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Roots of an Empire: The development and maintenance of Alberta's broadband infrastructure

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Abstract

This undergraduate honours thesis is a study of Alberta's internet delivery infrastructure. The study reviews the historic and present context of Alberta's internet delivery infrastructure, answering the research question: How has Alberta's internet delivery infrastructure been designed and built and is this infrastructure sustainable with the influx of contemporary data-heavy technologies? Focusing on internet delivery technologies being copper, fibre, wireless, and satellite, this research identifies the importance of provincial policies with regards to broadband infrastructure as new, more data-consumptive technologies emerge. It finds that province-wide strategies for internet delivery infrastructure are historically beneficial to connecting both rural and urban end users, thereby providing equality for internet access. As well, this research reveals how public services such as libraries and their corresponding policy can aid in the development of provincial internet delivery infrastructure projects as found with the case study of Alberta SuperNet.

Keywords: broadband; telecommunications infrastructure studies; Alberta SuperNet; wireless internet infrastructure; satellite internet infrastructure; Alberta *Libraries Act*; last mile connectivity

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List of Abbreviations

AGT – Alberta Government Telephones

CRTC – Canadian Radio-television Telecommunications Commission

DSL – Digital Subscriber Line

FTTP – Fibre to the Premise

FMRCI – Final Mile Rural Connectivity Initiative

FWA – Fixed Wireless Access

GB – Gigabytes

Gbps – Gigabits per second

ISP – Internet Service Provider

ITU – International Telecommunications Union

OECD – Organisation for Economic Co-operation and Development

OTT – Over-the-Top

Mbps – Megabits per second

QoS – Quality of Service

RRBS – Rural and Remote Broadband Systems

W/m^2 – Watts per metre-squared

WISP – Wireless Internet Service Provider

Chapter One: Introduction

In 2016, the Government of Canada announced that there would be a federal review of the *Broadcasting Act*, the *Telecommunications Act*, and the *Copyright Act* (CBC News, 2016). What was meant to be a year-long review of these acts to then result in a set of revised modern, twenty-first century communication cultural laws are still under review as of April 2019, after an announced extension by former Minister of Canadian Heritage, Mélanie Joly on the 28 September 2017 (Government of Canada, 2017). The International Telecommunications Union (ITU), which is the international technology and telecommunications regulator, specify in their annual *Measuring the Information Society Report: Volume 1* that governments around the world must continuously be updating their technological infrastructure and digital literacy strategies and laws in order to ensure that citizens of all ages, abilities, and genders will have the technological opportunities needed to flourish in new and existing job markets which are becoming more technologically advanced (ITU, 2018b). This is not an issue that is only being highlighted on the international stage. The Auditor General of Canada recently published a report on Canada's internet connectivity for both rural and remote regions of the country and recommended that a national broadband strategy was necessary for a changing digital landscape (Auditor General of Canada, 2018). Reviewing both the international and national landscape of internet delivery infrastructure, this thesis aims to identify the research question: How has the current internet delivery infrastructure in Alberta been designed and built, and is this infrastructure and its corresponding policy sustainable for Albertans following contemporary data demand such as the influx of over-the-top (OTT) streaming services?

Beginning with identifying the literature on internet delivery access, this thesis will then outline the theoretical framework for why access to internet delivery infrastructure matters and is

a policy issue for any government. Next, the methodology used to collect and analyze the data is identified. Following this, an analysis of the data which includes an explanation of various internet delivery technologies, a historical context of these technologies in Alberta, and a review of both international and national statistics and trends has been completed in order to best understand the trajectory of needed internet upload and download speeds with emerging data-heavy consumptive technologies. The internet delivery technologies which have been reviewed for this thesis includes fibre wires, copper wires, fixed and mobile wireless, and direct-to-home satellite infrastructure. These internet delivery infrastructures have been chosen based on their use and availability in the province of Alberta. The remainder of this chapter will give context to the economic, social, and political importance of access to the internet.

In Canada, two federal policies are directly related to internet infrastructure. These include the *Telecommunications Act* and the *Radiocommunication Act*. The *Telecommunications Act* encompasses all issues related to Canada and telephony, international telecommunications services licences, international undersea cable licences, who must receive telecommunications services (all Canadians), who may sell these telecommunications services, and overall, how telecommunications must work towards the common good of all Canadians with being able to connect to one another and have cultural sovereignty through this connection (*Telecommunications Act*, 1993). The *Radiocommunication Act*, however, does not have the same cultural distinctions as the *Telecommunications Act*, and is written instead to ensure that the use of valuable radio-spectrum, a key aspect of the current internet delivery infrastructure globally, is not misused by unlicenced radio operators (*Radiocommunication Act*, 1985).

As telecommunications is a broad issue with different related aspects being international regulation, federal regulation, regulation of cables, regulation of radio-spectrum, and so forth,

this thesis limits its scope by reviewing how internet delivery communications infrastructure for the province of Alberta has been designed and built and if this infrastructure is sustainable with regards to higher uses of data in recent years following over-the-top (OTT) streaming services like Netflix. Limiting the scope for this thesis was important as different internet delivery technologies will work best in different geographic locales, so reviewing a single locale gives a better, more focused understanding of internet delivery infrastructure technologies.

As earlier mentioned, the four internet delivery infrastructures analyzed in this thesis are fibre cables, copper cables, fixed and mobile wireless, and satellite. Wireless towers and fibre and copper cables both represent what are termed 'fixed' internet delivery infrastructures in that they are physically laid-out towers and cables that must connect to a given residence, public office, or business (Auditor General of Canada, 2018; Nuechterlein, & Weiser, 2013, pp. 178-180). Mobile wireless and satellite infrastructure are considered mobile internet infrastructures in that a physical cable in not laid out which creates an ease for setup as end users connect to the internet via transmissions on electromagnetic airwaves, known as radio-spectrum (Nuechterlein, & Weiser, 2013, p. 86). Mobile wireless and satellite do differ, however, in that satellite infrastructure is on a per-residence basis – as well on trains and trucks – and does not take as much work for setup, whereas mobile wireless is on a per-user basis such as data use on a mobile phone plan. Both wireless and satellite internet requires purchases of spectrum licences, that purchase being done in the form of spectrum auctions in Canada (Taylor, 2013), as well for wireless infrastructure, a fixed wireless tower is needed to bring internet services to people within the tower's given radius (Auditor General of Canada, 2018; Nuechterlein, & Weiser, 2013, pp. 81-125). With all of this internet delivery infrastructure, why does a review of the infrastructure even matter? Is a review of this infrastructure just looking to help users connect to

Netflix faster? Should that really dignify academic and political discourse? Yes, there is a very large commercial benefit with internet delivery services being regular users downloading music, movies, liking 'posts' they see on social media platforms, sending email, and so forth. As previously mentioned, however, there is an economic consequence for those who do not have access to internet delivery services, as studied by the ITU.

The following figure from the ITU's 2018 *Measuring the Information Society Report: Volume 1* shows how people who do not have basic computer skills like 'Copying or moving a file or folder' have a 17 percent decrease in being employed. It should be noted, however, that these numbers do not contain Canadian representation in the international context as the Canadian Radio-television Telecommunications Commission (CRTC), Canada's telecommunications regulator, did not provide the ITU with this data (ITU, 2018). Even without the measurement of Canadians in this context, however, European countries that did release this data to the ITU can show parallels in these trends of the importance to be able to acquire digital skills. The ITU does note in their report, however, that the first step in accumulating digital literacy to assist with participation in the twenty-first century's digital landscape is to have access to the internet (ITU, 2018).

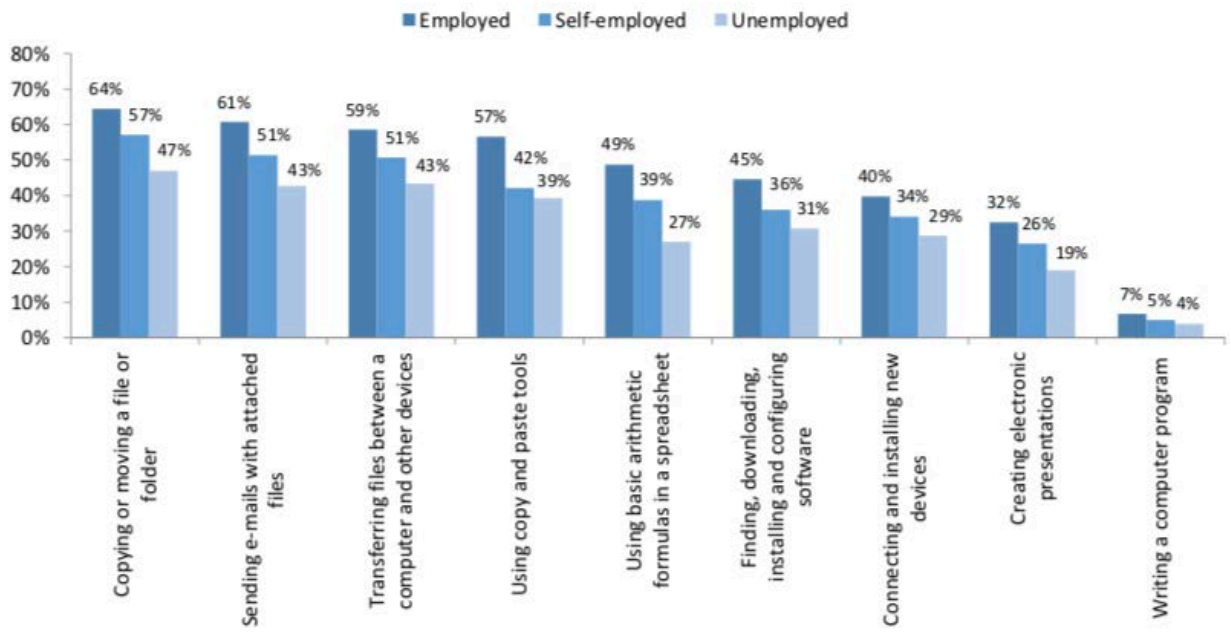

Figure 1.1: Skills by employment status, 2017 (ITU, 2018, p. 36)

Not only is access to the internet a social issue with not being able to connect to others, it is also an economic issue as shown in the data above. The social issue, which can relate to Benedict Anderson's theory of Imagined Communities (Anderson, 2006) in that citizens of a given country only imagine that they are in a community because they have an idea of what their community is based on an identification, acceptance, and respect for the symbols, rituals, and rules of a given locale. This imagined community is challenged when Canadians are not able to digitally connect to each other. By being able to connect to one another through communications technologies, social and cultural ties can be established. The internet is the largest communications technology today, as evident with its everyday use by citizens. The economic issues, which may have larger consequences as unemployment may lead to food insecurity in not being able to afford it, political agitation from not receiving help with the creation of more jobs which may cause populist ideas to spur, and homelessness from not having a livable income are directly related to digital skills as the ITU has found (ITU, 2018). The below figure represents

how even people with basic skills relating to computers (e.g., being able to attach a file to an email), have lower rates of unemployment as jobs that did not need digital literacy previously are now requiring these basic skills. As is apparent in the below graph, the need for access to acquire these skills has real economic consequences for Canadians and their families.

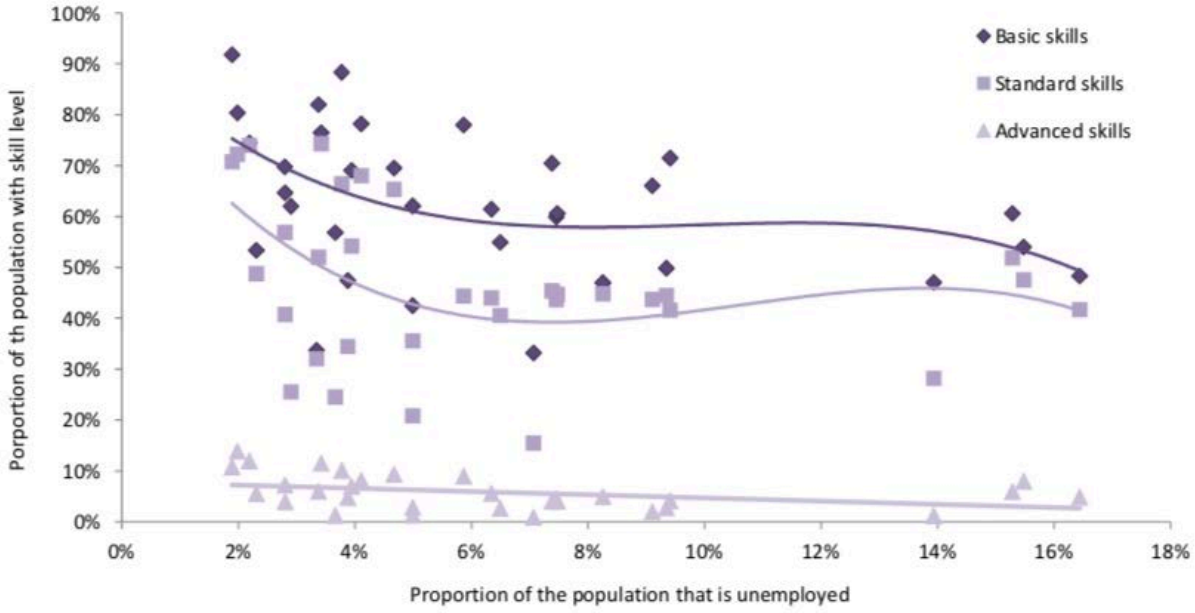

Figure 1.2: Rate of unemployment and basic, standard and advanced skill levels, 2017

(ITU, 2018, p. 36)

What is also interesting with regards to how skills are obtained and have economic translations, is how rural inhabitants are able to utilize internet infrastructure. As represented in the figure below, people of all digital skill sets are living in rural areas. Without connection, however, this could lead to unemployment and further economic consequences. Regardless of skill sets, people are living in rural areas and, therefore, having internet access would be a requirement of their employment with the digitization of more jobs as previously discussed. Without having a strong internet connection, this could lead to the consequences listed above.

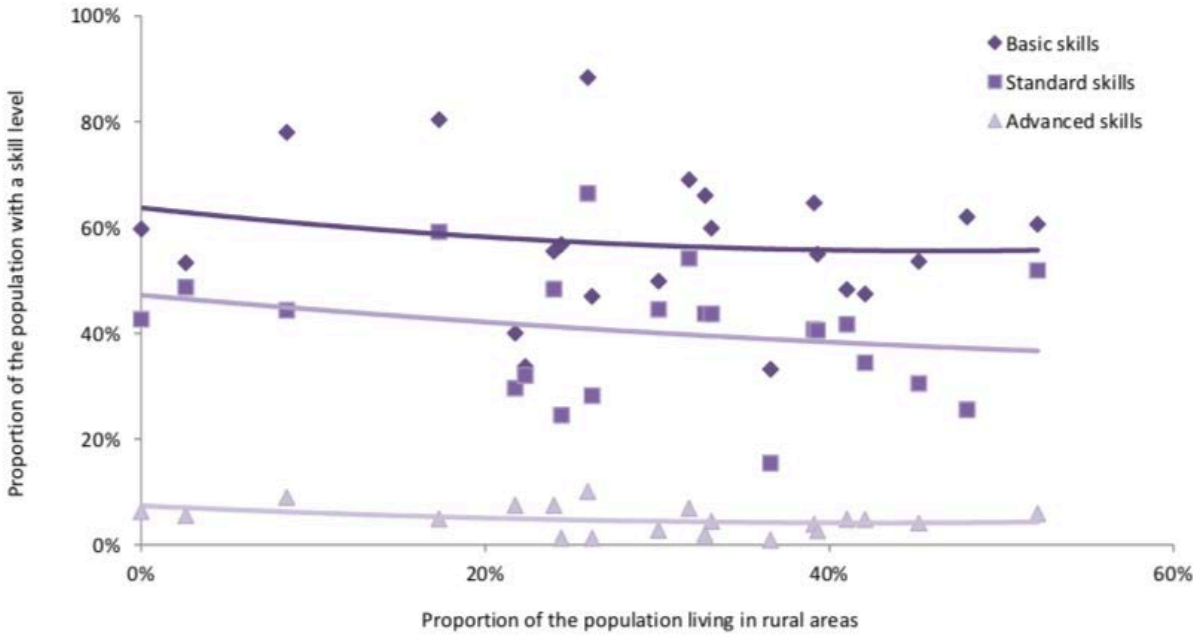

Figure 1.3: Proportion of the population living in rural areas (ITU, 2018)

As is apparent with the statistics and trends outlined in this chapter by the ITU, internet access is not just a means of connecting to entertainment, it has ripple effects to residents' economic livelihoods. This is why studying access to the internet, being internet delivery infrastructure, is important to have this first step – access – available to citizens, permanent residents, and visitors. Star (1999) discusses the importance of infrastructure studies, even with its 'boring nature,' in the field of technical work as the importance of this scholarship rests in topics that are not in the mainstream and can instead be found in "semi-private settings" (p. 378). She notes that with infrastructure it is important to review because further political discourse stems from the origins of this infrastructure as per her quote, "Study an information system and neglect its standards, wires, and settings, and you miss equally essential aspects of aesthetic, justice, and change." (Star, 1999, p. 379). Mattten (2015) discusses similar aspects with an urban historian context in that media infrastructure is important to review as urban spaces throughout history have been designed to make communication between people and parties more efficient.

This is why, she explains, work on infrastructure is important as uncovering the past will lead to understanding the present and future with regards to media infrastructure and that, specifically, cyber infrastructure has a tendency to be overlooked (Matten, 2015). This is why this thesis works to review an aspect of cyber infrastructure being internet delivery infrastructure, to determine how this overlooked aspect of communication and media studies relates to economic, social, and political discourses in Canadian society.

Chapter Two: Literature Review

For Canada, like many other countries, the majority of citizens reside in cities. Urban areas have numerous benefits regarding access to resources because there is a large population of people that are available to spend money in close proximity to one another. As the given population is high density, this is specifically desirable to industries such as the telecommunications industry, where their services are most profitable when customers are closely inhabited to one another. Sarnoff's Law states that, "The value of the network is proportionate to the number of customers it reaches." (Gunasekaran & Harmantzis, 2007, p. 29). At the time of developing his law, David Sarnoff was discussing television broadcasting (Westland, 2010), however, his law can also be applied to other forms of telecommunications given that economies of scale and density where serving a telecommunications service to high density areas will result in a higher return on investment from up-front costs (Neuchterlin & Weisner, 2013, pp. 8-9). This is problematic, however, for rural locales that lack the population density necessary for profitable telecommunications networks as they do not have as many residents in close proximity to one another to be deemed as being profitable to telecommunications companies (Neuchterlin & Weisner, 2013, p. 10).

In Canada, the CRTC has set goals that every Canadian household and office should be able to access 50 Megabits per second (Mbps) of download speeds and 10 Mbps of upload speeds regardless of geographic locale being either urban or rural (CRTC, 2018). To conceptualize, however, this means that in a household, two people may watch ultra HD quality video streamed from an OTT service, such as Netflix, at the same time and no other internet consumption may take place during these streams as this would hit the 50 Mbps allotted amount because each stream of ultra HD quality video requires a download speed of 25 Mbps (Netlix,

n.d.). Note that not all streaming must be done in ultra HD quality, however, this example sets context of internet speeds and usage. This shows how the allotted 50 Mbps download speed by the CRTC is not reasonable for a policy decision as Canadians are increasingly using the internet for more services as it relates to entertainment, business, and education (Rajabium & Middleton, 2013). Furthermore, the internet service providers (ISPs) have in their marketing that their networks may reach *up to* specified upload and download speeds, however this may not actually take place as these speeds will differ depending on how many other people are on the network as, for example, evenings will have more people on a network than the middle of the night (Middleton, 2017; Rajabuin & Middleton, 2013; Rajabuin & Middleton, 2018). The question then arises of what internet access infrastructure technologies are best for reaching higher internet speeds and consumption and are these technologies easily accessible to all Canadians. The CRTC's policy specifically states that there are required upload and download speeds for each Canadian regardless of if they live in Toronto, a rural small town in Saskatchewan, or remotely on Baffin Island. Therefore, these technologies that hit the required speeds must be able to be used in urban, rural, and remote contexts. This literature review will identify how different studies have reviewed rural internet access and the issues that people without internet access may face economically, socially, and politically.

The Different Technologies and Policy Implications

There are four different types of internet delivery technologies, each of which have varying capacities for reaching the 50 Mbps download speeds. Fibre, copper, wireless, and satellite each have benefits and drawbacks for their ability to give Canadians a strong internet connection and are used complementary to one another depending on locale. Currently, copper wires, which were the first telecommunication infrastructure (Fischer, 2011), are being

refurbished from its original telephone use to be used for internet delivery (Kateeb, Burton, Peluso, Chopade, & AlOtaibi, 2013; Middleton, 2016). Of the four internet delivery technologies, fibre is the fastest with being able to transmit data at the speed of light (Middleton, 2016).

In their article, Kateeb et al. (2013) argue that although fibre is the fastest form of internet delivery infrastructure, its costs of implementation far outweigh its benefits. They discuss how the economics of the development of internet infrastructure are the most important consideration when new networks are being planned (Kateeb et al., 2013). In essence, the social and political issues do not matter as much as the economic determinants. This point is also supported by other authors who do acknowledge that there are economic benefits with continuing a copper network opposed to upgrading to fibre (Neuchterlin & Weisner, 2013, pp. 179-180).

Although Neuchterlin and Weisner (2013) agree that there are economic benefits to the continued use of copper infrastructure with not having to build a new network, they still acknowledge that fibre is the best internet delivery infrastructure and note that refurbishing copper wires continuously to meet contemporary data demands may prove problematic in the future, but is economically feasible in the present (pp. 179-180). The refurbishment of cables being problematic is also briefly noted by Rajabuin and Middleton (2013) and Middleton (2016).

In their article, Rajabuin and Middleton (2013) study how provincial policies may lead to better quality of service (QoS) internet infrastructure technologies because provinces have a stronger incentive in providing higher QoS broadband as provinces also take care of other public services. They note that Canada has extensive broadband coverage, however, has low QoS which is an issue for end users with regards to being withheld from the digital economy. According to Rajabuin and Middleton (2013), provinces and municipalities are able to develop and implement

policies to have high QoS backbone infrastructure, the main cables that will connect a geographic locale with internet opposed to only connecting end users, which can then be made of fibre to ensure this backbone infrastructure will not become dated as fibre is the fastest internet delivery infrastructure.

Kateeb et al. (2013), Neuchterlin and Weisner (2013), Rajabuin and Middleton (2013) and Middleton (2016) all identify that fibre infrastructure is the strongest internet delivery technology. Where Kateeb et al. (2013) and Neuchterlin and Weisner (2013) identify cost as being a limitation of fibre deployment and suggest refurbishing copper wires, Rajabuin and Middleton (2013) and Middleton (2016) are strong proponents that the importance with internet infrastructure is to lay the foundation (the backbone infrastructure) with the best technology which is fibre. As specified earlier, wireless and satellite technologies are also part of the internet delivery infrastructure landscape and will be reviewed next.

Both wireless and satellite technologies utilize electromagnetic airwaves that sit on different radio-spectrum frequencies to then have data packets transmit to the end user (Neuchterlin & Weisner, 2013, pp. 83-125). They use differing radio-spectrum bandwidths as their services are better utilized depending on factors such as mountains and trees (Neuchterlin & Weisner, 2013, pp. 90-106; Scheibe et al. 2006; Taylor 2018). Current radio-spectrum technologies have lower upload and download speeds than the aforementioned fibre cables, however, are able to cover large areas for a cheaper price due to lower ‘fixed’ costs of implementation (Neuchterlin & Weisner, 2013, pp. 83-125).

In their articles, both Kanno et al. (2012) and Scheibe, Carstensen, Rakes, and Rees (2006) use different economics and mathematical theories to determine how there is no one-size-fits-all approach to broadband infrastructure and different technologies will work better for

different locales. Scheibe et al. (2006) specify that areas with geographies that include mountains and forestry will need varying radio-spectrum frequencies to permeate complex geographies. Kanno et al. (2012) identify how a strong broadband network could be a coherent radio-over-fibre (RoF) transmission system where fibre specifically provides the backbone infrastructure to a wireless last mile infrastructure system. This would give the best internet speeds at the cheapest up-front costs. Although not policy-specific articles, these two studies do demonstrate how, with regards to wireless internet delivery infrastructure, there are different approaches that different locales can take which may be determinants of different internet infrastructure policies.

On a similar note to the above, Taylor (2018) determined through his study of remote rural broadband systems (RRBS) that there is no one-size-fits-all solution to bridging discrepancies in broadband access and that multiple policies will be needed to ensure equitable access in rural and remote areas of Canada which tend to be the most underserved with regards to internet access. Reviewing the federal RRBS policy that allows smaller ISPs to access unused radio-spectrum, Taylor (2018) identifies that this policy, which is primarily used by northern Canadians, assists rural and remote Canadians with receiving equitable internet access. This policy has notably been used in abundance by northern Alberta residents as the physical geography of a prairie province with residents separated far apart on farms had this policy making sense for them (Taylor, 2018).

It should be noted that for each of the above listed technologies (copper, fibre, wireless, and satellite), Sarnoff's Law, which was outlined earlier, still holds and has impacted rural communities in not receiving adequate services being the minimum 50 Mbps download speeds and 10 Mbps upload speeds (Neuchterlin & Weisner, 2013, p. 83-125; Philpot, Beaton, & Whiteduck, 2014). With Kanno et al. (2012), Scheibe et al. (2006), and Taylor (2018) these

authors identify the need for different policies for different locales as each locale will have different internet infrastructure needs.

As the three academic studies outlined above indicate, poor internet access in urban areas is not an issue, but in rural and remote areas it proves to be problematic and in need of government intervention. Because of this, the rural and remote demographic is of immediate concern by policymakers in Canada (Auditor General of Canada, 2018). Other countries are also working to bridge their own urban-rural digital access divides as this is not an issue unique to Canada (Neuchterlin & Weisner, 2013). It is not that the demand for higher QoS internet access by the residents in rural and remote areas is not there, simply the supply by government and ISPs in developing and maintaining networks has not reached an equilibrium due to the high initial costs of developing a network without the guarantee of it turning a profit (Neuchterlin & Weisner, 2013, pp. 8-40).

The next section of this literature review will identify the urban-rural internet access divide.

Urban-Rural Internet Access Digital Divide

As identified in the previous section, the urban-rural digital divide is an issue of QoS opposed to connectivity. In their article, Rajabiun and Middleton (2015a) review the implications and uncertainties in the QoS end users experience from their broadband network. They argue how speeds are the most important aspect of economic value from the internet and call for more transparency on QoS speeds since competition between ISPs is not always available for given locales to incentivize better service (Rajabiun & Middleton, 2015a). The authors specify that transparency can be achieved by technologies, business models, and public policies that would

force ISPs to deliver advertised speeds, opposed to *up to* speeds which are not regularly hit in some areas, but ISPs advertise customers will be able to reach (Rajabiun & Middleton, 2015a).

In the same year, Rajabiun & Middleton's (2015b) article studies European Union countries with regards to how different policies resulted in different technological change and development of broadband infrastructure. The authors note that high capital investment does not always lead to high-quality broadband infrastructure. They found, however, that countries that do implement stronger policies that promote entry and competition in telecommunications services reap the benefits of better internet delivery infrastructure as a result. These two articles by Rajabiun and Middleton (2015a; 2015b) demonstrate the importance of policy in providing rural areas with similar QoS internet as their urban counterparts, thereby reducing the urban-rural internet access digital divide.

The Case For Wires Over Wireless

As mentioned earlier, wireless and satellite technologies are cheaper and easier to set up and maintain to cover a large network. For wireless specifically, this is because a wireless cell tower will cover a large radius which will encompass all of the space in its given location (Marcus, 2012; Nuechterlin & Weisner, 2013, pp. 128-133). It should be noted, however, that wireless and satellite infrastructure are not perfect systems as *up to* speeds that was previously described are not always met with these technologies, leaving end user with a low QoS. Users are then left unable to access the internet at their needed speeds at given points in a day, such as during 'peak' times.

Alternatively, copper and fibre infrastructure are able to incur higher usage and more devices connected to the networks (Auditor General of Alberta, 2018). Building fibre networks is nick-named 'future-proofing' because fibre has the capacity to have unlimited users on its

network which those users' data packets travel at the speed of light (Middleton, 2016). Fibre also allows for the same upload and download speeds which also increase the speed of the network (Rajabuin & Middleton, 2018). With regards to the articles, reports, and chapters reviewed thus far, it becomes apparent that fibre infrastructure is the solution to QoS problems, a key issue for a sustainable and resilient internet delivery infrastructure network. These fibre networks, however, are not built due to high costs and instead wireless networks are opted in for connectivity. As specified in the previous sections with Rajabiun and Middleton (2013; 2015a; 2015b), policies have the ability to implement fibre networks where private-sector business would refuse to. The next section of this literature review will identify the supply-demand economics of internet delivery infrastructure.

The Supply-Demand Economics of the Telecommunications Industry

The supply-demand economics principle occurs when an equilibrium is established when the supply of a product or service by a seller has equal demand by a buyer (Alhouse et al., 2011). When there is too much supply and not enough demand, the provider will typically reduce prices in order to create an incentive to purchase the product. In contrast, when there is more demand than there is supply, the producer is able to raise prices to maximize their profits as there is an exclusivity regarding their product (Alhouse et al., 2011). The latter explanation of price differentiation in supply-demand economics is what regularly occurs in the telecommunications industry (Neuchterlin & Weisner, 2013, p. 8-14). The primary reason for this has been that internet demand has only increased, especially since the introduction of OTT video streaming which consumes larger amounts of data (CRTC, 2017).

Winseck (2017) outlines that telecommunication infrastructure does have a history of sudden booms in its development followed by lags in changing or updating this infrastructure.

This is where policy has the ability to ensure that lags do not occur, which then are able to have innovative technologies, such as fibre, be built when demand is substantially higher for a telecommunications network than when one was first built.

An issue for supply-demand economics to work is that the producer must be better off by selling their product or service at the end of the day. If there is no opportunity for an ISP to turn a profit by providing network access to rural and remote locales, then it is not feasible for them to build the necessary infrastructure in the first place (Neuchterlin & Weisner, 2013, p. 8-14). Again, policymakers must be ready to step in and either build the infrastructure or develop innovative policies in order to ensure that all areas are networked with QoS network infrastructure in order for Canadians to enjoy all aspects of the internet.

Conclusion

There are discrepancies in the urban-rural internet access landscape as technologies are not matching demand based on the types of networks in place for rural and remote areas. This imbalance is leading to an internet access digital divide with regards to QoS. By not addressing how current legislation for upload and download speeds are not realistic for the networks in place in many jurisdictions, the CRTC is not being resilient, proactive, or socially sustainable to Canadians. With many services being moved to digital platforms, the demand for internet consumption is only increasing and with this a strong network that is able to meet the demand of citizens is needed for the digital economy. The academic literature that this chapter reviewed address how policies can help with implementing high QoS networks to bridge the urban-rural internet access digital divide. These policies may relate to fibre networks or to wireless ones as demonstrated by Rajabuin and Middleton (2013; 2015a; 2015b; 2018) and Taylor (2018). The reviewed literature also determined how price and supply-demand economics affects networks

and that price specifically should be taken into consideration when internet delivery infrastructure networks are developed (Kateeb et al., 2012; Neuchterlin & Weisner, 2013, pp. 179-180). It is apparent from this literature review, however, that different geographic locales will require different internet delivery infrastructure policies and developments (Kanno et al., 2012; Scheibe et al. 2006). Therefore, there is no one-size-fits-all approach that can be taken to internet delivery infrastructure.

Chapter Three: Theoretical Framework

The following chapter will identify the theory used to guide this thesis regarding assumptions made and data collection. This thesis' primary goal is to better understand the role of government and policy in rural broadband infrastructure. Narrowing the scope of this issue to the province of Alberta and post-2010 – after OTT streaming services like Netflix were introduced to the Canadian market – the research question that this thesis aims to identify is: How has the current internet delivery infrastructure in Alberta been designed and built, and is this infrastructure and its corresponding policy sustainable for Albertans with higher data usage technologies such as OTT streaming services? This theoretical framework will identify the governing theory for this thesis, identify the key points that the chosen theory answers in relation to the research question, outline other theories that were considered for the formation of this thesis, and identify how this theory assists with the methodology used for data collection.

As described in detail in the next chapter, this thesis uses three research methods: historical analysis, primary document analysis, and data analysis. When reviewing different theories to use for this thesis, the hypothesis that a theory would have to support with regards to the data collection was that there is inequality between rural and urban internet delivery infrastructure, and this is known by the CRTC. The theory chosen, therefore, would have to identify the ways in which internet delivery technologies can be used in order to bind residents in a rural context to the same extent as those technologies being used by their urban counterparts. The theory that was the most appropriate for the binding of space (regarding rural residents being spatially apart from urban residents and thereby the economic advantages of urban areas) and the binding of time (with rural residents able to receive the same quality of service regarding their

internet access as their urban counterparts), was Harold Innis's theory of space-biased and time-biased communication.

Harold Innis was an early twentieth-century economist who, later in his career, transitioned from the field of economics history to pursue communications scholarship (Schabacher, 2015). Innis was originally born on a small farm near Otterville, Ontario and was a World War I veteran who would carry his Canadian-ness proudly in his career as an academic (Schabacher, 2015). His life of being born in a rural setting, as well living through the Great War in which he would encounter the brute understanding of empire may have led to his pursuit of understanding how the role of space and time in relation to empire will create a bias of communication. Empire in the context of this thesis is the political community of Canada. It is significant to review 'empire' in this thesis as the preservation of the given empire is a reflection of how well the empire is being ruled and maintained by its figure of authority.

Innis identified how empire can be accomplished through space-biased communication such as the role of papyrus and an easy to transcribe alphabet as granting an ability for a given ruler to expand their empire by means of this communication (Innis, 2008, p. 7). With papyrus and parchment being able to hold the ideologies, beliefs, and laws of the given empire, the spread of an empire through this communication would be much easier. The issue with using papyrus or parchment, however, was that it would not be able to escape the issue of time in that it was easily susceptible to the harms of an environment and could deteriorate and face ruin (Innis, 2008, p. 11). Time-biased communication, therefore, would also assist in the building of empire such as the Egyptian pyramids in withstanding deterioration, however, not being able to be easily transmitted through space to secure a larger empire as the pyramids cannot be moved around. Used together, this monopoly of both space-biased communication and time-biased

communication would be able to achieve a long-lasting empire (Innis, 2008, p. 100). The idea of empire and how it relates to data consumptive technologies such as Netflix and high-quality internet access can be understood with the following philosophical construct:

(1) The internet delivery communications infrastructure will be a time-biased communications source to help solidify empire (empire being the nation-state of Canada and the rule of law held by the Government of Canada);

(2) With access to high-quality internet consumption, the issue of space-biased communication will be limited with the information of the internet readily available to all Albertans, also solidifying empire;

Therefore,

(3) The role of ruler should be to ensure that internet delivery communications infrastructure is available and upkept in order to continue control over the given empire. (Note that the ruler in this case is the Government of Canada, and more specifically the CRTC as they monitor Canada's communications sector).

As the above notes, it is only logical for the 'ruler' to ensure that internet delivery communications infrastructure is readily available in order to secure power. What is evident from this thesis' data collection, however, is that this sound and valid argument is not being upheld as there is not a national broadband strategy (Auditor General of Canada, 2018). It is evident then that the role of ruler in the context of Canada (more narrowly Alberta), is not being fulfilled which then may lead to a lost empire. A critique of the above construct, however, could be that although having access to the internet will overcome the issue of space-biased and time-biased communication to then establish empire, the internet gives information about other 'empires' that

may limit the effectiveness of Canada's 'empire.' This claim, although true in parts, can be countered in that the *Canadian Broadcasting Corporation* (CBC) is the most searched news outlet by Canadians on the internet (Alexa Internet Inc., 2019). With the CBC being Canada's public broadcaster, their responsibility is to further establish empire by emphasizing Canadian-ness through public broadcasting (Taras, 2015, p. 225). This example of the CBC demonstrates that by having internet delivery communications infrastructure with high quality of service across Canada, and more narrowly across Alberta, empire is able to be built through Canadian mass communications. The onus to have internet delivery communications infrastructure then is not just a question of equality between urban and rural Albertans, it is a question of securing an empire in the form of a nation-state.

The concept of the idea of nation was considered when determining which theory would best suit this thesis. Other theories such as Maurice Charland's technological nationalism and Benedict Anderson's imagined communities were both considered. Maurice Charland identified that technological nationalism is how Canada became a country, first with the development of the Canadian Pacific Railroad (CPR) and then with the radio (Charland, 2004). His premise was that Canada has become a country because of technological advances that have connected citizens to one another. Similar to Innis's space-biased and time-biased communications theory, the CPR conquered space whereas the radio conquered both for connecting the country. Charland's theory was not chosen because it only focuses on how technological accomplishments are able to advance a national identity. The focus of this thesis is not to review any form of nationalism, but instead to identify the explicit political issues with citizens not having access to emerging communications technologies, opposed to reviewing the cultural issues.

Benedict Anderson's theory of nations being imagined communities in that the nation is a social construct because people in a given nation will not know one another was also considered for this thesis. Nations being imagined communities as people may never meet their fellow citizens, however, will feel a sense of shared identity because they come from the same place (being the nation's name and not a given small geographic locale where they might actually meet) (Anderson, 2006, p. 7). Similar to the theory of technological nationalism, Anderson's theory would not be appropriate for this thesis as it focuses mainly on issues of culture and culture's social construct. Chen (2006) found in her study of Chinese-Canadian immigrants' use of information communication technologies (ICTs), that by having access to ICTs, Chinese immigrants living in Canada (specifically Toronto), were able to connect to two areas, being Toronto and China (specifically for transnational entrepreneurship), because of ICT technologies, but this technology was not what created community for them. The studied immigrants would still need to go in person to strengthen business ties in both Toronto and Bei Jing face-to-face opposed to just through ICTs. Therefore, it was evident that in the case of ICTs, an imagined community is 'not enough' for developing bonds over the Internet and that face-to-face communication is still needed in conjunction. The theory chosen for this thesis would therefore need to establish the importance of internet delivery infrastructure as a political and economic means, opposed to primarily a cultural means.

Harold Innis's space-biased and time-biased communication theory, specifically drawn from communication infrastructure studies, is necessary for this thesis because infrastructure studies as an area of scholarship has been recognized increasingly as necessary for the overall understanding of internet studies (Bowker et al., 2010; Sandvig, 2013). Because the internet builds off of different layers, internet delivery infrastructure being the base layer, the materiality

of communications infrastructure matters in understanding the further politics and governance of the internet (Sandvig, 2013). As Sandvig (2013) notes on communication infrastructure, “The first such attribute of infrastructure states that it is normally invisible, becoming apparent only when it breaks.” (p. 96). Similarly, Bowker et al. (2010) state the importance of infrastructure studies lies in uncovering marginalized aspects related to infrastructure which can become buried in a political landscape but is still necessary to be knowledgeable about as it is a part of a society. It is not just what is seen, however, it can be what is not such as cyber infrastructure in code or wires and machines in walls (Bowker et al., 2010). Reviewing infrastructure studies is not either a social or technical study, instead it is a study of infrastructure that results in either a social or technical solution, or a combination of the two being the result of a survey of the problem (Bowker et al., 2010).

This infrastructure also layers on top of one another as new communications infrastructure uses pieces of the older infrastructure (Bowker et al., 2010). This ecosystem of infrastructure builds off one another with each aspect acting as a different gatekeeper to a different layer of the overall internet (Crawford, 2013). With regards to space-biased and time-biased communication theory, because the infrastructure is continuously being built upon, it withstands time in its development to permeate space. It is then apparent that the review of internet delivery communication infrastructure is necessary in order to determine the further solidifying of empire through use of the internet as per noted earlier in this chapter.

> “Culture is concerned with the capacity of the individual to appraise problems in terms of space and time and with enabling him to take the proper steps at the right time.”
>
> (Innis, 2008, p. 85).

The theory of space-biased and time-biased communication was used in data analysis for this thesis to determine if the CRTC and more broadly, the Government of Canada, were working to secure empire through internet delivery communications infrastructure. As the data shows later in this thesis, the Government of Canada has not been upholding empire through utilizing space-biased and time-biased communication thereby forfeiting their right to empire in the context of Alberta.

Chapter 4: Methodology

The following chapter will outline the different methods used as an overall methodological framework for the data collection and analysis of this thesis. The research question that this thesis aims to answer is: How has the current internet delivery infrastructure in Alberta been designed and built, and is this infrastructure and its corresponding policy sustainable for Albertans following contemporary data demand such as the influx of OTT streaming services? The key issues that this thesis explores are: firstly, how different geographic locales in the province of Alberta receive different quality of service regarding broadband connectivity. Secondly, the ways in which different quality of service between the different locales (e.g., rural areas opposed to urban areas), has been built. Lastly, this thesis aims to determine if the current internet delivery infrastructure is sustainable with the popularity of OTT streaming services, like Netflix, becoming increasingly popular that also require higher download speeds than are available in rural areas.

In order to address this question and explore its key issues being examined, a mixed methods approach has been chosen. Mixed methods research is defined as a research methodology which utilizes both qualitative and quantitative methods in answering a given research problem (Cresell, 2014). Based on the data output by both the qualitative and quantitative methods for a given piece of research, a conclusion is then drawn based on the combined strengths of the different types of methods used (Cresell, 2014). In theory, by having this combined conclusion of both qualitative and quantitative methods, the research problem will be better understood based off of this collective strength (Cresell, 2014). This methodological approach was decided based on the research question being a multi-variable question. As discussed above, there are three key issues that this research looks to address. A mixed methods

methodology allows for these different points to each be answered to have a holistic understanding of the issue at large being rural broadband connectivity in the province of Alberta.

A limitation of a mixed methods approach, however, is that it may result in an attempted triangulation of the data which was unnecessary. Triangulation is the data analysis technique where the researcher identifies three sources which all come to the same conclusions regarding a given topic to assess its validity (Merrigan, Huston, & Johnston, 2012, p. 164). Triangulation with regards to using different methods in this study was unnecessary as the multi-variable research question simply needed a mixture of methods in order to understand the question's different variables, not to ensure one variable was accurately answered. Triangulating data based on separate statistics, however, was beneficial in order to determine the validity of the given statistics (e.g., using international and national statistics to determine trends in internet usage). Mixed methods has the potential to also create researcher bias in that the researcher may favour a qualitative method over a quantitative one, or vice-versa, which could provide inaccurate results, or results that are not as strong as what they could have been had mixed methods research not been conducted. In order to ensure that this has not happened in this thesis, I used techniques such as triangulation and resistant reading. Resistant reading is an approach where the researcher determines the author's perspective of the given piece under analysis, and carefully considers the facts presented in this piece for their validity (Merrigan, Huston, & Johnston, 2012, p. 165). By using triangulation and resistant reading this reduces the potential limitation of using a mixed methods approach. The following will outline the different qualitative and quantitative methods to be used for this research.

Qualitative Methods

Historical Analysis

The first method discussed for this thesis is historical analysis. As this is a thesis that focuses on public policy, historical analysis, and more broadly media history, is used in order to situate telecommunications policies with the ways in which Albertans are receiving different quality of service broadband speeds across the province. Historical analysis is the method in which both primary and secondary documents are reviewed in order to either understand a topic by reconstructing the historical time period in which it had occupied, or to understand a topic by determining how it has changed or developed over time (Merrigan, Huston, & Johnston, 2012, p. 144). The benefits of this method are that by constructing a chorological and thematic inquiry of the ways internet delivery infrastructure, and more broadly telecommunications services, in the province of Alberta were designed and built, it will allow for me to determine why rural areas are underserved with low quality of service broadband speeds. This then will touch on one of the key issues of this research being how the current internet delivery infrastructure in Alberta was designed and built.

For this thesis, historical analysis was constructed through the review of secondary sources such as Robert Babe's (1990) book *Telecommunications in Canada*, Tony Cashman's (1972) book *Singing Wires*, and scholarly articles on telecommunications history which also use historical analysis to determine how Canada's telecommunications infrastructure and policy was designed and built. A more recent example of historical analysis, Shepherd (2018) uses this method to situate her research on the cultures of internet policymaking, however, supplements this historical analysis with a case study being the Review of Basic Telecommunications Services by the CRTC in 2016.

Primary Document Analysis

The next method described is primary document analysis. Stemming from historical analysis, primary document analysis is also a method that can be encompassed under 'media history' (Seale, 2018, pp. 285-304). Media history stems from communication and media studies in that a media artefact – which can be print, web, film, or sound – is analyzed in a historical context and thereby the media artefact would be the primary document under analysis (Seale, 2018, pp. 285-304). The primary sources evaluated in this thesis include CRTC reports, government acts that relate to Alberta's internet delivery infrastructure, reports by the Government of Alberta, and reports by Innovation, Science and Economic Development (ISED) Canada. To gather the primary documents, which will further be referred to as 'primary data' in this thesis, the CRTC's website (https://crtc.gc.ca), the Government of Alberta website (https://www.alberta.ca/index.aspx), and ISED Canada's website (http://www.ic.gc.ca/eic/site/icgc.nsf/eng/home) were reviewed. Government reports were chosen specifically after 2010 as this was the year Netflix was introduced to the Canadian market, thereby resulting in higher data consumptive activities by Canadians, and more generally Albertans.

The benefits of this method are that in order to have primary data to analyze which is necessary for a thesis, primary documents would have to be analyzed. Ali and Duemmel (2018) also use this method in their evaluation of a rural broadband regulator in the United States being the Rural Utilities Service (RUS). They used a thematic organization of Federal Communications Commission's (FCC) interventions regarding decisions that related to the RUS. This recent example shows how primary document analysis for policy papers is a well-chosen method.

This is the primary method used for this research as all of the government reports and acts that have been analyzed for this thesis are considered primary documents. This method, like

the previously discussed historical analysis method, is also qualitative. This method works in answering my research question in that the policies that have been put out after OTT streaming services have entered Canada are reviewed to determine the sustainability of these policies in conjunction with the quantitative method listed below.

Quantitative Method

Data Analysis

Data analysis is the quantitative method used for this research. The numerical data being analyzed in this thesis is secondary and has been published by the CRTC, ITU, and the Organisation for Economic Co-operation and Development (OECD). These three agencies each provide statistics on how broadband, broadband access, quality of service, and prices regarding the telecommunications sector are trending. The CRTC provides Canadian-exclusive context, the ITU compares Canada with other countries, and the OECD compares Canada to other OECD countries which are countries that have strong economies in comparison to the rest of the world with the exclusion of China, India, and Brazil (OECD, 2018).

This method was chosen in order to review the statistics of what the quality of service for broadband users is in Alberta in comparison to the rest of Canada and other countries was. This then gives the ‘hard facts’ on Albertans’ broadband distribution based off of the policies that are put in place that had been analyzed with the primary document analysis method.

Analysis of Collected Data

As described above, the three methods of historical analysis, primary document analysis, and data analysis will provide a mixed methods methodology for this research. This data works collectively by, first, providing a historical understanding of what policies and initiatives were used to construct Alberta’s current internet delivery infrastructure. Next, an analysis of policy

decisions and reports regarding broadband. Finally, the methodology then triangulates the overall collected qualitative data with numerical evidence collected by federal and international institutions that focus wholly, or partially, on telecommunications statistics and trends. The historical analysis and primary document analysis were coded chronologically to provide a timeline for each type of internet infrastructure (copper, fibre, wireless, and satellite) to determine how this topic has changed over a given period of time (Merrigan, Huston, & Johnston, 2012, p. 144). The data analysis from statistics and trends collected by the CRTC, ITU, and OECD were then used to buttress the qualitative data.

Chapter Five: Analysis

In the following chapter I will outline my findings and the corresponding analysis. I will begin by defining what broadband is as this is the means of internet connectivity needed to support high data consumptive activities such as OTT video streaming. From this I will identify the four areas of internet delivery infrastructure that were studied for this thesis being copper, fibre, wireless, and satellite with regards to how their technology works in supporting internet access to Albertans. Following the explanation of the four different internet delivery technologies, I will then present a historical analysis of how these different internet delivery infrastructures were built in Alberta in order to identify the portion of my research question which asks how the current internet delivery infrastructure in Alberta has been designed and built. After the historical analysis I will identify my findings through my data analysis from statistics collected by the CRTC, the OECD, and the ITU. The data analysis will determine what speeds are necessary for sustainable internet delivery infrastructure based on trends of current data usage both in Canada and internationally. To conclude I will relate the analysis to my theoretical framework to make final concluding remarks of the state of Alberta's internet delivery infrastructure based off of this analysis.

What Is Broadband and Why Does It Matter?

At its most basic definition and understanding, broadband is a method of connectivity to the internet and has a minimum speed of two Mbps (ITU, 2003 September). It is always on, there is no need to 'dial up' or make choices between using your home telephone or your internet access at a given moment (McNally, McMahon, Rathi, Pearce, Evaniew, & Prevatt, 2016). Where the internet is a space of economic, social, and political engagement, broadband is the means of getting to that space. Broadband's 'always on' ability is necessary as the internet is

more than just a space for communication between people, it also connects vital aspects of Canadian society such as traffic lights, food transportation orders, water services, and more as communication between these services/industries must be 'always on' in order to increase efficiency of basic services for a more harmonious society (McNally, et al., 2016). The need for broadband, therefore, is not just one of entertainment value where multi-million dollar infrastructure is built simply for internet users to watch more Netflix, it also assists in the organization of basic services in Alberta, and more broadly Canada.

Internet delivery infrastructure in Alberta uses a combination of infrastructure for different regions of the province. These include: fibre wires, copper coaxial wires, copper digital subscriber line (DSL) wires, fixed wireless access (FWA), mobile wireless, and direct-to-home satellite (Cybera, 2016). Not including DSL on its own (i.e., not partnered with a fibre-optic cable) due to its slow speeds on its own, rendering it not being 'always on,' the other identified internet delivery technologies can support broadband, however, at differing speeds with fibre having the fastest and most reliable connectivity (Cybera, 2016; McNally et al., 2016). Other internet delivery infrastructure technologies include, satellite community aggregator access which can be found in Canadian provinces and territories excluding maritime provinces and Alberta (CRTC, 2014; Cybera, 2016).

It should be noted as well that one part of Alberta's internet delivery infrastructure does include Internet Exchange Points (IXPs) which can be found in both Calgary (YYCIX) and Edmonton (YEGIX) (Cybera, 2016). IXPs route traffic of the internet to end users providing the entirety of the internet, being a critical piece of the Internet's overall infrastructure. More information on IXPs can be found in Cybera (2016), as well Clement and Obar (2014). IXPs will not be analyzed further in this chapter as they are part of the internet's overall infrastructure,

however, do not fit the category of its 'last mile' delivery access which this thesis aims to identify, the 'last mile' being the final point of internet delivery to the end user. The following section will outline the ways in which the different internet delivery infrastructures work in providing internet access to Albertans. As stated earlier, different infrastructures are available in different regions of the province. An explanation for why there are different technologies for different areas will be identified later in this thesis where I outline the historical analysis of these infrastructures.

Alberta's Available Internet Delivery Technologies and What This Means For Access

As mentioned, Alberta uses both fixed, fixed wireless, and wireless solutions for internet delivery infrastructure. A 'fixed' internet delivery infrastructure describes copper wires, fibre wires, and wireless towers that are connected to a fibre or copper backbone wire for their internet delivery (Auditor General of Canada, 2018; Cybera, 2016; Innovation, Science and Economic Development Canada, 2018; McNally et al., 2016). Wireless infrastructure includes internet delivery infrastructure that uses microwaves via radio-spectrum to distribute data signals (Auditor General of Canada, 2018; CRTC, 2014; Innovation, Science and Economic Development Canada, 2018, McNally et al., 2016). The following image taken from the Auditor General of Canada's (2018) report titled *Report 1 – Connectivity in Remote and Rural Areas* visually outlines these different internet delivery infrastructures.

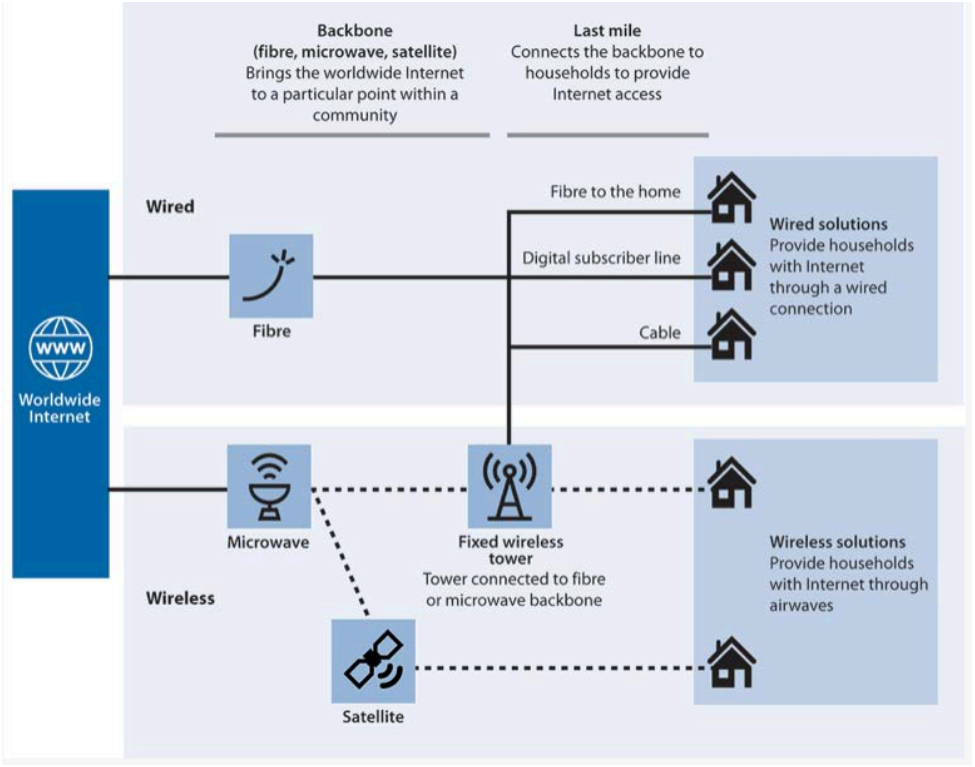

Figure 5.1: Broadband internet providers access to essential services (Auditor General of Canada, 2018)

As the above figure shows, there are two primary aspects to internet delivery infrastructure: the backbone and the 'last mile.' The backbone and 'last mile' are the infrastructure which allow access to the internet. This consists of different technologies to then allow for the 'last mile' being the final connection to the end user to be achieved. The following section will identify how each of the earlier specified internet delivery technologies works to provide internet access to 'last mile' users.

Cooper Infrastructure

In Alberta, copper internet delivery infrastructure is used by DSL and coaxial cable lines. DSL and coaxial cables are fixed (wired) internet delivery infrastructure in that they need a physical wire either trenched into the ground or strung along phone poles. DSL are able to reach up to 100 Mbps per user with the latest technology, however, depending on how far the DSL

user is from the DSL Access Multiplexer (the internet exchange which can be found in Calgary or Edmonton), this will slow down upload and download speeds (Cybera, 2016; McNally et al., 2016). Coaxial cables, on the other hand, are the fastest copper wire infrastructure and are able to hit speeds up to 160 Mbps in an aggregate, however, may decline with more users on a given network (McNally et al., 2016). This is achieved by the modem for coaxial cables separating internet signals from television signals (McNally et al., 2016). It should be noted with regards to multiple users on a coaxial cable, this does not only include multiple users in a specific household, but multiple users in a given area using this cable. Therefore, during 'peak times,' the data speeds will be slower based on a given household and all of their neighbors using the internet at the same time in a high capacity (e.g., numerous neighbors on a street all watching a movie on Netflix around 7PM).

Fibre Infrastructure

As stated earlier, fibre infrastructure is the fastest internet delivery system. Fibre is able to have speeds between 1 Gbps (1000 Mbps) to 10 Gbps (in some areas of the United States this is being tested for speeds, however not in Canada) (McNally et al., 2016). Fibre optic cables are made of fibreglass and are able to transport data at the speed of light when 'lit up' (Kateeb et al., 2013). The term 'lit up' is used for fibre optic cables because, when the cables are in use, they literally light up, whereas when they are dormant they do not illuminate, thereby referred to as 'dark fibre.' Fibre as an internet delivery infrastructure is not slowed down itself by multiple devices being connected to it like other internet delivery infrastructures. Instead, the speed of data being transported along a fibre network is only slowed down at the endpoints being the electronics attached (Lau, 2009, p. 125-134; McNally et al., 2016). It should be noted that these electronics do not just include a personal device, but also include routers, modems, and

demodulators (Lau, 2009, p. 125-134). As the internet router in a home or office is where internet may arrive via Wi-Fi, this is where the network slows down for the end user, to sum not the fibre infrastructure itself.

The primary barrier to fibre optic cables' deployment is the cost of implementation. With fibre infrastructure being a fixed (wired) internet delivery infrastructure, this means that trenches would have to be dug to bury the wires underground, phone poles would have to either be erected or leased for space, as well the overall maintenance of these wires would have additional long-term recurring costs. In Calgary, for example, deployment of fibre optic cables in 'brownfield' areas, areas which were previously developed in urban spaces but are then under new development, costs approximately $200 per metre (McNally et al., 2016). For areas that are sparsely populated and require long distances for the wires to cover, the cost-benefit of fibre may reduce the desire for the speeds that could be achieved.

Wireless Infrastructure

Wireless infrastructure uses invisible radio-spectrum to distribute data on electromagnetic waves (Auditor General of Canada, 2018; Cybera, 2016). By having a wireless cell tower, this fixed and mobile infrastructure is able to distribute internet access to users within a given radius. For fixed wireless specifically, the transmission from the tower must have a direct (fixed) point to deliver internet access (McNally et al., 2016). Receptors (being the antennas either mounted on buildings or even the antenna in a cellphone) in fixed and mobile areas are able to 'pick up' the data on the electromagnetic wavelengths as can be seen in the figure below (Cybera, 2016).

Wireless infrastructure has the power in some cases to outperform wired connections, which tend to be faster options for internet delivery (such as DSL cables), however wireless typically offers speeds up to 100 Mbps in a given aggregate (McNally et al., 2016). As noted

earlier, when the speeds are distributed among an aggregate, this means that the up to 100 Mbps speeds are not allocated to one user, but instead to multiple users.

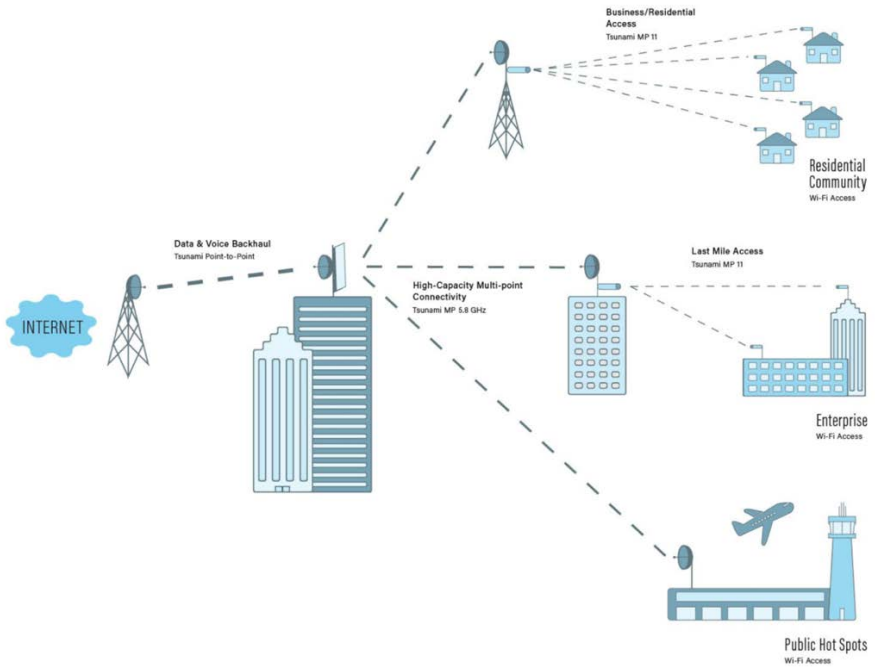

Figure 5.2: High-level overview of the network architecture for delivery of internet services by WISPs (Cybera, 2016)

Barriers to this technology include the cell towers being expensive to erect and their upkeep. Further barriers include that these towers are not aesthetically appealing thereby having citizens not wanting these towers in 'their own backyard,' as well there have been highly contested arguments that the radiation from wireless signals can lead to cancerous cells (Mukherjee, 2016). This feared radiation, however, is non-ionizing and therefore should not have health effects on citizens in its proximity so long as the electromagnetic field of the radius is below 4.5 W/m^2 (Mukherjee, 2016). Another large barrier for having mobile wireless infrastructure is the need to accumulate the necessary radio-spectrum frequencies to operate on (McNally et al., 2016). These frequencies are purchased via an auction format which can be difficult for smaller incumbents to have the financial capital to bet on spectrum against the larger

telecommunications companies (Innovation, Science and Economic Development Canada, 2018; McNally et al., 2016; McNally et al., 2016; Taylor, 2013).

Satellite Infrastructure

Like wireless infrastructure, satellite infrastructure also uses radio-spectrum to distribute data along electromagnetic waves. Satellite internet infrastructure falls into two categories: direct-to-home access and community aggregator access. Direct-to-home access has the satellite distribute signals to a home or office directly giving straight access, whereas community aggregator access will have the satellite in orbit connect with an Earth station which then distributes the internet signals to cables which will then connect to the end user being a home or office (CRTC, 2014; Cybera, 2016). In Alberta, geostationary or geosynchronous (GSO) satellites are located approximately 35 000 km above the Earth's surface measured at the equator (Cybera, 2016). The following figure visually describes the difference between direct-to-home access and community aggregator access.

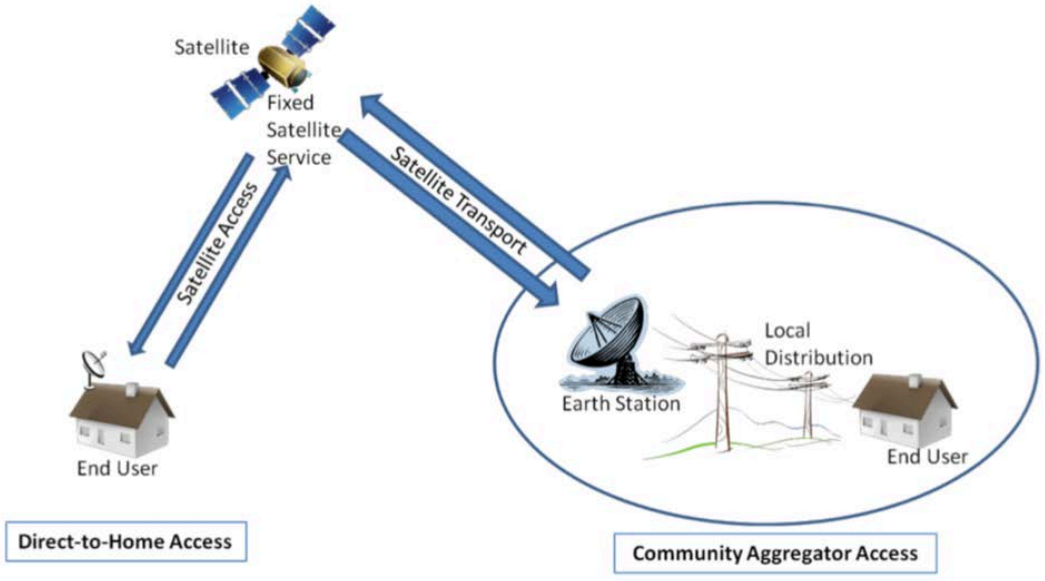

Figure 5.3: Direct-to-home and community aggregator models (CRTC, 2014)

Satellite internet infrastructure is advertised as being able to hit up to 10 Mbps, however, has a tendency to not meet five Mbps for download speeds (CRTC, 2014). It should be noted that in Alberta only direct-to-home access is available via the internet service provider (ISP) Xplornet, an ISP that specializes in satellite internet delivery. This is because in 2013 the Government of Alberta began its Final Mile Rural Connectivity Initiative (FMRCI) which included its 2013 Central Alberta Satellite Initiative that focused on direct-to-home access and provided funding to Xplornet for one-time satellite installation fees (Cybera, 2016). A pitfall of this broadband infrastructure is that it is expensive to operate with its space stations, radio-spectrum need, and overall upkeep (McNally et al., 2016).

As this past section identified the different internet delivery technologies with their technological ability, download speeds, and limitations, the following section will review the histories for each of these infrastructures. In order to be mindful of the scope of this thesis, the history will analyze the Albertan context of these technologies being built in the province. This will identify the findings of the historical analysis portion of the methodology.

Historical Account of Alberta's Copper Infrastructure

As specified earlier, copper wires use existing telephone infrastructure as internet infrastructure. To understand the history of Alberta's copper internet infrastructure a review of Alberta's telephone infrastructure is necessary. Telephones were first created by the Canadian inventor, Graham Alexander Bell in 1876 (Fischer, 2011), however, Alberta did not receive the telephone until 1887 which was put in the City of Calgary (Cashman, 1972, p. 38). These copper lines built for telephony only connected two telephones to one another (Cashman, 1972, pp. 115-118). At the time a switchboard was not available in these cities as there were not enough subscribers in them for Bell to add this essential piece of multi-use telephony (Cashman, 1972, p.

36). This and Bell's refusing to connect rural farmers frustrated Albertans as telecommunications was being known as a tool to strengthen economic relations between businesses in the province and country (Cashman, 1972, p. 115-116).

Once Calgary and Edmonton were working to build their telecommunications infrastructure, the Royal Canadian Mounted Police (RCMP) began to advocate for telephone infrastructure in more prairie towns, instead of just the two cities, in order to help with the rounding of criminals (Cashman, 1972, pp. 49-52). For this, the RCMP in Alberta advocated that by having telephones to connect the different police offices, they would be able to save 'horseflesh' thereby dramatically reducing costs and increasing efficiency (Cashman, 1972, pp. 49-52). Advocates for Alberta's telecommunications did not just lay in policing, however, the third urban area of Alberta that advocated and worked to build telecommunications infrastructure was Banff in 1889 as the town was becoming a well-known tourist hot spot in North America. (Cashman, 1972, pp. 53-55). These were the early advocates of Alberta's telecommunications infrastructure: the police and the hotels.

With the popularity of telephony in Alberta from the Calgary, Edmonton, and Banff exemplars, smaller towns also wanted this infrastructure. Bell holding a Dominion Charter from the Canadian government at the time, however, was not interested in connecting smaller towns as there were not as many subscribers to make a high return on investment (Cashman, 1972), similar to what is seen today with internet infrastructure not being deployed in rural towns. At the time, Albertans were becoming agitated with the federal government for giving monopoly power to large companies like Bell that were more focused on Eastern Canada relations than Western Canada infrastructure needs (Cashman, 1972, pp. 100, 106). This frustration led to the creation of Alberta Government Telephones (AGT), Alberta's now decommissioned, as of 1990

when it began privatization (Wilson, 2000, p. 185), provincial telecommunications provider, in 1905 following the formation of the province the same year (Cashman, 1972, p. 124).

AGT's operational policy was then focused on building first and testing second, in that studies were unnecessary with what was determined to be essential infrastructure in the province, and that the only studies needed were to build the telecommunications infrastructure, see if it worked, and deem that a 'study' of if an area in Alberta would benefit following use (Cashman, 1972, p. 130). This resulted in a speedier development process in Alberta telecommunications, an interesting mandate to possibly fall back on with internet delivery technology now. AGT's mandate to always push boundaries in telecommunications in Alberta can be seen with it, as being part of the Alberta Liberal government, being the first government-operated telecommunications agency in North America to build and operate its own telephone system (Cashman, 1972, p. 132).

It should be noted regarding early Canadian and Albertan telecommunications infrastructure that the telegraph and telephone's origins lay on that of the Canadian Pacific Railway (CPR) (Babe, 1990, p. 118). Telephones lines were originally put to connect CPR stations as a cheaper form of communication to that of the telegraph (Cashman, 1972, p. 17). In Canada, designing telecommunications infrastructure along the railroad made sense as this concentrated two large infrastructure projects along one line (Cashman, 1972, pp. 105, 119), a tool for public infrastructure projects that telecommunications policy advocates still recommend with fibre lines today (McNally et al., 2016).

Historical Account of Alberta's Fibre Infrastructure

As described earlier, fibre is the fastest form of telecommunications where data is able to travel at the speed of light. In the early 2000s, the Conservative Alberta government began talks

regarding a province-wide fibre optic telecommunications infrastructure project in order to support the emerging innovation of the day– the Internet. Starting the project in 2000 (The Globe and Mail, 2005 February 20), this telecommunications infrastructure achievement was finally completed in 2004 titled the Alberta SuperNet, thereby providing Canada's first province-wide fibre system (Government of Alberta, n.d.a; Government of Alberta, 2005). The image below maps the Alberta SuperNet.

Figure 5.4: The Alberta SuperNet (Axia NetMedia Corporation, 2007)

In the above image the base SuperNet infrastructure are the fibre optic cables which are represented in orange solid lines. The red-dotted lines are fixed wireless infrastructure that rely on the SuperNet's fibre optic cables as its backbone infrastructure. As is apparent in the above

map, the province as a whole is not connected, however, in terms of a large government-led broadband initiative, the coverage area of the SuperNet project is noteworthy.

SuperNet was a project that aimed to connect Alberta's schools, hospitals, government and municipal offices, and libraries in 429 communities with high-speed internet access (Government of Alberta, n.d.a; Government of Alberta, 2005). The Government of Alberta advertised that not only would Albertans benefit economically and socially from internet access, they would also not have to worry about travelling for health, teaching and learning activities, or business because daily tasks would be able to be done electronically (Government of Alberta, 2005). For 2005 where online shopping, teleconferencing, and entire university degrees being offered in an online format was not as widespread/available as it is today, this forecasting of the power of the internet should not go underappreciated. There were delays in when the project was meant to be completed (Ministry of Restructuring and Government Efficiency, 2005), however the final result was a high-speed backbone infrastructure for ISPs to connect to, thereby connecting Albertans.

The project was not seen as extraordinary by many Albertans, which frustrated the policy-makers who worked to make the project a reality (Bakaradjieva & Williams, 2010). The goal of SuperNet, however, was not to connect these individual Albertans, it was to connect institutions being the previously mentioned hospitals, schools, government and municipal offices, and libraries. Interestingly, one institution that was required to be connected in order to share resources were Alberta's libraries. In Canada, each province is able to have its own *Libraries Act.* Alberta's *Libraries Act* and *Libraries Regulation* specifically states that libraries are to adhere to and follow a given 'Plan of Service' for patrons as developed by a municipal library board of a given Albertan city or town (*Libraries Regulation*, 2018; *Libraries Act*, 2007).

These Plans of Service may include sharing knowledge resources with other Alberta libraries which is routinely done throughout the province. The *Libraries Act* was established in 2000, whereas the *Libraries Regulation* was created in 1998, two years before construction of the Alberta SuperNet began. On the Government of Alberta website, the only available operational policy for SuperNet has to do with its mandate of connecting Alberta's libraries (Government of Alberta, n.d.b). As apparent, libraries legislation in the province of Alberta has had a clear linkage to broadband development in the province, a first in the Canadian context, with this thesis being a first in identifying this linkage. The history of Alberta's fibre internet delivery infrastructure, therefore, has its historic roots in Alberta's libraries legislation.

It should be noted that Albertans themselves are unable to connect to the SuperNet. Instead, the SuperNet infrastructure only directly connects to the public institutions mentioned earlier (McNally et al., 2016). ISPs have the ability to connect to SuperNet as a backbone infrastructure in order to then provide their services to citizens instead (McNally et al., 2016). This analysis of the history of SuperNet is important in determining internet delivery infrastructure sustainability as, described in the literature review chapter of this thesis, fibre is termed as being 'future-proof' in that users and ISPs do not need to worry about upgrading the network again as the best has already been put in place by the government. The provincial government's decision at the time shows a continued commitment by various provincial governments over more than a century to Alberta telecommunication infrastructure, with regards to breaking barriers and building without recourse as what AGT had done with original copper lines in the province.

Historical Account of Alberta's Wireless Infrastructure

Wireless technology was first developed as a means of communicating Morse code over electromagnetic wavelengths (Kern, 2011). The history of it begins with an influential paper written in 1864 by James Clerk Maxwell that argued the existence of electromagnetic waves and their ability to communicate information over space (Kern, 2011). In 1887 Heinrich Hertz executed experiments in his laboratory which proved the existence of these wavelengths, resulting with his name being honoured as the name we use today for fractions of the electromagnetic spectrum being kilohertz, megahertz, and gigahertz (Kern, 2011). This experimentation and production of knowledge of electromagnetic waves taking place over 30 years led to, in 1894, Guglielmo Marconi creating a device that was then able to transmit and receive signals over the radio-spectrum, and with that the birth of wireless telecommunications (Kern, 2011).

Alberta did not receive wireless communication immediately upon its inception as this was kept on the east coast in its beginning. Canada, however, was an early site for wireless communication as the first trans-Atlantic wireless communication occurred off the coast of Newfoundland in 1901 to reach the United Kingdom (Raboy, 2016, p. 170-189). Bridging the Atlantic Ocean to join North America, specifically the United States, and Europe was highly important. It should be noted, that at the time of the trans-Atlantic signal, Newfoundland was not yet a Canadian province. Canada being a relatively new country at the time, however, was extremely interested in Marconi's technology and welcomed him with open arms and a subsidized monopoly on wireless communication in the country (Raboy, 2016, p. 184). This was because the Government of Canada believed in the need for communications technologies to connect citizens and create a national identity (Raboy, 2016, p. 184). This belief with regards to how communications companies in Canada are treated persists today (Babe, 1990, p. 6; Raboy,

2016, p. 184). The primary benefit of wireless technology was it being significantly cheaper than wired communication, that being the telegraph at the time (Raboy, 2016, p. 181). This inexpensive model was highly attractive to the Alberta government too as, in 1953, the aforementioned AGT measured distances throughout the entire province in order to determine the best spaces for wireless communications towers to provide over-the-air television to Albertans (Cashman, 1972, p. 409). Originally being used for televised entertainment, wireless communication in the province is now used for earlier mentioned fixed wireless and mobile wireless internet delivery. It should be noted that communications towers are not under regulation by provincial governments and are instead federally regulated (Agriculture and Forestry, n.d.). This division of power over communications infrastructure may therefore cause uncertainties and issues as the history of Alberta's relationship with the Government of Canada with regards to communications technologies has been one of pushback (Cashman, 1972).

Historical Account of Alberta's Satellite Infrastructure

As mentioned earlier in this chapter on satellite infrastructure, there are two types: community aggregator access and direct-to-home access. In Alberta, only direct-to-home access is available for internet delivery infrastructure (Cybera, 2016). This is due in part to, in 2013, the Conservative Government of Alberta's decision to provide funding for one-time satellite installation fees via XplorNet (Cybera, 2016). This initiative was focused on bringing internet access to rural areas by helping with what is referred to as the 'last mile' in connectivity (Cybera, 2016). As mentioned earlier, satellite internet has some of the slowest upload and download speeds for internet delivery infrastructure. These speeds, not always meeting five Mbps, thereby falling grossly short of the CRTC's required 50 Mbps download and 10 Mbps upload speeds. It should also be noted that, not only do these speeds for satellite internet delivery infrastructure not

meet Netflix's minimum 25 Mbps speeds required for ultra HD quality streaming, but this also does not meet speeds needed for teleconferencing, voice over Internet Protocol (VoIP) phone solutions, or other OTT video streaming such as political debates or watching the news online. The history of satellite internet delivery infrastructure which is still a newer technology in terms of receiving internet access, is evidently problematic with how slow its data speeds are, but is still receiving funding from the provincial government instead of investing in different internet delivery infrastructure solutions. The provincial government, as evident with the historical analysis of copper and fibre infrastructure, has a history of providing funding and initiatives to wired internet delivery infrastructure, but not to radio-spectrum dependent infrastructure. This may be because of issues of ownership with wireless types of infrastructure having confusing property rights due to spectrum licence attainment, or simply it could be that radio-spectrum infrastructure is not a type of project that the provincial government is used to working on and does not want to test or 'break barriers' like they had done with wired infrastructure.

Data Analysis

The following section provides a data analysis of trends and statistics provided by government agencies, both in Canada and international, in how people are using the internet and why this matters.

CRTC

With the data analysis section of this thesis, all data that the three studied bodies, being the CRTC, the OECD, and the ITU, published comes from the CRTC, with the exception of some Statistics Canada data used by the ITU prior to the start of the CRTC's annual *Communication Monitoring Report*. For this section, the CRTC's *2017 Communications Monitoring Report* was reviewed. This was done for two reasons. First, the *2018*

Communications Monitoring Report was released in late December with sections missing from it, thereby showing an incomplete analysis of Canada's communications landscape. Secondly, because the *2018 Communications Monitoring Report* was released so late, this led to other data reviewing agencies like the OECD and ITU using data from the CRTC's *2017 Communications Monitoring Report* for their own annual reports. Therefore, comparing the *2017 Communications Monitoring Report* to the OECD and ITU made sense opposed to the *2018 Communications Monitoring Report*.

The data the CRTC has published shows that internet usage is only rising with streaming using 44.24 gigabytes (GB) out of an average low-internet usage 50 GB per month of data plan and 128.59 GB out of a high-usage 175 GB plan (CRTC, 2017, pp. 68-69). 55 percent of internet users in Canada report regularly streaming videos on YouTube. CRTC data also shows that anglophones are streaming content more than francophones (CRTC, 2017, p. 116), however, although anglophones are streaming more than francophones, this is only by a small margin which shows the usage by all Canadians in using streaming services (CRTC, 2017, p. 153). Interestingly, Albertans are the highest Netflix users in all of Canada with 56 percent of Albertans subscribing to the streaming platform, thereby showing Albertans higher data intensive behaviour (CRTC, 2017, p. 203). With Albertans using higher amounts of data, this trend shows the importance of Albertans in having strong, resilient, and sustainable internet delivery infrastructure in comparison to other Canadian provinces.

At the 25-49.9 Mbps download range, Alberta has the highest broadband availability in Canada for the province at 95 percent of households (CRTC, 2017, p. 284). This is important because the CRTC has mandated that Canadians must have 50 Mbps upload and 10 Mbps download speeds which Alberta appears to be hitting just below these targets, which is the best

in Canada for this category. In terms of 50 Mbps or higher, Alberta has 83 percent coverage with the top coverage at 50 Mbps for Canada being British Columbia at 92 percent. This is significant as the province is not hitting the CRTC's mandated 50/10 Mgbs goal for the entirety of the population, whereas British Columbia being one province over with a complex landscape, due to large trees and more mountains, is hitting the 50 Mbps goal at a higher success rate than Alberta. Although Alberta has an internet delivery infrastructure network like the SuperNet, the speeds that the fibre network provide are not being transferred to the entirety of the population which shows that the use of this network is not being valuable to citizens as it is not proportionate to the number of users it serves, thereby breaking Sarnoff's Law which states the value of the network is directly proportionate to the number of customers it reaches (Gunasekaran & Harmantzis, 2007).

Alberta does have the highest coverage rate for wireless tied with British Columbia at 99.8 percent, and has the second highest LTE coverage at 99.9 percent, second to Prince Edward Island (CRTC, 2017, p. 328). What is interesting about LTE coverage, however, is that Alberta is a much larger province both in population and geography than Prince Edward Island, so having a coverage rate of a decimal less than the small Maritimes province is impressive nonetheless. As this shows, although Alberta does not have its own radio-spectrum internet delivery infrastructure initiatives as earlier described, the province still has impressive wireless coverage. The Alberta SuperNet does provide a backbone for wireless coverage, as well ISPs also build and manage cell towers for this coverage.

What this CRTC data shows is that Canadians are using data-heavy internet activities at higher capacities each year with Albertans having data-heavy behaviours at the highest capacity in Canada. Alberta, however, is close to meeting federal targets for coverage at higher speeds

which may be due to infrastructure projects like SuperNet. Initiatives like XplorNet's funding does not hit the necessary targets and therefore will not be counted as an innovative or positive solution to high internet usage in the province as necessary speeds for data-heavy activities cannot be met with satellite technology.

OECD

In terms of broadband availability, Canada has fixed broadband availability at 37.85 percent of the country which is higher than the OECD 30.35 percent average (OECD, 2017b). Canada does have relatively average internet speeds at 16.2 Mbps with the median internet speeds being held by Germany at 15.3 Mbps (OECD, 2017a). Canada is rated as having some of the lowest fibre deployments at 12.3 percent of total broadband subscriptions, which is below the OECD average of 23.3 percent (OECD, 2017c). As mentioned at the beginning of this chapter, fibre is the fasted broadband infrastructure and therefore, with fibre not being as widespread in Canada, this means we will not be as 'future proof' for new data-heavy technologies. With this, however, Alberta does have Canada's first province-wide fibre infrastructure which does help, but its coverage does not completely cover the province with high-speed internet resulting in SuperNet coverage gaps. Canada's lower fibre deployment across the country may have geographic issues related to it as Canada has a population sparsely spread across its high landmass. Here, however, I would argue that if the province of Alberta is able to have a fibre infrastructure backbone being the SuperNet, it shows that the rest of the country also has the ability to develop similar initiatives in other provinces. With more development of province-wide fibre infrastructure projects, this innovation may assist in new ways of constructing internet delivery infrastructure networks which could lead to more prosperous networks, learning from other initiatives to build a better broadband network nation-wide.

ITU

In 2017, only 38.02 percent of Canadians had fixed-broadband subscriptions (ITU, 2018a). As specified earlier, fixed connections are more resilient than mobile wireless and satellite, making them a better choice for data-heavy online activities. Mobile subscriptions by Canadians, however, has reached 86.54 percent and is continually trending upwards (ITU, 2018c). It should be noted that this does not mean that more people are choosing mobile over fixed broadband as many of the 38.02 percent likely have a mobile device which would have a mobile broadband subscription attached for its LTE service. As is evident, Canadians are subscribing to mobile-broadband more than fixed-broadband. This may be from fixed infrastructure not being as readily available as the case with rural and remote areas. It could also be, however, that Canadians may not feel the need to have a home internet connection when already paying for a mobile internet connection either for their cellphone, or another device. The available data by the national and international agencies does not provide information from interviews as to why Canadians or Albertans may not be subscribing to more than a mobile wireless data plan for their internet use.

The next and final chapter will provide a discussion of the historical analysis and data provided throughout this chapter. This discussion will identify how the earlier analyzed internet delivery infrastructure technologies are working and not working for Albertans and relate this back to this thesis' theoretical framework.

Chapter Six: Conclusion

The following chapter will discuss the analysis section in conjunction with the theoretical framework to answer all questions set forth in the introduction of this thesis. Following this discussion, limitations of the thesis will be identified.

Discussion

This thesis' primary goal was to review Alberta's internet delivery infrastructure to determine if the current infrastructure is sustainable for all Albertans with the influx of contemporary data-heavy technologies, answering the question: How has the current internet delivery infrastructure in Alberta been designed and built, and is this infrastructure and its corresponding policy sustainable for Albertans following contemporary data demand such as the influx of OTT streaming services? Reviewing the different available technologies in the province and how these technologies were developed in Alberta through a historical analysis, this thesis determines that available internet delivery infrastructure technologies like satellite which has short bandwidth and may be the only option for some rural and remote areas in Alberta, is not sustainable for Albertans. This is because, with regards to data analysis of the CRTC, Albertans are using data-heavy technologies, such as Netflix, at a higher capacity than residents in other provinces of the country. This means that internet delivery infrastructure with high-bandwidth capacity is needed in order to interact with contemporary and any emerging technologies that use large amounts of data. Internet delivery infrastructure like satellite which provides up to 10 Mbps for download speeds is not enough for users when that 10 Mbps amount is not even achievable and instead has a tendency of only hitting five Mbps (CRTC, 2014).

A solution to the bandwidth issue is fibre infrastructure, the fastest internet delivery infrastructure, but this does tend to be expensive at approximately $200 per metre (McNally et

al., 2016). With government initiatives like the Alberta SuperNet, however, this infrastructure becomes more feasible to deploy. The provincial government could use their history of breaking barriers in government-funded telecommunications projects and work towards a fixed-wireless infrastructure strategy. Although this would not be as fast as fibre infrastructure, it could provide speeds up to 100 Mbps which would be fast enough to support contemporary high-data technologies for Albertans. Instead of the provinces looking to solve broadband access issues, the Government of Canada could also provide stronger leadership with a national broadband strategy as recommended by the Auditor General of Canada (2018).

Other questions that this thesis looked to identify include, with all of the different types of internet delivery infrastructure, why a review of the infrastructure really mattered. As I have argued throughout this thesis, infrastructure studies as a field matters as studying and being knowledgeable about internet delivery infrastructure writes a story of the current infrastructure landscape. With infrastructure being the first step to internet access, this means that infrastructure is the first layer of citizens being able to interact with the digitized economy, social and political spheres. Because internet access is not just surfing the web, but also has economic and political issues attached to it, this dignifies academic and political discourse in building a more egalitarian Alberta, and more broadly Canada.

Limitations of the Study

Limitations of this study include not having interviews which would have assisted in determining further questions for analysis like how end users felt about their internet access speeds and if they would pay more for internet delivery infrastructure like fibre deployed to their home, or more broadly in rural contexts, to their entire town. Interviews, however, were not feasible given the time and resources constraints of an honours thesis. Although interviews were

not used as a method, this thesis did work in answering its primary question of how Alberta's internet delivery infrastructure has been designed and built and if that infrastructure is sustainable in a post-Netflix Canada. The limitation with not having interviews was simply to not have further questions under analysis as part of this thesis. This information, however, can be generalized from the CRTC's notice of consultations from Canadians, calls for consultation available through their website. The scope of any further study, however, would likely have to be limited to a few consultations. This thesis was not reviewing specific events, but instead technology and access which would make analyzing consultations irrelevant. Therefore, although interviews were not used as a method for data collection, this did not limit the overall findings of this thesis, but instead limited the amount of questions under analysis.

Conclusion

> "I thank the Auditor General and his office for their report. We accept the recommendations and will move forward to improve rural and remote connectivity. Ensuring rural and remote communities are connected to the Internet is one of my top priorities. Few aspects of life today are untouched by information and communications technology. No matter their region, all Canadians need access to high-speed Internet to live, study and work in today's digital world."

(Navdeep Bains, Minister of Innovation, Science and Economic Development, 2018, November 20).

With regards to the theoretical framework outlined early in this thesis, the role of ruler in securing empire parallels that of a government of a nation-state in securing internet delivery infrastructure to ensure time-biased and space-biased communication for the political community of the given nation-state. In Alberta, the provincial government has achieved strong

infrastructure development projects throughout its history. The country of Canada, however, with the CRTC responsible for telecommunications components of the Canadian political body, is not succeeding in its right as ‘ruler’ by not having a broadband strategy for provinces or Canada as a whole. As the above response by Minister Navdeep Bains suggests, however, is that the Government of Canada recognizes the need for stronger internet delivery infrastructure policies and initiatives, and they are prepared to make this happen. Time will tell as of how quickly this talk becomes a reality for Albertans, however one thing is for sure, with internet delivery infrastructure significance is not only awarded to economics, socialization and political discourse, it also has the ability to assist in securing and maintaining empire through its space- and time-biased communication. By governments working to build stronger internet delivery infrastructure networks this will continue to build and secure the technological roots of an empire.

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