. This creates difficulties for internet infrastructure, and just one single type of technology will not be adequate to connect the country. Many different

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70. Canadian Radio-Television and Telecommunications Commission, "Broadband Fund Closing the Digital Divide," Government of Canada, August 12, 2020, crtc.gc.ca/eng/internet/internet.htm#apply

71. Government of Canada, "Universal Broadband Fund," Innovation, Science and Economic Development Canada, August 27, 2020, www.ic.gc.ca/eic/site/139.nsf/eng/h_00006.html

72. Government of Canada, "High-Speed Access For All: Canada's Connectivity Strategy," Innovation, Science and Economic Development Canada, July 16, 2019, www.ic.gc.ca/eic/site/139.nsf/eng/h_00002.html

73. Ibid.

74. 2018 Fall Reports of the Auditor General of Canada to the Parliament of Canada, "Report 1—Connectivity in Rural and Remote Areas," Office of the Auditor General of Canada, September , 2018, www.oag-bvg.gc.ca/internet/English/parl_oag_201811_01_e_43199.html

75. Government of Canada, "High-Speed Access For All: Canada's Connectivity Strategy," Innovation, Science and Economic Development Canada, July 16, 2019, www.ic.gc.ca/eic/site/139.nsf/eng/h_00002.html

76. Ibid.

77. Ibid.

78. Ibid.

technologies are necessary, including wireline, wireless, radio, and satellite connectivity.[79] The CRTC and the Federal Ministry of Innovation, Science, and Economic Development (ISED) have combined their data to create The National Broadband Data Information and National Broadband Map. This map describes where broadband infrastructure has been laid and where backbone infrastructure is still needed.[80] Some of these maps for Manitoba, showing coverage for various broadband speeds and ongoing projects and programs, can be found in Appendix III of this report.

BROADBAND, EDUCATION, AND EQUITY

Digital Trends in the Classroom

The state of education in Canada and around the world is changing. Many schools are turning to online learning, which comes with a set of unique opportunities and challenges. The recent accelerated move to digital education inspired by the COVID-19 pandemic presents an acute challenge for some Manitoban communities, particularly those outside of urban centres. With a majority of K-12 educators leveraging some form of technology in the classroom and assigning homework that requires a fair internet connection,[81] concerns surrounding the digital divide continue to grow. Many educators must now find new and creative ways to address issues of inequity. Some do so by offering two options for homework: online and physical submission, ensuring that student grades do not solely rely on connectivity.[82] Approximately 1 in 3 Canadian students use the internet for school on a daily basis, making the lack of access to reliable and high-speed internet in rural and remote communities a growing concern.[83]

79. Ibid.

80. Government of Canada, "National Broadband Data Information," Innovation, Science and Economic Development Canada, August 27, 2020, www.ic.gc.ca/eic/site/139.nsf/eng/00007.html

81. Vega, V., & Robb, M. B., "The Common Sense census: Inside the 21st-century classroom." Common Sense Media, 2019, www.commonsensemedia.org/sites/default/files/uploads/research/2019-educator-census-inside-the-21st-century-classroom_1.pdf

82. Ibid.

83. Google for Education, "Future of the Classroom: Emerging Trends in K-12 Canada Edition," Google, 2020, services.google.com/fh/files/misc/canada_future_of_the_classroom_country_report.pdf?utm_source=web&utm_medium=campaign&utm_campaign=FY19-Q2-global-demandgen-website-other-futureoftheclassroom

In an attempt to address internet equity, educational institutions around the world are piloting creative solutions. One school district in the State of Washington installed kiosks that provide free internet to low-income families in subsidized housing.[84] Another school in Virginia provides at-home, high-speed internet through a 4G wireless network that used to be dedicated for commercial use.[85] In Canada, institutions such as Brandon University in Manitoba are planning studies that will evaluate how local communities and their schools have deployed innovative ways to improve connectivity and access to education.

Canada, Manitoba, and Community

In Canada, the aforementioned Connecting Families Program aimed to invest $13.2 million to distribute 50,000 computers to households making less than $30,000 a year, households which otherwise have limited or no access to computers of their own. Ideally, this program looked to provide Canadian youth with access to internet resources that otherwise would have been difficult or financially challenging to obtain.[86]

Beyond simple connectivity, strong and reliable access to the internet can enable customized learning experiences. These allow students to learn anywhere, anytime, and in different ways, focusing on a child's mode of learning: visual, auditory, or kinesthetic. New digital learning experiences also allow students to learn interactively, despite doing distance education, using modelling tools or interactive games.[87] Furthermore, online classroom learning is also evolving. Videoconferencing is increasingly used to allow students to receive supports that are tailored to their needs, if and when strong internet connectivity is available.[88]

Manitoba Education is offering a combination of online and face-to-face learning opportunities that serve both student and family needs.[89] They are looking to provide distance education that, where adequate connectivity exists, offers learners enhanced

84. Krueger, Keith & Bjerede, Marie, "How Digital Equity Can Help Close the Homework Gap," The Journal, September 10, 2015, thejournal.com/articles/2015/09/10/how-digital-equity-can-help-close-the-homework-gap.aspx

85. Ibid.

86. Government of Canada, "Connecting Families," Innovation, Science and Economic Development Canada, November 11, 2019, www.ic.gc.ca/eic/site/111.nsf/eng/home

87. Newman, Daniel "Top 5 Digital Transformation Trends in Education for 2020," Forbes, August 1, 2019, www.forbes.com/sites/danielnewman/2019/08/01/top-5-digital-transformation-trends-in-education-for-2020/#746bc3e35739

88. Ibid.

89. Distance Learning Unit, "Distance Learning," Manitoba Education, 2020, www.edu.gov.mb.ca/k12/dl/index.html

access to learning resources, as well as diversified learning experiences that respect individual and community needs and implementation plans.[90] In addition, in 2014, Manitoba Education proposed a "Bring Your Own Device" (BYOD) policy, which was designed to allow students to bring their own personal laptops, smartphones, and tablets from home to use for educational applications.[91] Adoption of this BYOD policy since 2014 varies by school district: certain boards such as the Mountain View School Division (MVSD) have created a clear and distinct framework for both parents and students.[92] As Kirsten Thompson, Coordinator of ICT at MVSD explains:

"Almost every school division, if not individual schools within divisions, has some type of approach to BYOD, but they range from informal school-based practices to formal administrative procedures depending on the division."

BYOD policies are part of an effort to continue encouraging students to use technology in school, while supporting creative and critical thinking.[93]

90. Distance Learning Unit, "Distance Learning," Manitoba Education, 2020, www.edu.gov.mb.ca/k12/dl/index.html

91. Manitoba Education and Advanced Learning, "Bring Your Own Device Guide," Manitoba Education, 2014, www.edu.gov.mb.ca/k12/docs/support/byod/document.pdf

92. Rathgeber, M., "BYOD (Bring Your Own Device) Program," [Class Handout] Mountain View School Division, 2020

93. Manitoba Education, "Information and Communication Technology (ICT)," Manitoba Education, 2020, www.edu.gov.mb.ca/k12/tech/index.html

COVID-19 has necessitated the immediate and widespread adoption of online distance learning. Physical school and workplace closures related to the pandemic have created drastic shifts in network traffic.[94] As families across Canada begin to work and educate from home, residential networks have seen a significant rise in bandwidth consumption.[95] Reduced service quality and potential overage charges are issues that can disproportionately affect rural, remote, and low-income households, which tend to be served by older infrastructure with lower capacity or capped data plans.[96]

The rise of remote work and education will undoubtedly have notable impacts on households without access to the internet access. Previously, some students who lacked internet at home were able to make use of equipment and access points at schools or libraries—now, these resources have been removed due to public health reasons. According to recent research by ICTC on digital skills and education,[97] issues of economic inequity are a pressing concern for a future where education is increasingly accessed and conducted online. Shared personal computers at home, working parents, and limited broadband speeds were cited several times as critical issues impacting future learners. Similar concerns about equity were also raised in a recent survey of educators in Manitoba.[98]

Some ISPs have put in place temporary measures such as increasing data caps, suspending them altogether,[99] or extending free, public Wi-Fi hotspots into communities.[100] However, these are not holistic or long-term solutions. Ensuring that Canada fosters an inclusive digital ecosystem during, and after, COVID-19 will require accessible and affordable internet for all.

94. Carra, B., "OPINION: It's Time to Act on Rural Internet Access," CBC News, April 2, 2020, www.cbc.ca/news/canada/calgary/covid-19-rural-internet-access-cybera-1.5517643

95. McLeod, J., Jackson E., "Internet networks feel the strain as COVID-19 sparks surge in Canadians working from home," Financial Post, March 24, 2020, financialpost.com/telecom/networks-feel-strain-as-covid-19-sparks-surge-in-working-from-home

96. Ibid.

97. The Information and Communications Technology Council, "21st Century Digital Skills: Competencies, Innovations, and Curriculum in Canada," study forthcoming

98. Brandon School Division, "COVID-19 Employee Survey Final Report," Brandon University, April 2020, www.brandonu.ca/bu-cares/files/2020/04/BSD-Employee-Survey-Final-Report.pdf

99. Carra, Barb, "OPINION: It's Time to Act on Rural Internet Access," CBC News, April 2, 2020, www.cbc.ca/news/canada/calgary/covid-19-rural-internet-access-cybera-1.5517643

100. Smythe, Suzanne, "Digital Equity and Community Solidarity During and After COVID-19," Policy Note, April 21, 2020, www.policynote.ca/digital-equity/

The Current State of Broadband Access in MB

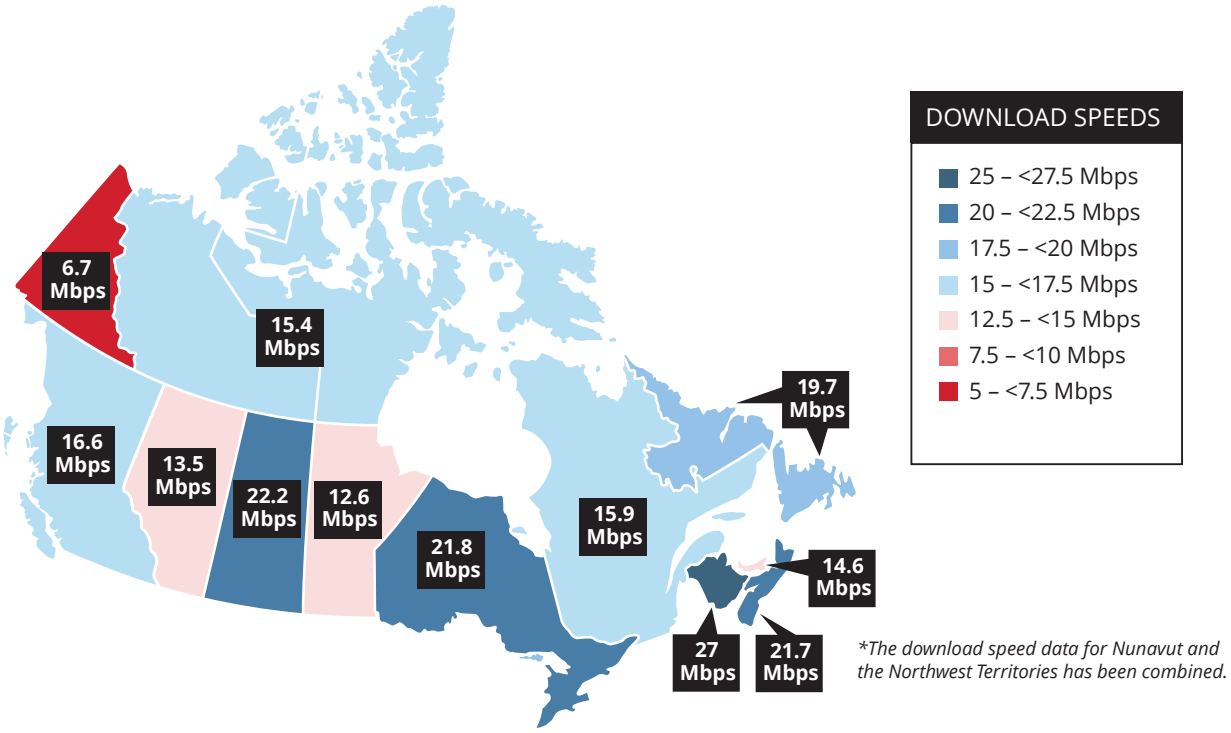

Figure 3: Broadband speeds in Manitoba are among the slowest in Canada. CBC News.

Broadband speeds in Manitoba are among the slowest in Canada. A 2016 report by the CIRA,[102] using data from online speed testing conducted in the second half of 2015, found that the average download speed in Manitoba was the second slowest in the country, only ahead of the Yukon. At that time, the report found that the average download speed in Manitoba was 12.6 Mbps.[103] While recent testing has shown an improvement in Manitoba's standing with regard to internet delivery,[104] it still lags behind the other large provinces when it comes to service quality and availability, especially in rural and remote communities, and First Nations reserves.[105]

101. CBC News, "Manitoba Internet Speeds Second Slowest in Canada," CBC News, June 2016, www.cbc.ca/news/canada/manitoba/internet-download-upload-speed-tests-canada-1.3558913

102. Canadian Internet Registration Authority, "Canada's Internet Performance: National, Provincial, and Municipal Analysis April 2016," CIRA, 2016, s3.documentcloud.org/documents/2819396/Canadas-Internet-Performance-Report.pdff

103. Ibid.

104. CIRA, "Canada's Internet Factbook 2020," Canadian Internet Registration Authority, 2020, www.cira.ca/resources/factbook/canadas-internet-factbook-2020

105. Canadian Radio-Television and Telecommunications Commission, "Communications Monitoring Report 2019," Government of Canada, 2020, crtc.gc.ca/eng/publications/reports/policymonitoring/2019/cmr9.htm

In terms of affordability, Manitoba is on par with the national average for broadband internet and mobile data costs. The average broadband internet connection (25/3 Mbps) in Manitoba in 2018 cost about $80.28, almost identical to the national average of $80.31.[106] For a 5GB mobile data plan, the average cost in Manitoba in 2018 was $47.6, compared to the national average of just over $51. The cost of a broadband connection is generally higher in rural communities when compared to urban centres, nationwide.[107]

Internet Provider	Features and Offerings (from ISP website)
Broadband Communications North gobcn.ca	• Provides broadband services to over 50 northern, rural, and remote communities in Manitoba • Speeds of up to 10 Mbps • Satellite, fixed wireless, microwave, and fibre services
Norway House Cree Nation Broadband nhcn.ca/broadband	• Provides broadband services to the Norway House Cree Nation (a community in Manitoba), a community of over 7,500 people. • High-speed internet and local television. • Broadband provided through a digital signal
Highspeed Crow highspeedcrow.ca	• Highspeed Crow uses local contractors and engineers • Offers 10 plans • Fibre and fixed wireless
Bell **bellmts.ca**	• Bell offers high-speed internet to over 50 Manitoban communities • Offers 14 plans • Internet provided through fibre and wireless
Xplornet xplornet.com	• Xplornet offers satellite internet—up to 50/25 Mbps • Aims to cover all of rural Manitoba with high speed Internet • Offers 4 plans • Provides internet through LTE and Satellite
Swift High Speed **swifthighspeed.com**	• Provides coverage to South East Manitoba • Offers 13 plans • Wireless and Fibre Optic
Westman Communications Group westmancom.com	• Hybrid fibre internet—up to 950 Mbps • Covers western Manitoba • Offers 7 residential plans
RFNow **rfnow.com**	• Offers 5 plans • Wireless and Fibre Optic Network • Provides coverage to southwestern Manitoba

106. Canadian Radio-Television and Telecommunications Commission, "CMR 2019-2018 Communications Services Pricing in Canada," Government of Canada, January 21, 2020, open.canada.ca/data/en/dataset/8bde476f-49e1-455d-9705-77e6ffab72ca

107. Ibid

Internet Provider	Features and Offerings (from ISP website)
Voyageur Internet voyageurinternet.ca	• Up to 55 Mbps • Offers 5 unlimited plans • Fixed wireless service provider
Full Throttle Networks ftnet.ca	• Up to 25 Mbps • Up to 4 residential plans available • Independent wireless service provider • Coverage for Winnipeg and surrounding communities
CommStream commstream.net	• Up to 100 Mbps • Up to 5 internet-specific residential plans • Wired and wireless service providers • Coverage for 27 communities, primarily in northern Manitoba
Hamiota hamiota.com/fibre-optics-internet	• Up to 1 Gbps (urban) and 100 Mbps (rural) • Up to 2 residential plans available • Fibre and wireless service provider • Coverage primarily for Hamiota and surrounding area, community model
Yellowhead Broadband yellowheadbroadband.ca	• Up to 85 Mbps • Wireless fibre optic network • Coverage primarily for the municipality of Yellowhead and surrounding area, community model
WiBand wiband.com	• Up to 10 Gbps (business) • Up to 3 business plans available • Wireless, fibre, and cable internet for business • Provides coverage to southern Manitoba
LesNet les.net	• Up to 1 Gbps (business) • Up to 2 business plans available • Fibre optic service • Provides coverage primarily to Winnipeg
Rionet rionet.ca	• Up to 150 Mbps (residential) • Up to 3 residential plans available • Fiber optic service available in Grandview, MB • Provides coverage to 20 communities

Table 2: Key Internet Service Providers in Manitoba.
Speeds and information may vary depending on services provided, region and other unadvertised issues. All information is provided directly from the related service provider.

Digitizing Rural and Northern Communities

A variety of solutions are being implemented to improve broadband access and connectivity in rural and remote communities across Canada. Technological solutions that are being explored include using idle bands of television spectrum, launching satellites in low Earth orbit, and laying fiber-optic cable. These solutions have varying degrees of applicability, based on geographic, technical, economic, and regulatory constraints. With over a quarter of its population living in rural and remote communities,[108] solutions like these are of particular importance to Manitoba.

Remote Rural Broadband Systems

The Remote Rural Broadband Systems (RRBS) is a Canadian wireless broadband initiative that encouraged new forays into the telecommunications sector by making use of unassigned television frequencies. The RRBS supplies broadband to the unserved and underserved by providing access to frequencies that can travel through obstacles such as walls, buildings, and trees.[109] The RRBS was a solution that sought to utilize the 600 MHz television spectrum to reach the unserved and underserved areas of Canada, and reduce the digital divide for rural and remote areas.[110]

RRBS systems provide wireless broadband to remote and rural areas through television waves in the 512–608 MHz and 614–698 MHz bands. Thus far, Canada has only authorized 614–698 MHz for RRBS. RRBS base stations provide service for a 220 km radius, depending on the equipment used and physical encumbrances.[111] Industry Canada's licensing procedure requires that operators work in locations at least 121 km away from the Canada–US border.[112] However, in the US, any RRBS service within 400 km of the US border is subject to non-interference with US signals. Hence, many RRBS providers operate much further north than the 121 km minimum stipulated by Canadian regulations.[113]

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108. Statistics Canada, "Population and Dwelling Count Highlight Tables, 2016 Census," Statistics Canada, Date accessed: October 28, 2020, www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/pd-pl/Table.cfm?Lang=Eng&T=302&PR=46&S=86&O=A&RPP=25

109. Taylor, Gregory, "Remote Rural Broadband Systems in Canada," Telecommunications Policy, 2018, doi.org/10.1016/j.telpol.2018.02.001

110, 111. Ibid.

112. Spectrum Management and Telecommunications, "Licensing Procedure for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV Channels 21-51)," Industry Canada, August 2011, www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/cpc2124e-issue2.pdf/$-FILE/cpc2124e-issue2.pdf

113. Taylor, Gregory, "Remote Rural Broadband Systems in Canada," Telecommunications Policy, 2018, doi.org/10.1016/j.telpol.2018.02.001

A television broadcaster still has the right of access, and the RRBS provider must not interfere with any nearby broadcasting signal. Many RRBS providers note having to change their transmission range if a television broadcaster decides to increase power from their transmitter.[114] Accordingly, Industry Canada announced that "the Department will permit as many applicants as the spectrum availability permits within a particular geographical area."[115] Many newcomers to the wireless market have submitted licenses to the RRBS, mostly in Alberta. In 2011, Industry Canada reported the geographical distribution of RRBS licences: 7 in British Columbia; 450 in Alberta; 56 in Saskatchewan; 36 in Ontario; 5 in Quebec; and 1 in Nunavut, although some of these licences were never used.[116]

In its early years, the RRBS system seemed to work well. The RRBS policy offered access to quality spectrum for smaller players that other market mechanisms simply could not offer.[117] RRBS was able to offer internet capabilities akin to fibre while still being cheaper than laying fibre-optic cable. However, RRBS equipment is still very expensive, costing around $600–700 per household. This expense, along with the decline in operating RRBS stations in Canada, means that RRBS faces an uncertain future.[118]

Low Earth Orbit Satellites

Telesat secured an $85 million contract with the Government of Canada in 2019 to help launch 298 Low-Earth Orbit (LEO) satellites. This constellation will provide high-speed internet to rural and remote communities. Telesat was also given a conditional $600 million over ten years to purchase and provide broadband capacity to the far north of Canada by 2022, and the remainder of the country by mid-2023. Telesat expects to generate $1.2 billion in revenue from the LEO project over the next decade by selling the internet capacity to the government and to the telecommunications service providers.[119]

114. Ibid.

115. Ibid.

116. Ibid.

117. Ibid.

118. Ibid.

119. Jackson, Emily, "Canada Backs Telesat in internet Space Race with $600-Million Deal," Financial Post, July 24, 2019, financialpost.com/telecom/canada-backs-telesat-in-internet-space-race-with-600-million-deal

A low earth orbit is a maximum of 2,000 km above the Earth, allowing LEO satellites to provide faster Internet speeds to remote areas, which typically only receive slow or choppy connections from other connection providers. Telesat claims that LEO satellite internet will seamlessly integrate with networks already in place.[120] It is the goal of the Government of Canada to provide internet speeds of 50 Mbps download and 10 Mbps upload to 95% of Canadians by 2026 and all of Canada by 2030. In the 2019 budget, the government committed to spend $100 million on LEO satellite projects over five years to achieve this goal in northern communities that rely on expensive and slow satellite Internet connections.[121]

In October 2020, the CRTC approved an application by Space Exploration Technologies (SpaceX) for a Basic International Telecommunications Services (BITS) license.[122] This will allow the company to serve Canadians through its Starlink project.[123] The project aims at bringing high-speed broadband access to remote and rural regions around the globe, through a network of LEO satellites orbiting 550 km above the Earth.[124]

Recent Developments

In an attempt to bring 50/10 Mbps connectivity to all of Manitoba, the federal and provincial government opened a public bid to service providers to help identify a solution to Manitoba's connectivity problem.[125] Manitoba Hydro installed thousands of km of fibre-optic cable several years ago which, according to an industry executive, has reportedly gone unused.[126]

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120. Blatchford, Andy, "Canada to Invest in Satellite Technology to Connect Rural, Remote Areas," CBC News, July 23, 2019, www.cbc.ca/news/politics/satellite-high-speed-internet-1.5222655

121. Jackson, Emily, "Canada Backs Telesat in internet Space Race with $600-Million Deal," Financial Post, July 24, 2019, financialpost.com/telecom/canada-backs-telesat-in-internet-space-race-with-600-million-deal

122. Canadian Radio-Television and Telecommunications Council, "Telecom Commission Letter addressed to Bret Johnsen (Space Exploration Technologies Corp.)," Government of Canada, October 15, 2020, crtc.gc.ca/eng/archive/2020/lt201015.htm?_ga=2.240133703.536872507.1604516923-628574277.1604516923

123. Starlink, "High Speed Internet Access Across the Globe," Starlink, 2020, www.starlink.com/

124. Smith, Connell, "Elon Musk's Satellite Internet Plan Gets Green Light from Canadian Regulator," CBC News, October 20 2020, www.cbc.ca/news/canada/new-brunswick/elon-musk-tesla-starlink-low-earth-orbit-high-speed-rural-internet-rockets-satellite-1.5768338

125. Robertson, D., "Manitoba Risks Loss of Internet Millions: Disputes Threaten Rural Connectivity Deal," Winnipeg Free Press, August 4, 2020, www.winnipegfreepress.com/local/manitoba-risks-loss-of-internet-millions-572009282.html

126. ICTC conducted a key informant interview with an executive member of one of Manitoba's key internet service providers. With that said, this information should be taken anecdotally and in isolation as the situation within Manitoba is currently evolving. New information is currently published at the time of this report.

In 2018, after several attempts to solicit confirmed funding and support, many First Nations communities publicly supported Clear Sky Communications, an Indigenous-owned telecommunications network. Clear Sky Communications won the $55.5 million bid to connect 72 remote communities in Manitoba by March of 2021. In hopes of connecting with the province's more rural and remote locations, the project required Clear Sky Indigenous Network to activate pre-existing dark fiber networks (5,170 km) in addition to a new 3,629 km extension. In September of 2020, however, Clear Sky Communications announced that the funding was being pulled and redistributed due to progress concerns. No further information on the matter is available at this time.

Research and Education Networks

Research and education institutions in Manitoba are connected to each other and to other institutions in Canada and around the world through Canada's National Research and Education Network (NREN). The NREN is a collective of infrastructure, tools, and people that bolster Canadian leadership in research, education, and innovation.

CANARIE

CANARIE is a federal partner in NREN. CANARIE and the thirteen other provincial and territorial cohorts that are part of NREN connect Canadian institutions with research, education, and innovation to pass along data and technology across the province, the country, and the world.[131]

127. Bergen, R., "Manitoba Plans to Boost Rural, Northern Internet Using Hydro-Built Fibre Optic Network," CBC News, May 15, 2020, www.cbc.ca/news/canada/manitoba/northern-manitoba-fibre-optic-network-rfp-1.5571434

128. Rosen, K., "$55 Million in Funding Pulled from Northern Manitoba Internet Network," CTV News, September 18, 2020, winnipeg.ctvnews.ca/55-million-in-funding-pulled-from-northern-manitoba-internet-network-1.5111033

129. Ibid.

130. Canada's National Research and Education Network, "Canada's National Research and Education Network (NREN)," NREN, September 2020, www.canarie.ca/wp-content/uploads/NREN_2020-1.pdf

131. CANARIE, "National Research and Education Network," CANARIE Network, 2020, www.canarie.ca/network/nren/

CANARIE also funds and promotes national research data initiatives and reusable research software tools to aid the academic community and boost Canada's commercialization of the technology sector.[132] In addition, CANARIE provides high-speed access to web-based resources and content providers via the CANARIE Content Delivery Service (CDS). CANARIE connects Manitoban and Canadian research centres, universities, government, laboratories, schools, and other eligible institutions, to create an international peer network.[133]

MRnet

Manitoba's Regional Advanced Research and Education Network (MRnet) is Manitoba's provincial contributor to Canada's NREN.[134] MRnet works to provide high-speed fibre-optic internet to connect researchers and educators in Manitoba to global research and education networks. MRnet supports education, research, and advanced application development in Manitoban research, education, and industry.[135] MRnet is a consortium of private and public research and development organizations that aim to advance broadband networking and network applications.[136]

MERLIN

Manitoba Education, Research, and Learning Information Networks (MERLIN) was established in 1995 and provides access to CANARIE and MRnet.[137] MERLIN was created to coordinate the delivery of technology services to the education community of Manitoba. Currently, MERLIN operates under the Department of Central Services and offers gateway internet services to educational institutions that can directly connect to MERLIN.
It also provides firewall, anti-spam, anti-virus, and web content filtering, though anyone partnering with MERLIN receives unfiltered access to the internet once connected. MERLIN is one of the top three largest users of CANARIE's CDS in Canada.[138]

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132. Ibid.

133. MERLIN, "Services - MERLIN," Province of Manitoba, 2020, www.merlin.mb.ca/services

134. Manitoba Research Network, "About Us," MRNet, 2020, mrnet.mb.ca/about/

135. CANARIE, "National Research and Education Network," CANARIE Network, 2020, www.canarie.ca/network/nren/

136. Manitoba Research Network, "About Us," MRNet, 2020, mrnet.mb.ca/about/

137. MERLIN, "Who We Are - MERLIN," Province of Manitoba, 2020, www.merlin.mb.ca/who-we-ar

138. MERLIN, "Services - MERLIN," Province of Manitoba, 2020, www.merlin.mb.ca/services

The MERLIN Partner Program provides technology services that can help lower costs for the education system in Manitoba. MERLIN negotiates, manages, and provides educational licensing for several of the most commonly used software tools and products. Today, 100% of K-12 Manitoban schools are part of the MERLIN Partner Program. MERLIN is currently renegotiating the Partner Program for post-secondary schools in Manitoba.[139]

Infrastructure and Service Gaps

The information noted in this report highlights a need for improved services for rural and remote northern Manitoban communities. Several members of this study's steering committee commented anecdotally on problematic connectivity issues even within certain areas of Winnipeg[140]—the most densely populated region in the province.[141] Without the committed and ongoing efforts of Indigenous ISPs such as Highspeed Crow, Norway House Cree Nation Broadband, Broadband Communications North, etc.[142], gaps in internet accessibility may become accentuated for these communities—particularly with the increased need brought on by COVID-19.

The COVID-19 pandemic has underscored the importance of broadband connectivity and the need to ensure people across the province have access to critical information, such as distance learning programs or internet-based mental health services. [...] We want to help close the telecommunication gap in our province to better connect rural, remote, and Indigenous communities, [and] improve safety and access to information and learning resources.

Jeff Wharton, Minister of Crown Services, PC
The Legislative Assembly of Manitoba

Dacey, Elisha, "Province to Issue Tender to See Broadband, Cellular Expanded in Rural, Northern Manitoba", Global News, May 15 2020, https://globalnews.ca/news/6948069/crown-services-minister-to-update-manitobans-friday

139. Ibid.

140. Redekop, B., "Capital region fed up with slow internet: Municipalities look to create utility-like service in effort to improve speed," Winnipeg Free Press, February 28, 2020, www.winnipegfreepress.com/local/capital-region-fed-up-with-slow-internet-475117803.html

141. Statistics Canada, "Population and Dwelling Count Highlight Tables, 2016 Census," Statistics Canada, Date accessed: October 28, 2020, www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/pd-pl/Table.cfm?Lang=Eng&T=302&PR=46&S=86&O=A&RPP=25

142. Wong, N., "Remote First Nations receive nearly $10M for broadband internet" Winnipeg Sun, August 15, 2020, winnipegsun.com/news/news-news/remote-first-nations-receive-nearly-10m-for-broadband-internet

The challenges Manitoba faces as they relate to tech equity are difficult, but not necessarily unique to the province. Factors like an expansive geography, sparse population, and systemically disadvantaged communities are challenges that Manitoba shares with several other countries and communities across the globe. The following section highlights various case studies of how countries, states, and communities have addressed issues of connectivity and tech equity.

1. Australia: Connecting Remote Outback Communities

Although most Australians live in major urban centres, there are many remote communities in the Australian outback that share the challenge of internet access. As of 2020, there were 2.5 million Australians who were not online due to issues of location, affordability, or a lack of digital literacy.[143]

Nationally, broadband access and affordability have improved steadily in the last few years.[144] Around 87% of Australians have access to the internet.[145] There is, however, a stark gap in broadband access: 91% of student-age Australian children (aged 5 to 14) living in advantaged communities have internet access at home, compared with only 68% in disadvantaged communities.[146] Moreover, the connectivity gap between urban centres and rural communities does not appear to have narrowed over time.[147] According to data from the Australian Bureau of Statistics,[148] 87.9% of Australians living in major cities have internet access at home compared with 77.1% in remote areas. This dataset does not include Indigenous communities, where internet access is usually very poor. [149]

143. Hunter, Fergus, "'Digital Divide': 2.5 Million Australians With no Internet Connection," The Sydney Morning Herald, March 27, 2020, www.smh.com.au/politics/federal/digital-divide-2-5-million-australians-isolated-with-no-internet-connection-20200327-p54egn.html

144. Barraket, Thomas J, et al., "Measuring Australia's Digital Divide: The Australian Digital Inclusion Index 2019," RMIT University and Swinburg University of Technology, 2019, www.csi.edu.au/media/2019_ADII_Report.pdf

145. International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database, "Individuals Using the Internet (% of Population)- Australia," The World Bank, 2020, data.worldbank.org/indicator/IT.NET.USER.ZS?locations=AU

146. Graham, Amy & Sahlberg, Pasi, "Schools are Moving Online, But Not All Children Start Out Digitally Equal," The Conversation, March 26, 2020, theconversation.com/schools-are-moving-online-but-not-all-children-start-out-digitally-equal-134650

147. Thomas, Julian, Wilson, Chris & Park, Sora, "Australia's Digital Divide is Not Going Away," The Conversation, March 29, 2018, theconversation.com/australias-digital-divide-is-not-going-away-91834

148. Australian Bureau of Statistics, "Household Use of Information Technology," Australian Bureau of Statistics, March 2018, accessed on: October 20, 2020, www.abs.gov.au/statistics/industry/technology-and-innovation/household-use-information-technology/latest-release

149. Thomas, Julian, Wilson, Chris & Park, Sora, "Australia's Digital Divide is Not Going Away," The Conversation, March 29, 2018, theconversation.com/australias-digital-divide-is-not-going-away-91834

The National Broadband Network (NBN) is an Australian national open-access data network project, the largest infrastructure project in Australia's history. It was first proposed and commenced planning in 2007.[150] The NBN was initially a fibre to the home (FTTH) open-access network in planning and trial phases, run by the Australian federal government. The NBN aimed to provide up to 1000 Mbps speeds and connect to 93% of Australian households and businesses.[151] In the span of ten years, Australia has spent $5.5 billion on fixed wireless and satellite broadband services.[152] As of July 1, 2020, the NBN is required to provide download speeds of at least 25 Mbps and an upload speed of 5 Mbps during peak hours as part of the expanded Universal Service Obligation.[153]

The Australian Government's Regional Connectivity Program began taking applications in July 2020.[154] The program is funded with $53 million in targeted investment in local telecommunications infrastructure projects in regional, rural, and remote communities. Funds can be used for projects such as infrastructure upgrades to improve access to telehealth, remote education, retail internet, or the creation of enterprise-grade broadband networks to support local agricultural, manufacturing, and tourism businesses.[155] The Minister for Communications, Cyber Safety, and the Arts is "encouraging telecommunications providers, regional communities, regional development organizations, as well as state, territory, and local governments to collaborate and apply for funding through the Program."[156] The Minister commented, "we are taking a 'place-based' approach to investment through the Program because we recognise our regions make an enormous contribution to our economy nationally but have distinct digital needs and in some cases require custom solutions."[157] The program was designed to complement the ongoing work of the NBN.[158] In addition, the Minister for Regional Communications noted that, "potential applicants should work together to develop projects for funding to maximise the benefits for communities," as they are "looking for projects that will provide the most profound benefit to local communities" and that "by joining forces, [the Minster is] confident they will see many great solutions come from the bush to improve services in the bush."[159]

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150. LeMay, Renal, "NBN: What Does "Retail Service Provider" Actually Mean?" Delimiter, March 9, 2011, delimiter.com.au/2011/03/09/nbn-what-does-retail-service-provider-actually-mean/

151. Eckerman, Robin, "Getting Some Reality Into Debates About NBN FTTP," TelSoc Telecommunications and the Digital Economy, October, 2013, telsoc.org/journal/ajtde-v1-n1/a13

152. Budde, Paul, "A Community Fix for Australia's Second-Rate Rural Broadband," Independent Australia, September 16, 2019, independentaustralia.net/business/business-display/how-australias-second-rate-rural-broadband-could-be-fixed,13107

153. Lysaght, Gary-Jon, "Federal Parliament Laws Now Guarantee Minimum Broadband Speeds for all Australians," News, July 2, 2020, www.abc.net.au/news/2020-07-02/high-speed-internet-universal-service-obligation-legislation/12415512

154. "Applications Now Open for Regional Connectivity Program Funding," Mirage, July 28, 2020, www.miragenews.com/applications-now-open-for-regional-connectivity-program-funding/

155. Ibid.

156. Ibid.

157. Ibid.

158. Ibid.

159. Ibid.

- Activ8me is an Australian program that provides 301 satellite-connected, solar-powered telephones with public Wi-Fi in isolated Indigenous communities. Calls from these phones to all fixed phones in Australia are free.[160] Founded in 2005, Activ8me was created with the mission of connecting every part of Australia with broadband internet and phone services.[161]
- Easyweb Digital partnered with NG Media (an Indigenous-owned media corporation) to provide a Wi-Fi network to remote Western Australia Indigenous community. Easyweb Digital's goal is to provide wireless network internet access and to broadcast digital radio.[162] They currently have over 570 locations across Australia (many of them remote), where they provide public Wi-Fi.
- Northern Territory Library (NTL) is another program in Australia that provides free public Wi-Fi to remote Indigenous communities. NTL collaborates with regional councils and authorities to provide Wi-Fi in 46 remote communities. The initiative is recognised as a fundamental public service and is supported by the Northern Territory Government.[163]

2. Supai, Arizona: Bringing Broadband to the Most Remote Village in the USA

Many rural communities in the United States lack sufficient broadband access.[164] On tribal lands, the problem is more acute.[165] MuralNet and the Havasupai Tribe partnered to provide high-speed internet to the most remote community in the continental United States—Supai, Arizona. Shortly after being granted use of the 2.5 GHz spectrum by the Federal Communications Commission (FCC), the Havasupai tribe made use of the LTE network to make the first end-to-end high-speed internet connection in the community. A week later, twelve homes and the community's Head Start[166] building were connected to the internet.

160. Activ8me, "About Activ8me," Australian Private Networks Party Ltd, 2020, www.activ8me.net.au/about/

161. Accan, "Connecting Remote Indigenous Communities," Accan, August 11, 2017, accan.org.au/media-centre/hot-issues/1415-connecting-remote-indigenous-communities

162. Ibid.

163. Ibid.

164. Levin, Blair & Mattey, Carol, "In Infrastructure Plan, A Big Opening for Rural Broadband," The Brookings Institution, February 13, 2017, www.brookings.edu/blog/the-avenue/2017/02/13/in-infrastructure-plan-a-big-opening-for-rural-broadband/

165. MuralNet, 2020, www.muralnet.org/

166. Head Start is a United States Department of Health and Human Services program that provides free early childhood education, health, nutrition, and parent involvement services to low-income children and their families.

In early 2018, the Havasupai tribal council applied for an emergency Special Temporary Authorization to use the 2.5 GHz bandwidth (known as the Educational Broadband Spectrum), and was granted this authorization as the tribe's network focused on educational initiatives.[167]

In the summer of 2018, the network was expanded to be strong enough to support video streaming in each home.[168] For LTE networks to work, the LTE antenna is connected to an entity providing backhaul (school, hospital, service provider, etc.) and the signal is then beamed to homes equipped with routers and modems that convert the signal to Wi-Fi. Speeds of up to 32 Mbps were recorded at the time of deployment,[169] and efforts are now being focused on increasing the backhaul. The Havasupai Tribal Council has 50 Mbps to service each home.[170] MuralNet (the only financial contributor) paid less than $10,000 for the equipment used to provide service to the Havasupai community, and Niles Radio donated their time to install the infrastructure.[171]

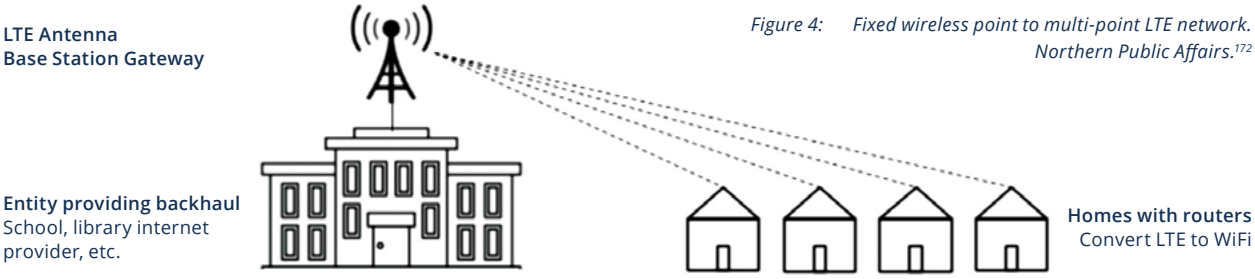


Figure 4: Fixed wireless point to multi-point LTE network. Northern Public Affairs.[172]

Educators in Supai now have access to online resources, allowing them to implement the latest curricular strategies into their lessons and homework plans. This will allow them to better support current and future educational needs of the Havasupai tribe.[173] Upon completion of the project, a Havasupai tribal member stated, "this will be an opportunity, probably the first opportunity Supai has ever had to actually do online courses, extended education courses, associate's programs, GED programs, correspondence classes, online training classes, and maybe get a bachelor's or college degree."[174]

167. Triggs, Mariel, "Tribal DIY: Self-Deploying High-Speed Internet Networks on remote Tribal Lands in the United States," Northern Public Affairs, October, 2018, www.northernpublicaffairs.ca/index/volume-6-special-issue-2-connectivity-in-northern-indigenous-communities/tribal-diy-self-deploying-high-speed-internet-networks-on-remote-tribal-lands-in-the-united-states/

168. MuralNet, 2020, www.muralnet.org/

169. Triggs, Mariel, "Tribal DIY: Self-Deploying High-Speed Internet Networks on remote Tribal Lands in the United States," Northern Public Affairs, October, 2018, www.northernpublicaffairs.ca/index/volume-6-special-issue-2-connectivity-in-northern-indigenous-communities/tribal-diy-self-deploying-high-speed-internet-networks-on-remote-tribal-lands-in-the-united-states/

170. MuralNet, 2020, www.muralnet.org/

171. Triggs, Mariel, "Tribal DIY: Self-Deploying High-Speed Internet Networks on remote Tribal Lands in the United States," Northern Public Affairs, October, 2018, www.northernpublicaffairs.ca/index/volume-6-special-issue-2-connectivity-in-northern-indigenous-communities/tribal-diy-self-deploying-high-speed-internet-networks-on-remote-tribal-lands-in-the-united-states/

172. Ibid.

173. Ibid.

174. Ibid.

3. Lithuania: Leveraging Development Funds for Non-Tech Sectors

In 2005, the Lithuanian Government formed a non-profit public organization, Plačiajuostis Internetas, to help bridge the digital divide between urban and rural parts of the country.[177] The Rural Area Information Technology Broadband Network (RAIN) project was launched by this organization to help make rural areas more competitive via access to the internet.[178] Lithuania was able to connect 51 networks, spanning multiple municipalities, through the RAIN project.[175] It leveraged the European Regional Development Fund[176] to provide middle-mile fibre-optic infrastructure to remote areas across the country.

With rural communities having fewer subscribers, no previous infrastructure, and dispersed settlements, many service providers were disinterested in investing significantly in these areas. RAIN sought to fill this gap, with key goals including "data transmission services for 80% of rural schools as set out in the nation's education strategy, 75% of all rural public administration authorities, 75% of rural healthcare institutions (part of a national e-health strategy), and 75% of public internet access points set up by local authorities."[179]

The value of the RAIN project was estimated at EUR 22 million.[80] RAIN made possible the launch of further projects, most notably RAIN-2, a second phase under which 5,775 km of fibre-optic cable was laid and 2,789 broadband access points were set up to serve some 700,000 people, across 950 towns, including approximately 700 schools and 850 libraries.[181] In 2015, Lithuania's RAIN-2 project won the 2015 European Broadband Award in the socio-economic impact and affordability category.[182]

175. European Commission, "Improving Broadband Access in Rural Lithuania," European Union, 2020, ec.europa.eu/regional_policy/en/projects/lithuania/improving-broadband-access-in-rural-lithuania

176. European Commission, "European Regional Development Fund," European Union, 2020, ec.europa.eu/regional_policy/en/funding/erdf/

177. Plačiajuostis Internetas, "About Us," Plačiajuostis Internetas, 2020, www.placiajuostis.lt/en/about-us

178. European Commission, "Improving Broadband Access in Rural Lithuania," European Union, 2020, ec.europa.eu/regional_policy/en/projects/lithuania/improving-broadband-access-in-rural-lithuania

179. Ibid.

180. Lithuania Tribune, "Lithuania Leads Europe in Fibre-Optic Internet Penetration," Lithuania Tribune, April 12, 2015, lithuaniatribune.com/lithuania-leads-europe-in-fibre-optic-internet-penetration/

181. European Commission, "Improving Broadband Access in Rural Lithuania," European Union, 2020, ec.europa.eu/regional_policy/en/projects/lithuania/improving-broadband-access-in-rural-lithuania

182. Ibid.

Another follow-up project, the Support for Broadband Infrastructure: Phase 2 (PRIP-2) was a joint winner at the European Broadband Awards in 2019.[183] The PRIP network is an extension of Lithuania's previous two national broadband networks, RAIN and RAIN-2. The PRIP project succeeded in connecting 443 rural activity centres and agricultural locations via 486 km of fibre-optic cable.[184] The EU also contributes funds to bring high-speed broadband to rural Lithuanian agri-businesses via the PRIP-2 project.[185] The goal of the PRIP-2 project "is to bring next generation access to agri-businesses in rural areas" that lack connectivity, and are not economically appealing to commercial interests. A large portion (85%) of the project was funded by the European Agricultural Fund for Rural Development (EAFRD).[186] PRIP-2 has provided a backbone of 342.6 km of fibre-optic cable, which allows service providers to step in and supply the "last mile" connections to end users, including farmer homesteads, food processing businesses, and other agricultural business centers.[187]

As of 2018, RAIN and PRIP were supplying over 55 providers with broadband access, many of them small operations. Due to RAIN and PRIP, 61.6% of rural households in Lithuania now have access to broadband, a large increase from the 4.9% in 2006.[188]

183. Patricolo, Claudia, "Croatia and Lithuania Win the European Broadband Awards Targeting Rural Areas," Emerging Europe, December 5, 2019, emerging-europe.com/news/croatia-and-lithuania-win-the-european-broadband-awards-targeting-rural-areas/

184. European Commission, "Lithuania's Rural Broadband Infrastructure Expansion: PRIP," European Union, May 20, 2019, ec.europa.eu/digital-single-market/en/news/lithuanias-rural-broadband-infrastructure-expansion-prip

185. European Commission, "EU Funds Bring High-Speed Broadband to Rural Lithuanian Agri-Businesses," European Union, February 14, 2020, ec.europa.eu/digital-single-market/en/news/eu-funds-bring-high-speed-broadband-rural-lithuanian-agri-businesses

186. Ibid

187. Ibid

188. European Commission, "Improving Broadband Access in Rural Lithuania," European Union, 2020, ec.europa.eu/regional_policy/en/projects/lithuania/improving-broadband-access-in-rural-lithuania

4. Slovenia and Croatia: Building a Cross-Border Broadband Network

The Rural Network (RuNe) project aimed to develop a greenfield cross-border wholesale broadband network targeting underserved areas in Slovenia and Croatia.[189] RuNe won the European Broadband Award in 2019 for helping tackle the most daunting social and economic challenge faced by both regions—depopulation. The project was designed to improve education and healthcare services, facilitate conversations with government services (including starting up e-government services), and revitalize current industrial practices while creating opportunities for the emergence of new technological applications across sectors.[190]

RuNe has laid fibre-optic cable across more than 14,000 km^2 to bring access to more than 3,600 villages in the rural and remote areas along the border between the two countries. This project will guarantee broadband connections to more than 370,000 households, businesses, and public institutions in rural areas, making up 92% of all addresses in the targeted area.[191] Gigabit Next Generation Access (NGA) broadband infrastructure will provide Fibre to the Home (FTTH) and is only offered through wholesale options.[192]

RuNe is the first project to be funded by the Connecting Europe Broadband Fund (CEBF) and is predicted to gain a total investment of 246 million EU, 110 million EU from the CEBF and the remainder from private equity funds.[193] With technical assistance from the European Commission, the end result is expected to allow users to choose between various service providers, counter depopulation, create new business opportunities, and increase local education and healthcare services.[194]

189. European Commission, "Broadband Good Practices," The European Broadband Awards, 2019, ec.europa.eu/information_society/newsroom/image/document/2019-49/good-practices-in-broadband-projects_european-broadband-awards-2019_1_92B68833-FEC7-7FB7-0823BE79EEA624F9_63595.pdf

190. Ibid.

191. Ibid.

192. Ibid.

193. Patricolo, Claudia, "Croatia and Lithuania Win the European Broadband Awards Targeting Rural Areas," Emerging Europe, December 5, 2019, emerging-europe.com/news/croatia-and-lithuania-win-the-european-broadband-awards-targeting-rural-areas/

194. Ibid.

5. New Zealand: Equitable Access through a Student-Focused Managed Network

New Zealand's own Network for Learning (N4L) company connects the country's schools to high-quality internet services,[195] granting children access to digital technology and enabling them to thrive in innovative educational environments. N4L is a Crown company that supports the government's objectives of equitable access to digital technology through a student-focussed managed network. This network has connected 99% of New Zealand schools to internet services. By outsourcing all network setup and maintenance responsibilities to N4L and its technology partners, schools are able to focus entirely on the teaching and learning experience.[195] N4L's Managed Network is the largest of its kind in New Zealand, working with education, government, and technology stakeholders to provide excellent digital connectivity and grant young New Zealanders the best chance to succeed in education and workforce engagement.[197]

Like other examples discussed in this paper, N4L has a particular focus on rural and remote communities, designating school buildings as the community's digital hub. By leveraging school internet infrastructure to provide community internet connectivity, this digital hub system—as in Supai, Arizona—is able to provide internet access that otherwise would be deemed unaffordable or unavailable in certain communities.[198]

195. N4L, 2020, www.n4l.co.nz/

196. Ibid.

197. Ibid.

198. Education Government of New Zealand, "Enabling Home Internet Access for Your Community," Government of New Zealand, 2020, www.education.govt.nz/school/digital-technology/your-schools-ict-network/enabling-home-internet-access-for-your-community/

Conclusion

Access to high-speed internet is becoming indispensable to everyday life across Canada and around the world. A large and growing number of daily activities now rely on access to a stable, secure, high-speed, broadband internet connection, including communication, work and productivity, education, leisure, and accessing financial, health, and government services. Universal and affordable access to the internet is part of the United Nations' Sustainable Development Goals,[199] a target that is re-emphasized by Canada's commitment to high-speed internet as a basic telecom service.[200]

While large portions of urban Canada already have broadband infrastructure in place, there is a gap in connectivity and service quality among rural and remote communities and in low-income neighbourhoods. A lack of reliable and affordable high-speed internet is particularly detrimental to learners, as an increasing number of educational resources and experiences rely on access to technology. Manitoba, with a relatively large proportion of rural and remote communities, is likely to feel the effects of this divide acutely.

The COVID-19 pandemic has served to underscore the need for high-quality and affordable internet for all Canadians. As Canadians continue to work and learn from home, digital inequity becomes a pressing challenge that can disproportionately affect rural, remote, and low-income households, some of whom are already facing the brunt of the economic fallout of the pandemic and lockdowns.[201,202] The present economic downturn presents a timely opportunity to redress this situation and bring reliable and affordable broadband to Manitoba. A report from BDO Canada outlines a series of sensible and contextually relevant recommendations when considering a pathway forward within the province. This includes the following:

199. United Nations, "Infrastructure and Industrialization - United Nations Sustainable Development," United Nations, 2020, www.un.org/sustainabledevelopment/infrastructure-industrialization/

200. Dobby, Christina, "CRTC Rules High-Speed internet a Basic Service, Sets Target," The Globe and Mail, December 21, 2016, www.theglobeandmail.com/report-on-business/crtc-rules-high-speed-internet-a-basic-telecom-service/article33405960/

201. Wherry, Aaron, "One Country, Two Pandemics: What COVID-19 Reveals About Inequality in Canada," CBC News, June 13, 2020, www.cbc.ca/news/politics/pandemic-covid-coronavirus-cerb-unemployment-1.5610404

202. Purchase, Lindsay, "How COVID-19 Is Affecting Rural Communities Across Canada," CERIC, June 9, 2020, ceric.ca/2020/06/how-covid-19-is-affecting-rural-communities-across-canada/

- Municipalities are encouraged to consider broadband infrastructure as a pillar to their community action plans, with due consideration placed on consultations with current service providers.
- Municipalities are encouraged to invest in broadband development strategies that commit to adequate access for each citizen to bolster economic competitiveness. This includes, when possible, strategies to explore fibre optic, WiFi and LTE infrastructure development initiatives.
- Strategies are encouraged that focus on regional, provincial, and federal accountability towards broadband infrastructure development. This includes well-articulated deliverables and goals, encouraging a solution for the province's growing digital divide.[203]

A recent position paper by the Federation of Canadian Municipalities (FCM) reaffirms such strategies as an important step towards shaping an inclusive and resilient post-COVID recovery in Canada.[204]

As the federal government looks to accelerate the targets for its national connectivity strategy,[205] Manitoba should seize this opportunity to facilitate public-private partnerships to make investments in fixed and wireless broadband projects serving its rural and northern communities. The international case studies highlighted in this report provide a useful framework for the continued development of innovative, multifaceted strategies capable of helping close Manitoba's digital divide.

203. BDO, "Broadband: The Next Essential Utility," BDO/CPC, 2017, www.bdo.ca/getattachment/8bc81ac6-dac6-4d24-9224-b09d3fc8f801/attachment.aspx/

204. Federation of Canadian Municipalities, "Building Back Better Together Municipal Recommendations for Canada's Post-COVIC Recovery," Federation of Canadian Municipalities, November 2020, data.fcm.ca/documents/COVID-19/fcm-building-back-better-together.pdf

205. Paddon, David, "Pandemic has Underlined Needs for Better Internet in Rural Areas, Throne Speech Says," CBC News, September 24, 2020, www.cbc.ca/news/business/throne-speech-rural-broadband-1.5737083

Appendices

I. Research Methodology

The research in this study consisted of an environmental scan and literature review using existing, secondary data sources. Limited primary research was conducted for this study. In addition to performing the environmental scan and literature review, ICTC established a steering committee to discuss the research findings and validate the results.

Secondary Data Sources

The findings in this report are based on information and data derived from various secondary sources, including the Government of Canada, the Province of Manitoba, the Canadian Internet Registration Authority (CIRA), and the Canadian Radio-Television and Telecommunications Commission (CRTC). These sources were identified through an initial literature review and environmental scan, which focused on publications by relevant organizations on the topics of broadband availability, broadband accessibility, and education. The relevant organizations were identified using a waterfall approach that began with key stakeholders in Manitoba's telecommunications ecosystem, including the CRTC; Innovation, Science, and Economic Development Canada (ISED); and the Government of Canada. The literature review included studies on topics such as: telecommunications infrastructure, the digital divide, digital equity, rural and urban connectivity, and technology use in the classroom.

Advisory Committee

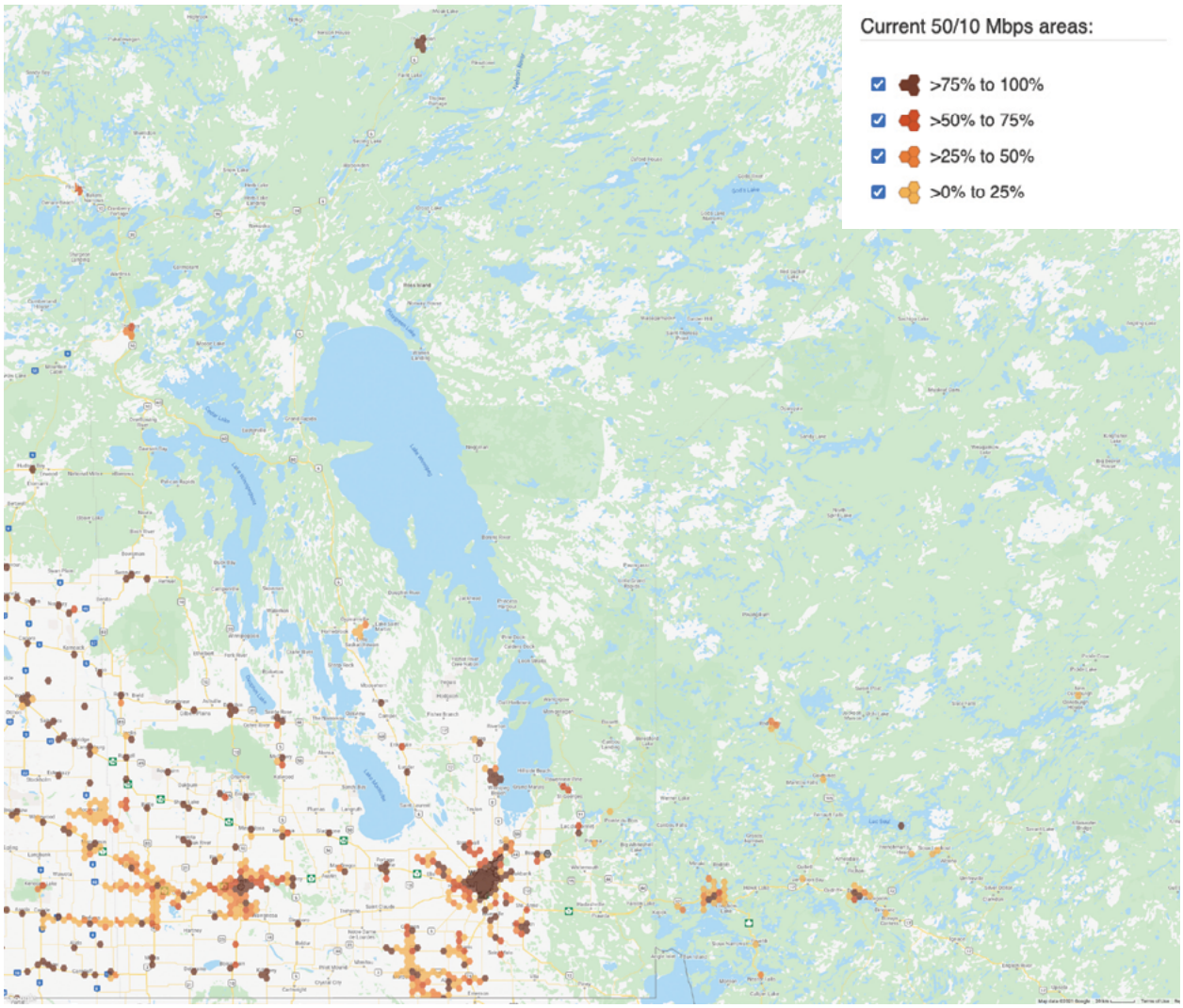
A Steering Committee was set up in July 2020 and was active for the duration of the project. The research team met with the committee throughout August 2020 to review and discuss the research findings and provide additional insight. The advisory committee was comprised of 13 individuals from industry, primary, secondary, and post-secondary education; and non-profit associations from across Manitoba.

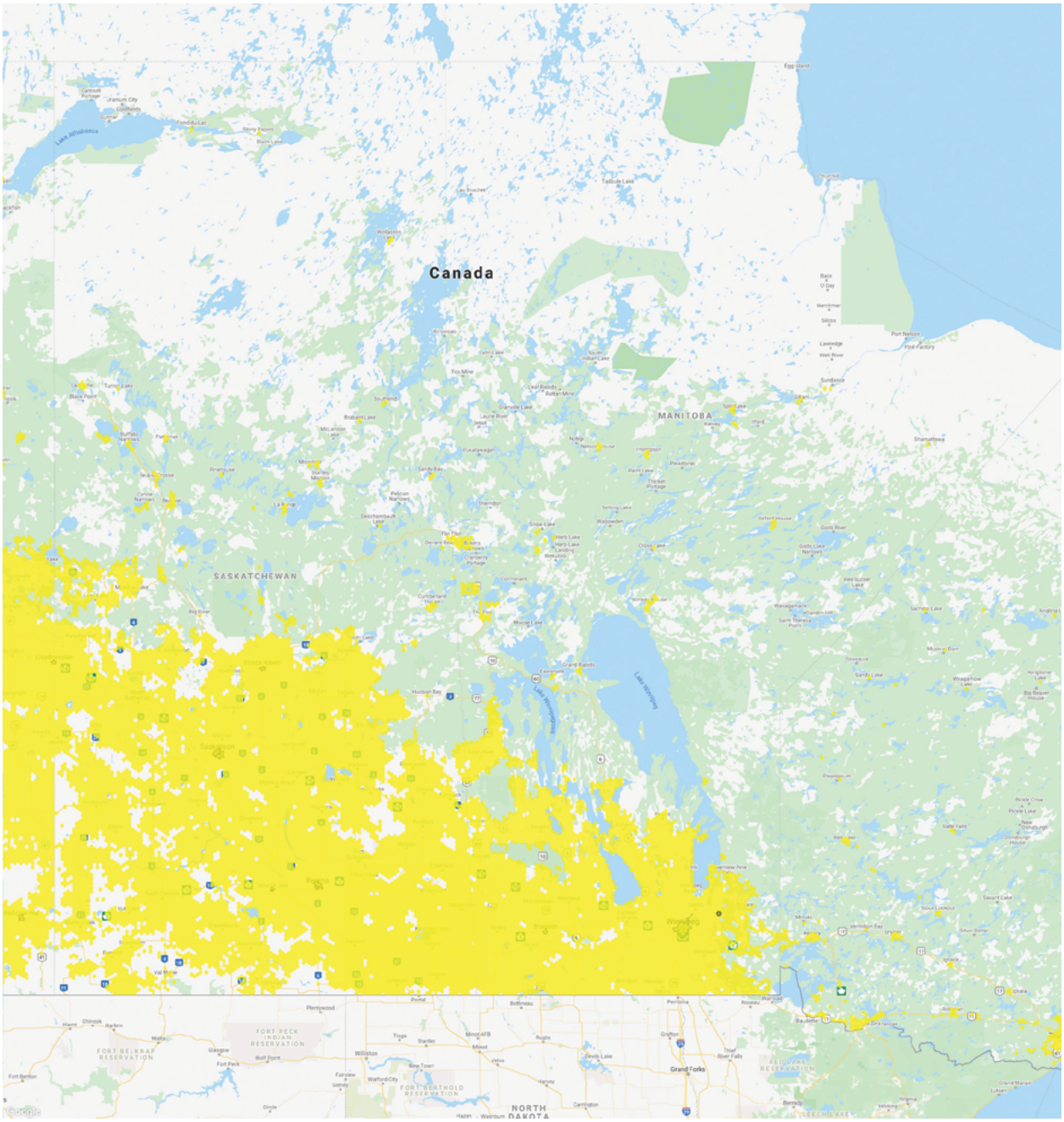
II. Limitations of Research

This report was informed by secondary data sources with limited to no primary research. A key informant interview with an independent Internet Service Provider (ISP) in Manitoba was conducted. This unstructured discussion was designed to provide additional perspectives surrounding issues of infrastructure development, fibre optic networks, and issues of inequality. While every effort was made to source the latest data from multiple, credible sources, some gaps are inevitable. The research team was entirely reliant on pre-existing information that was, in some cases, dated or not directly linked to Manitoba. The findings should therefore be interpreted as a review of existing data and publications. Additional research is needed to follow up on this initial study, particularly primary research that can uncover key challenges and opportunities for the province of Manitoba.

III. Manitoba: Current Internet Coverage & Projects

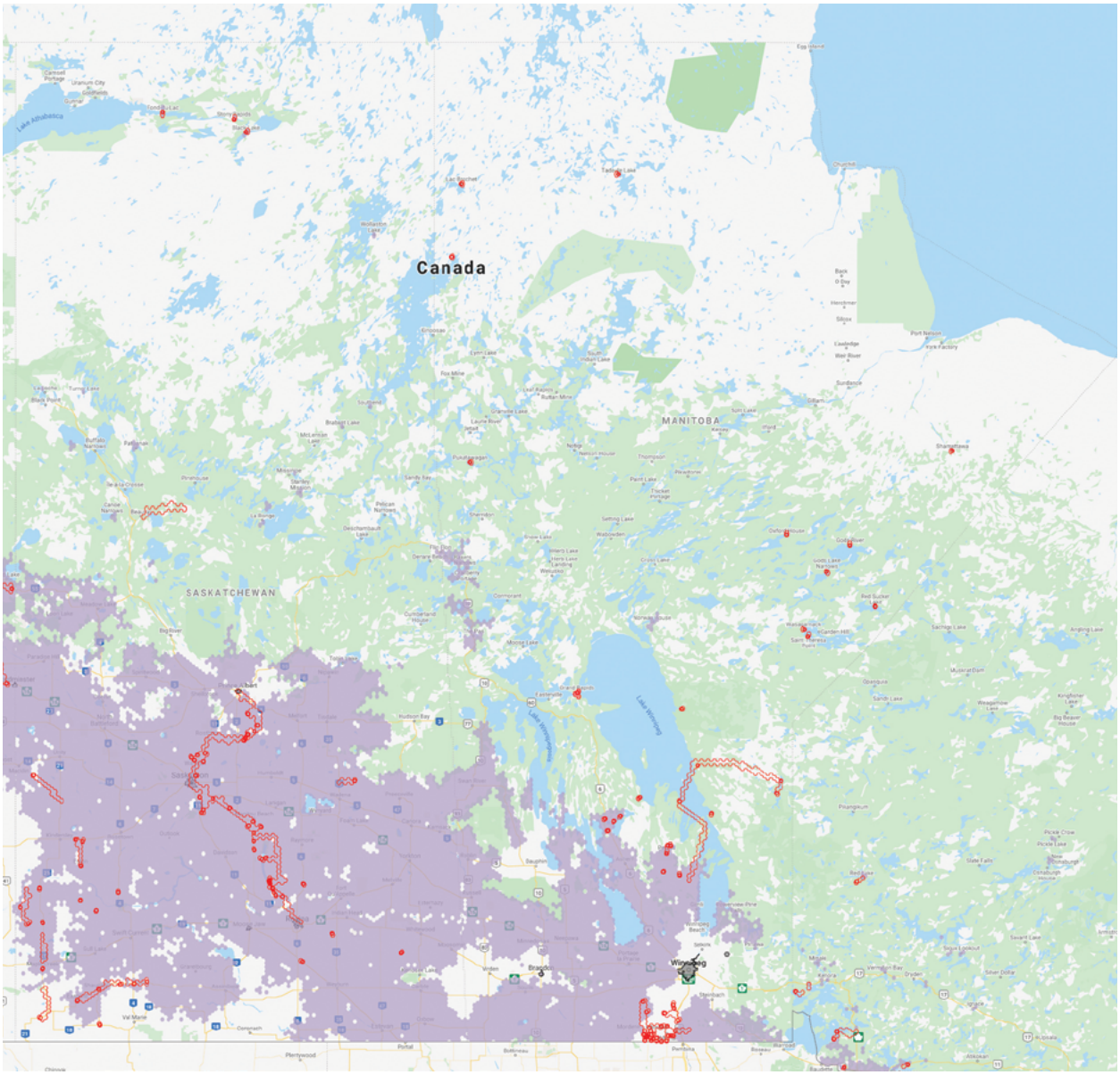
The following maps were all produced by querying the National Broadband Internet Service Availability Map web service in September 2020.





Current 5/1 Mbps areas:

- [x] >75% to 100%



Program Supported Areas:

- [x] CCP projects coverage
- [x] CTI projects areas
- [ ] CTI projects coverage
- [ ] CTI projects backbone