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The Gradual Dependence on Starlink and Its Impact on the Digital Organization of Arctic Territories in Canada

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Introduction

Satellite-based telecommunications systems are socially and politically constructed objects. They are not only determined by a technical dimension but also by the geopolitical contexts in which they are conceived, developed and used. Even though communication satellites orbit in outer space, their design, operation and the services they provide are firmly rooted in terrestrial policies.[2] The development of these systems and their improvement over time are the result of political, economic, social, ideological, philosophical and ethical choices (or lack thereof). This is one of the main reasons why the rapid development and deployment of low-earth orbit (LEO) satellite constellations is now at the center of social, economic and, above all, geopolitical issues, as these systems also profoundly change the spaces and territories in which they are embedded.

With more than 4 million subscribers in 100 countries as of September 2024,[3] the Starlink satellite constellation is attracting significant attention, especially as the company is now fully involved in strategic sectors such as the digital development

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2 B. Warf, Geopolitics of the satellite industry, *Tijdschrift voor Economische en Sociale Geografie*, 2007, 98, pp. 385–397.

3 A. Alamalhodaei, Starlink hits 4 million subscribers, *TechCrunch*, 26 September 2024. Available at: https://techcrunch.com/2024/09/26/starlink-will-hit-4-million-subscribers-this-week-spacex-president-says/ (accessed: 29/09/2024).

of underserved areas, Internet governance, and space governance. While it currently represents only a small proportion of global Internet traffic, Starlink is seen as an important tool for providing internet services in rural and remote regions where the installation of terrestrial infrastructure is complex and costly.[4]

Satellite constellations such as Starlink offer considerable potential for remote regions with limited access to digital resources. In 2023, the International Telecommunication Union estimated that approximately one-third of the world's population, or 2.6 billion people, still lack Internet access.[5] However, these inequalities are not solely due to a lack of telecommunications infrastructure. While many people could technically benefit from these technologies, financial barriers often prevent them from doing so. This problem is particularly pronounced in areas that rely on satellite communications, as the high cost of these services makes them inaccessible to many users. In the Canadian Arctic, this reliance on satellites is particularly critical, as geophysical and geographical challenges such as thawing permafrost, polar climate, extremely low population density and a lack of road infrastructure make it difficult to develop traditional digital infrastructure like cable. Nunavut in the Eastern Canadian Arctic is a notable example because the entire population and all services are completely dependent on satellite technology.[6] This heavy reliance not only hinders the decentralized governance of the territory, but also exacerbates social inequalities and the digital divide, disproportionately affecting the Indigenous population[7]—particularly the Inuit, who make up nearly 86% of Nunavut's population.[8]

The technical limitations of satellite telecommunications systems, combined with the geographic, climatic and geophysical challenges associated with Canada's Arctic regions, have hampered their digital development. However, the organization and structure of the Arctic telecommunications market, which is dominated by the Internet service provider NorthwesTel, has also played an important role. NorthwesTel hardly cooperates with smaller competitors and invests mainly in the most populated and profitable areas, which exacerbates the inequalities between the Arctic communities. This situation has allowed constellations such as Starlink to quickly capture the market and position itself as a truly competitive player against NorthwesTel.

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4 C. Rabouam, L'avènement des constellations de satellites dédiées au haut débit dans les territoires isolés: le cas de Starlink dans l'Arctique canadien, *L'Espace Politique*, 2024, 51–52(2023-3/2024-1), p. 2.

5 ITU press release. Available at: https://www.itu.int/fr/mediacentre/Pages/PR-2023-11-27-facts-and-figures-measuring-digital-development.aspx (accessed: 23/09/2024).

6 C. Rabouam, *op. cit.*, pp. 3–4.

7 M. Klyne, La Fracture Numérique Au Canada Pénalise Les Populations Autochtones et Rurales: Sénateur Klyne, *SenCa+*, 8 February 2023. Available at: https://sencanada.ca/fr/sencaplus/opinion/la-fracture-numerique-au-canada-penalise-les-populations-autochtones-et-rurales-senateur-klyne (accessed: 24/09/2024).

8 Statistique Canada, *Inuit: Fact Sheet for Nunavut*, 29 March 2016. Available at: https://www150.statcan.gc.ca/n1/pub/89-656-x/89-656-x2016017-eng.htm (accessed: 24/09/2024).

In Nunavut, and to a lesser extent in Yukon and the Northwest Territories, the reliance on satellites, the lack of competition and the resulting unstable and expensive services have created a particularly favorable environment for the rise of constellation operators such as Starlink and OneWeb.[9] In this context, anticipated improvements in the technical performance of satellite systems have been eagerly awaited, as the geographic and geophysical constraints in the Canadian Arctic make these technologies essential for an equitable connectivity solution across the territory. The launch of Starlink, which positions itself as both a competitive Internet provider and a partner for local stakeholders, has sparked great optimism in isolated communities of the Canadian Arctic. However, it also raises growing concerns about the potential hegemony of private American players over space telecoms infrastructures and network topology, which are fundamental spaces for the expression of economic and political power.[10]

The operational deployment of LEO satellite constellations in the Canadian Arctic is inherently a geographic and geopolitical issue. The deployment of this new telecommunications system in territories still dependent on satellites changes the spatial logic of infrastructure organization while redefining power dynamics between the actors traditionally involved in the digital development of these territories (federal government, territorial government, traditional service providers, Indigenous organizations). The technological evolution of satellites thus contributes to the redefinition of power relations at local, regional and global levels, as the development and control of these technologies is concentrated in the hands of a minority of state and private actors who can use them to strengthen their economic, military or cultural influence.[11]

By focusing on the case of the Canadian Arctic, this article aims to examine the different effects of the arrival of broadband satellite constellations on the digital organization of these territories. It also aims to show how Starlink's strategy of rapid adaptation to local actors, particularly in Nunavut, has enabled rapid integration into the territory's digital ecosystem and has even become a key element within it.

The first part of this article will aim to demonstrate that various factors are hampering the digital development of the Canadian Arctic regions. The second part will then examine the opportunities and challenges arising from the improvement of satellite communication systems and their increasing control by private actors. Finally, the third part will aim to identify the concrete impacts of the growing reliance on Starlink on the digital organization of the Canadian Arctic, with a particular focus on Nunavut.

9 C. Rabouam, *op. cit.*, pp. 31–36.

10 F. Musiani et al. *Governance by Infrastructure*, [in:] F. Musiani, D. Cogburn, L. DeNardis, N. Levinson (eds.), *The Turn to Infrastructure in Internet Governance. Information Technology and Global Governance*, Palgrave Macmillan, New York 2016, pp. 3–21.

11 C. Rabouam, *op. cit.*, p. 4.

The digital organization of arctic territories in Canada: unequal development shaped by various factors

The challenges in developing digital infrastructure in the Arctic territories

The territories that make up the Canadian Arctic (Yukon, Northwest Territories and Nunavut) are unequally connected to the rest of Canada from a physical standpoint. While Yukon and the Northwest Territories (NWT) have a road network, Nunavut is only accessible by air or sea. In terms of telecommunications, these three territories are not connected in the same way or with the same technologies. Telecommunications services in the Yukon rely almost exclusively on land-based fiber optic cable, with the exception of one satellite-dependent community, the NWT relies on a combination of technologies (satellite, cable and microwave tower networks), and Nunavut relies entirely on satellite-based telecommunications systems.[12]

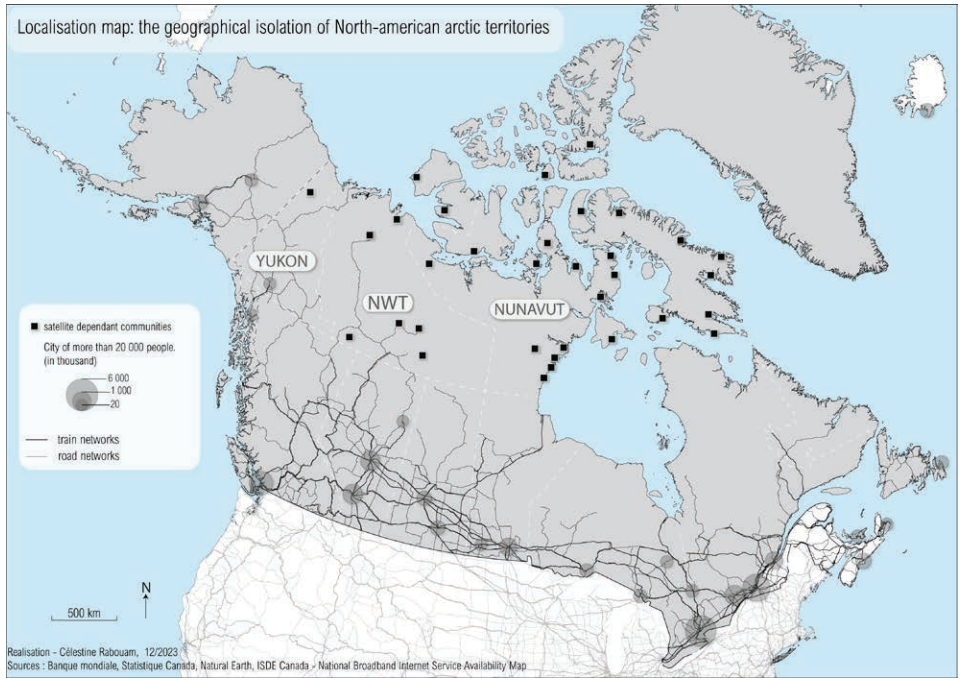

Fig. 1. Localisation map: geographical isolation of North American Arctic territories
Source: author's own work.

12 M. Delaunay, *Internet dans l'Arctique canadien, enjeu de Soft Power pour l'État fédéral et les Inuit*, Université de Paris-Saclay, Paris 2021, p. 221. Available at: https://theses.hal.science/tel-03599610/ (accessed: 24/09/2024).

Geostationary (GEO) satellites[13] are extremely practical communication systems for connecting the most remote and isolated communities, as they allow coverage of vast areas and avoid the constraints of building traditional digital infrastructures such as fiber optic cables. This is one of the main reasons why the Canadian federal government and Internet Service Providers (ISPs) have chosen to connect numerous rural and Arctic communities via this technology.

In the Canadian Arctic, the technical and economic challenges associated with laying cables or microwave tower networks indeed necessitate the use of satellites. The installation of terrestrial infrastructure is subject to extreme weather conditions and the instability of permafrost, while the laying of underwater cables in the Northwest Passage requires significant feasibility and environmental impact studies, as this maritime route is covered with ice for part of the year. If the cable is damaged by ice cracking or any other cause, the repair will be even more costly, as the contractors will have to wait to rent a vessel capable of navigating Arctic waters and wait until summer to repair the cable, which would be unusable until then. Furthermore, even if an underwater cable were to reach these Arctic waters, the costs associated with deploying the final kilometers of cable to connect communities and end users would be too high and would likely be passed on to the users.

Indeed, the demographic distribution and low population density of these areas pose a major challenge for large-scale infrastructure projects, and the most significant projects—such as the *Dempster Fiber Project* and the *Mackenzie Valley Fiber Link*—are generally concentrated in the more populated areas. The regional capitals of Yukon (Whitehorse) and the NWT (Yellowknife) are the two largest population centers in the Canadian Arctic and are being connected to fiber because their populations of 20,000 to 30,000 people make terrestrial infrastructure projects financially viable. In the least populated communities and even in Iqaluit, the capital of Nunavut, with a population of about 7,000 people, the profitability of a cable project is far less attractive.

In addition, the Arctic territories are particularly vast and there are very few road networks, along which wireless telecommunications infrastructure, microwave towers and fiber optic cables are usually installed. The most striking example is Nunavut: this territory, which covers more than 2 million square kilometers, has no roads connecting communities to each other or to the rest of Canada, and it is also the least well-connected territory on a national scale.[14] The polar climate and the presence of permafrost further complicate the logistical processes required to establish terrestrial infrastructure (feasibility studies, construction time, maintenance and durability of infrastructure, upgrades). In the Northwest Territories, the territorial government supported the installation of a fiber optic cable in the Mackenzie Valley back in 2014. This project connected several communities that relied

13 These satellites circulate in a geostationary orbit (circular or geosynchronous) at an altitude of approximately 36 000 km from the users.

14 C. Rabouam, *op. cit.*, p. 29.

on satellites. However, Ledcor, the company laying the cable, faced significant geological challenges caused by permafrost along the cable route.[15]

These geographic, demographic, and geophysical constraints have played an important role in the entrenchment of satellite dependence in Arctic communities, but this dependence has also been reinforced by the decisions of federal and territorial governments as well as local administrations. The financial and logistical investments of these stakeholders are essential to support the digital development of Arctic territories, and most telecommunications projects are therefore funded through federal or territorial government grants. In Nunavut, public investment support has proven essential since the launch of the first Internet services. The Qiniq network, which was rolled out to all Nunavut communities in 2005, was made possible primarily through $ 175 million in public and private investment, which helped maintain a minimum service rate of $ 80 per month until 2018.[16]

A market traditionally controlled by the Bell Canada—NorthwesTel—Telesat trio

The federal government's support for the Canadian satellite operator Telesat also played an important role in the decision to connect people in the Arctic via satellite technology. Telesat was founded in 1969 with public funding, and its first satellite, Anik A1, launched from Cape Canaveral in 1972, provided some Arctic communities with access to telephone services as early as January 1973.[17] In fact, the name of the first satellite "Anik"—which means "little brother" in Inuktitut—was intended to echo the Inuit population it would primarily serve in the north, at a time when Inuit claims in Canada were becoming increasingly important. The operator then received substantial government subsidies until its privatization and takeover by Bell Canada in 1998.[18] Bell Canada is also the parent company of NorthwesTel—the main Internet and telephone provider in the Canadian Arctic—and Bell Mobility, which provides cellular and Internet services in the Far North. In satellite-dependent communities, NorthwesTel and Bell Mobility rely on Telesat's satellite bandwidth. However, it is important to note that NorthwesTel had a stronger presence in Yukon and the Northwest Territories in the past. Initially, the company focused on the more populated communities in Nunavut and only expanded its services to all communities in Nunavut in 2019 with the help of a federal grant of approximately 50 million dollars.[19] Another Internet service provider, SSi Micro, was already present in satel-

15 D. Thurton, Inspection reports cite environmental concerns with Mackenzie Valley fibre optic project, *CBC News*, 1 February 2016. Available at: https://www.cbc.ca/news/canada/north/mackenzie-valley-fibre-inspection-1.3428012 (accessed: 29/09/2024).

16 M. Delaunay, *op. cit.*, p. 294.

17 R. Collins, *Une voix venue de loin. L'histoire des télécommunications au Canada*, McGraw-Hill Ryerson Limited, Toronto 1997, p. 263.

18 L. St. Germain, Fire, Ice, and Politics: The Evolution of Domestic Satellite Communications in Canada, *IEEE Conference on the History of Electronics*, 2004, p. 16.

19 Ottawa gives Northwestel $50 million to improve Nunavut internet, *Nunatsiaq News*, 15 September 2017. Available at: https://www.qiniq.com/wp-content/uploads/2017/10/NO-2017-09-15.pdf (accessed: 06/11/2024).

lite-dependent communities in the Northwest Territories, as well as in all Nunavut communities. SSi Micro also participated in connecting all Nunavut communities to the Internet for the first time using the Qiniq network in 2005.[20]

The subsidies granted by the government and federal authorities partly increase the dependence on satellites in the Arctic territories and at the same time prevent real competition in the telecommunications market. On the one hand, the subsidy programs will always pick one winner instead of distributing the money to several players; on the other hand, the subsidies are almost systematically awarded to NorthwesTel or SSi Micro, which already have know-how and infrastructure in the North. For the authorities that run these subsidy programs, such as the Canadian Radio-television and Telecommunications Commission (CRTC), projects to improve satellite-based telecommunications services also have the advantage of covering multiple communities or territories, unlike terrestrial infrastructure projects that usually only connect a few communities.

Government decisions—at both the federal and territorial levels—regarding the funding of telecommunications projects have thus also contributed to the continued reliance of many Arctic communities on satellite technology. These decisions also explain the slow and complex implementation of cable projects in these regions. This situation is particularly evident and problematic in Nunavut, where investment has focused so heavily on satellite technology and infrastructure that it has now become difficult to envision a financially viable basis for developing terrestrial infrastructure. Satellites are expensive, and public investment to support their deployment in Canada is extremely high. For example, between 2002 and 2014, more than $200 million of public money was spent to bring satellite connectivity to remote areas of Canada, and this estimate does not take into account the various funds that have been established to provide coverage to remote areas.[21]

A reliance on satellites that exacerbates inequalities in access to digital resources

Satellite communications are very costly, both for ISPs, who commit to expensive long-term contracts with satellite operators, and for users. Internet plans are particularly costly and offer very limited data. For example, NorthwesTel's largest plan includes only 300 GB of data per month for $109, which is especially restrictive for remote workers or families with multiple users.[22] Moreover, NorthwesTel customers often face very high overage fees when they exceed their data limit.[23]

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20 M. Delaunay, *op. cit.*, p. 294.

21 Canadian Radio-television and Telecommunications Commission, *Rapport d'enquête sur les services par satellite*, Gouvernement du Canada, 2015, p. 55. Available at: https://crtc.gc.ca/fra/publications/reports/rp150409/rp150409.pdf (accessed: 31/10/2024).

22 NorthwesTel Internet plans. Available at: https://www.nwtel.ca/internet-plans (accessed: 01/10/2024).

23 Canadian Radio-television and Telecommunications Commission, *Telecom Notice of Consultation CRTC 2022-147*, Gouvernement du Canada, 2022, pp. 10–12. Available at: https://crtc.gc.ca/eng/archive/2022/2022-147.htm (accessed: 10/10/2024)

In the Northwest Territories and Yukon, most of the population is connected via terrestrial cable or microwave towers. In Nunavut, on the other hand, the satellites operated by Telesat and SES Networks (since 2020) are the only systems that provide bandwidth to the entire territory. This reliance on just two satellites leads to significant bandwidth congestion issues, despite improvements made on these geostationary satellites in terms of throughput. At peak times, the volume of data packets—which are converted into signals to reach the satellite and connect users to the Internet—is usually too large for the system to handle all user requests, resulting in higher latency.[24] In general, the latency of satellite communication is much higher than that of fiber optic communication. The time it takes for data to travel between the different equipment (satellites, ground stations and user terminals) results in very high latency, which widens the gap between users with fiber optic connections and those who depend on these satellites. In addition, the distance that the signals have to travel to reach the different devices makes them vulnerable to terrestrial and extra-atmospheric weather interference.[25]

In Canada, reliance on GEO satellites hinders equitable access to digital resources for rural and Arctic populations, not only because their cost excludes a portion of the population, but also because they no longer meet the needs of users today. However, this system will always be part of the connectivity solution in territories like Nunavut, as it will likely never be possible to install redundant cables or microwave towers in all communities due to geographic, geophysical and demographic constraints.

For many years, Inuit organizations and local authorities in Nunavut have been soliciting investment in cable projects, but these projects will only connect a few communities. One cable project is being undertaken by the Government of Nunavut to connect the capital city of Iqaluit, and two others are being led by private Inuit organizations and supported by regional Inuit associations. The Sednalink project, led by the Inuit company CanArctic Inuit Networks, also aims to connect the capital city of Iqaluit, and the *Kivallik Hydro Fiber Link* project will connect five communities in southern Nunavut.[26] These projects do not aim to connect all Nunavut communities to the fiber network, but rather to free up satellite bandwidth for the rest of the territory.

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24 Propagation latency is the term to describe the time it takes to transmit from source to destination across a network.

25 C. Rabouam, *op. cit.*, p. 8.

26 Nukik Corporation, *Kivalliq Hydro-Fibre Link*. Available at: https://www.nukik.ca/kivalliq-hydro-fibre-link/ (accessed: 10/10/2024).

The Operational Launch of Satellite Constellations: Opportunities and Challenges for Local Stakeholders

Improved performance of communication satellites from GEO to LEO: A game-changing development for satellite-dependent communities

Geostationary satellites are indeed a very effective technology to circumvent the constraints of installing terrestrial infrastructure in Arctic regions. Positioned about 36,000 km from Earth, these systems allow for the connectivity of vast areas through large transmission and reception beams, but the latency caused by the distance between the satellite and terrestrial equipment poses several problems. These systems also raise numerous technical and financial challenges, both for users and for the Internet service providers that rely on them. On the one hand, the technological vulnerability of satellites and the lack of alternatives to ensure communications redundancy mean that Arctic networks are not very resilient, and on the other, the cost of satellite communications excludes part of the population from having access to them, leading to major inequalities in access to digital resources.

Improving the technical performance of satellite telecommunication systems is therefore essential to envision a more equitable and fair connectivity solution for all Arctic communities. By reducing the distance between ground equipment and satellites and increasing their number to cover the entire globe (or a large part of it), operators of low-earth-orbit satellite constellations aim precisely to enable the most remote areas to benefit from latency times closer to those of fiber optic networks. The Starlink and OneWeb constellations currently available in the Canadian Arctic have their satellite fleets positioned at altitudes between 500 and 2,000 km, which is a significant difference from geostationary satellites.

When a user connects to the Internet via a GEO satellite connection, their data packets are converted into signals by their user terminal before traveling through outer space to the satellite. The satellite then decodes the user's request and sends the signal to a ground station connected to an Internet backbone. The signal must then travel back to the satellite at an altitude of 36,000 km and then back down to the user terminal to connect it to the Internet. These round trips between the user terminal, the satellite and the ground station have a noticeable impact on latency times for users. In general, the propagation latency is not perceptible to the user, as the data packets converted into signals travel at the speed of light between network equipment.[27] The speed of light in a vacuum is 299,792 km/s,

27 C. Rabouam, *op. cit.*, pp. 8–10.

while it is estimated to be around 200,000 km/s in fiber optic cables.[28] Latency is generally lower in fiber optic communications than in satellite communications because the distances traveled by data at the speed of light are shorter. Even if the data is transmitted via a cable encircling the Earth (approx. 40,000 km), the distance—and therefore ultimately the theoretical latency time—is shorter than with satellite communication. With a geostationary satellite, the data must travel 36,000 km to the satellite and then back to earth (72,000 km). Furthermore, an additional round trip is usually required for the data to reach the gateway station of the Internet service provider, which is connected to an Internet backbone.[29]

Some constellation operators also rely on inter-satellite optical links, which allow data to travel from one satellite to another at the speed of light to quickly reach a ground station connected to an Internet backbone and then the user's terminal device. This system helps to reduce latency and the need for ground infrastructure by creating an interconnected mesh network. Users' data packets are routed from satellite to satellite until they reach the nearest ground station, then back to a satellite and onwards via the satellites in the constellation to the one closest to the user before reaching their terminal.[30] Currently, the second generation of Starlink satellites is the only one equipped with this technology. This allows the operator to avoid the costs of building ground stations in the Arctic to operate its system.[31]

The importance of public investments in satellite in Canada

Improving the capabilities of communications satellites is consistent with specific geopolitical contexts at different levels. In Canada, Justin Trudeau's Liberal government has been working for many years to implement a digital policy aimed at both bridging the digital divide and reducing reliance on American digital players and infrastructure. For example, in June 2024, a law backed by the Trudeau government came into effect that levies a 3% tax on foreign tech giants that generate revenue from Canadian users—a measure that is being contested by the US Government.[32]

In this context, the Canadian operator Telesat has been working on the development of its own high-speed satellite constellation since the project was announced in 2017. Telesat's Lightspeed constellation was one of the first to be announced,

28 S. Bigo and J-P Hamaide, La fibre optique embobine la Terre, *Pour la Science*, 2006. Available at: https://www.pourlascience.fr/sd/physique/la-fibre-optique-embobine-la-terre-2448.php (accessed: 25/10/2024).

29 C. Rabouam, *op. cit.*, pp. 8–10.

30 I. Rodríguez-Pérez et al. Inter-satellite links for satellite autonomous integrity monitoring, *Advances in Space Research*, 2011, 2(47), pp. 197–212.

31 J. Foust, SpaceX adds laser crosslinks to polar Starlink satellites, *SpaceNews*, 26 January 2021. Available at: https://spacenews.com/spacex-adds-laser-crosslinks-to-polar-starlink-satellites (accessed: 12/10/2024).

32 G. Malone, Les États-Unis s'opposent à la taxe canadienne sur les services numériques, *La Presse*, 2 July 2024. Available at: https://www.lapresse.ca/affaires/2024-07-02/les-etats-unis-s-opposent-a-la-taxe-canadienne-sur-les-services-numeriques.php (accessed: 15/10/2024).

after Oneweb and Starlink in 2015 and before Amazon's Kuiper project in 2019. Originally, the constellation was to be built in partnership with Thales Alenia Space and consist of around 300 satellites. However, problems in securing sufficient investment prompted Telesat to reduce the number of satellites to 198 and replace the prime contractor with the Canadian company MDA Space.[33] Telesat, which was experiencing severe financial difficulties,[34] eventually received support from the Canadian federal government and the Quebec government, which enabled the company to move forward with its Lightspeed constellation project. This support came in the form of two loans: The federal government provided CAD 2.14 billion with various interest – rate agreements, and the Quebec government provided CAD 400 million, with terms largely reflecting those of the federal loan.[35]

The constellation will thus consist of 198 satellites distributed across several orbits, providing complete global coverage, including the polar regions. Like Starlink, Lightspeed will use optical links between the satellites and aims to optimize the performance of the network as much as possible.

In the case of Lightspeed, the substantial financial involvement of the Canadian and Quebec governments can be seen as a clear effort to regain control of rural and Arctic telecommunications at the national level. Since 2015, the federal government has launched numerous programs to bridge the digital divide in Canada, but these efforts to connect rural areas to high-speed Internet remain insufficient. In a March 2023 report by the Auditor General of Canada pointed out that the gap between urban areas and other regions could lead to equity issues as jobs, education and many services are dependent on Internet access. While nearly 91% of Canadian households had high-speed Internet access in 2021, only 59.5% households in rural and remote regions had the same access, a figure that drops to 42.9% households on First Nations reserves.[36]

The main goal of the Lightspeed constellation, then, is to provide a tangible technological solution for Canada's least connected population. It also aims to

33 Telesat Press Release, *Telesat Contracts MDA as Prime Satellite Manufacturer for Its Advanced Telesat Lightspeed Low Earth Orbit Constellation*, 11 August 2023. Available at: https://www.telesat.com/press/press-releases/telesat-contracts-mda-as-prime-satellite-manufacturer-for-its-advanced-telesat-lightspeed-low-earth-orbit-constellation/ (accessed: 25/10/2024).

34 J. Rainbow, Telesat still bullish on Lightspeed despite funding uncertainty, *Space News*, 30 March 2023. Available at: https://spacenews.com/telesat-still-bullish-on-lightspeed-despite-funding-uncertainty/ (accessed: 25/10/2024).

35 Telesat Press Release, *Telesat Completes $2.54 Billion Funding Agreements for Telesat Lightspeed Satellite Constellation with Strong Government Backing*, 13 September 2024. Available at: https://www.telesat.com/press/press-releases/telesat-completes-2-54-billion-funding-agreements-for-telesat-lightspeed-satellite-constellation-with-strong-government-backing/ (accessed: 25/10/2024).

36 R. Raycraft, Canada falling behind on connecting rural areas to high-speed internet: report, *CBC News*, 27 March 2023. Available at: https://www.cbc.ca/news/politics/federal-government-internet-rural-1.6792060 (accessed: 25/10/2024).

strengthen Canada's digital sovereignty and prevent this market from being completely dominated by foreign companies such as Starlink or OneWeb. Currently, these two constellations are the only ones operating in rural and Arctic areas of Canada. OneWeb has been available through Canadian distribution partners since the summer of 2022, and Starlink expanded its services to Yukon, the Northwest Territories and Nunavut in November of the same year.[37] In August 2021, OneWeb signed a Memorandum of Understanding with NorthwesTel, which was looking to expand connectivity solutions in Yukon and the Northwest Territories as part of its "*Every Community*" project. NorthwesTel originally planned to use the Telesat constellation, but eventually turned to OneWeb due to delays in the deployment of the Lightspeed constellation. The Canadian constellation, which was originally scheduled to be operational by 2024, has been significantly delayed compared to OneWeb and Starlink and has now postponed its launch to 2026.[38]

The arrival of the Starlink and OneWeb constellations in the Arctic market long before the launch of the Canadian Lightspeed constellation has resulted in a significant loss of influence for the Canadian operator Telesat. As Starlink and OneWeb launched their services first, they were able to quickly win over a large share of users and strengthen their partnerships with local players, reducing Telesat's influence in this market.

The impact of growing dependence on Starlink on the digital organization of Arctic territories: the case of Nunavut

Starlink's business model and its rapid adaptation to local stakeholders: an advantage over its competitors

In the Canadian Arctic, the lack of competition, the criticized practices of ISPs and the costly, unstable services they provide have led to strong demand from users and created particularly fertile ground for operators of low-earth orbit satellite systems. User criticism of NorthwesTel's services in satellite-dependent communities has focused primarily on the high cost of Internet plans that do not deliver the promised speeds, as well as significant overage fees.[39] While the company offers unlimited data plans in more populated areas where it operates fiber optic cable, these options are not available in satellite-dependent communities.

37 C. Rabouam, *op. cit.*, p. 34.

38 P.B. De Selding, Telesat may trim Lightspeed constellation size to counteract inflation; estimated in-service date now – 2026, *Space Intel Report*, 2022. Available at: https://www.spaceintelreport.com/telesat-may-trim-lightspeed-constellation-size-to-counteract-inflation-estimated-in-service-date-now-2026/ (accessed: 27/10/2024).

39 CRTC, *op. cit.,* pp. 10–12.

In this context, improvements in satellite system capabilities have been eagerly anticipated, and user frustration with the wait for reliable and efficient services has contributed greatly to the positive perception of Starlink and SpaceX CEO Elon Musk. The business model SpaceX adopted for its Starlink constellation has allowed the company to quickly establish itself in the Arctic digital ecosystem and even become an integral part of it. By selling its Internet packages directly to users without intermediaries, Starlink positioned itself as a real competitor to traditional ISPs. Initially perceived as a disruptive actor in contrast to OneWeb and Lightspeed, which both work with traditional ISPs, the American company eventually adapted its strategy to become both an ISP and a reseller of bandwidth in the same market.

By subscribing to Starlink, users can now bypass traditional ISP constraints, such as NorthwesTel's requirement that customers purchase a landline phone service in order to use an Internet package. NorthwesTel's largest package offers just 300 GB of monthly data for $109 (with no overage fees), while Starlink offers a package with 1 terabyte (about 8,000 GB) of data for $140 per month. Users can also exceed this data limit without additional costs, though their connection will then have a lower priority on the Starlink network, so the speed will be slightly slower once the terabyte has been reached.

Starlink represents an unprecedented shift for residential users, but also for companies and public administrations, which have so far been confronted with high basic fees that made Internet access a real economic challenge. The rapid deployment and adaptation of Starlink in the Canadian Arctic appears to have caught NorthwesTel off guard, as the company has lost significant share of the market in favor of Starlink. Even before SpaceX's service was available in the Arctic, NorthwesTel asked the CRTC for assistance in responding to the competitive threat posed by Starlink. In 2021, the company specifically asked the regulator to change the process for filing tariffs for retail Internet services to better prepare for the arrival of the American constellation.[40]

The arrival of Starlink and Oneweb represents a major change for users of the Arctic network. On the one hand, Starlink, as a private American player, offers a business model that truly competes with traditional Internet providers. On the other hand, the satellite systems of OneWeb and Starlink bring a new source of bandwidth to the Arctic and support telecommunication services in these areas.

A significant reconfiguration of power relations among actors traditionally involved in the digital development of the territory

The telecommunications market in the Canadian Arctic is dominated by three historical players: the satellite operator Telesat, Bell Canada and its subsidiary Northwestel. The emergence of a player like SpaceX in November 2022 therefore generated

40 Northwestel tells CRTC it's in "urgent" need of ability to respond to Starlink's competitive threat, *CARTT.CA*, 10 December 2021. Available at: https://cartt.ca/northwestel-tells-crtc-its-in-urgent-need-of-ability-to-respond-to-starlinks-competitive-threat/ (accessed: 25/10/2024).

as much concern for these incumbents as it did opportunity for smaller competitors like SSi Micro, who are trying to maintain their position in this market.

SpaceX has quickly integrated into the Arctic market by further developing the services of its Starlink constellation and adapting them to the specific needs of local communities. Originally targeting residential users, Starlink services were later extended to businesses and public administrations. About a year after the launch of its services, in December 2023, the American company announced its collaboration with SSi Micro through a federal grant of around 27 million dollars. This grant will enable SSi Micro to improve services in 25 communities in Nunavut by installing Starlink terminals and utilising the constellation's bandwidth.[41] A few months earlier, SpaceX had also announced the signing of an agreement with Rogers Communications—one of Bell Canada's main competitors in southern Canada— that would allow the company to launch its next service, "*Starlink Direct to Cell*", in the cellular sector.[42]

For its part, NorthwesTel relies on OneWeb services for satellite-dependent communities in the Northwest Territories and Yukon, but the company has no low-earth orbit satellite coverage for Nunavut. Under an agreement between operator Galaxy Broadband and PanArctic[43] (the private arm of the Qikiqtani Inuit Association dedicated to telecommunications), all of OneWeb's bandwidth capacity has been reserved for this territory and therefore cannot be used by NorthwesTel. The Inuit associations in Nunavut are particularly committed to projects to improve communication services, and the Qikiqtani Inuit Association has also tried to adapt to the emergence of satellite constellations in the market by setting up its own service. This attempt to adapt led to the creation of Inuknet in 2023, the first Inuit-owned Internet service provider to emerge from the partnership between OneWeb and Galaxy Broadband.[44]

The growing dependence on Starlink and its strategic consequences

On June 11, 2024, Bell Canada announced its intention to sell NorthwesTel to a consortium of First Nations, Métis, and Inuit from the Canadian Arctic. Presented as a "monumental" step that would contribute to national efforts towards

41 D. Lochead, Northern firm gets up to nearly $27M to speed up Nunavut's internet, *Nunatsiaq News*, 21 December 2023. Available at: https://nunatsiaq.com/stories/article/northern-firm-gets-up-to-nearly-27m-to-speed-up-nunavuts-internet/ (accessed: 25/10/2024).

42 Rogers Press Release, *Rogers Signs Agreement With SpaceX to Bring Satellite-to-Phone Coverage to Canada*, 26 April 2023. Available at: https://about.rogers.com/news-ideas/rogers-signs-agreement-with-spacex-to-bring-satellite-to-phone-coverage-to-canada/ (accessed: 25/10/2024).

43 D. Lochead, New company plans for faster internet in Nunavut, *Nunatsiaq News*, 1 May 2023. Available at: https://nunatsiaq.com/stories/article/new-company-plans-for-faster-internet-in-nunavut/ (accessed: 26/10/2024).

44 P. Lipscombe, Inuit-owned telco InukNet launches in Nunavut, Canada, *Data Center Dynamics*, 28 April 2023. Available at: https://www.datacenterdynamics.com/en/news/inuit-owned-telco-inuknet-launches-in-nunavut-canada/ (accessed: 26/10/2024).

reconciliation with Indigenous populations in Canada,[45] this sale also highlights Bell Canada's desire to gradually withdraw from the Internet market in the Arctic, as Starlink continues to establish itself as a key player in the sector.

In Nunavut, the territory's entire telecommunications infrastructure depends on satellites, and Starlink services are now widely used by the population. This dependence on satellites has made Nunavut, its government and its businesses important customers for the Canadian operator Telesat. Telesat also plans to build its own constellation with the help of federal investment. Its main goal is to improve connectivity for rural and Arctic populations in Canada — an objective already largely fulfilled by Starlink and OneWeb since their deployment in the Arctic in 2022. The Territorial Government of Nunavut, which previously relied on the NorthwesTel network[46] and thus Telesat's GEO satellite bandwidth, has also contracted with SpaceX to build a ground station in Iqaluit (the capital of Nunavut) and transfer government services to the Starlink network. Following this investment, the Department of Community and Government Services did not need to renew its contract with Telesat for $2.796 million and with Northwestel for $3.543 million.[47]

Starlink's rapid capture of the Arctic market also increases technological dependence, not only on satellite technology, but also on American infrastructure and players. Improving the performance of the government network by installing Starlink ground stations in Nunavut is taking place while the territorial government's submarine fibre optic cable project to Iqaluit is gradually being sidelined. This project was originally intended to eliminate the territory's dependence on satellites, but the territorial government now views investing in a cable as far more complex and risky than investing in satellite infrastructure. On the one hand, the benefits of this cable would only be visible in a few years, while the installation of Starlink ground stations can be completed in a few months. On the other hand, building a submarine cable to Iqaluit would require a significant logistical effort to bury and reinforce the cable to prevent it from breaking when sea ice forms in Baffin Bay. Although the cable project was of interest before the arrival of Starlink, given the market share that the American operator has now captured, there are no longer enough users for the cable to at least break even at the end of its life. From the territorial government's point of view, it therefore makes more sense to invest

45 Sixty North Unity, Northwestel and Bell Canada announce transformative partnership to advance economic reconciliation, *CISION*, 11 June 2024. Available at: newswire.ca/news-releases/sixty-north-unity-northwestel-and-bell-canada-announce-transformative-partnership-to-advance-economic-reconciliation-818958051.html (accessed: 10/10/2024).

46 NorthwesTel was used as the main network by the Government of Nunavut, as the company had built a fiber optic network in Iqaluit to connect the ground station and users more quickly. To ensure redundancy of government networks, the SSi Micro network was used as a back-up.

47 Legislative Assembly of Nunavut, *Letter from MDJ to COW Chair Hickes-Winter 2024 Commitments Follow Up*, 22 May 2024. Available at: https://assembly.nu.ca/sites/default/files/2024-05/2024-05-22-Letter%20from%20MDJ%20to%20COW%20Chair%20Hickes-Winter%202024%20Committments%20Follow%20Up-eng.pdf (accessed: 25/10/2024).

in a more efficient satellite infrastructure, as this is more cost-effective and can be used in the most remote communities.[48]

Starlink's capture of a large share of the Arctic telecommunications market also reinforces the technological dependence of Arctic networks on US infrastructure and operators. Indeed, the Starlink constellation and ground stations are US infrastructure, and SpaceX, whose industries are located in the US, is subject to US legislation. Furthermore, decisions made on the Starlink network, such as data routing strategies, are entirely determined by SpaceX.[49]

While there are numerous cable projects in Nunavut that could tangibly improve the territory's digital resilience, public investment in satellite technology remains predominant. Whether at the territorial level with the agreement between the Government of Nunavut and SpaceX for Starlink services or at the national level with the significant investments made by the Canadian and Quebec governments in the Lightspeed Telesat constellation, satellite still seems to be the preferred choice, although numerous studies, consultations and research show that it is necessary to rely on different technologies to make telecommunications more reliable for the population and all services in these territories.

Conclusion

The economic model of the Starlink constellation gives SpaceX control over its end-to-end network and positions the company as an increasingly influential and indispensable player in discussions about Internet governance, its standards, the regulation of outer space and the resources (launchers and frequencies) needed to access it. The emergence of satellite constellations in rural telecommunications markets also underscores the intense competition between private players and highlights the competitive threat that Starlink poses in the satellite telecommunications sector. The aim of low-earth orbit satellite constellations is to bridge the global digital divide and universalize Internet access. However, it's important to emphasize that these constellations also serve governmental and private interests that are often far removed from the concerns of communities still dependent on limited and costly Internet services.

In Nunavut, the favorable position and the rapid adaptation of Starlink to the specific needs of local actors concretely reinforce the logic of technological dependence on satellite technology, as well as on American infrastructure and actors

48 Interview conducted in Iqaluit on 09/30/2023. On file with author.

49 Boomerang routing refers to the fact that a significant proportion of Canadian Internet traffic, even domestic traffic, is routed via the United States - a person in Canada accessing a Web site physically located in Canada will generally see their data routed via the United States. See: A. Clement, *Canadian Network Sovereignty – A Strategy for 21st Century National Infrastructure Building*, Centre for International Governance Innovation, 26 March 2018. Available at: https://www.cigionline.org/articles/canadian-network-sovereignty/ (accessed: 06/11/2024).

in the most isolated communities of the Arctic. However, the introduction of Starlink and OneWeb services also represents the beginning of a new era for users in the Canadian Arctic. They now have slightly more options in terms of Internet service providers and access to higher-performing networks at more affordable prices. Satellites will likely always be part of the connectivity solution in the Canadian Arctic, and the arrival of these new players thus brings technological solutions to address the challenges associated with the digital development of these territories.

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