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The Government's Spectrum Policy Will Reduce the Quality of Wireless Services for Rural Canadians

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Executive Summary

- Canada's three national wireless carriers have provided remarkably high-quality broadband services to rural subscribers despite Canada's low population density and often difficult terrain, but they will have difficulty maintaining this performance because of the government's spectrum policy

- The Canadian government has allocated too little mid-band (3500 GHz) 5G spectrum for its forthcoming auction and delayed the auction until June 2021, while other countries have allocated more spectrum to 5G and moved ahead with their 5G auctions much more rapidly.

- The government has further encumbered the mid-band auction with set-asides for regional carriers, a policy it has pursued in earlier auctions in order to artificially encourage the development of a fourth national carrier.

- The set-aside policy has burdened rural Canadians because it has diverted valuable rural spectrum from the three national carriers, who would use it much more intensively to improve wireless connectivity in rural areas than have the regional carriers who receive the set-asides.

- The attempt to promote a fourth national wireless carrier has been a failure; but even if it had succeeded, it would have reduced carrier investment in new facilities, particularly in rural areas.

- The government's flawed spectrum policy and the delay in auctioning the 5G spectrum have been estimated to cost Canada more than $30 billion in lost Gross Domestic Product over the next twenty years.

I. Introduction

Wireless technology has advanced rapidly throughout the world. The first iPhone was introduced just 13 years ago. (The first Blackberry was only 8 years earlier!) When first introduced, these devices could perform only rather simple operations over networks that offered very modest speeds. Since that time, wireless networks have become much more sophisticated, offering such high speeds that users may now download large video files – and even entire movies –to watch on a device smaller than the palms of their hands.

Canada's wireless networks have led the way in deploying these new, ever faster technologies – 2G, 3G, and 4G (LTE-A) – and offering some of the highest quality services in the world despite the enormous obstacles posed by Canada's low population density and vast geographical expanse. But now the world is moving forward and adopting an even faster, more sophisticated technology that can improve the lives of all consumers. This technology, described as 5G, is already being built into wireless networks in many countries.

Unfortunately, Canada is lagging behind in adopting this new technology, not because its carriers have lost their competitive edge, but because the Canadian government is not providing the requisite access to the spectrum that will fuel 5G. Once leaders in wireless telecommunications, Canadian carriers now face the prospect of not being able to provide the quality of services that 5G could unleash. This threat is particularly concerning for rural Canadians who must rely on sophisticated, high-speed wireless communications to keep apace of their urban brethren.

II. The Promise of 5G

The Internet began as a set of interconnected networks that were accessed over telephone wires and cable systems. The introduction of smartphones allowed consumers to access the Internet over wireless connections for rather limited purposes, such as accessing email, because wireless networks offered limited speed. The first 3G networks were built in the early 2000s, but they were slow to spread until Apple introduced the iPhone in 2007, which initially could not even support 3G speeds. Thereafter, as smartphones and other devices evolved, wireless operators began to deploy 4G technology, and Canadian wireless companies, in particular deployed a particularly fast version of 4G, called LTE-A. The development of apps and social media transformed the smartphone from a luxury to a necessity. Today, Canadian consumers use these devices to access an enormous variety of essential services and, especially, entertainment services.

Canada's wireless networks now offer extremely fast broadband access speeds. (See the discussion below.) But even these speeds will be eclipsed by those that can be offered over the new 5G technology. Moreover, 5G's speeds and lower latency (response delay) will allow the development of a host of new services, some of which are clearly on the immediate horizon and others that cannot be seen yet. Just 13 years ago, when the first iPhone was introduced, few people had heard of YouTube or Twitter, and Instagram was still three years away. As

smartphone adoption soared, wireless network operators responded by offering greater speeds, and new applications followed.

5G will provide much more than higher-speed access for smartphone users. The 5G technology should also allow a large number of devices to be connected in real time, propelling the "Internet of Things" (IoT). Internet-connected cars, environmental sensors, thermostats, and other household appliances will proliferate in the next few years. Autonomous cars will be able to communicate with each other, providing a much safer travel experience. Connections with roads, lights, parking meters, and signals will add to this experience.

Not all of the consumer benefits of 5G can be foreseen at this time, but GSMA identifies a number of services already on the horizon:

"These new services could include 4K and 8K ultra-HD video, 3D video, holograms, AR/VR, applications for gaming and immersive TV, and digital services and content for connected stadia and smart cities. A number of these have already had initial trials in Canada, with further trials in use cases such as AR/ VR expected over the next 12 months."[1]

Moreover, 5G's low latency will facilitate the remote delivery of sophisticated services, such as surgery and a variety of medical diagnoses and treatments. Manufacturing and service industries will also be able to control their operations remotely, much like Amazon's proposed use of drones for package delivery, but with better, faster, and more immediate controls.

For 5G to be deployed in a timely, standalone manner, substantial spectrum must be made available at auction. This required spectrum is of three types: low band, mid-band, and ultra-high band.[2] The wireless industry trade association, GSMA, has provided recommendations for the amount of spectrum that will be required to accommodate the anticipated intensity of use of 5G. Unfortunately, Innovation, Science and Economic Development Canada (ISED) has not allocated a sufficient amount of the mid-band spectrum for this purpose and will not even auction this limited amount until next year.

III. The Traditionally High Quality of Rural Canadian Wireless Service Could Be Threatened by ISED's 5G Spectrum Policy

Until now, a favorable regulatory climate in Canada, including a reliance on platform competition, has resulted in aggressive competition among the three national wireless carriers and several large regional carriers. This competitive environment has produced high-quality services and affordable wireless rates for all Canadians, in both urban and rural areas, despite Canada's low population density and often challenging terrain. Unfortunately, this performance may now be threatened by the lack of adequate access to the required spectrum.

[1] GSMA Intelligence, "5G and economic growth: An assessment of GDP impacts in Canada," September 2020, p. 12.
[2] See the discussion below.

The share of Canadians able to obtain access through high-speed LTE-Advanced services increased from 93% in 2014 to 99% in 2018.[3] As a result, the average download speed for mobile in Canada has now reached 67.7 Mbps, according to Speedtest's latest rankings, placing it eighth among the 138 countries measured.[4] Canada's average wireless speed is much greater than the speeds generally available in Europe and the United States. The median European Union country had an average wireless download speed of 41.6 Mbps, and the United States realized 44.1 Mbps in July 2020.[5]

In September 2019, Open Signal reported that *rural* wireless subscribers in Canada were able to access a 4G connection 80.8% of the time and enjoy an average download speed of 32 Mbps.[6] This compares with a 73.5% 4G availability in Germany. In fact, rural Canadian subscribers enjoyed faster average connection speeds than the average subscriber, *urban and rural*, in all but 11 of the countries surveyed by Open Signal. It concluded its report by noting that:

> "Despite our Canadian users experiencing large differences in 4G Download Speed across rural and urban areas, our rural users on average had a faster 4G connection than what our users experienced on average in 76 countries. If rural Canada were a country, it would rank 12th in our Download Speed Experience ranking, with our rural Canadian users on average seeing faster 4G download speeds than our users in Sweden, New Zealand, France, and 73 of the other countries we reported on.
> Our analysis shows that Canada offers users among the fastest and most accessible 4G networks across its vast rural landscape."[7]

A May 2020 update of Open Signal's report finds that rural Canadian wireless speeds have increased dramatically over the past year, rising to an average of 42 Mbps across the three national carriers.[8] Once again it notes that Canada's rural wireless speeds exceed the *average* speeds of most large, developed countries:

> "Astoundingly, rural Canadian users have far better download speeds than users in five of the seven G7 countries in the world. . . Speeds for [rural] Canadian users on each of the three networks – Bell, TELUS, and Rogers – are between 20% and 110% faster than the overall speeds of users in five of G7 countries. Among the G7, only Japanese users experienced a higher speed than some rural Canadians, with an overall download speed of 49.3 Mbps."[9]

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[3] CRTC, *Communications Monitoring Report 2019*, Figure 10.27.
[4] Speedtest Global Index, July 2020, available at https://www.speedtest.net/global-index.
[5] *Id.*
[6] Open Signal, *The State of Rural Canada's Mobile Network Experience,* September 25, 2019, available at https://www.opensignal.com/blog/2019/09/25/the-state-of-rural-canadas-mobile-network-experience.
[7] *Id.*
[8] Open Signal, The State of Rural Canada's Mobile Network Experience – May 2020, released May 25, 2020.

[9] *Id.*, pp. 3-4. Note: Canada is one of the seven member countries of the G7. "Rural" was omitted in the original, but the entire paragraph clearly addresses rural speeds in Canada.

As wireless services continue to improve, more and more Canadians are abandoning their wireline services and relying solely on wireless communications services. The CRTC reports that a steadily declining share of Canadian households subscribe to a fixed wireline service. Since 2013, more Canadian households have subscribed to wireless services than to wireline services, and by 2017 fully 36 percent of households relied solely on wireless connections.[10] These trends strongly support a conclusion that wireless access is clearly a substitute for traditional wireline services, a conclusion that is further supported for broadband services by the extremely fast average speed of Canadian wireless services, even in rural areas.[11]

The strong performance of the Canadian telecommunications sector in providing wireline and wireless broadband availability is reflected in the latest annual issue of the Economist Intelligence Unit's (EIU's) Inclusive Internet Index, which covers 100 countries.[12] This Index rates each country's broadband Internet services in terms of Affordability and Availability (as well as two other criteria). Canada emerges with very high ratings in both categories in the 2020 Index, ranking #3 in terms of overall Affordability and #18 in Availability across the 100 countries surveyed despite the obvious disadvantages of its low population density and vast, difficult geographic expanse. But these ratings will be difficult to maintain in the coming 5G world.

IV. Canada's Flawed Spectrum Policy

The remarkable performance of Canada's wireless carriers – even in comparison with those in much more densely populated developed economies – is now in danger of regressing. Beginning in 2008[13], the Canadian government set aside spectrum for smaller, regional carriers as part of an auction policy designed to create a fourth national wireless carrier, a policy that has not only failed but has needlessly punished Canadian wireless subscribers.[14] Despite auctions with these set-asides, there are still only three national carriers. The beneficiaries of the set-asides have obtained spectrum at a substantial discount from the prices paid by the national carriers, but they have not utilized this advantage to become national carriers, and they have largely avoided using this spectrum in rural areas. Had this spectrum not been reserved for the regional carriers, it would have been deployed much more fully in rural areas by the three national carriers.

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[10] This measure likely refers to traditional voice services, but the CRTC does not explicitly assert that these data are for voice services.

[11] More recently, the Pew Research Center has reported that 20 percent of U.S. households rely solely on smartphones to access the Internet. See https://www.telecompetitor.com/pew-smartphone-only-homes-grow-now-1-in-5-use-smartphones-exclusively-for-internet-access/?utm_campaign=Newsletters&utm_source=sendgrid&utm_medium=email

[12] The Economist Intelligence Unit, *The Inclusive Internet Index: Bridging Internet Divides,* 2020.

[13] Industry Canada, "Policy Framework for the Auction for Spectrum Licenses for Advanced Wireless Services and other Spectrum in the 2 GHz Range," November 2007.

[14] Prior to this auction, the government utilized spectrum caps.

A. The Flawed Spectrum Policy Continues in the 5G Era

Canada's government continues to employ set-asides in in the face of a revolution in wireless technology and now threatens to deprive Canadians of new, faster, and more sophisticated services through this policy. ISED has established the rules for the forthcoming 3500 MHz auction, and these rules continue to provide set-asides for the rural carriers.[15] This problem has been compounded by the decision to allocate too little 3500 MHz band spectrum for 5G and by the failure of ISED to hold the auction in a timely manner. These failures have combined to slow the rollout of 5G, including the deployment of facilities using 5G spectrum to deliver rural fixed wireless broadband services.

Canadian carriers have invested heavily in providing fixed high-speed broadband services – over copper wires, coaxial cable and fibre-optics – to urban and rural areas. However, it is often uneconomic to provide these wireline services to remote areas in Canada, of which there are many. Instead, carriers extend their wireless services to these areas through a fixed wireless topology, but these services, especially when used by residences, can place a strain on the carriers' networks because of the enormous amount of bandwidth required to accommodate modern data and video streaming applications. Without adequate spectrum the three national carriers cannot extend fixed wireless services much farther. Thus far, Canadian regulators have not addressed this deficiency of spectrum.[16]

B. The National Carriers Have Paid Substantial Premiums for Spectrum Due to Set-Asides

The most recent auction of 5G spectrum in the 600 MHz band provided for set-asides for regional carriers, such as Xplornet, Videotron, Freedom (Shaw), and Sasktel. As a result of the set-asides, Freedom paid $ 0.78 per MHz-Pop and Videotron paid $0.99 per MHz-Pop for the spectrum they acquired.[17] In this auction, the two national carriers with winning bids paid substantially more – Rogers paid $1.71 per MHz-Pop and TELUS paid $2.35 per MHz pop.[18] All four regional carriers succeeded in bidding for licenses in areas that included the largest metropolitan areas, but the two national carriers paid more than twice as much per MHz-Pop than the two regional carriers paid. The other regional carriers also paid less than $1.00 per

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[15] Innovation, Science and Economic Development Canada, *3500 MHz band spectrum auction,* available at https://www.canada.ca/en/innovation-science-economic-development/news/2020/03/3500-mhz-band-spectrum-auction.html.

[16] By contrast, the United States Federal Communications Commission (FCC) has granted wireless carriers "emergency" access to spectrum during the Covid crisis in response to the surge in network use. (https://www.fcc.gov/document/fcc-grants-verizon-temporary-spectrum-access-during-covid-19-pandemic) See Mark Goldberg, "Minding the Gap," April 28, 2020, available at http://mhgoldberg.com/blog/?p=13635.

[17] All prices are expressed in Canadian dollars. MHz-Pop is the standard metric used in evaluating spectrum purchases; it is the amount of spectrum (in MHz) multiplied by the population covered.

[18] Bell did not have any winning bids.

MHz-Pop, but, unlike Freedom and Videotron, they did not obtain spectrum in the largest metropolitan areas.[19]

C. The Set-Aside Policy Has Punished Rural Canadians

Despite having obtained spectrum at favorable rates through set-asides, Canada's regional wireless carriers have not become national players, nor are they using their spectrum in rural areas as intensively as the three national carriers. The three national carriers have spectrum with national coverage, and thus with full rural coverage could serve 5.7 million rural Canadians. As Table 1 shows, TELUS uses 63 percent of the spectrum that it holds in rural areas to deliver service to rural subscriber; Bell uses 78 percent of its rural spectrum; and Rogers uses 49 percent.

By contrast, Shaw and Videotron, have spectrum that covers 2.4 million and 1.7 million rural Canadians, respectively. However, they only use 15 percent and 17 percent of this rural spectrum, respectively, to serve rural Canada. SaskTel and TBayTel have acquired spectrum in much more limited areas, but they still only use 54 percent and 49 percent of their rural spectrum, respectively. Clearly, if the three national carriers had been able to acquire more spectrum in open auctions – *i.e.,* auctions without set-asides – there would be much greater deployment of wireless spectrum, and therefore even better wireless service in rural Canada today.

Table 1
Wireless Carriers' Spectrum Utilization in Rural Canada

Rural (where spectrum held)	TELUS	Shaw	Videotron	SaskTel	TBayTel	Bragg	Bell	Rogers
Population base	5,732,741	2,378,763	1,695,571	363,143	263,575	1,344,608	5,732,741	5,732,741
Regions where spectrum is held	National	ON, AB, BC	QC, ON	SK	ON	ON, NB, NS, PEI	National	National
Rural holdings (MHz)	169.5	93.1	127.7	220.0	29.8	90.1	129.8	198.5
Rural usage (MHz)	107.2	13.7	21.6	118.1	14.7	13.6	101.2	96.5
Spectrum utilization	63%	15%	17%	54%	49%	15%	78%	49%
Coverage (any band)	95.5%	15.8%	59.2%	99.8%	41.0%	27.8%	95.5%	82.1%

Source: TELUS

[19] These results are reported in Haig Sarkissian and Berge Ayvazian, "The Canadian 600 MHz spectrum auction by the numbers (Analyst Angle)," Wireless 20/20, April 15, 2020, available at https://www.rcrwireless.com/20190415/policy/canadian-600-mhz-analyst-angle.

D. The 2021 3500 MHz Spectrum Auction Will Further Penalize Rural Canadians

The transition from 4G to 5G requires a substantial amount of spectrum in low, medium, and ultra-high spectrum bands. The lower band spectrum, generally in the 600 MHz or 700 MHz bands, is utilized for coverage. Mid-band spectrum, in the 3500-4200 MHz range, is extremely valuable for providing capacity. The ultra-high bands, presumably in the 26 GHz to 42 GHz range, will be needed to provide the highest-speed services.[20]

Even in the early stages of 5G deployment, carriers will need substantial mid-band spectrum to satisfy the needs of consumers, business, and the public-sector. GSMA suggests that auctions be designed to provide at least 80-100 MHz per carrier in the 3500-4200 MHz band.[21] However, ISED has allocated just 200 MHz of 3500 MHz band spectrum for auction next year, 50 MHz of which is to be set aside for regional carriers.[22] This leaves just 150 MHz for the three national carriers, or only an average of 50 MHz per carrier, far too little to deploy 5G effectively.

GSMA points out that failure to offer sufficient spectrum will impede the delivery of needed wireless services:

> "Where 5G spectrum is held back from the market unnecessarily (e.g. through set-asides) then commercial 5G services are likely to suffer and operators may overpay at auctions which risks limiting network investment thus harming consumers.[23]

The combination of insufficient mid-band spectrum, set-asides, and a delayed auction will retard 5G deployment in Canada. In urban areas, this will make deployment of new services very difficult. Equally important, the lack of sufficient spectrum in the lower band plus the 3500 MHz band will make it impossible for the national carriers to fully extend fixed wireless into rural and remote areas of Canada. Thus, ISED's spectrum policy has both long-term and more immediate adverse effects on rural Canadian households.

E. Other Countries Are Far Ahead of Canada in Auctioning 5G Spectrum

For 5G to develop, mid-band and ultra-high band spectrum will be required. Most countries have begun or even completed the auctioning of spectrum in the 3500-3800 MHz bands. The U.S. has completed one auction of 3500 MHz spectrum[24] and is planning a further mid-band auction. Many European countries have auctioned spectrum in the 3400-3600 MHz band already. Unfortunately, Canada's 3500 MHz auction will not take place until mid-2021. Clearly, Canada is a laggard in making the vital mid-band spectrum available to carriers.

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[20] See GSMA, *5G Spectrum: GSMA Policy Position*, March 2020.
[21] *Id.*
[22] Innovation, Science and Economic Development Canada, *3500 MHz band spectrum auction,* available at https://www.canada.ca/en/innovation-science-economic-development/news/2020/03/3500-mhz-band-spectrum-auction.html.
[23] GSMA, *5G Spectrum: GSMA Policy Position*, March 2020.
[24] FCC, "FCC Announces Winning Bidders in 3.5GHz Auction, : September 2, 2020, available at https://www.fcc.gov/document/fcc-announces-winning-bidders-35-ghz-band-auction.

The current status of 5G spectrum auctions in North America and the major European countries is shown in Table 2.[25] Most countries have allocated and auctioned spectrum in the low bands. The United States completed its "incentive auction" of 600 MHz spectrum in 2017.[26] Most European countries have auctioned 700 MHz spectrum, some as early as 2015.[27] Canada completed its 600 MHz auction in April 2019, but it will not begin its 3500 MHz auction until 2021. Of the countries shown in Table 2, only Netherlands lags as far behind as Canada.

Table 2

Status of Low-Band and Mid-Band 5G Spectrum in North America and Europe

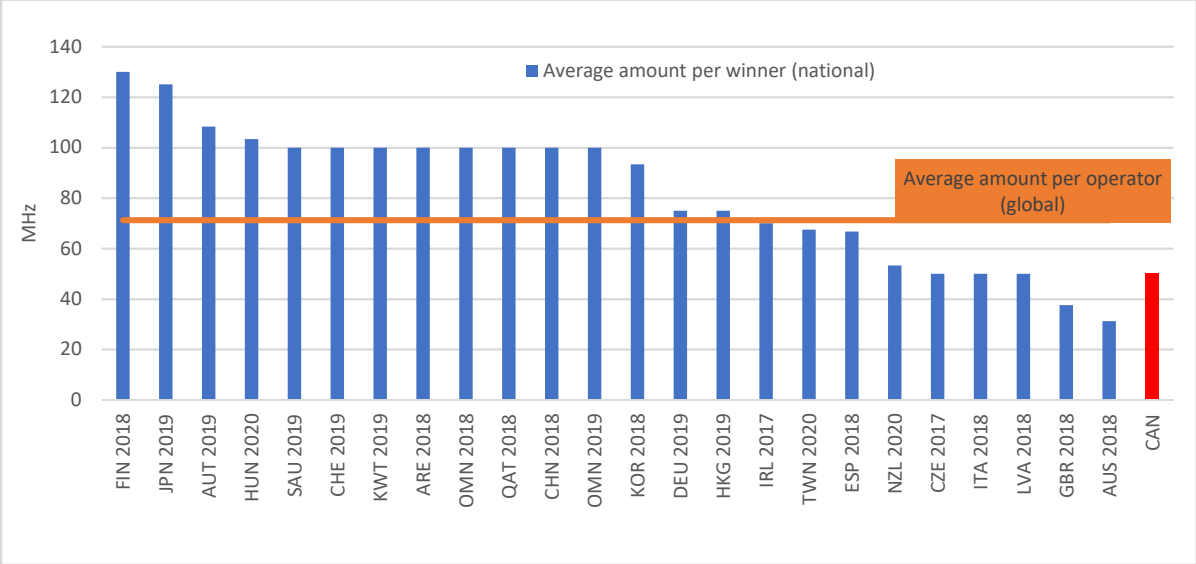
Country	Low Band (600 --700 MHz)	Mid Band (3500 – 4200 MHz)
North America:		
Canada	Auction April 2019	**Auction scheduled for June 2021**
United States	Auction March 2017	Auction September 2020
Europe:		
Austria	Auction July 2020	Auction March 2019
Belgium	Temporary licenses awarded April 2020	Temporary licenses awarded March 2020
Denmark	Auction March 2019	Auction planned 2020
Finland	Assigned November 2016	Auction October 2018
France	Auction 2015	Auction planned September 2020
Germany	Auction 2015	Auction June 2019
Greece	Auction scheduled July 2020	Licensed March 2014; further auction by end of 2020
Ireland	Temporary licenses issued April 2020; auction to follow	Auction May 2017
Italy	Auction October 2018	Auction October 2018
Luxembourg	Auction began July 2020	Auction began July 2020
Netherlands	Auction scheduled June 2020	**Auction expected 2022**
Portugal	Auction expected 2020	Auction expected 2020
Spain	Auction delayed in early 2020	Auction July 2018
Sweden	Auction December 2018	Auction postponed to November 2020
United Kingdom	**Auction scheduled January 2021**	Auction April 2018; further auction January 2021
Switzerland	Auction January 2019	Auction January 2019

Sources: CRTC (Canada); FCC (U.S.); European 5G Observatory[28]

[25] Auctions scheduled for later than 2020 are highlighted in bold face.
[26] https://www.fcc.gov/wireless/bureau-divisions/broadband-division/600-mhz-band.
[27] https://5gobservatory.eu/5g-spectrum/national-5g-spectrum-assignment/#1533307441058-1f1bbc1b-307c
[28] Accessed at (https://5gobservatory.eu/5g-spectrum/national-5g-spectrum-assignment/#1533313745961-d2a5cc14-241a.)

Not only have most developed countries auctioned their 5G spectrum more quickly than Canada, but they have also released more 3500 MHz spectrum for use in 5G deployments. Figure 1 shows the amount of 3500 MHz spectrum regulators have released per national operator and the dates of the auctions. Clearly, Canada lags behind most countries in both dimensions.

Figure 1
Spectrum assignments in the 3.5 GHz band – maximum average amount per national operator



Source: GSMA Intelligence

F. Canada Is Behind Other Countries in 5G Deployment

Although the new 5G wireless technology is in the very early stages of deployment throughout the world, Canada already lags behind most developed countries in launching 5G operations. Table 3 shows the early-stage deployments of 5G by Canadian carriers. Bell, Rogers, and TELUS have launched limited deployments in major cities and are poised to expand these deployments once sufficient spectrum is available.

Ookla's latest tabulations of 5G carrier deployments shows 63 separate carrier operations over all of Canada.[29] By comparison, there are several thousand such deployments across the United States, principally by T-Mobile.[30] Many European countries are also far ahead of Canada

[29] Ookla 5G Map, available at https://www.speedtest.net/ookla-5g-map. Each observation is for a carrier operating in a separate community, regardless of the extent of the deployment.
[30] *Id.*

in launching 5G operations. Carriers in the United States, Germany, Spain, and the United Kingdom have launched stand-alone 5G operations on low-band spectrum; Canada has not.[31] Austria, Germany, Netherlands, Switzerland, and the United Kingdom each have hundreds of new 5G operations. Of the major EU countries, only France, Italy, Sweden and Denmark are lagging as far behind as Canada.

Table 3
5G Deployments in Canada by Operator

Operator	Launch details	Comments
TeraGo	Trials in early 2020 in Toronto and the Golden Horseshoe area.	Partnering with Nokia for 5G fixed wireless access (FWA).
Rogers Communications	Initial deployments in Vancouver, Toronto, Ottawa and Montreal, with a broader commercial launch later this year.	The goal is to expand to another 20+ markets across Canada before the end of 2020.
TELUS	Initial deployments in Vancouver, Montreal, Calgary, Edmonton and the Greater Toronto Area. Deployments will continue to expand to an additional 26 markets across Canada throughout the remainder of 2020.	Ericsson and Nokia have been selected to support building its 5G network.
Bell Canada	Initial deployments in Montreal, Toronto, Calgary, Edmonton and Vancouver. Bell expects to expand its current 5G network to 28 additional markets between 2020 and 2021.	Bell Canada selected Ericsson's 5G radio access network (RAN) technology to support its nationwide 5G mobile and FWA deployments.
Videotron	Late 2020 launch date.	Videotron to deploy LTE-A and 5G following supplier agreement with Samsung.

Source: GSMA Intelligence

Most 5G deployments to date are "non-standalone" operations, using low-band (600 MHz -700 MHz) spectrum. Carriers in many countries will soon begin to deploy standalone 5G operations as they have access to mid-band, 3500 MHz to 4200 MHz spectrum, but Canadian carriers will not be able to do so for some time because this spectrum has yet to be auctioned by

[31] GSA, *Evolution from LTE to 5G*, August 2020, Figure 11.

the federal government. The two auctions of this spectrum will not occur until 2021 and 2023, respectively. Without this spectrum Canadian carriers cannot begin to deploy 5G in earnest.

V. The Government's Policy of Promoting a Fourth National Carrier Has Not Worked and Would Not Improve Consumer Welfare if It Did

The Canadian government's repeated use of set-asides in spectrum auctions is based on its desire to expand the number of national wireless carriers from three to four in an attempt to increase competition in the wireless sector. This policy has proved to be futile, but given the experience in other countries, it is unnecessary and likely counterproductive.

After more than a decade of spectrum set-asides, there is very little evidence that Canada will be able to sustain four rival national carriers. The regional carriers simply have not used their access to spectrum at artificially low prices to develop national footprints. As shown above, they have not even built out many of the rural areas that their spectrum covers. Equally important, there is substantial evidence that the government's pursuit of a fourth national carrier through its spectrum policy will reduce consumer welfare, rather than increase it.

A. Attempting to Create a Fourth National Wireless Carrier in Canada Is an Exercise in Futility

Wireless telecommunications is a network industry subject to economies of scale and density. Canada is a country with 37.6 million people spread out over nearly 4 million square miles. Even Canada's largest cities –Toronto, Vancouver, Montreal and Calgary – do not have the population density of many major cities in the developed world. The densest of these four Canadian cities, Vancouver, has a population density that is only half of that of New York or London and less than one-third of Paris or Athens.[32] It is unlikely that four carriers with ubiquitous wireless coverage could survive in such a vast, lightly-populated country. Indeed, Sprint's recent experience in the more populous and more densely-populated United States is the latest example of how difficult it is for four competing national carriers to coexist in this industry.[33]

B. Three National Networks Provide a Better Subscriber Experience than Four Networks

Even if a fourth national Canadian wireless network were feasible, it would not necessarily provide a superior subscriber experience. Recent research suggests that a wireless market with three national carriers is likely to provide greater consumer value than a market with four national players. A survey of the economic literature on the effects of market concentration in the wireless industry by Eric Fruits, *et. al.* finds that the research consensus is that markets

[32] Josef Filipowicz, "Room to Grow: Comparing Urban Density in Canada and Abroad," Fraser Institute, January 2018, available at https://www.fraserinstitute.org/studies/room-to-grow-comparing-urban-density-in-canada-and-abroad.
[33] Sprint merged with T-Mobile in April 2020.

with three carriers have the highest level of country-wide capital investment.[34] It also finds that wireless prices did not generally rise following a merger – the probability of a price increase was about equal to the probability of a price decrease.[35] The authors of the survey offer a policy conclusion that is particularly important for Canada:

> **"**From an investment perspective, the optimal number of wireless firms in a given market appears, in some studies, to be three; however, in some jurisdictions (such as those that are more densely populated), the optimal number may well be four, while in others (such as those with small populations that are widely dispersed) the optimal number may well be two. Regardless, there is little or no support for categorically claiming that the optimal number of firms in larger jurisdictions, or indeed in any jurisdiction, is four."[36]

They also conclude:

> "When evaluating the merits of a merger, authorities are charged with identifying the effects on the welfare of consumers. On the basis of the studies that we review, 4-to-3 mergers appear to generate net benefits to consumer welfare in the form of increased investment, while the effects on price are inconclusive."[37]

A 2018 study by Glen Woroch of the effect of concentration in *spectrum* reaches similar conclusions.[38] He finds that wireless penetration in the United States "Cellular Market Areas" in 2012-13 was directly related to the concentration of spectrum ownership in the vast majority of these areas.[39] Moreover, penetration was a direct function of the quality of service, leading Woroch to conclude from his detailed statistical analysis:

> "These regressions show a strong correlation between fast, reliable data transmissions as well as coverage of 4G wireless technologies, and subscription to carriers' services. In addition, **the measures of network quality and coverage are in turn directly related to local aggregation of spectrum holdings**. This latter finding suggests that the spectrum held by the largest carriers was combined with complementary investments to deliver consumers better service."[40] (Emphasis added.)

In short, concentration of spectrum holdings in the U.S. led to higher-quality wireless services for subscribers than a less concentrated set of holdings could have delivered.

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[34] Eric Fruits, *et.al.,* "A Review of the Empirical Evidence on the Effects of Market Concentration and Mergers in the Wireless Telecommunications Industry," ICLE Antitrust & Consumer Protection Research Program White Paper, September 2019, available at https://laweconcenter.org/resource/a-review-of-the-empirical-evidence-on-the-effects-of-market-concentration-and-mergers-in-the-wireless-telecommunications-industry-2/.
[35] *Id.*
[36] *Id.*.
[37] *Id.*
[38] Glenn A. Woroch, "Spectrum Concentration and Performance of the U.S. Wireless Industry, October 2018, available at https://ssrn.com/abstract=3165051.
[39] The relationship is an "inverted U," with most areas lying in the rising area of the concentration-penetration relationship.
[40] *Id.*

Finally, a very recent empirical study of European wireless markets conducted by GSMA Intelligence concludes that three-firm wireless markets generally have provided consumers with higher-quality services than have four-firm markets.[41] GSMA examined the performance of wireless networks in Europe during the "4G period" (2011-18), finding that though some markets evolved from four carriers to three carriers, the inequality among network market shares among the remaining players actually declined. Moreover, three-firm markets provided greater upload and download speeds by the end of the period. Three-firm markets evidenced greater investment per unique connection, generating this superior performance.[42]

Importantly, GSMA found that prices and average revenues per subscriber were no greater in three-firm markets than in four-firm markets at the end of their study period. GSMA's conclusions, which emerge from this careful study, are relevant to the current issues in Canadian spectrum policy:

- "Operators in three-player markets may have been able to better optimize their assets, including spectrum. From 2016, when the majority of European countries had assigned spectrum in the 800 MHz and 2600 MHz bands (and some refarming of 1800 MHz), **operators in three-player markets had on average 14% more 4G spectrum than operators in four-player markets**." (Emphasis added)

- "… we observed that from 2015, **operators in three-player markets invested more per connection and as a proportion of revenues**. This meant they could invest more in newer and faster technologies, for example LTE Advanced." (emphasis added)

- "… our analysis cannot attribute the better performance of three-player markets totally and unequivocally to greater investment. We find strong evidence of operator investment being greater in more concentrated markets, but **the results also attribute an important role to the greater efficiency in three-player markets in the use of resources, including spectrum a**nd sites." (Emphasis added)

These results surely throw into question ISED's continuing sacrifice of the value of wireless service quality, particularly *rural* service quality, in its futile effort to promote a fourth national carrier.

[41] GSMA Intelligence, *Mobile market structure and performance in Europe: Lessons from the 4G era*, February 2020.
[42] *Id.*

VI. Canada's Spectrum Policy Will Reduce the Country's Economic Growth

The telecommunications industry provides more than consumer services. It is a network industry that is part of the basic infrastructure of a modern digital economy. New innovations in transportation, manufacturing, financial services, and medical services rely increasingly upon this infrastructure. If Canada lags other countries in deploying the latest telecommunications infrastructure, these "vertical" industries will also fall behind in developing and deploying new technologies, goods, and services.

The role of telecommunications in economic growth has been studied for decades.[43] In recent years, a great deal of attention has focused on the effect of the growth of wireless subscriptions on growth, in both developing and developed countries. [44] Most of this research has examined the effect of subscriber penetration of telecommunications or broadband on the economy or on economic growth. The issue facing Canada today, however, is how an improvement in wireless *technology*, moving from 4G to 5G, will affect the economy.

For this purpose, GSMA Intelligence has prepared a report on the potential effects of the migration from the current 4G (LTE-A) wireless network in Canada to 5G.[45] This report draws on previous research conducted by one of the authors of the report and two others on the effects of wireless network upgrades from 2G to 3G and from 3G to 4G.[46] Their research finds that an increase of 10 percent in mobile wireless adoption increases GDP by 0.5 – 1.2 percent. It also finds that the effect of increased adoption rises by 15 percent when the network upgrades from 2G to 3G and by 25 percent when the network upgrades to 4G relative to 2G.[47] Importantly, the effect of network upgrades increase with a country's adoption rate and with its underlying human capital:

> "The impact of mobile increases with adoption levels, suggesting network effects; countries with more skills enjoy greater impacts, suggesting complementarities with human capital accumulation; and we found some evidence of higher impact where services and manufacturing represent a greater share of economic activity, suggesting complementarities with capital and labour in these sectors."[48]

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[43] Among the many papers on this topic are the following: P. Koutroumpis, (2009). "The Economic Impact of Broadband on Growth: A Simultaneous Approach," *Telecommunications Policy*, 33(9), pp. 471-4; L.H. Röller, and L. Waverman, (2001). "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach," *American Economic Review*, 91(4), pp. 909-923; L. Waverman, M. Meschi, and M. Fuss, (2005). "The Impact of Telecoms on Economic Growth in Developing Countries," Vodafone Policy Paper Series, 2, pp. 10-23; B. Whitacre, R. Gallardo, and S. Strover, (2014), "Broadband's Contribution to Economic Growth in Rural Areas: Moving Towards a Causal Relationship," *Telecommunications Policy*, 38(11), pp. 1011-10.

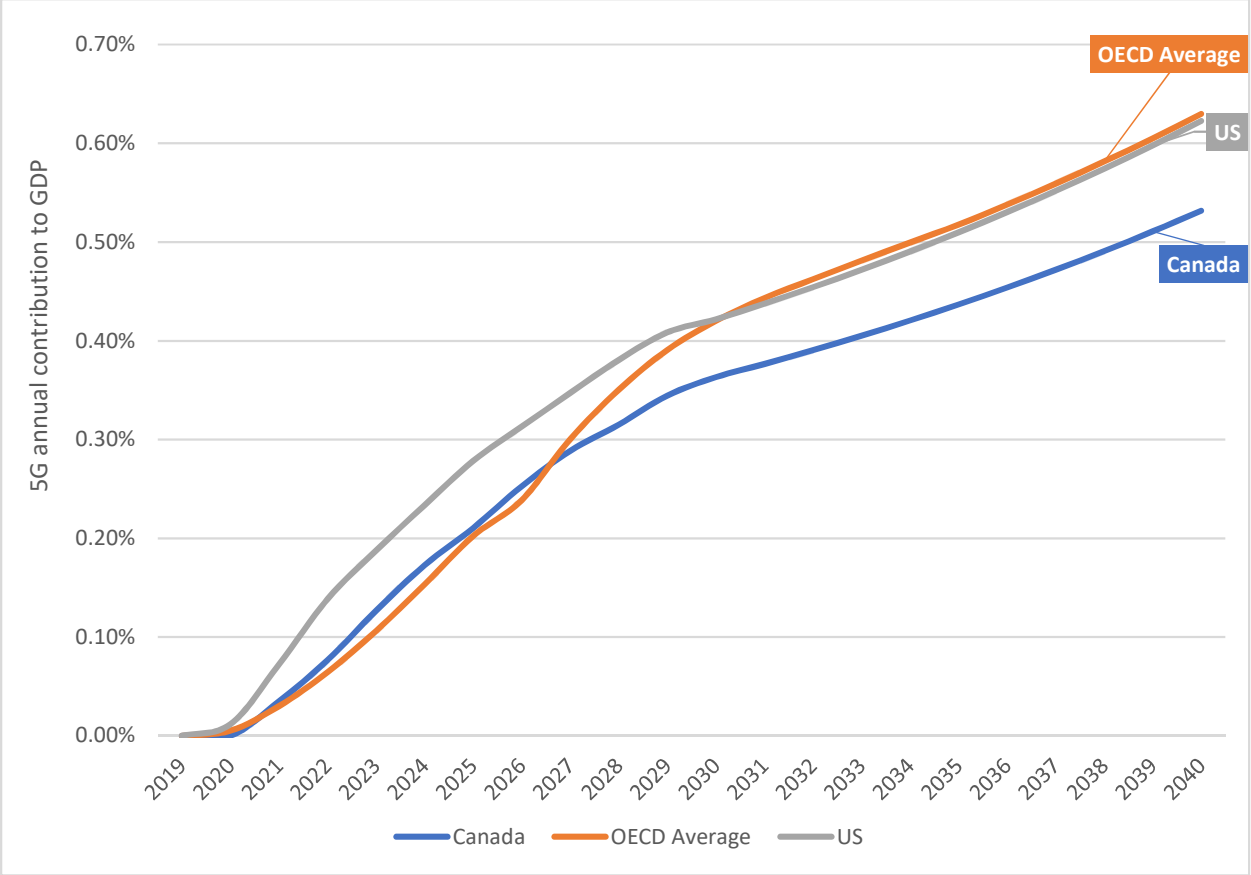
[44] H.G. Thompson and C. Garbacz (2011), "Economic Impacts of Mobile Versus Fixed Broadband," *Telecommunications Policy*, 35(11), pp. 999-1009; M.R. Ward and S. Zheng (2016), "Mobile Telecommunications Service and Economic Growth: Evidence from China," *Telecommunications Policy*, 40(2-3), pp. 89-101.
[45] GSMA Intelligence, *5G and economic growth: An assessment of GDP Impacts in Canada*, September 2020.
[46] K. Bahia, P. Castells, and X. Pedros, "Mobile technology: two decades driving economic growth," GSMA Intelligence Economic Research Working Paper, March 2020.
[47] *Id.,* p. 17.
[48] *Id.*

Thus, a country like Canada, with a very high adoption rate and an abundance of human capital, is likely to benefit substantially from an upgrade in wireless technology.

GSMA's analysis of the likely effects of 5G on GDP is shown in Figure 2 below. The projected benefits in terms of Canada's GDP are substantially lower than the benefits for the average developed-country (OECD) and for the U.S. because of Canada's spectrum policy.

Figure 2

The Projected Effects of 5G on GDP in Canada, the United States, and the OECD



Source: GSMA Intelligence, *5G and economic growth: An assessment of GDP Impacts in Canada*, September 2020.

With insufficient mid-band spectrum allocated to 5G, one-quarter of it set aside for regional carriers, and the delay of the 3500 MHz auction, Canada will realize a substantially smaller increase in GDP than most of the developed world. Over the next 20 years, these spectrum policies will reduce Canada's GDP by a cumulative $30 billion, according to GSMA's

analysis.[49] This is a large price for Canadians to pay for ISED's thus-far futile and, in any case, counterproductive attempt to increase the number of national wireless networks.

VII. Concluding Comments

Rural Canadians have been the beneficiaries of a competitive wireless industry that has provided them with extensive coverage and very high broadband speeds despite the country's difficult geography. Unfortunately, as we approach the new 5G era in wireless telecommunications, Canada's (ISED's) spectrum policy places this superior performance in danger. ISED has allocated too little spectrum to 5G, set aside one-quarter of it for regional carriers who do not typically deploy facilities as extensively into rural areas as do the national carriers, and has delayed the auction for this vital spectrum until June 2021.

This spectrum policy inevitably condemns Canada's wireless carriers to a delayed and less effective rollout of the new 5G technology, thus denying Canadian subscribers – particularly *rural* subscribers – much of the benefits that could flow from use of 5G. It will also delay the development of new services by Canadian companies that a fully-deployed 5G infrastructure could make possible.

Much of ISED's spectrum policy is driven by the desire to stimulate the development of a fourth national carrier, which has proven impossible in Canada because of its geography and modest population and which would be counterproductive even if it were successful. The cost of this policy is projected to be a cumulative loss of $30 billion in GDP over the next 20 years. Given these costs and the negligible prospective benefits of such a policy as we enter the 5G era, it is surely an appropriate time for the Canadian government to change its approach to allocating the spectrum.

[49] GSMA Intelligence, *5G and economic growth: An assessment of GDP Impacts in Canada*, September 2020, p. 35.