

Understanding the increasing value of wireless services for Canadians

A report for the Canadian Wireless Telecommunications Association (CWTA)

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Executive summary

Smartphones and mobile wireless services have become an integral part of the lives of Canadians. Investment by Mobile Network Operators (MNOs) has resulted in widespread availability of advanced 4G networks in Canada, and the launch of 5G networks. These networks have enabled improved smartphone features through the advent of millions of applications for recreational and productivity purposes, such as social media, video streaming, and many more. These features have increased the value consumers receive from their wireless services, both in terms of the value of the features themselves, and in terms of the value of the high quality network needed to enable these features.

This report assesses the value that Canadians receive from their wireless services, through considering:

1. Trends in Canadian data consumption, and the cost of that consumption
2. Trends in average Canadian household wireless expenditure and wireless substituted expenditures (including landline, photo, video, audio, and printed materials)
3. The consumer surplus of wireless services for Canadians today

Finally, this report considers the additional value that Canadians should expect to receive from wireless services, as Canada begins to deploy and adopt 5G network technology. 5G networks are forecasted to support a wave of new technology innovation that will enable the digital economy, and help deliver economic, social and environmental benefits for society.

Report findings

The value Canadians receive from their wireless services is due to innovations across hardware, software, and connectivity. While device quality has improved and new applications have helped consumers in many aspects of their lives, wireless network providers have enabled these innovations by continuously investing in advanced wireless networks with faster speeds and lower latency, and offering this connectivity at decreasing prices per gigabyte (GB) of data used. Our research in Canada found:

- From 2015 to 2019, Canadians almost tripled their average data usage, growing at 27% compound annual growth rate (CAGR). This trend is forecasted to accelerate due to the widespread launch of unlimited data plans in 2019.
- Average Revenue per User (ARPU) has remained relatively flat for wireless service providers, increasing at just 1.9% CAGR from \$64 to \$69 between 2015 and 2019.
- The average cost per 1 GB of data in Canada has dropped from almost \$28 to just \$10 from 2015 to 2019. Notably, consumers can now purchase plans with unlimited data for less than \$3 per GB of high speed data.

As wireless technology has matured, smartphones have replaced other, formerly common, Canadian household expenditures, such as landline phones, cameras and print materials. To assess this, PwC analyzed average Canadian household wireless and wireless substituted categories (landline, photo, video, audio, postal and printed materials) expenditures from 2010 to 2019. The analysis found that:

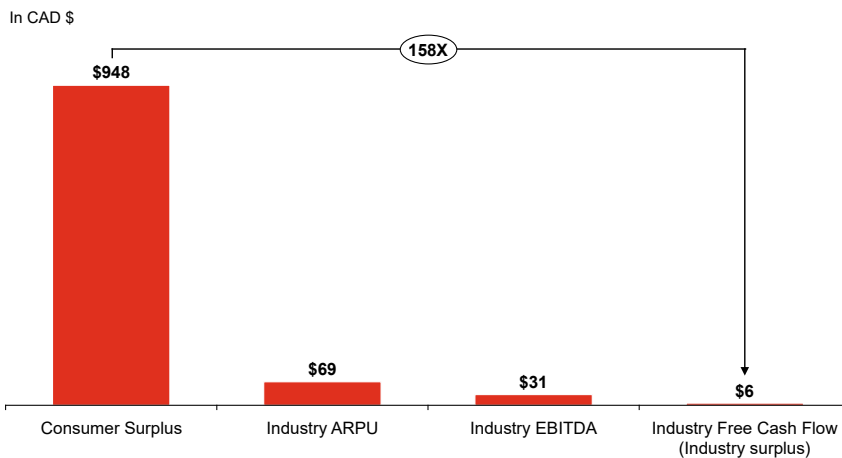
- While Canadians have increased their expenditures¹ on wireless, the increase is mostly offset by decreases in spending on wireless substituted categories; and
- Expenditures on wireless and wireless substituted categories as a percent of income have declined by 2.2% CAGR, effectively increasing discretionary income for Canadians to save or spend on other household expenditures.

Today, consumers derive additional value from new smartphone applications that are enabled by wireless connectivity, such as Uber, Yelp, Peloton, Duolingo, Wealthsimple, Amazon and more. To assess the increased value Canadians now receive from their wireless services, PwC surveyed Canadians to determine the consumer surplus received from their wireless services. The survey used a 'Willingness to Accept' approach that asked consumers how much money they would accept each month to give up access to their wireless services for an entire year. The assessment of the survey results found that:

- Consumers benefit from an average consumer surplus of \$948 per month, or \$11,376 per year.
- 17% of consumers would not accept less than \$2500 per month, or \$30,000 per year.
- 59% of respondents said they would accept no less than \$150 per month to give up their smartphone. At \$1800 per year, this represents almost 4% of the average individual income in Canada, or almost a full month of work for a minimum wage worker.
- On a per consumer basis, the average consumer surplus of \$948 per month is 158x the industry surplus (Free Cash Flow) of \$6 per month per wireless subscriber.
- Consumer surplus increases as consumers have higher data usage, have a greater urgency to use their phone, or spend more time on their phone.

Industry and consumer surplus comparison

Industry and consumer surplus



¹ An increase in expenditure is not an increase in price. As the value of wireless services continues to increase, many Canadians are electing to spend more on their wireless services.

The importance of this surplus is compounded when considering the factors of production that Canadian mobile network operators (MNOs) face when building wireless networks. A July 2020 report by PwC determined that Canada has the highest factors of production amongst a set of six peer countries, resulting in high costs to build networks in Canada. However, despite these high factors of production, Canadian MNOs have built wireless networks that have the fastest 4G download experience in the world, enabling the value consumers receive from their smartphones.

Finally, this report assesses the benefits that Canadian wireless consumers will receive as Canada transitions to 5G networks. Previous studies commissioned by the CWTA determined that 5G wireless networks will contribute as much as \$40 billion annually to Canada's economy by 2026, while creating 250,000 jobs. This will largely come through the adoption of use cases in the digital economy, primarily from technology innovation across automation, Artificial Intelligence, Internet of Things (IoT) platforms, smart sensors and more. The benefits of the digital economy will continue to compound as it grows, resulting in significantly more value to the consumer.

With 5G networks enabling the increased adoption of the digital economy, Canadians can expect to receive significant economic, social and environmental benefits. For example, advances in remote healthcare will create social benefits by providing better quality services for those in rural communities. Similarly, precision agriculture will lead to better land use and more environmentally efficient practices. These benefits go beyond the consumer surplus calculated, and are just a few examples of the value consumers will receive as 5G networks mature and inspire new innovation for the digital economy.

1. Canadians receive more value from wireless services every year as the cost per GB falls

It has been almost 30 years since the first feature phone came to market, with the launch of the *Simon Personal Communicator* by IBM at the COMDEX computer industry trade show in Las Vegas in 1992.² By 1994, the Simon phone was commercially available, and included the first basic features of the smartphone, including cellular calls, faxes, emails, an address book, calendar, calculator, clock and notepad.³ In the years that followed, other basic feature phones were launched around the world, but broader adoption didn't take off in North America until the turn of the century. At this point, the Blackberry smartphone was quick to be adopted, followed by LG and Apple launching their first touchscreen smartphones in 2006 and 2007, respectively.

Since 2007, both consumer adoption and the capabilities of smartphones enabled by wireless connectivity have grown significantly. Today, there are 34.4m retail mobile subscribers in Canada, with 90% of them subscribing to data services, and 99.5% of Canadians having access to LTE services where they live.⁴ This growth has coincided with a significant increase in the functionality and value that consumers receive from their smartphones, as illustrated in Table 1.

Today, the 'app economy' provides a wide breadth of services that enrich many aspects of consumers' lives. Since 2008, the Apple App Store has grown from 100k apps to over 4.3m, while the Google Play store today has around 2.5m apps, up from 60k in 2010.⁵ These apps include ones that focus on providing consumers with everything from retail, health, travel, business and productivity, to widely used social and entertainment apps, such as podcasts, video streaming and video calling apps. These applications provide new value to consumers, while eliminating redundant devices, services and products in people's lives.

Table 1: Wireless uses since the introduction of data services

			Quantum computing
			Augmented reality
		Retail (Amazon, Wayfair)	Customer insights
		Health (Tele-health)	Big Data/AI/ML
	Camera/video	Sharing economy (e.g. Uber)	Smart sensors
	Music (CDs, Walkman, iPod)	Productivity (e.g. banking)	3D printing
Contact management	Reading materials	Podcasts/YouTube	Smart authentication
Basic email	Mail (email)	Business apps	Human-machine interfaces
Text message	Web browsing	Social media	Location detection
Phone calls	Video streaming	Video calling	IoT platforms
Basic wireless features	Early wireless features	Current wireless features	Future wireless features

² Sager, Ira (June 29, 2012). "Before iPhone and Android Came Simon, the First Smartphone". Bloomberg Businessweek. Bloomberg L.P.

³ Note that basic feature cell phones existed before the 'feature phones' such as Simon

⁴ CRTC Communications Monitoring Report 2020

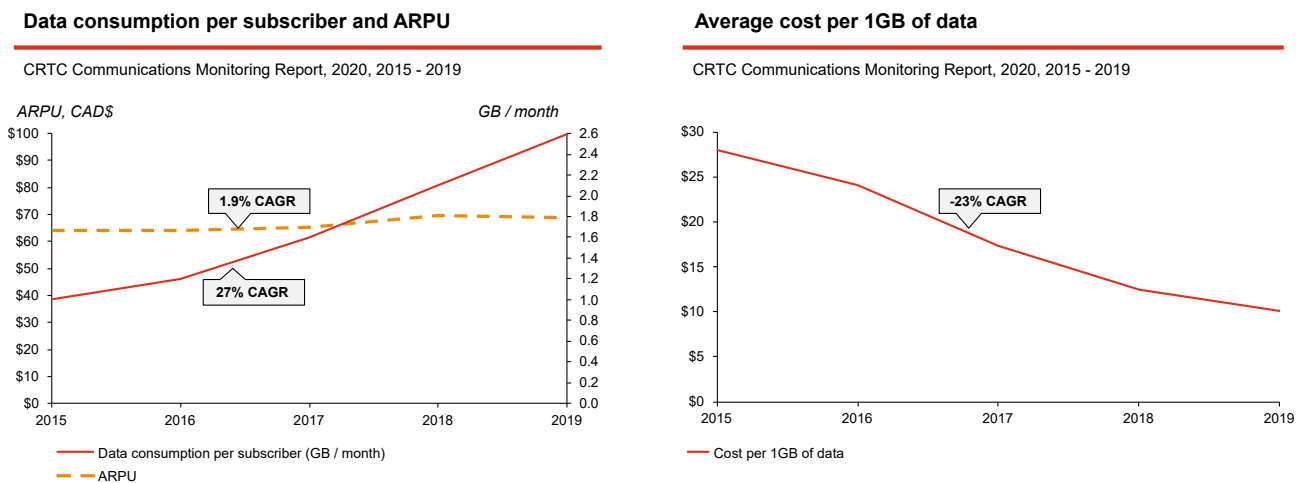
⁵ Business of Apps 2021 app data report, using data from PocketGamer and AppBrain

Furthermore, consumers can expect to benefit from a new wave of innovation, as wireless connectivity unlocks the potential of the digital economy. The digital economy is expected to provide value for consumers beyond their personal devices, and to deliver significant benefits across economic, social and environmental factors.

As wireless connectivity and smartphone technology has matured, consumers have derived more value from their wireless services, resulting in increased data consumption. As Figure 1 shows, Canadians have almost tripled their average data consumption between 2015 to 2019, from 1 GB per month to 2.6 GB per month. In that same time, the industry Average Revenue per User (ARPU), has stayed relatively flat, increasing from just \$64 per month to \$69 per month. As a result, the average cost per 1 GB of data has decreased significantly, dropping from \$27.96 per GB in 2015 to just \$10.07 per GB in 2019.

Today, consumers have access to entry-level unlimited data wireless plan options with 30 GB of the fastest speed available for \$80 per month, with no overage fees. This represents a further drop in the cost per GB by over 70% from 2015 to 2019, to less than \$3 per GB. Consumers have also benefited from increasing wireless speeds, which have increased from an average of 13 megabits per second (Mbps) in 2014 to 61 Mbps in 2021.⁶ In addition, consumers who have transitioned to unlimited data plans use more than double the amount of data of a consumer on a legacy plan.⁷ Taken together, it can be seen that over time, as the average price per GB of data has decreased and the quality of wireless connectivity has increased, consumers have received increased value from their wireless services.

Figure 1: Data consumption, ARPU, and average cost per 1GB of data in Canada



6 LTE Report, Opensignal 2014 - 2021

7 The Motley Fool, Rogers Communications Inc (RCI) Q3 2020 earnings call transcript

2. Smartphone functionality has replaced many traditional household expenditures, saving Canadian households money

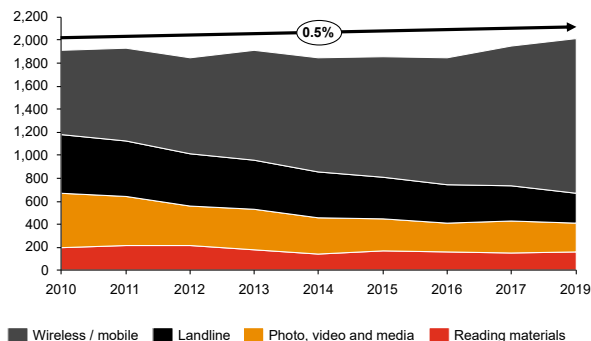
As wireless technology has matured, the value of smartphones has cannibalized certain Canadian household expenditures. In a 2019 PwC report, titled *Understanding affordability of consumer mobile wireless services in Canada*,⁸ the research found that an average Canadian's household expenditure on wireless and wireless substituted categories (landline, photo, video, audio, postal and printed materials) declined slightly from 2010 to 2017 at a CAGR of -0.1%, while these categories' cumulative share of adjusted household disposable income declined at a CAGR of -2.2%. This means that as the functionality of the modern smartphone increased it replaced many other products and services for consumers, saving Canadian households money. The research found this to be observed across all income quintiles and age groups. Furthermore, the analysis assessed wireless affordability against two thresholds: impact on non-discretionary expenditures and the Alliance for Affordable Internet (A4AI) telecommunications affordability metric. The report found that wireless expenditure in Canada met both affordability thresholds across all income quintiles.

For the purposes of this report, the research was updated with more recent Statistics Canada data to assess whether this trend continued to be true. As Figure 2 shows, the overall trend continues. Absolute expenditures across categories have increased slightly, to 0.5% CAGR, while expenditures as a percent of income remain the same at -2.2%. It can be concluded that wireless services have cannibalized household expenditures on wireless-substitute expenses, notably landline, photo, video and printed reading materials. In addition, expenditures across categories as a percentage of income have continued to decline, releasing discretionary income for Canadians to save or spend on other household expenditures.

Figure 2: Expenditure across categories, 2010-2019: Absolute and as a % of income⁹

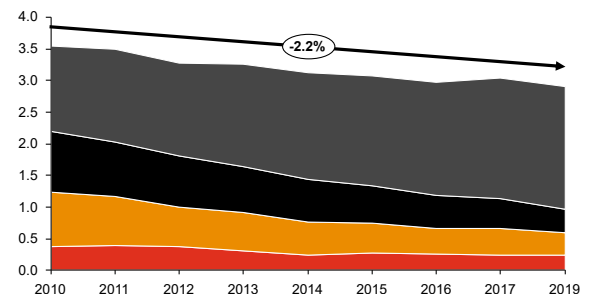
Expenditures across categories 2010 - 2019, absolute

Nominal CAD, 2010 - 2019



Expenditures across categories 2010 - 2019, % of income

Nominal CAD, 2010 - 2019



⁸ <https://www.pwc.com/ca/en/communications/publications/understanding-wireless-affordability-in-canada.pdf>

⁹ Note that postal service was excluded from the updated assessment due to the termination of the field in 2017.

3. Canadians value their wireless services at \$11,000/year more than they pay

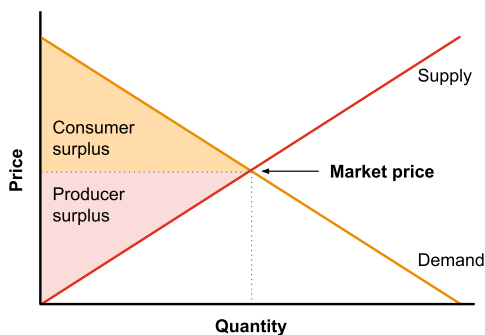
3.1 Using a consumer surplus approach to understanding the value of wireless

Over the past decade, wireless connectivity has become the foundation of the digital economy, transforming Canadians' way of life through seven key use-case buckets of value from wireless connectivity: communications, social media, entertainment, business, productivity, leisure and health, and retail. Over time, the use cases in each of these buckets have matured, and companies have innovated to create new products and services that create value for consumers.

This report looks to understand what value consumers receive from their wireless connectivity and the seven key use-case buckets, through understanding consumer surplus. This is in contrast to producer surplus, which is the profit that a company receives.

Consumer surplus is the value a consumer receives from a product or service above what they actually pay

Figure 3: Illustrative example of consumer and producer surplus



To determine the consumer surplus of wireless services in Canada, PwC conducted a consumer wireless survey in July 2021. The survey determined a consumer surplus by testing Canadians' Willingness to Accept (WtA) a payment each month to give up their smartphone for an entire year. The WtA methodology is a commonly used approach to assess consumer surplus, as it tests the true value consumers believe they receive from a good or service. For the purposes of this survey, there are two key points to note on approach and methodology:

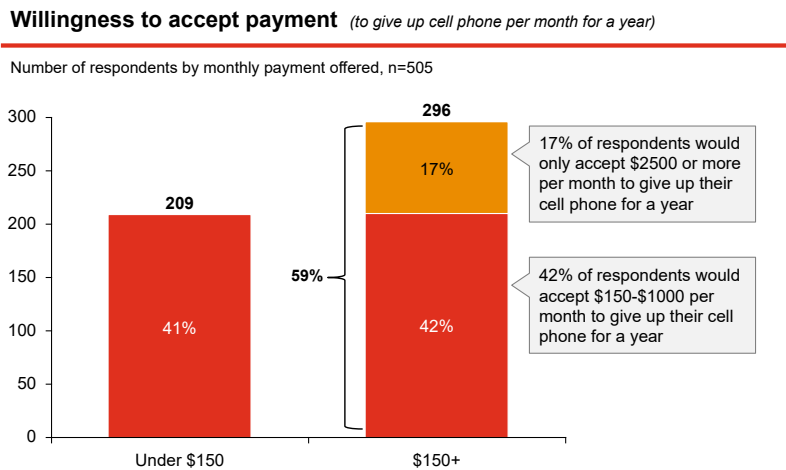
- A staircase methodology was used to test WtA. This approach offers respondents a monetary amount to give up their smartphone each month for a year. If the respondent accepted, they finished the survey. If the respondent did not accept, the next question would offer the respondent a higher monetary amount.

- The survey explained that the respondent would not be able to buy a new smartphone or borrow another smartphone during the one-year period. It also stated that the amount offered would be in addition to the savings they would receive from not having to pay for wireless services during the year. However, the survey did note that respondents could continue to access home internet through other devices, such as a laptop.

3.2 Canadians have an average consumer surplus of \$948 per month for their wireless services, significantly higher than the industry surplus of \$6 per month

The survey results found that consumers benefit from an average consumer surplus of \$948 per month, or \$11,376 per year. As Figure 4 illustrates, 59% of respondents said they would accept no less than \$150 per month to give up their smartphone, a total of \$1800 per year. This represents almost 4% of the average individual income in Canada, or almost a full month of work for a minimum wage worker.¹⁰ Furthermore, about 1 in 6 Canadians (17%) would not give up their smartphone for less than \$2500 per month or \$30,000 per year. This is a significant amount of value that a segment of Canadians attribute to their smartphone, especially given the average individual income in Canada was \$49,000 in 2019.¹¹

Figure 4: Willingness to accept payment by offered amount



The consumer surplus Canadians receive from their smartphones becomes more apparent when compared to industry surplus. The CRTC 2020 Communications Monitoring Report found that ARPU in the Canadian wireless industry was \$69. It also reported that the average wireless Earnings Before Interest, Tax, Depreciation and Amortization (EBITDA) margin was 44.2%, equal to approximately \$31. In addition, PwC research determined that the industry average Free Cash Flow (FCF) is 8.6%, or approximately \$6.

It is important to compare the consumer surplus to the industry's FCF, as EBITDA as a measure of profitability does not account for capital expenditures. Due to higher costs to build and maintain networks in Canada, capital expenditure as a percentage of revenue is circa 5 percentage points higher than in comparison countries. As a result, Canadian wireless service providers maintain around 5 percentage points higher EBITDA as a percentage of revenue than telcos in peer countries. Ultimately, FCF is the best measure of the industry surplus, because it best represents the profits that wireless network operators earn at the end of the financial year.

¹⁰ Minimum wage in Canada is between \$11.45 (SK) and \$16 (Nunavut). Calculation assumes an average minimum wage of \$13.50 working 37.5 hours / week.

¹¹ Average individual income of \$49,000 as of 2019. Statistics Canada. Table 11-10-0239-01 Income of individuals by age group, sex and income source, Canada, provinces and selected census metropolitan areas

Figure 5: Industry and consumer surplus comparison

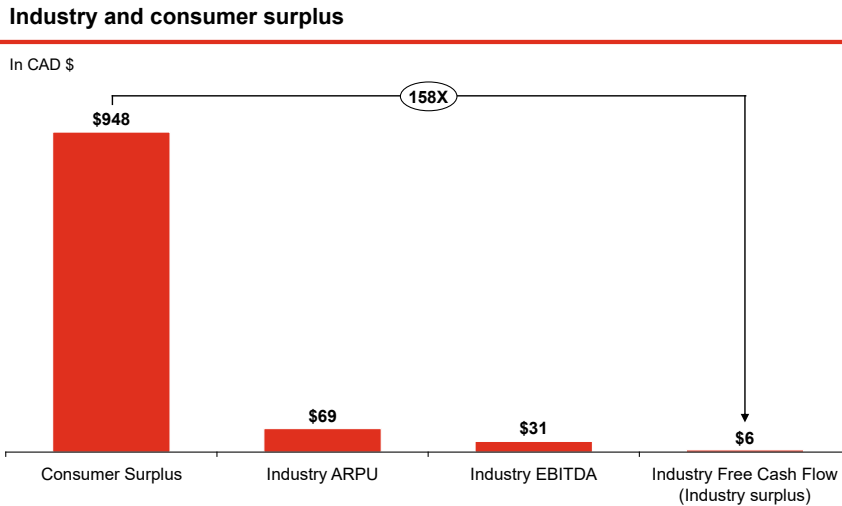
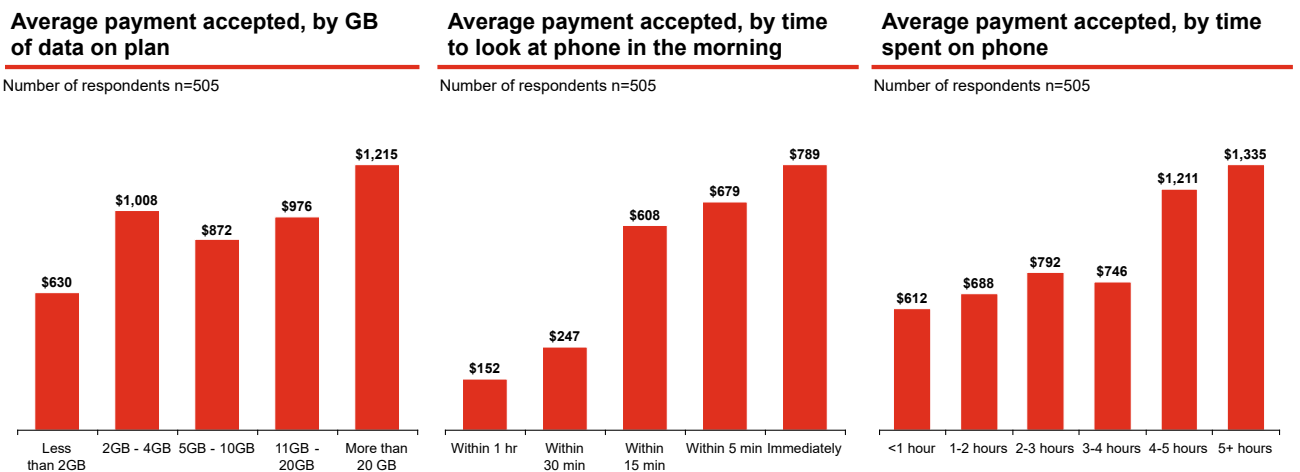


Figure 5 demonstrates the significant difference in surplus between consumers and industry, by comparing the dollar value of the consumer surplus to the industry ARPU, EBITDA and FCF. While wireless service providers receive an average of \$6 per customer per month in FCF profit, consumers indicate they get \$948 of value from their wireless services—158x more.

3.3 Consumers who use more data and spend more time on their smartphones attribute more value to their wireless connectivity

To determine the drivers of the respondents' consumer surplus, additional survey questions were analyzed, identifying three key trends (see Figure 6): (i) consumers had higher surplus, the more data they consumed; (ii) consumers had higher surplus, the greater the urgency they had to use their smartphone after waking up in the morning; and (iii) consumers had higher surplus, the more time they spent on their phone.

Figure 6: Consumer surplus trends



It is important to note that the analysis also assessed consumer surplus against income, age, gender and wireless provider, and found no notable trends. For example, individuals making between \$20,000 - \$40,000 and individuals making over \$150,000 had an average consumer surplus of over \$1100. However, individuals making less than \$20,000 and between \$100,000 - \$150,000 had an average consumer surplus of \$833 and \$675, respectively.¹² Consumer behaviour and usage of wireless services were the greatest determinants of a higher consumer surplus. The survey also asked respondents about whether their wireless services usage had increased, decreased or remained the same over the past two years, coinciding with the COVID-19 pandemic. Notably, 86% of respondents indicated that the value they received from their wireless connectivity had remained the same or increased. 68% of respondents said that their usage had increased in at least one of the seven key use-case buckets.

¹² Other income brackets were varied. Incomes of \$40K - \$60K, \$60K - \$80K and \$80K - \$100K had average consumer surpluses of \$790, \$1062, and \$828, respectively.

4. Canadians benefit from some of the best quality wireless networks globally; the deployment of 5G will only grow consumer surplus through enabling the digital economy

A 2020 PwC study, titled *The importance of a healthy telecommunications industry to Canada's high tech success*,¹³ investigated the factors of production involved in the building of a wireless network. The study benchmarked Canada against six peer countries¹⁴ and determined that Canada has the highest factors of production amongst them all. This means that Canadian wireless service providers face the highest costs to build networks among the peer countries, explained by three key factors: low population density, high spectrum costs and smaller scale MNOs.

Despite this, Canadian wireless service providers have created nationwide networks that have the fastest 4G download experience in the world, along with 4G availability that ranks among the top 10 globally, despite Canada's low population density.¹⁵ These high quality networks exist across Canada, with LTE population coverage above 97% in rural areas and 99.9% in urban areas. High quality wireless services are a key driver in enabling consumers to benefit from their smartphones and receive the consumer surplus they currently attribute to their wireless services. The value Canadians receive can be expected to continue increasing as Canada rolls out 5G technology that will enable the transition to the digital economy from the information economy.

As 5G networks roll out in Canada, it is expected that a new wave of innovation will be enabled by faster data speeds and lower latency. The majority of this innovation is expected to move from business-to-consumer (i.e., Airbnb, Uber, Instagram etc.) to business-to-business. This business-to-business innovation is typically referred to as the fourth industrial revolution, or more generally as the transition from the information economy to the digital economy. The digital economy will be enabled by many technological innovations, including Machine Learning and Artificial Intelligence, smart sensors, location detection technology, augmented reality and more. Table 2 below illustrates a number of digital economy use cases across select sectors.

Table 2: Industry 4.0 use cases across select sectors

Financial services	Healthcare	Manufacturing	Agriculture
<ul style="list-style-type: none"> Wireless POS terminal Insurance telematics Branchless banks Smart building infrastructure Fraud detection 	<ul style="list-style-type: none"> Remote health Wearable devices Smart Asset Management VR / AR therapy Drone-delivered emergency response Wireless robotics assisted surgery 	<ul style="list-style-type: none"> Automated industrial drones Augmented reality maintenance Condition based maintenance Wearables for operators Tele-operated mobile robotics 	<ul style="list-style-type: none"> Sensor climate monitoring Greenhouse automation Automated crop management Cattle health monitoring Precision farming Drone seed planting

¹³ PwC Canada, *The importance of a healthy telecommunications industry to Canada's high tech success*, July 2020

¹⁴ US, Australia, UK, France, Austria, Germany

¹⁵ Opensignal, *the state of mobile experience* May 2020

A common misconception regarding digital economy use cases is that these are far-off examples, only available once 5G has reached maturity. While this may be true in some use cases, there is a significant amount of activity already underway, many of them on 4G networks, or early stage 5G networks. Some examples include:

- Toyota - partnered with Nokia to create their own 5G private network to be used for real time data of sensor equipped production lines.
- Clickmox solutions - developed an underground system to explore new mine cavities, using 5G enabled drones to determine if miners can safely enter.
- TC Energy - partnered with SkyX, a drone company, to monitor a pipeline and its right-of-way, scanning for debris, construction activity and excavation that could damage the infrastructure.

The deployment of these technologies across the economy is expected to deliver significant economic benefits to Canadians. A CWTA commissioned report by Accenture Strategy in 2018 found that innovation from 5G wireless networks will contribute as much as \$40 billion annually to Canada's economy by 2026, while creating 250,000 jobs.¹⁶ However, the digital economy is expected to have an impact beyond economic value, including societal and environmental benefits. For example, advances in remote healthcare will create social benefits by providing better quality services for those in rural communities. Similarly, precision agriculture can lead to better land use and more environmentally efficient practices, while providing higher skilled and paid jobs to citizens living in rural communities.

As 5G networks are built across the country, and the readiness and adoption of new and innovative use cases continues to expand, Canadians are poised to receive increased value from their wireless services. This paper has demonstrated that consumers today receive significant consumer surplus as a result of 4G network innovations, many of which could not have been predicted 10-15 years ago. Similarly, consumers can expect 5G to do the same. Not only will consumers gain additional surplus from new technology innovations, they will also experience broad societal benefits such as job creation, access to healthcare and positive environmental change.

¹⁶ Accenture Strategy, Fuel for Innovation, Canada's path in the race to 5G



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