The Benefit of the Wireless Telecommunications Industry to the Canadian Economy, 2012/13

Prepared for:

The Canadian Wireless Telecommunications Association (CWTA)

Prepared by:

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Contents

Executive Summary

Over the past three decades, wireless communications has grown to become an integral part of Canadians' everyday lives. Today, more than 90% of the population (aged 15 and over) uses a mobile phone, and millions of Canadians now use smartphones and wireless tablets to shop, study and stay in close touch with family friends.[1] At the end of 2011 there were 27.4 million subscribers to mobile wireless services in Canada, including 22.1 million post-paid subscribers.[2]

Canada's wireless industry continues to yield significant economic benefits. The supply-side impacts include the gross domestic product (GDP) and employment attributable to economic activity within the wireless sector. The demand-side impacts include the consumer surplus generated by the competitive pricing and innovative services available to Canadians.

In 2011, the Canadian wireless industry's economic benefit increased significantly as Canadians' adoption of smartphones, wireless tablets, and mobile data services and applications also increased at a rapid pace.

- The Canadian wireless industry generated an overall economic benefit of **$50.2 billion** in 2011, when direct and multiplier effects associated with the industry's GDP (**$38.7 billion**) are combined with the consumer surplus generated by wireless voice and data services ($11.5 billion). The overall economic benefit represented an increase of 16.7% from $43 billion in 2010.
- The Canadian wireless industry generated **$20.7 billion** in **direct GDP** in 2011.[3] Direct GDP was up by 15% from $18 billion in 2010. Most of this increase was associated with Canadians' increasing use of smartphones and wireless data services.
- Out of the wireless industry's direct GDP of $20.7 billion, **$13.4 billion**, or 64%, was **retained in Canada**.
- Canada's wireless industry supported **280,000 jobs** in 2011, including direct, support-staff and indirect employment. The inclusion of induced impact employment brought the wireless industry's total employment impact to **308,000**.
- Canadian wireless network operators made capital investment totalling **$2.6 billion** in 2011.

[1] Data from Statistics Canada, CANSIM, table 051-0001 indicates that the population aged 15 and over was 29,217,300 in the fourth quarter of 2012.

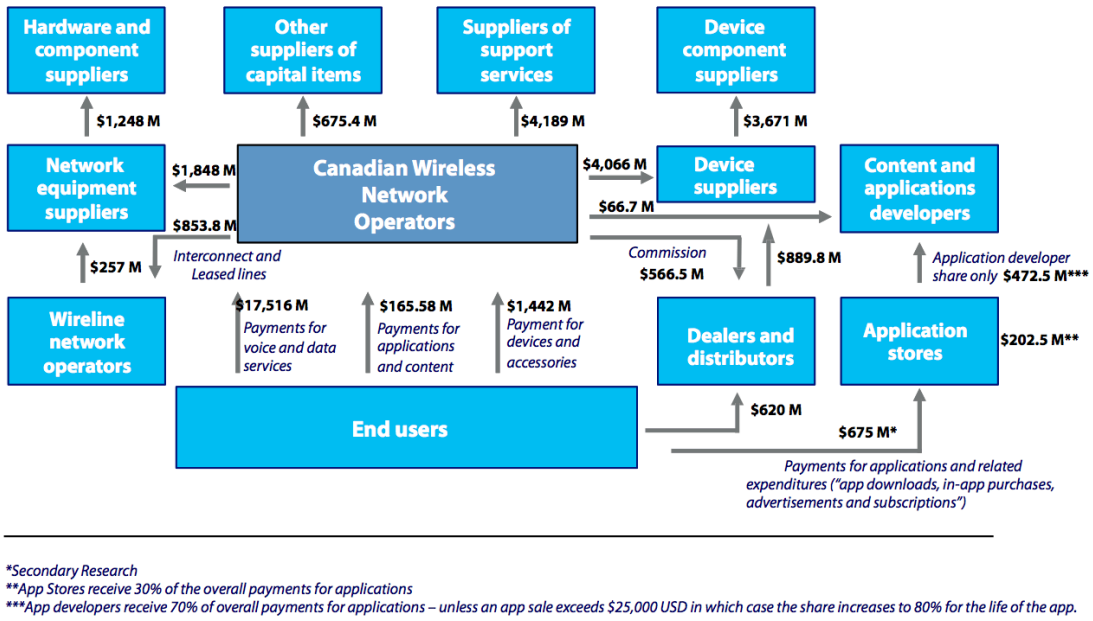
[2] CRTC. (2012). "Communications Monitoring Report 2012".

[3] Direct GDP excludes output multiplier effects.

Canada's wireless ecosystem

Canadian wireless network operators form the core of the industry's ecosystem (Figure 1). In 2011, Canadian wireless network operators earned over $19.1 billion in revenue, including $17.5 billion from payments for voice and data services, $1.4 billion from the sale of devices and components and $166 million from consumer payments for mobile content and applications.

Figure 1 The ecosystem for wireless services in Canada



*Secondary Research
**App Stores receive 30% of the overall payments for applications
***App developers receive 70% of overall payments for applications – unless an app sale exceeds $25,000 USD in which case the share increases to 80% for the life of the app.

Source: Nordicity research

In comparison with the wireless network operators, the revenues generated in other three subsectors: device suppliers, applications developers and equipment suppliers were smaller and had significant variances in their growth rates. With the proliferation of smartphones and mobile tablet devices, device suppliers grew in prominence with the ecosystem. Device suppliers' revenue increased from $4.3 billion in 2010 to $5 billion in 2011. Consumer expenditures on mobile applications and content also grew strongly in 2011. These payments increased from $168 million in 2010 to $675 million in 2011. The network equipment suppliers' revenues grew from $1.725 billion in 2010 to $1.848 billion in 2011.

In 2011, the Canadian wireless industry generated $20.7 billion in direct GDP. This total is up from $18 billion in 2010. The increase in direct GDP was, in large part, due to the increased revenue associated with wholesale provision of consumer devices to wireless network operators and retail sales to consumers through dealers. After taking into account multiplier effects, the total GDP impact generated by the Canadian wireless industry was $38.7 billion.

Due to the global nature of the wireless value chain, not all of the GDP generated by the Canadian wireless industry stays within Canada. While the majority of the valued added generated by wireless network operators, wireline operators and dealers occurs in Canada, for many other players in the ecosystem – particularly consumer device suppliers and device component suppliers – the majority of valued-added activities, such as design and assembly actually occur outside of Canada. In 2011, an estimated $13.4 billion of GDP (out of total ecosystem GDP of $20.7 billion) was retained in the Canadian economy.

Consumer surplus

Canadians benefit from access to one of the most advanced and extensive wireless networks in the world. More than 99% of Canada's population has access to a mobile wireless network and 99% of Canadians have access to the high-speed wireless broadband infrastructure, including 3G and HSPA+.[4] Canadians also benefit from some of the most competitive pricing among members of the Organization for Economic Cooperation and Development (OECD).[5]

In estimating the consumer surplus generated by the wireless sector, Nordicity considered the consumer benefit from both mobile voice services and mobile data services. Mobile voice generated an estimated $9 billion in consumer surplus in 2011. Mobile broadband services, for which adoption and utility is growing rapidly, generated an estimated $2.5 billion in consumer surplus. In total, therefore, the wireless industry generated $11.5 billion of consumer surplus for Canadian in 2011.

[4] CRTC. (2012). "Communications Monitoring Report 2012".

[5] Nordicity. (2011). "International Wireless Market Comparison"

1. Introduction

1.1 Context

In 2010, The Canadian Wireless Telecommunications Association (CWTA) initiated publication of *The Benefit of the Wireless Telecommunications Industry to the Canadian Economy*. This first annual report provided a detailed analysis of the wireless industry for the 2008 year[6] and provided the first data set necessary for time series analysis. The annual reporting was developed in response the needs of policy-makers, regulators and other stakeholders to better identify the economic benefits of this critical and rapidly growing sector to the national economy as well as to explain the underlying key trends and drivers of that contribution.

In 2008, Canada's wireless industry generated an economic contribution of $39 billion and supported nearly 274,500 jobs for Canadians.[7] By 2010, (3rd edition, published June 2012), the wireless communications industry economic contribution had increased to $43 billion.[8]

1.2 Scope and mandate

In the current report – the 4th edition covering 2011 – our research and analysis continues to build upon and develop the framework previously developed by CWTA. Thus, updates are made to the total revenue within the wireless ecosystem, the direct, indirect and induced economic impacts for employment, and the overall economic contribution from both the supply side and demand side. These impacts are separated within the analysis to isolate the wireless industry's impact on the Canadian economy.

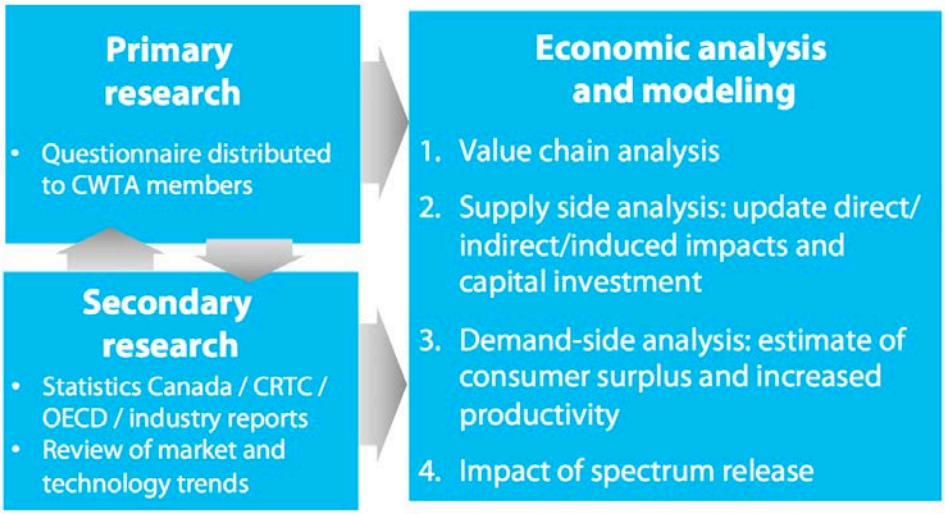
This report also expands upon CWTA's previous studies, with the development of the following elements: a review of capital investment, the economic benefits of wireless broadband, the economic benefits from spectrum release, and a forward-looking perspective on potential economic and social benefits.

1.3 Overview of methodology

Our methodology consists of three key phases: (i) Primary research; (ii) Secondary research; and, (iii) Economic analysis and modelling, as illustrated in the following figure:

[6] The lag in publication of consolidated industry data is explained by the annual reporting cycle of companies, different year ends and time required to analyze the consolidated industry data.
[7] Ovum. (2010). "The Benefit of the Wireless Telecommunications Industry to the Canadian Economy". Page 1
[8] *Ibid* Page 2.

Figure 2 Overview of methodology



A questionnaire was distributed to seven of Canada's wireless operators, representing roughly 90% of the wireless industry in terms of revenues, jobs and contribution to GDP. The questionnaire provided estimates of operator's cash flows, revenues and costs for year-end 2011. These parameters were used to inform our economic impact model and ecosystem analysis.

Secondary research consisted of a detailed review of data from Statistics Canada, past publications from the Canadian Radio-television and Telecommunications Commission (CRTC), Organization for Economic Co-operation and Development (OECD), Federal Communications Commission (FCC) and other recent wireless industry reports. Careful attention was also paid to current market and technology trends and how these play a role in the Canadian wireless ecosystem. Results of our analysis were used in the construction of our questionnaire, as well as providing important contextual information in our economic impact analysis.

Every effort was made to adhere to the methodology used in previous studies published by the CWTA. This ensured data comparability and enabled continuity for demonstrating ongoing trends in the industry. The economic analysis and modelling phase consisted of four sub-phases: (i) Value chain analysis, (ii) Supply-side analysis, (iii) Demand-side analysis, and (iv) Impact of spectrum release. A more detailed explanation of the methodology used in this report is offered in Appendix A.3.

In some cases, new analytical elements had to be developed within the economic impact model in order to adapt to new market information or lack thereof. In developing these new elements, we adhered to economic logic and tested methods. Additional information about the new elements can be found in the appendix.

2. Overview of the Canadian Wireless Sector

In this section, we provide an overview of recent trends and developments in the Canadian wireless industry, including the growth in subscribers and revenue, and the industry's track record of capital investment.

2.1 Growth in subscribers and revenue

Wireless subscribers and revenues continue to grow in the Canadian marketplace. In 2011, the Canadian wireless revenues grew 6.3% over the previous year, increasing from $17.9 billion in 2010 to $19.1billion in 2011[9]. The number of mobile subscribers followed a similar trend, growing by 6% from 25,825,400 subscribers in 2010, to 27,387,200 in 2011.[10]

Other breakdowns of mobile subscribers such as by age provide interesting illustrations of the demographic profile of the Canadian mobile end-user. A recent study by comScore found that the majority (66%) of Canadian mobile subscribers are between the ages of 35 and 54 (35%) and those aged 18-34 (31%). The remaining age groups are either over 55 (28%) or between the ages of 13 and 17 (7%).[11] When compared with data from previous years, it is clear that subscribership has increased significantly in all age groups i.e. mobile devices are no longer the exclusive domain of the 'early adopters' or the younger demographics.

2.2 Capital investment in wireless networks

Rapid growth in subscribership, development of new larger-screen wireless devices and higher intensity of usage of wireless networks have resulted in massive new demands on Canada's wireless network infrastructure. In response, Canadian wireless network operators have made significant capital investments in upgrading and expanding their networks.

In 2011, Canadian wireless network operators made capital investments of $2.6 billion. This level of capital investment was up slightly from $2.5 billion in 2010. Indeed since 2009, Canadian wireless network operators have kept their annual level of capital investment between $2.5 billion and 3 billion.

Canadian wireless network operators capital investments over the past three years (2009 to 2011) follow a long track record of significant annual capital investment dating back 25

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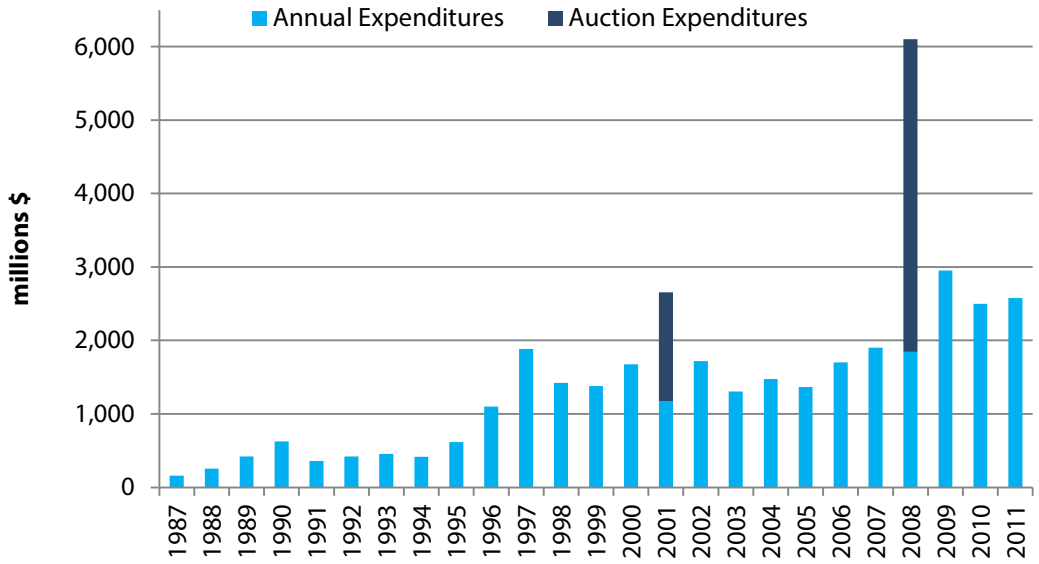
[9] CRTC. (2012). "Communications Monitoring Report 2012".

[10] *Ibid.*

[11] comScore. (2013). "Canada Digital Future in Focus". Accessed May 13, 2013 from: http://www.comscore.com/Insights/Presentations_and_Whitepapers/2013/2013_Canada_Digital_Future_in_Focus

years. In 2008 alone, auction payments brought the industry's annual level of capital investment to over $6 billion. And since 1987, Canadian wireless network operators have made capital investments totalling $37.4 billion, including $31.7 billion in investments in network infrastructure and a further $5.7 billion of capital investment in the acquisition of spectrum

Figure 3 Wireless carriers' capital investment in Canada 1987-2011



Source: 1987-1995 compiled from The Canadian Cellular Service Industry: Historical Statistics 56-001-XIB; 1995-2005 compiled from Statistics Canada Quarterly Telecommunications Statistics 56-002-XIE; 2006-2008 compiled from CRTC Communications Monitoring Report 2009; 2009 Ovum; 2010 Ovum; 2011 CRTC Monitoring Report 2012.

Despite the decline in capital investment from 2009 to 2011, the annual network-related portion of capital investments continued to exceed those in previous years – as shown in Figure 3 above. Furthermore, with the 700MHz auction slated for November 2013, there will certainly be a spike in capital investments associated with spectrum acquisition. This spike in capital investment may also be followed by higher levels of capital investment in network infrastructure, as new and existing network operators incorporate new spectrum into their networks.

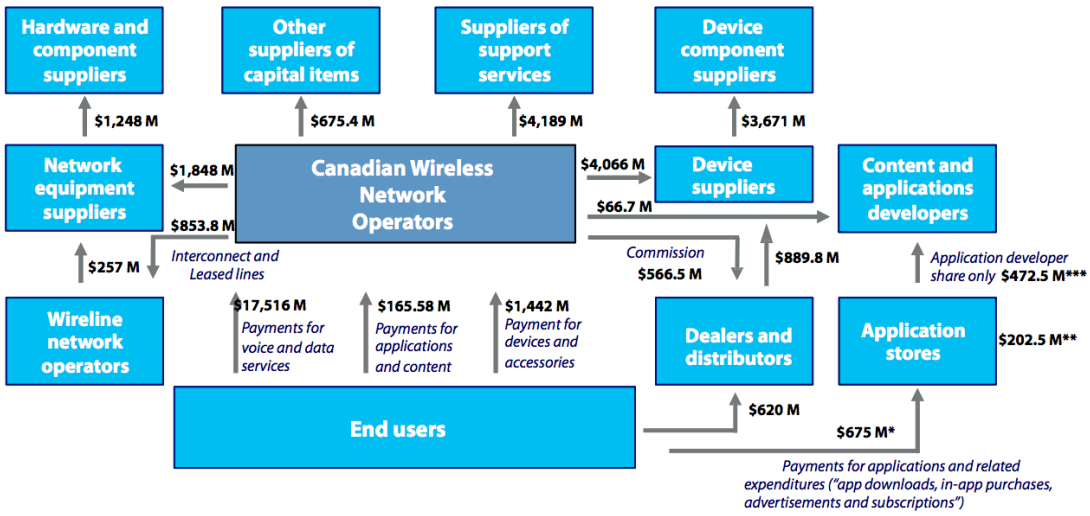
3. Supply-side Impacts

In the following section, we analyze the supply-side impacts of the Canadian wireless industry. These supply-side impacts comprise the effects that economic activity within the wireless value chain or ecosystem has on GDP and employment.

3.1 Canadian wireless ecosystem

While the wireless industry has traditionally been viewed in terms of a value chain, in recent years the development of the sector suggests that it is probably best viewed as an ecosystem with a high degree of interdependence among the constituent segments. Figure 4 summarizes the various component subsectors of the ecosystem along with the revenue flows between specific subsectors.

Figure 4 The ecosystem for wireless services in Canada



*Secondary Research
**App Stores receive 30% of the overall payments for applications
***App developers receive 70% of overall payments for applications – unless an app sale exceeds $25,000 USD in which case the share increases to 80% for the life of the app.

The data points in this analysis of financial flows within the ecosystem have been generated primarily from detailed accounting information provided by the wireless network operators in the survey questionnaire and supported by additional secondary research. In some cases, the data from previous editions of this report were also used to update the financial flows within the wireless ecosystem.

At the core of the Canadian wireless ecosystem are the Canadian **wireless network operators**. According to the CRTC, Canadian wireless network operators earned over $19.1 billion in revenue in 2011. Approximately 92% of this total revenue, or $17.5 billion, came

from payments for voice and data services. Payments for devices and accessories generated over $1.4 billion in revenue for Canadian wireless network operators. They also earned an estimated $166 million from consumer payments for mobile wireless applications and content. Device suppliers earned an additional $890 million through dealers and distributors, bringing their total revenue to $5 billion in 2011.

Through the procurement of wireless equipment and services, wireless network operators, in turn, support numerous other segments of the wireless ecosystem. In 2011, wireless network operators paid an estimated $854 million to Canada's wireline network operators for interconnection and leased lines. These payments stimulated wireline network operators to invest an estimated $257 million in network infrastructure. Wireless network operators, themselves, invested over $1.8 billion in network equipment.

These investments made in network infrastructure by both wireless and wireline network operators led to over $1.2 billion in purchases of telecommunications hardware and components.

In 2011, Canadian wireless network operators spent $4 billion on the procurement of **wireless consumer devices**. Part of these expenditures was recovered through sales to consumers; however, a large portion of these expenditures were subsidized by wireless network operator, with a view to recovering the subsidies through payments for voice and data services.

Wireless network operators also procured $4.2 billion in **support services** (e.g., marketing, customer relationship management and financial accounting services) from other companies in 2011. They also made expenditures of $675 million on the acquisition or construction of other capital assets.

Within the wireless ecosystem, an increasing amount of economic activity takes place directly between end users and other third parties, namely **dealers and distributors**, and **app stores**. Dealers and distributors provide another sales channel through which consumers can shop for the equipment and wireless services that best meet their communications needs. App stores offer consumers a sales channel and payment system for acquiring wireless apps, which increase the functionality or entertainment value of their wireless devices.

In 2011, dealers and distributors in Canada earned an estimated $620 million in revenue from consumers' purchases of wireless equipment and services. Sales by dealers and distributors led to an additional $890 million in payments to device suppliers.

The rapid adoption of smartphones in recent years has underpinned exponential growth in the use of smartphone applications and content over various leading application platforms: iOS, Android and BlackBerry. According to a recent study by the Information and Communications Technology Council (ICTC), total Canadian expenditures on mobile apps

and related expenditures reached an average of $675 million in 2011[12], representing an 8% increase over the previous year. Apple's App Store (iOS) accounted for a majority of the payments and adhered to its global market policy of keeping 30 cents of every dollar spent on application purchases.[13] Using this revenue-sharing model to project across the Canadian wireless industry, mobile app store revenues would be an estimated $202.5 million (in agency fees), while the revenue of content and application developers would be an estimated $472.5 million.

Today, the assembly of wireless consumer devices often involves complex global supply chains in which the various device components (i.e., microchips, software, touch screens and batteries) are produced by a network of suppliers. We estimate that fulfilment of over $4 billion in wireless devices generated nearly $3.7 billion in payments to device **component suppliers**.

A detailed explanation of the calculation of the financial flows within Canada's wireless ecosystem can be found in Appendix A.4.

3.2 Gross domestic product (GDP)

In this section we quantify the GDP generated by the Canadian wireless industry. We examine two types of GDP measurements: (i) direct GDP and (ii) total GDP (including multiplier effects). Direct GDP refers to the sum of value added generated by the companies operating within the wireless ecosystem; total GDP refers to the sum of direct GDP and the spin-off GDP associated with the multiplier effects.

We derived the estimates of direct and total GDP in one of two ways:

- Where detailed financial data were available, we summed wages, salaries and benefits and operating surplus (i.e. operating profit) to calculate GDP; or,
- Where detailed financial data were not available for a particular industry within the Canadian wireless ecosystem, we used the GDP-to-revenue ratio for that industry or a similar to convert our revenue estimates into GDP estimates.

In total, Canada's wireless industry generated $20.7 billion in direct GDP in 2011. This level of direct GDP represents an increase of 15.2% over the $18 billion in GDP generated in 2010.

[12] ICTC. (2012). "Employment, Investment and Revenue in the Canadian App Economy".

[13] Secondary research conducted by Nordicity indicates that application developers and content rights holders receive 70% of application expenditures across all the major app stores.

Table 1 Direct GDP generated within the Canadian wireless industry

Subsector	GDP, 2010 ($M)	GDP, 2011 ($M)	Percentage of total industry GDP, 2011
Dealers	325*	166.6	<1%
App stores and app developers		462.0	2%
Wireless operators	6,778	7,546.1	25%
Wireline operators	361	598.5	2%
Support service suppliers	3,542	4,189.0	14%
Network equipment suppliers	714	764.9	3%
Hardware and components	1,165	1,248.0	4%
Device suppliers	1,303	1,573.9	8%
Device component suppliers	3,039	3,671.0	18%
Other capex suppliers	773	675.4	2%
Total	**18,000**	**20,728.9**	**100%**

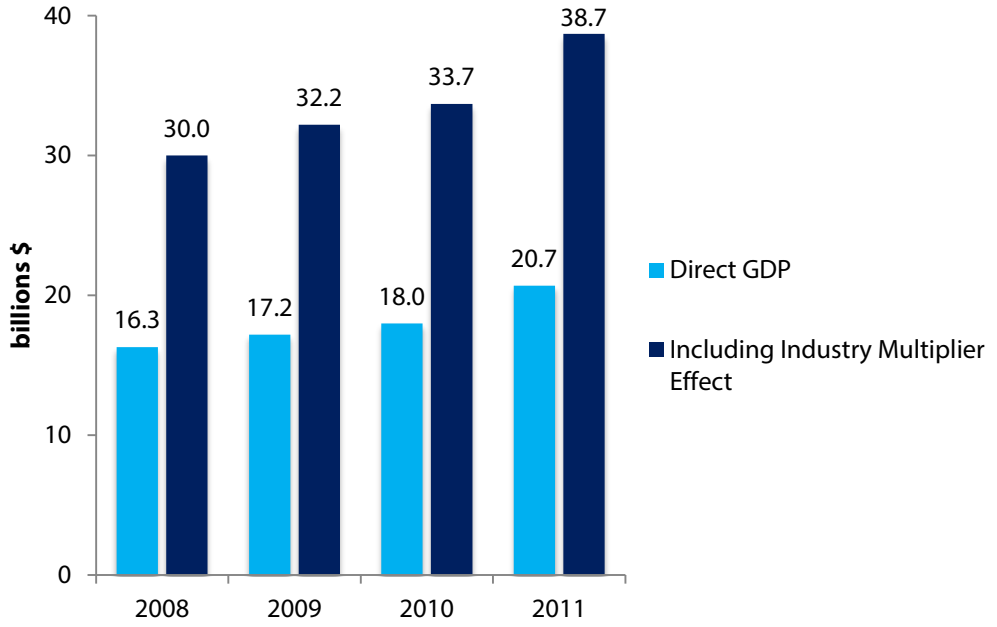
Source: Nordicity and Ovum
Note definitions of ecosystem categories are provided in Appendix A.4
* A breakdown of GDP for dealers, and app stores and app developers was not available for 2010.

The GDP estimates in Table 1 represent the levels of GDP generated in each subsector within the wireless industry. However, as the companies in these subsectors purchase inputs from their upstream suppliers in industries outside the ecosystem, and in turn, those suppliers purchase inputs, a so-called multiplier effect takes place. We apply a multiplier of 1.87 to estimate the overall economic value of the Canadian wireless industry. This multiplier is based on Statistics Canada's multiplier for the integrated telecommunications industry and corresponds with CWTA's previous studies of the economic contribution of the wireless industry. [14]

The multiplier of 1.87 implies that the total GDP impact of the Canadian wireless industry was equal to $38.7 billion in 2011 ($20.7 billion × 1.87 = $38.7 billion).

[14] Ovum. (2012). "The Benefit to the Canadian Economy from the Wireless Telecommunications Industries: An Economic Impact Assessment". p. 21.

Figure 5 Total and direct GDP generated by the Wireless industry in Canada, 2008-2011



Source: Nordicity estimates based on from online survey, Ovum and Statistics Canada

3.3 Gross domestic product (GDP) retained in Canada

In the previous section, we estimated the total value of the GDP generated by the Canadian wireless industry.[15] The economic activity generated by the Canadian wireless industry is not confined to the Canadian economy, however. Each subsector within the wireless industry relies upon imported inputs – and thereby imported valued added – to some degree. While for some industries within the wireless ecosystem, such as the wireless network operator industry, the vast majority of value added occurs in Canada; for other industries within the wireless ecosystem, such as device component suppliers industries, the vast majority of value added actually occurs outside Canada: specifically in the countries where the components are designed or manufactured. [16]

[15] It is important to note that according to the Statistics Canada NAICS codes 'wireless services' is a subsector of the telecommunications industry, which itself is a sub-sector of the Information and Communication Technologies (ICT) industry. For purposes of this study, we will use the term wireless sector and the various components e.g., operators, etc. as subsectors.

[16] The wireless service industries in other countries also have a positive impact on the Canada's GDP. For example, the demand for BlackBerry devices outside of Canada necessarily has an impact on GDP in the

After accounting for the portion of GDP in each wireless industry that is retained in Canada, we conclude that $13.4 billion in direct GDP remains in Canada (Table 2), or 64.49% of the overall direct GDP impact of $20.7 billion generated by the Canadian wireless industry in 2011.

Table 2 Wireless industry GDP retained in the Canadian economy, 2011

Subsectors	GDP ($M)	Share of GDP retained in Canada	GDP ($M), and retained in Canada ($M)
Dealers	166.6	10.0%	166.6
App stores and app developers*	462.0	7.0%	32.3
Wireless operators	7,546.1	94.5%	7,133.1
Wireline operators	598.5	98.1%	586.9
Support service suppliers	4,189	100.0%	4,189
Network equipment suppliers	764.9	25.1%	191.8
Hardware and components	1,248.0	25.0%	311.7
Device suppliers	1,573.9	7.3%	114.7
Device component suppliers	3,671	3.6%	133.7
Other CAPEX suppliers	675.4	100.0%	675.4
Total	**20,728.9**	**64.5%**	**13,368.6**

Source: Nordicity estimates based on from online survey, Ovum and Statistics Canada
* The GDP ratio for App stores and app developers adapted from Statistics Canada Software Publishers. (NAICS 5112).

For most of the subsectors listed in Table 2, we adhered to the GDP-retention shares applied in the previous CWTA study, when estimating the portion of overall direct GDP retained in Canada. In other words, we assumed that there was no change in the geographic distribution of direct GDP between 2010 and 2011. For two subsectors, however, we developed new assumptions for the geographic distribution of direct GDP or updated the assumption in the previous CWTA study.

- In the case of app stores, we developed our hypothesis of the revenue split based on the assumption that virtually all of the 30% agency fee levied on wireless apps revenue is captured by non-Canadian applications developers/portal owners as per the industry view of the revenue split for Apple. Of the remaining 70% of apps revenue, which flows to the app developers, we assumed that Canadian companies held a 10% market share. The implication of these two assumptions is that only 7%

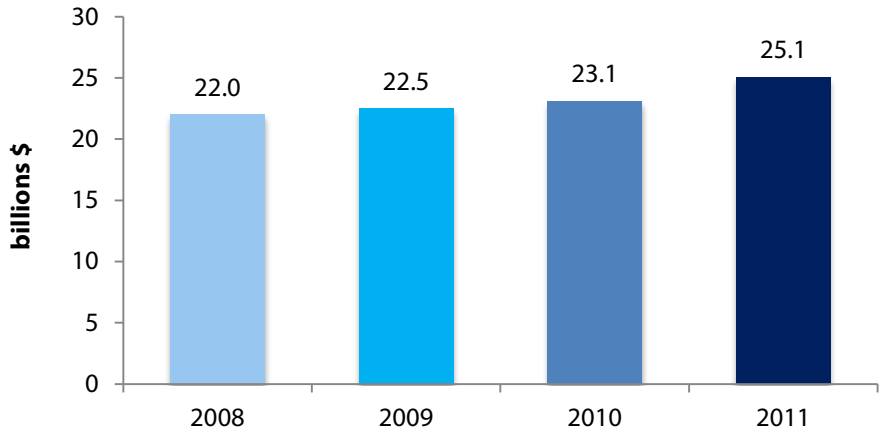
Canadian economy. In this analysis, however, we have ignored the GDP effects of foreign markets, since our focus is the contribution that the Canadian wireless *services* industry makes to the Canadian economy.

(10% × 70% = 7%) of total GDP generated in the apps store industry is likely to be retained in Canada.

- We also made adjustments to the calculation of the share of direct GDP retained in Canada in the consumer device supplier industry, in order to account for changes in the market share held by BlackBerry. Because part of the value in the design and manufacturing of the BlackBerry takes place in Canada, the higher the share of new device shipments held by BlackBerry, the higher the share of the direct GDP retained in Canada.

We also used Statistics Canada integrated telecommunications industry multiplier of 1.87 to estimate the total GDP impact, including multiplier effects, generated by the wireless industry GDP retained in Canada. In total, $25.1 billion in GDP ($13.4 billion × 1.87 = $25.1 billion) was retained in Canada in 2011 (Figure 6).

Figure 6 Wireless industry's total GDP contribution to the Canadian economy (includes multiplier effects), 2008-2011



Source: Nordicity estimates based on from online survey, Ovum and Statistics Canada

3.4 Employment

The wireless industry also supports thousands of jobs across the Canadian economy. Many of these jobs pay wages that are well above average in the Canadian economy. Our estimates of the employment impact of the Canadian wireless industry were based on a breakout of direct, support, indirect and induced employment impacts – consistent with the approach adopted in previous CWTA studies.

- **Direct employment** includes jobs at companies in Canada in the wireless industry ecosystem.
- **Support employment** refers to the number of workers employed at companies that supply business support services (e.g. professional services, information technology, customer relationship management, outsourced network management services) to companies in the wireless sector ecosystem.
- **Indirect employment** refers to the employment associated with re-spending of tax, interest payments and shareholders income generated by the wireless sector in Canada.[17]
- **Induced employment** refers to the employment generated by the re-spending of income earned by workers comprising the direct employment and support employment.

With the exception of the calculation of direct employment at wireless operators, we estimated each type of employment impact by applying the jobs-to-GDP ratios from previous CWTA studies.[18] Before applying these ratios, we made an adjustment to each ratio to account for the change in wage rates between 2010 and 2011. As wage rates increase, the number of jobs generated for each dollar of GDP typically drops.

To calculate direct employment for wireless network operators, we summed the total value of wages, salaries and benefits paid by wireless network operators to their employees and divided this amount by an average employee cost of $65,558 (the average reported by wireless network operators on the survey).

In 2011, the Canadian wireless industry generated total employment of over 280,000 full-time equivalent jobs (FTEs). This total employment impact was comprised of:

- 61,230 direct FTEs;
- 107,607 support FTEs; and,
- 111,373 indirect FTEs.

[17] Ovum. (2012). "The Benefit to the Canadian Economy from the Wireless Telecommunications Industries: An Economic Impact Assessment". p. 24.

[18] As these ratios were not specifically documented in previous editions of the report, supplemental calculations were required to derive them.

With the inclusion of induced impact employment, the wireless industry's total employment impact in 2011 was 308,230 FTEs.

Table 3 Total employment generated within the wireless ecosystem (number of FTEs)

	Direct	Support	Indirect	Total
Dealers and app stores	3,900	2,500	2,500	8,800
Wireless operators	27,300	25,300	83,200	135,800
Wireline operators	3,700	5,400	2,400	11,400
Support service suppliers	14,000	60,000	18,700	93,600
Network equipment suppliers	1,600	1,900	400	4,000
Hardware and components	2,600	3,100	700	6,500
Terminal suppliers	967	1,156	255	2,379
Terminal component suppliers	1,123	1,344	296	2,764
Other CAPEX suppliers	6,000	6,000	3,000	15,100
Total	**61,230**	**107,607**	**111,373**	**280,209**
Total with Induced Employment Factor of 1.1	**67,353**	**118,367**	**122,510**	**308,230**
Total with Induced Employment Factor of 1.7	**104,091**	**182,931**	**189,333**	**476,356**

Source: Nordicity estimates based on Ovum ratios, Statistics Canada CANSIM Table 281-0027 Catalogue number 72-002-X.

4. Demand-side Impacts

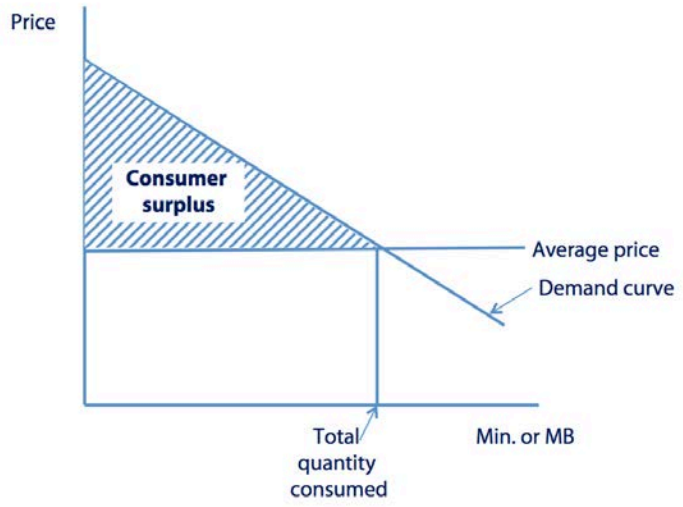
4.1 Consumer surplus

Consumer surplus is a concept used by economists to assign a monetary value to the benefits (or 'utility') gained by consumers through the use of a particular product or service. A consumer has a 'willingness to pay' for a service – that is, the own monetary value they place of that product or service. This willingness pay is greater than the market-determined price that the consumer actually pays for the product or service. The consumer surplus is therefore the difference between the consumer's willingness to pay and the actual price she pays.

Consumer surplus has steadily increased in the wireless portion of the information and communications technologies (ICT) industry sector. On one hand, carriers and other service suppliers have steadily lowered prices on a cost-per-minute and cost-per-MB (megabyte) basis due to technological advances and competitive forces while on the other hand, the perceived value to consumers has increased due to the introduction of innovative services.

In order to estimate the consumer surplus, the demand curve for the product or service must be known as well as the price. The value of consumer surplus is then represented by area between the demand curve and the average price paid for a product/service. The consumer surplus is therefore the shaded triangle in Figure 7.

Figure 7 Depiction of consumer surplus



Calculation of consumer surplus for the mobile voice

Mobile data services, including mobile applications and content, are also factored when determining the consumer surplus associated with the wireless industry. Estimating the consumer surplus associated with wireless data communications – particularly mobile broadband – is not easily done. However, we have derived an estimate based on existing empirical analysis.

The methodology in previous CWTA reports relied on a 2009 study that estimated that, in 2008, fixed broadband connectivity generated USD $32 billion of consumer surplus in the US. A more recent empirical analysis conducted by Greenstein and McDevitt (2012) for the OECD indicates that the fixed broadband connectivity generated an annual consumer surplus of USD $95 billion in 2010 in the US, and USD $6.1 billion in Canada.[19] We have used this more recent empirical work to develop an estimate of the consumer surplus associated with mobile broadband connectivity in Canada in 2011.

Statistics published by the CRTC indicate that approximately 26.6 million Canadians subscribed to fixed broadband Internet access in 2011. CRTC data also indicate that approximately 10.9 million Canadians subscribed to mobile broadband data services in 2011. In other words, the number of Canadian with a mobile broadband subscription in 2011 was 41% of the number of Canadian with access to fixed broadband (10,900,000 ÷ 26,600,000 = 41%). That relationship would suggest that the consumer surplus associated with mobile broadband could be equal to 41% of the consumer surplus associated with fixed broadband.

To determine the consumer surplus associated with mobile broadband in 2011, we multiplied Greenstein and McDevitt's estimate of fixed broadband consumer surplus of USD $6.1 billion by the ratio of mobile broadband and fixed broadband subscriber (41%). This approach yielded an estimate of $2.5 billion for the consumer surplus associated with mobile broadband in Canada in 2011 ($6.1 billion × 41% = $2.5 billion).

It is important to note that previous editions of the CWTA's report applied an 80% discount to the consumer surplus attributed to fixed broadband when deriving an estimate of the mobile broadband consumer surplus. Such an adjustment could be warranted by the view that mobile broadband usage (in terms of the volume of downloads/uploads) is typically a fraction of fixed broadband usage. However, we believe that no adjustment is necessary since the lower usage rate characterizing mobile broadband would probably be offset by the convenience offered by its inherent mobility. In other words, because smartphones now provide almost the same degree of accessibility as computers once did, there is very little need, in 2011, to apply a discount to the consumer benefits from mobile broadband access in relation to fixed broadband.

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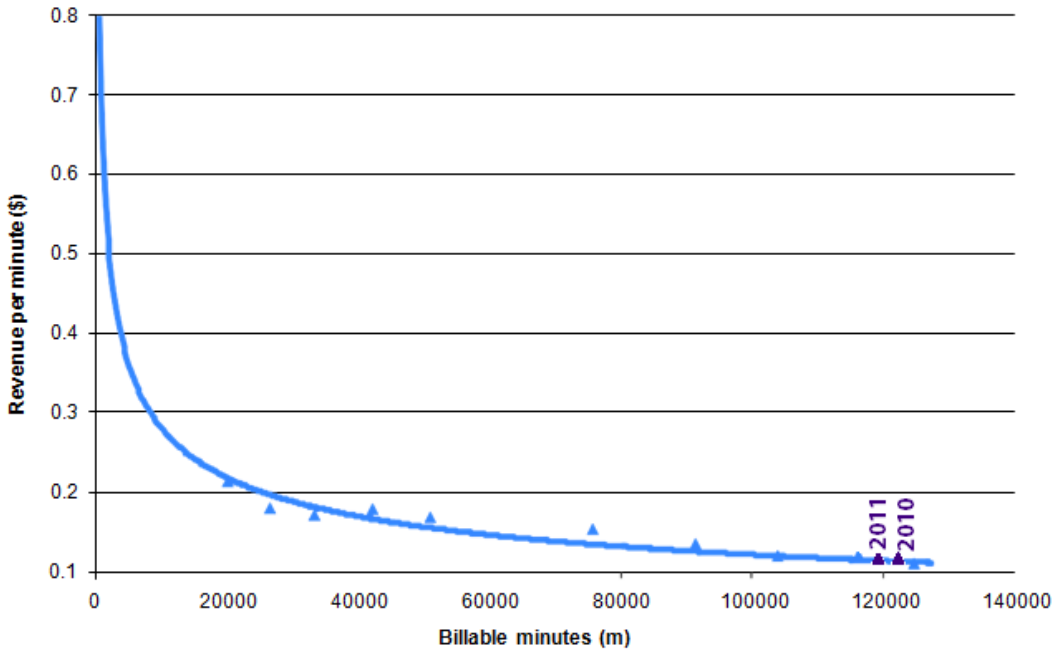
[19] Greenstein, S and R. McDevitt (2012), "Measuring the Broadband Bonus in Thirty OECD Countries", *OECD Digital Economy Papers*, No. 197, OECD Publishing.

Figure 8 Consumer surplus update in Canada (millions $)



This demand curve approach provides the CWTA with the basis for future quantification of the mobile data consumer surplus in Canada, without having to rely on the results of studies and analyses in other countries.

Calculation of consumer surplus for mobile broadband

Mobile data services, including mobile applications and content, are also important calculations when determining the consumer surplus associated with wireless telecommunications industry. Estimating the consumer surplus associated with wireless data communications – particularly mobile broadband – is based on a mix of existing empirical analysis and updated data points.

The methodology in previous CWTA report relied on a 2009 study that estimated that, in 2008, broadband connectivity generated USD $32 billion of consumer surplus. In absence of more recent data, we used this figure and adjust accordingly to calculate Canada's consumer surplus for mobile broadband. Using Canada's 2011 population (34,484,000[20]) and

[20] Statistics Canada. (2012). "Population by year, by province and territory".

2011 broadband subscriptions (32 mobile broadband subscriptions per 100 inhabitants)[21], we obtain an updated 2011 broadband penetration rate of 11.03 million mobile broadband subscribers[22].

Using this broadband penetration rate and preserving the same proportional growth in the rate that appears in previous studies, we obtain a consumer surplus figure of $4.3 billion. It is important to note that in previous editions of the report a 20% discount on the benefit attributed to fixed broadband was applied. We feel that this adjustment was not justified. Currently, smartphones provide the same degree of accessibility as computers do since this type of 'access on the go' is offsetting the benefits and therefore, we determine that no discount should be applied in relation to fixed broadband.

4.2 The Need for and economic benefits of spectrum release

Rapidly increasing demands on wireless networks is intensifying Canadian wireless service providers' need for more spectrum. As such, releasing mobile spectrum into the market generates significant benefits for wireless service providers, and the wireless industry as a whole. The increased ability to efficiently address capacity demands will also result in indirect benefits to the Canadian economy, including potential societal benefits.

Demand for additional bandwidth is driven by data-intense mobile devices and by subscribers' "always on" usage patterns. The development and rapid adoption of data rich smartphones and mobile devices with larger screens have had a major impact on traffic volumes and peaking in the wireless networks and thus the need for additional spectrum. The fastest way for carriers to avoid bottlenecks is through access to additional spectrum. In order for Canadian mobile operators to remain competitive within a very challenging marketplace, mobile operators require timely access to the appropriate spectrum in order to support technological innovation, enable introduction of new services and enhance their customer services.

Other calculations of the economic value of spectrum release have therefore focused on the direct benefit to wireless service providers in terms of efficient network deployment and upgrades. For instance, the FCC estimates that by 2014, the release of an additional 275 MHz of spectrum will save approximately $120 billion in capital expenses to accommodate increasing mobile data demand[23].

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[21] CRTC. (2012). "Communications Monitoring Report".

[22] A June 2012 study by OECD found that Canada had 36.6 mobile broadband subscribers per 100 inhabitants. In keeping with our 2011 reporting year, we use 2011 data from Statistics Canada and CRTC.

[23] FCC. (2010). "Mobile Broadband: The Benefits of Additional Spectrum". Accessed February 14, 2013 from: http://download.broadband.gov/plan/fcc-staff-technical-paper-mobile-broadband-benefits-of-additional-spectrum.pdf

However, even with reduced cost of network density alternatives, the financial benefit of 300 MHz of new spectrum in the US is likely to exceed US$100 billion. When adjusted for differences in population, a rough estimate of the potential economic benefit of the release of additional spectrum in Canada would be **CDN$33.33 million per MHz** on a national basis.

Based on past industry experiences and trends, the estimate based on the FCC methodology should be considered to be both high-level and conservative. A significant portion of the network deployment cost avoidance attributable to new spectrum would likely be captured through a spectrum auction. In addition, wireless network enhancement has historically resulted in previously unforeseen technological innovations that have resulted in significant economic and social benefits. The multi-million dollar mobile apps market provides one obvious example.

While it is difficult to conclusively separate the causal effects of additional spectrum from the other requirements and components of broadband networks, additional spectrum is a necessary ingredient for the development of wireless broadband networks. Thus, additional spectrum will generate additional revenues and jobs as categorized in direct, indirect and induced economic impacts.

A more detailed analysis of the demand for and benefits of spectrum release is available as an appendix to this report.

5. Summary of Key Findings

Over the past three decades, wireless communications has grown to become an integral part of Canadians' everyday lives. Today, more than 90% of the population (aged 15 and over) uses a mobile phone, and millions of Canadians now use smartphones and wireless tablets to shop, study and stay in close touch with family friends.[24] By the end of 2011 there were 27.4 million subscribers to mobile wireless services in Canada, including 22.1 million post-paid subscribers.[25]

Millions of Canadians now own smartphones that permit them to access applications and content. Canadian smartphone users – and all wireless subscribers in Canada – enjoy access to one of the most advanced communications infrastructures in the world. Over 99% of the population has access to 3G and HSPA+ networks. By all indications, Canadians are avid users of wireless data services, application and content. In recent years, wireless traffic and bandwidth usage have increased at double-digit rates due to video and other high bandwidth applications, always on devices, and file sharing.

Canada's wireless industry continued to make a significant contribution to the Canadian economy in 2011. This contribution came in the form of both supply-side and demand-side impact. The supply-side impacts included the GDP and employment attributable to economic activity generated by the wireless industry. The demand-side impacts were comprised of the consumer surplus generated by the competitive pricing and innovative services available to Canadians.

At the core of the Canadian wireless industry are the Canadian wireless network operators. In 2011, they earned over $19.1 billion in revenue, including $17.5 billion from payments for voice and data services, $1.4 billion from the sale of devices and components and $166 million from consumer payments for mobile content and applications. Overall, wireless network operators' revenue increased by nearly $2 billion in 2011, or 11%.

With the proliferation of smartphones and mobile tablet devices, device suppliers' economic contribution also increased. Device suppliers' revenue increased from $4.3 billion in 2010 to $5 billion in 2011 – a 15% increase. Consumer expenditures on mobile applications and content also grew significantly in 2011. These payments increased from $168 million in 2010 to $675 million in 2011.

In 2011, the Canadian wireless industry generated $20.7 billion in direct GDP. This is up from $18 billion in 2010. The increase in GDP was, in large part, due to the increased revenue associated with wholesale provision of mobile devices to wireless network operators and retail sales to consumers through dealers. After taking into account multiplier effects the total GDP impact generated by the Canadian wireless ecosystem was $38.7 billion.

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[24] Data from Statistics Canada, CANSIM, table 051-0001 indicates that the population aged 15 and over was 29,217,300 in the fourth quarter of 2012.

[25] CRTC. (2012). "Communications Monitoring Report 2012".

Not all of the GDP generated by the Canadian wireless industry stays within Canada. While the majority of the valued added generated by wireless network operators, wireline network operators and dealers occurs in Canada, for many other players in the ecosystem – particularly device suppliers and device component suppliers – the majority of valued added activities such as design and assembly actually occur outside of Canada. In 2011, an estimated $13.4 billion of direct GDP (out of total direct GDP of $20.7 billion) was retained in the Canadian economy.

In estimating the consumer surplus generated by the wireless industry, Nordicity considered the consumer benefit from both mobile voice services and mobile data services. Mobile voice generated an estimated $9 billion in consumer surplus in 2011. Mobile broadband services, for which adoption and utility is growing rapidly, generated an estimated $2.5 billion in consumer surplus. In total, therefore, the wireless industry generated $11.5 billion of consumer surplus for Canada in 2011.

When the value of the consumer surplus generated by wireless industry ($11.5 billion) is added to the total value of the supply-side impact, including multiplier effects ($38.7 billion), we conclude that the Canadian wireless industry generated a total economic benefit of $50.2 billion in 2011.

Figure 9 Summary of total economic benefit of Canadian wireless industry

Source: Nordicity estimates based on data from industry survey and Ovum

The wireless sector is part of a larger ICT industry that is subject to rapid technological and competitive forces and subject to changes in the economic cycle. Despite these challenges, the wireless sector has been able to maintain its growth and momentum.

The wireless industry is a major source of innovation in the Canadian economy, as illustrated by the use of wireless devices enabling significant productivity gains in health care, education and banking, to name a few.

Regular release of additional spectrum along with technology advances and network infrastructure investment are all necessary to meet rapidly growing broadband demand. The

benefits for carriers as a result of receiving addition spectrum also have positive impacts vertically in the industry – i.e., application developers, gear and network suppliers and well in the economy at large.

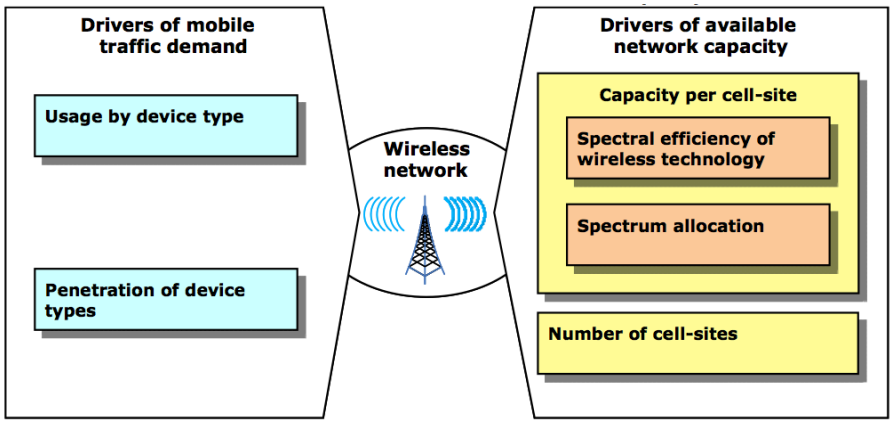
Appendix A.1 Supplementary Data and Analysis

In Section 2, we provided a profile of mobile subscribers and the operators' capital investments. In this section, we provide an analysis of the key drivers behind the rapidly increasing demands on wireless networks and corresponding need for additional capacity – including additional spectrum bandwidth. First, we consider drivers for the need of additional spectrum and the potential benefits of additional release of wireless spectrum for wireless carriers and to the wireless industry. We then consider the indirect benefits of additional spectrum to the Canadian economy, including potential societal benefits.

Drivers of mobile user demands on wireless networks

Demand for additional bandwidth is driven by data-intense mobile devices and by subscribers' "always on" usage patterns. The development and rapid adoption of data rich smartphones and mobile devices with larger screens have had a major impact on traffic volumes and peaking in the wireless networks and thus the need for additional spectrum. The figure below provides a visualization of the drivers of increasing mobile traffic demand and available network capacity.

Figure 10 Drivers of mobile traffic demand and mobile network capacity

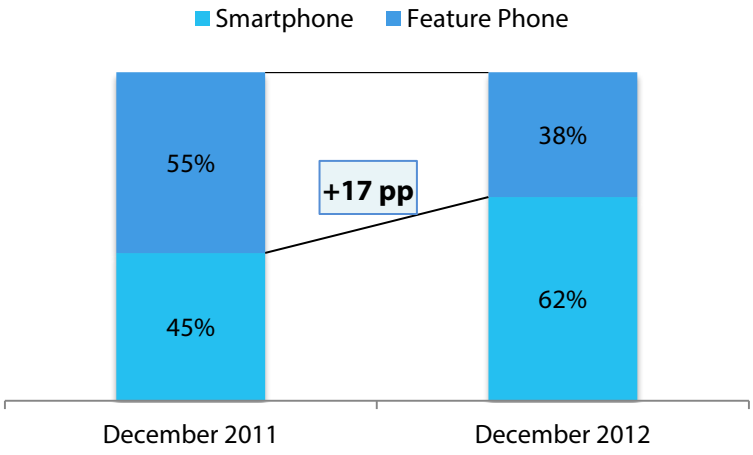


Source: FCC. (2010). "Mobile Broadband: The Benefits of Additional Spectrum". Page 7

In order for Canadian mobile operators to remain competitive within a very challenging marketplace, the mobile operators require timely access to the appropriate spectrum in order to support technological innovation, enable introduction of new services and enhance their customer services. The development and rapid adoption of data rich smartphones and mobile devices with larger screens have had a major impact on traffic volumes and peaking in the wireless networks and thus the need for additional spectrum.

In terms of smartphone penetration, between December 2011 and December 2012 smartphone ownership by mobile subscribers grew 17 percentage points, from 45% to 62%. As expected, this rise in smartphone ownership was a major contributor to a decline in 'feature phone' ownership from 55% in 2011 to 38% at the close of 2012 (see Figure 11). The move of Canadian subscribers to increasingly data-oriented smartphones plays a significant role in the increase in mobile data traffic. Cisco's latest Visual Networking Index forecasts that the average smartphone in Canada will generate 7,209 megabytes of mobile data traffic per month in 2016, a 22-fold increase from 316 megabytes per month in 2011.[26]

Figure 11 Smartphone market penetration by percent of mobile subscribers



Source: comScore. (2013). "Canada Digital Future in Focus". Page 17

Smartphones allow Canadians to engage in a variety of high-bandwidth applications that were previously not easily accessible via mobile devices. One such application is mobile video – arguably requiring the most bandwidth of all mobile applications. In December 2011, an estimated 3 million Canadian mobile subscribers watched TV or video via their mobile smartphone device.[27]

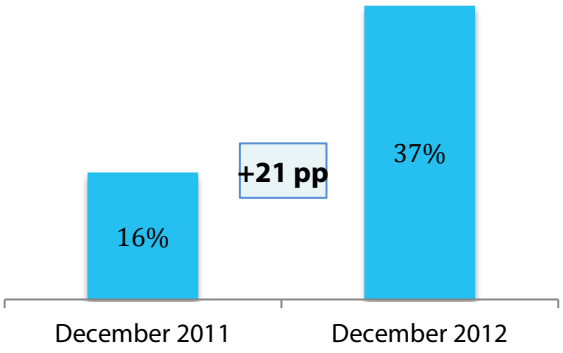
Other recent data confirms that mobile data bandwidth demands in Canada are on the rise.

[26] Cisco. (2013). "VNI Forecast Highlights". Accessed May 10, 2013 from: http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html
[27] comScore. (2013). "Canada Digital Future in Focus". Accessed May 13, 2013 from: http://www.comscore.com/Insights/Presentations_and_Whitepapers/2013/2013_Canada_Digital_Future_in_Focus

Smartphone subscriber video viewership in particular has increased 21 percentage points between December 2011(16%) and December 2012 (37%) (see Figure 12). This fact provides an indication of the general growth in mobile data consumption patterns – i.e., towards more data-intensive devices and content.

While this fact alone does not directly correlate with a need for additional mobile spectrum, it does provide an indication of the general growth in mobile data consumption patterns – i.e., towards more data-intensive devices and content.

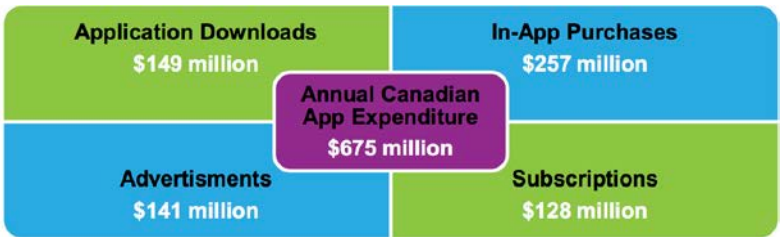
Figure 12 Percent of smartphone subscribers watching TV and/or video on mobile phones



Source: comScore. (2013). "Canada Digital Future in Focus". Page 20

Within the wireless value chain, Canadians are spending $675 million on applications – including downloads, in-app purchases, advertisements and subscriptions as shown in the figure below.

Figure 13 Canadian mobile app expenditures



Source: ICTC. (2012). "Employment, Investment and revenue in the Canadian App Economy". Page 19.[28]

[28] ICTC. (2012). ""Employment, Investment and revenue in the Canadian App Economy". Accessed April 23, 2013 from: http://www.ictc-ctic.ca/wp-content/uploads/2012/10/ICTC_AppsEconomy_Oct_2012.pdf

Canadian software firms are leading in the development of mobile applications for the Canadian and global markets and thus a keystone in strengthening Canada's economy.

International comparisons

In contrast to many contemporary media reports[29], wireless rates in Canada are actually quite competitive in comparison to other OECD countries. Despite Canada's geographic challenges, Canadian wireless providers charge rates below the international averages even though they provide services in the least densely subscribed network in the OECD. Canada's network serves 12 subscribers per km^2 – the fewest in the OECD – compared to 37 subscribers per km^2 in the United States and 312 subscribers per km^2 in the United Kingdom. Furthermore, Canada's average per-minute wireless costs are the 11th-lowest in the OECD, $0.02 below the OECD average. In fact, between 2005 and 2010, average wireless voice costs in Canada declined at a rate greater than the international average (2.65% vs. 2.46%). Considering the global differences in subscriber's average income, Canadian wireless voice costs are 10% lower than the OECD average and total wireless (voice and data) costs are 12% lower than the OECD average.[30]

Adoption rates for smartphones in different markets across the globe have also reached new heights. Out of the G8 nations, Spain (as part of the EU), the UK and Canada hold the top three positions for adoption rates (see Figure 14). The rapid growth in smartphone adoption among Canadians explains why Canada ranks third among the mobile majority in international markets in terms of smartphone penetration. Canada's high-ranking is facilitated by the quality of its infrastructure and competitive pricing of devices and bandwidth.

However, this rapid growth in smartphone adoption also means that bandwidth demand will experience fast growth. Cisco forecasts that mobile data traffic in Canada will grow 20-fold from 2011-2016, with mobile data traffic growing 4 times faster than Canadian fixed IP traffic.[31] Capital investment can only go so far to alleviate bandwidth bottlenecks in the short term. The fastest way for carriers to avoid bottlenecks is through access to additional spectrum.

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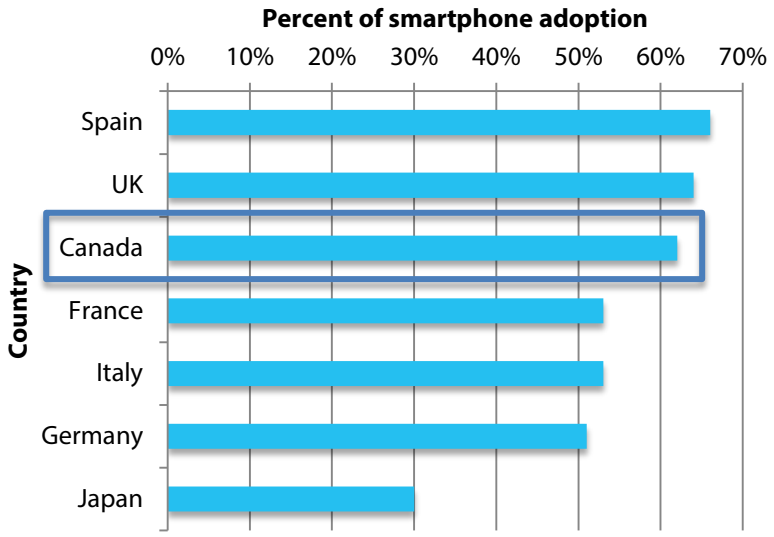
[29] See for instance: http://www.cbc.ca/news/technology/story/2009/08/11/canada-cellphone-rates-expensive-oecd.html ; and http://www.theglobeandmail.com/technology/canadas-cellphone-rates-among-highest/article4281477/

[30] Nordicity. (2011). "International Wireless Market Comparison"

[31] Cisco. (2013). "VNI Forecast Highlights". Accessed May 10, 2013 from: http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html

Figure 14 Smartphone adoption across markets

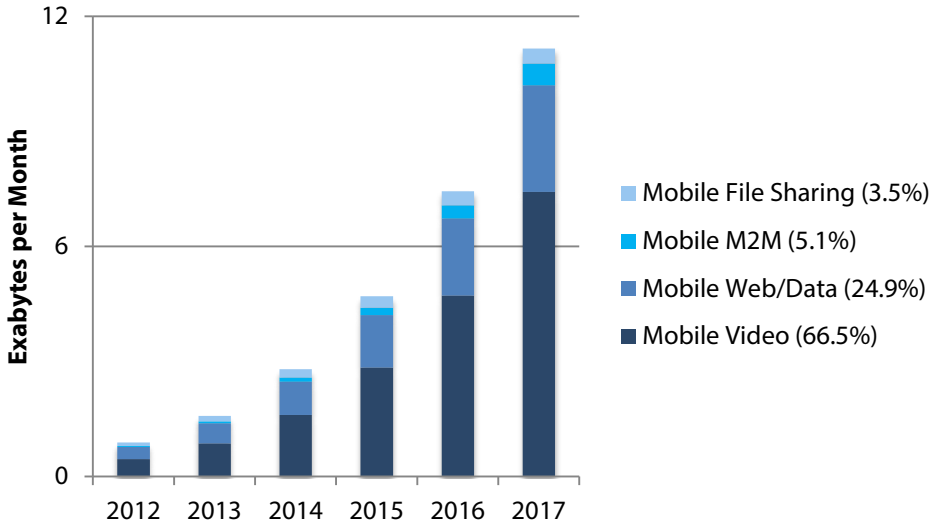


Source: comScore. (2013). "Mobile Future in Focus". Page 39.[32]

Similar to the trend observed in the Canadian case above, growth in mobile data traffic worldwide is expected to increase significantly over the next few years. Globally, Cisco reports that mobile traffic will grow at a compound annual growth rate (CAGR) of 66.5% between 2012 and 2017 and Canada in particular is expected to grow at an even faster rate. Cisco forecasts that mobile data traffic in Canada will grow 20-fold from 2011 to 2016, at a compound annual growth rate of 83%.

[32] comScore. (2013). "Mobile Future in Focus". Accessed March 14, 2013 from: http://www.comScore.com/Insights/Presentations_and_Whitepapers/2013/2013_Mobile_Future_in_Focus

Figure 15 Global mobile data traffic by application category, 2012-2017



Source: Cisco. (2013). "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017". Page 10[33]

These increases in bandwidth have been enabled by significant investment on the part of carriers in the infrastructure and underlying technology of their wireless networks (as described in Section 2.2 on one hand and by regular release of spectrum by regulators on the other.

[33] Cisco. (2013). "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017". Accessed March 14, 2013 from: http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf

Appendix A.2 The Economic Benefits of Additional Spectrum

In this section, we first consider the policy consideration behind, and potential benefits of additional release of wireless spectrum for wireless carriers and to the wireless industry and wider Canadian economy.

Wireless broadband is a vital driver and enabler in the development of the Canadian digital economy. It is the equivalent to the role railways played in making farms, forestry and manufacturing economy in the 1800s and 1990s globally competitive. That is, it is the connector of the industry that enables more development and rapid exchange in the wireless industry. Where wireless broadband connectivity is weak (like in the Northern Territories, for example), businesses and organizations that use wireless devices may experience the lag in their wireless devices negatively impact their productivity and they are at a competitive disadvantage compared to other businesses that have access to wireless broadband with decreased latency and lag in their networks.

Policy considerations

As indicated in the previous section, the regular release of spectrum is an essential condition to accommodating new demands, applications and services. As a practical example, the FCC has discussed the potential benefits of opening up currently unused portions of TV whitespaces spectrum. The potential benefits:

> *[R]epresent a valuable opportunity for more efficient use of spectrum because it can be used for unlicensed services. Unlicensed services are a powerful platform for innovation and experimental use. The result of innovation on unlicensed services has already led to a wave of new consumer technologies, including Wi-Fi and other innovations like baby monitors and cordless phones that have generated billions of dollars in economic growth.*[34]

Similarly in Canada, Industry Canada specifically cites the 'timely release of spectrum' as a policy guideline. This is to ensure that:

> *[I]t can be used and produce benefits for all Canadians. The Department will continue to forecast when, and in what situations, additional spectrum and satellite orbital positions will be released. Spectrum will not be withheld, except when specific policy issues advocate it.*[35]

[34] FCC. (2011). "Fiscal Year 2011 Annual Performance Review". Accessed March 13, 2013 from: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-312431A1.pdf

[35] Industry Canada. (2010). "Consultation on a Renewed Spectrum policy Framework for Canada and Continued Advancements in Spectrum Management: Reference Documents". Accessed March 13, 2013 from: http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08400.html

Value and performance

The FCC argues that:

> *The estimate of value created by releasing new spectrum for broadband is narrow, and limited to the avoidance of unnecessary costs but for the new spectrum…by holding cell site growth constant, we are able to compare the marginal cost of meeting mobile data demand by adding new cell sites relative to adding new spectrum. Doing so demonstrates that adding new spectrum will yield substantial economic value.* [36]

Measuring the benefits of spectrum release

An important metric in measuring the benefits of additional spectrum is to estimate the degree that spectrum increases the performance of wireless networks—in other words, a measure of its spectral efficiency. As the FCC contends: "The most important dimension of wireless network performance is spectral efficiency, typically measured in bits per second per Hertz. This metric reflects the amount of data a sector can transmit on a normalized time/bandwidth basis."[37]

As the spectral efficiency of air interface standards have evolved from 2G (GPRS) to 3G (HSDPA) to 4G (LTE) and beyond, the average spectral efficiency of wireless networks is set to increase. Over the next two to three years, we should continue to see increased migration from 3G to 4G technologies. While increases in spectral efficiency serve to mitigate the need for additional spectrum bandwidth and investment in networks by operators, all three elements are essential to generate the significant augmentation of network capacity necessary to meet mobile data demand.

Economic value of additional spectrum

As noted by the FCC, a primary substitute for utilizing new spectrum for adding broadband capacity to a network is to increase network density by adding more cell-sites. In the absence of new spectrum, carriers may need to increase the growth rate of cell-sites in order to meet rising consumer data traffic demands. Using this insight as a substitute for measuring the value of spectrum, the financial benefit[38] of new spectrum may be calculated in terms of cost avoidance.

In the FCC report, financial benefit is calculated by using indifference analysis in which the number of sites and their respective cost is plotted against the spectrum required for anticipated mobile data demand. "This indifference curve requires an approximation of the

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[36] FCC. (2010). "Mobile Broadband: The Benefits of Additional Spectrum". Accessed February 14, 2013 from: http://download.broadband.gov/plan/fcc-staff-technical-paper-mobile-broadband-benefits-of-additional-spectrum.pdf

[37] *ibid.*

[38] In the FCC report, the term used is 'economic benefit', since this is not a true economic impact calculation and is only calculated based on operator's cell-site costs, Nordicity has used the term 'financial benefit' to prevent confusion.

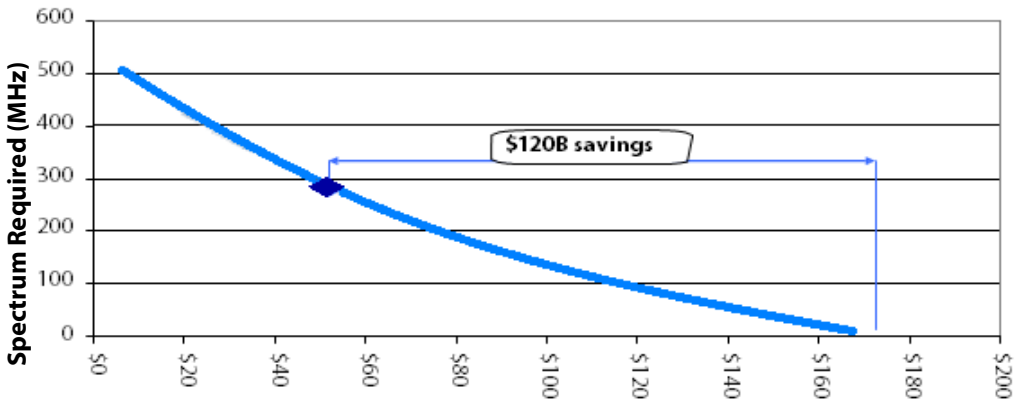
cost of a cell-site, which is the main capital substitute for spectrum in meeting mobile data demand."[39] Given that the majority of new cell-site deployment will leverage existing tower infrastructure to add capacity, it is assumed that all future cell-site growth will be related "infill" sites, rather than to broaden coverage area.

The FCC estimates the average cost of a cell-site to be US$550,000, including initial site development and operating costs. On the basis of these assumptions, the FCC estimates that by 2014, release of an additional 275 MHz of spectrum will save approximately $120 billion in capital expenses to accommodate increasing mobile data demand.

In Figure 16 below, the blue diamond indicates that in order to build and maintain current capacity, in addition to the release of 275 MHz of additional spectrum, the mobile broadband industry would still have to provide US$54 billion in capital investments. The graph also suggests that if no additional spectrum were to be released, the mobile broadband industry would have to invest US$174 billion in order to build enough cell-sites to meet demand.

[39] *ibid.*

Figure 16 Capital vs. spectrum indifference curve for 2014



Source: FCC. (2010). page 21

In the US, the National Broadband Plan currently recommends that an additional 300 MHz of spectrum newly available for broadband on a national basis be released in the near-term, a recommendation that is supported by the findings in the above indifference curve (Figure 16).[40] Additional indifference curves for different assumptions of cell-site cost levels in the US can be constructed, however they will show that even with reduced cost of network density alternatives, the financial benefit of new spectrum is likely to exceed US$100 billion. Thus, an estimate of the financial benefits of additional spectrum on a $/MHz basis can be calculated using the following formula:

> **Estimated benefit $/MHz =** (US$100 billion/300MHz = US$333.33 million per MHz on a national basis.

Considering that the Canadian wireless market is about ten times smaller than in the US

[40] In the 300MHz of additional spectrum there are various bands suggested for licensing thus this is a 'blended' valuation estimation. For example, it includes 20 MHz from the WCS band, 60 MHz from the AWS 2/3, 90 MHz from MSS, 10 MHz from the 700 MHz D Block, and120 MHz from Broadcast TV. See
FCC. (2010). "Connecting America: The National Broadband Plan". Accessed May 16, 2013 from: http://download.broadband.gov/plan/national-broadband-plan.pdf

(based on population size), a rough estimate[41] of the potential economic benefit of the release of additional spectrum would be CDN$33.33 million per MHz on a national basis. This means that operators in Canada will experience CDN $33.33 million/MHz in terms of financial benefits (cost avoidance). This figure, as FCC notes, rests on several assumptions but overestimates the true financial benefit since it does not include producer/consumer surplus or the cost of the licence of the spectrum.

We were unable to find other studies that calculate the true economic impact of spectrum, however, while it is difficult to separate the causal effects of additional spectrum from the other requirements and components of broadband networks, it is clear that additional spectrum is a necessary ingredient for the development of wireless broadband networks and is worth a substantial amount of money to operators in cost savings.[42] Thus, additional spectrum will generate additional revenues and jobs as categorized in direct, indirect and induced economic impacts.

Wireless broadband is a vital driver and enabler in the development of the Canadian digital economy. It is the equivalent to the role railways played in making farms, forestry and manufacturing economy in the 1800s and 1990s globally competitive. That is, it is the connector of the industry that enables more development and rapid exchange in the wireless industry. Where wireless broadband is weak (like in the Northern Territories, for example), businesses and organizations that use wireless devices may experience the lag in their wireless devices negatively impact their productivity and they are at a competitive disadvantage compared to other businesses that have access to wireless broadband with decreased latency and lag in their networks.

Potential social benefits

Efficiencies produced by the usage of broadband networks not only generate economic but also social benefits in the economy. The ability to conduct business over broadband networks from any location and at any time of the day allows citizens to telecommute, thus reducing non-productive time spent in traffic, and demand on highway and rapid transit infrastructure. This increase in virtual mobility allows small and medium sized enterprises to access global markets while lowering their overhead costs and increasing the efficiency and productivity of every employee.

From a societal point of view, broadband networks are essential to improving quality of life by reducing time spent in non-productive activities such as commuting and shopping,

[41] By 'rough estimate' implicitly recognizes that further calculations would be required to take into account various adjustment factors in order to obtain a better estimate. For example, the US estimation is based on a grouping of specific bands that have suggested for release, whereas the estimate for Canada is an average across all spectrum bands.

[42] As such, these costs savings can be redirected into the economy in the form of new investments, for example.

increasing family and leisure time, enabling access to global knowledge and creating affinity and allowing citizens to remain in smaller communities without forgoing the comforts, goods and services found in larger cities.

Broadband networks are critical to the delivery of modern public services - in particular, health, education, policing and justice and correspondingly, the generation of cost savings and efficiencies in the delivery of those services. For example, broadband enables clinics in remote areas to send Cat-scans to hospitals in metro areas that have specialized staff and diagnostic equipment thus providing significant improvements in diagnosis time, interaction with the patient and avoiding costly and sometimes unsafe movement of patients by ground or air travel. Similarly, broadband networks are essential to the delivery of 'anywhere, anytime' personalized access to on-line educational resources. Broadband networks allow school boards to enable students and other teachers access to specialized teaching staff via videoconferencing as well as ebooks and magazines, video material and data files stored and accessed in 'whiteboard' applications. Correspondingly, broadband networks generate significant cost savings in travel and accommodation expense, more efficient use of personnel, more personalized education and better educational outcomes.

The benefits for carriers as a result of receiving addition spectrum can also have positive impacts vertically in the industry – i.e., application developers, gear and network suppliers – as well as in the Canadian economy as a whole.

Appendix A.3 Detailed Methodology

i. Primary research

1. Survey research

At the heart of this engagement is the collection of data from the companies that comprise Canada's wireless industry. In previous years, Mobile Network Operators (MNOs), Network Equipment Vendors, and Terminal Suppliers formed the core of the sampling population. This year, Mobile App Developers have also been invited to participate in the study. In doing so, this report builds upon CWTA's previous efforts by seeking to account for the economic contribution of App Developers. The importance of Applications ('Apps') in the wireless ecosystem is still being recognized, and its inclusion in this study represents CWTA's ongoing effort to build a comprehensive map of the Canadian wireless industry.

In order to align with CWTA's earlier studies, Nordicity obtained the Excel-based survey questionnaires that were provided to CWTA members in previous years. To ensure that the data resulting from this exercise will be comparable to previous economic impact studies, we transposed the existing questionnaire into Nordicity format. After review and finalization of the question sets with the guidance of CWTA, pertinent clarifications were suggested based on responses from previous studies and comments from members. In our review of the previous questionnaires, we were able to provide additional clarity to questions in an effort to facilitate increased participation and data capture from respondents.

Nordicity has worked closely with the CWTA to minimize year-to-year changes in the questionnaire and to ensure continuity for respondents. A copy of the Excel-based questionnaire can be found in Appendix A.5.

Survey additions and refinements

This year, a new questionnaire was developed to provide an estimate of mobile application developers' revenues and costs, and in particular revenues from the supply of mobile apps into the Canadian telecommunications industry (those segments that provide fixed wireless network and mobile network services that are dependent on the use of spectrum). In this questionnaire we also ask app developers about the value-added services that they provide, for example, applications and content provided through their own on line application stores, portals or through a third-party content portals. In order to identify key companies and key contacts within this industry, Nordicity drew on senior team members with extensive experience in the wireless industry as well as outside industry experts such as Wavefront.

In previous years, MNOs were asked a set of questions regarding mobile broadband subscription plans. In these previous studies, very few respondents filled out this section of the questionnaire and so a joint decision was made to not include this question set for the

2012/2013 study. Nordicity has highlighted it as a potential action item for next year's study given the rising demand for broadband subscriptions and the attendant rise in high-end smartphones and tablets that require access to increasing amounts of data. In lieu of capturing this data directly from the MNOs, this year's study took a comparative approach to analysing mobile subscriptions by comparing data from previous years with other studies and OECD data.

While question sets for Network Equipment Vendors and Terminal Suppliers were not changed from previous years', the clarity of all four questionnaires was enhanced by re-definition of some accounting terms, standardizing units as well as updating equipment terms to reflect current device ecosystems.

Once the survey was designed and tested, Nordicity asked the CWTA to distribute the Excel-based questionnaire to its members in the operator category on behalf of Nordicity. This included the national incumbents, regional operators and new entrants from the 'class of 2008' spectrum auction licensing.

Once Nordicity and CWTA were satisfied with the response rate, Nordicity finalized the collection of survey data, and began tabulating the results to feed into the economic impact analysis.

ii. Secondary research

Secondary research for this project included sourcing of secondary data and a review of relevant industry literature, including documents provided by CWTA.

In addition to the data collected through the survey, Nordicity also collected data from a variety of secondary sources. Authoritative data on the overall size of the wireless telecommunications industry in Canada was sourced from Statistics Canada and the CRTC Communications Monitoring Report. Statistics Canada provided data on average wages, and comparative data from other industries, and the CRTC provided key industry metrics from its annual Communications Monitoring Report.

Publications available from the Organization for Economic Cooperation and Development (OECD) provided useful comparable metrics for industry background and the economic analysis. Publicly-available financial reports for the major wireless network operators in Canada were also used in our analysis.

In our research, previous 'best practice' studies demonstrating economic impacts of the wireless industry and the linkages between the wireless industry and economic growth in Canada and the global markets, such as those listed in Table 4 are also included.

Table 4 Preliminary list of industry studies

Titles
CWTA "The Benefit of the Wireless Telecommunications Industry to the Canadian Economy" Reports for 2010, 2011 and 2012 covering the period 2009, 2010 and 2011 respectively.
N. Czernich et al. (2009). "Broadband Infrastructure and Economic Growth"
Kim, Y. et al. (2010). "Building broadband: Strategies and policies for the developing world"
Kalapesi, C. et al. (2010). "The Connected Kingdom: How the Internet Is Transforming the U.K. Economy"
Dutz, M. et al. (2009). "The Substantial Consumer Benefits of Broadband Connectivity for U.S. Households"
Rosston, G. et al. (2010). "Household Demand for Broadband Internet Service"
Horrigan, J. (2010). "Broadband Adoption & Use in America"

One of the new areas of study in this report included secondary research on previous studies of applications (or "apps") in the wireless industry. Nordicity utilized this information to contextualize value chain analysis and to enhance the results from previous years. The list of studies that were reviewed is provided in Table 5.

Table 5 Preliminary of list of studies and data sources for wireless applications market

Title	Theme
Hann, I-H. et al. (2011). "The Facebook App Economy"	Social Games (Facebook)
Vision Mobile. (2012). "Developer Economics 2012"	Data on App developers
ICTC. (2012). "Employment, Investment, and Revenue in the Canadian App Economy"	App economy in Canada
Ipsos-Reid (2012). "Mobil-ology"	Study of the Mobile Market in Canada
OECD "Internet Economy Outlook"	Data on evolving Internet economy

iii. Economic impact analysis and modeling

The economic impact analysis and modelling followed the framework in the previous CWTA economic assessments and considered both supply side and demand side impacts. It consists of four sub-phases: (i) Value chain analysis, (ii) Supply side analysis, (iii) Demand side analysis, and (iv) Impact of spectrum release.

Value chain analysis

The value chain analysis comprised two phases:

1. Mapping of the functional relationships amongst the players in the wireless industry; and,
2. Quantification of the flows of revenue.

In the mapping the functional relationships, we examined current trends, potential disruptive events and likely future developments in the in the wireless industry. We also examined the changing relationships between the applications developers, the handset manufacturers, gear providers and carriers. For example, we investigate how the role of Apple has changed the applications development process for both developers and service bundling and revenue splits with carriers in the global marketplace.

The relationships between the wireless industry and other industry sectors are also examined. For example, applications development for intelligent machine instrumentation ('Internet of Things') and the potential impact on Business-to-Business applications development and impacts on carrier networks.

In our analysis, Nordicity provided a visual mapping of the firms in the Canadian and major and/or leading markets in global value chains, noting key differences in consumer and business applications – e.g. Korean uptake of 4G applications such as the digital wallet.

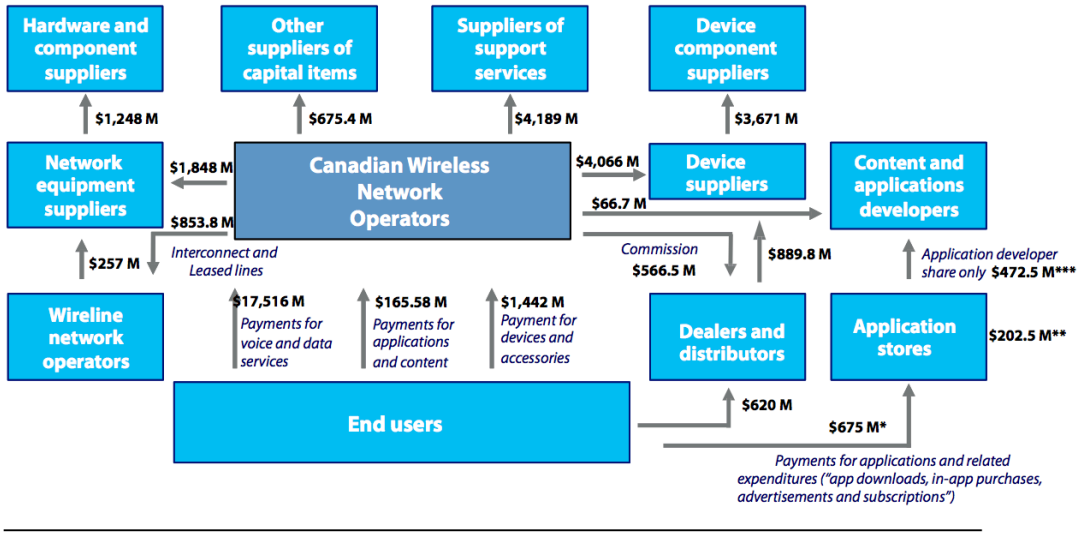
By quantifying revenue flows, Nordicity's value chain analysis provided the basis for the rest of the supply-side analysis.

Secondary and primary research in this report examined how revenues earned by wireless network operators are distributed to their own direct input suppliers (i.e. employees and capital suppliers) as well as to both upstream (e.g. terminal suppliers, wireline network operators) and downstream players (e.g. dealer commissions) in the value chain. We also quantified how end users' demand for terminal equipment stimulates incremental revenue for equipment dealers and retailers and how end users' *rapidly increasing* demand for applications generates revenue for platform providers (e.g. Apple App Store, RIM BlackBerry World), and content and application developers.

With data for each value chain player's revenue and cost structures, we were able to convert the revenue-flow data to estimates of ***unduplicated*** value added. That is to say, the key task within this value chain analysis is to remove any double-counting of end user spending across the value chain, so as to properly apportion value added across the value chain.

With additional consideration of the value added by mobile apps to the wireless ecosystem, Nordicity was able to provide a more complete picture of the wireless ecosystem.

Figure 17 The wireless value chain, including mobile apps



*Secondary Research
**App Stores receive 30% of the overall payments for applications
***App developers receive 70% of overall payments for applications – unless an app sale exceeds $25,000 USD in which case the share increases to 80% for the life of the app.

iv. Supply side analysis

The supply side impacts include more traditional measures of economic impact associated with the increase in value added (i.e. GDP), wages, employment and capital investment that results from the provision of wireless telecommunications services.

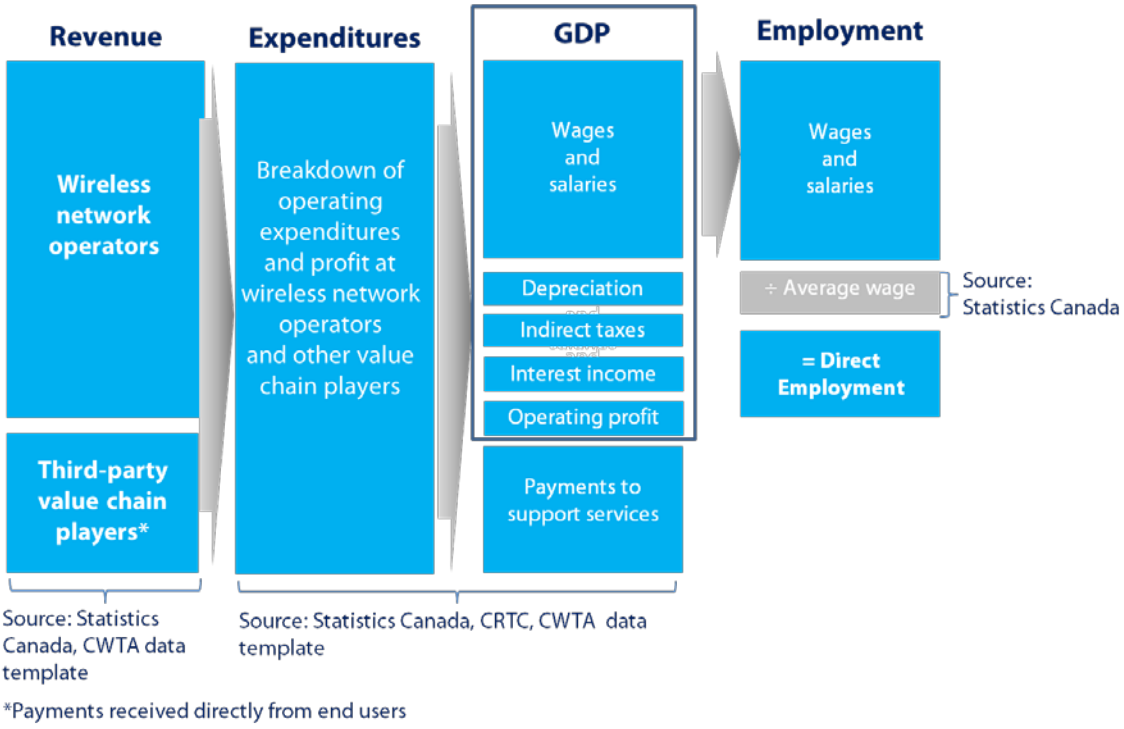
Direct impacts

In the context of this study, the direct economic impact refers to the changes in GDP, wages, employment and capital investment across the players in the Canadian wireless telecommunications value chain, including wireless network operators and their suppliers. We derived the estimates of direct GDP, wages, employment and capital investment on the basis of the collected survey data and Statistics Canada data (i.e., total revenue of network operators and average wage).

Figure 18 depicts the calculation of the direct impact. From Statistics Canada revenue data and the results of value chain analysis, we isolated the components of GDP (i.e., wages and salaries, depreciation, interest income and operating profit) for network operators and other value chain players. Combining the data on wages and salaries with information from

Statistics Canada for average wages in the wireless telecommunications industry, we estimated direct employment.

Figure 18 Overview of direct impact



Capital investment: Utilizing data from Statistics Canada, the CRTC, company financial reports and the CWTA data templates (i.e. questionnaires), we estimated the value of capital investment by wireless network operators and other value chain players in 2011.

Indirect and induced impacts (multiplier effects)

The economic activity generated by the wireless telecommunications value chain at the direct impact stage also yields indirect and induced economic impacts. In the context of this study, indirect impacts includes the increases in GDP, wages and employment associated with suppliers outside the value chain (i.e. support services); as well as the re-spending of operating surplus earned by shareholders, interest expenses earned by financial institutions and government tax revenue. The induced economic impact refers to the impact that arises when businesses and workers in the value chain (i.e. direct workers) re-spend their income throughout the Canadian economy.

In order to maintain continuity with previous years' reports, we implemented the following three methods to estimate the combined indirect and induced economic impacts:

1. GDP (valued added): We applied the output multiplier of 1.87 to direct impact GDP to derive the overall GDP impact – i.e., the impact that includes the direct, indirect and induced impacts. The output multiplier is sourced from Statistics Canada.

2. Support and Indirect employment: In accordance with previous reports, we identified the sum of wages and salaries applicable to support industries (e.g., IT outsourcing, advertising and marketing) and then divided these amounts by average wages to arrive at an estimate of employment.

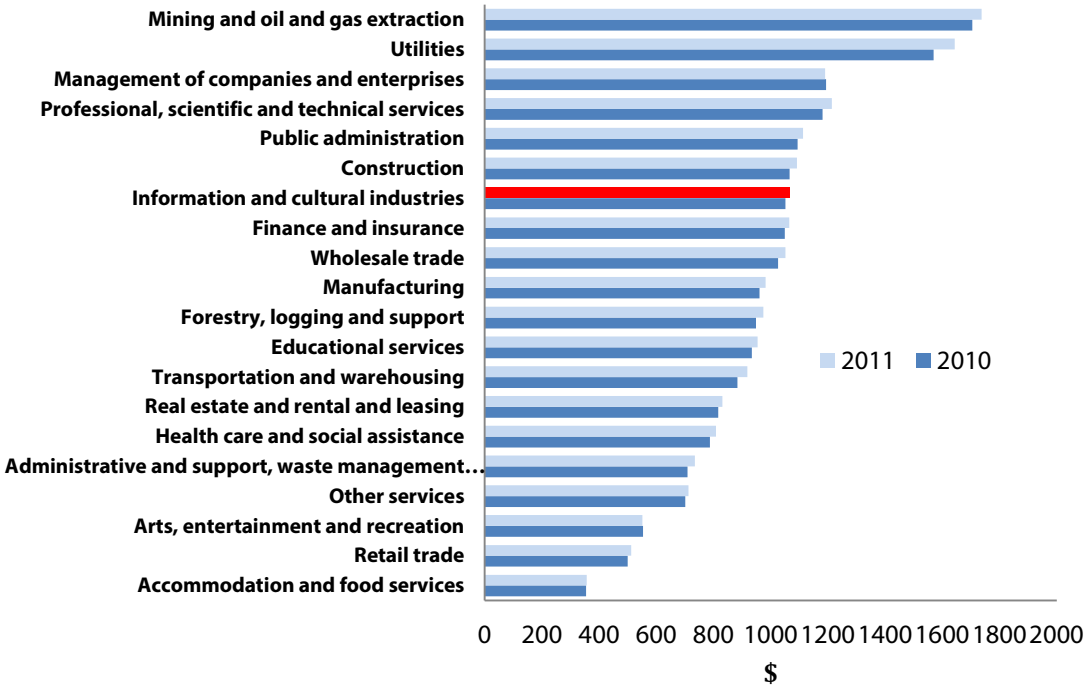
3. Induced employment: To maintain continuity with CWTA's previous reports, we estimated the magnitude of induced impact employment by applying a multiplier range of 1.1 to 1.7 to the estimates of direct, support and indirect employment.

The employment calculations were based on Ovum's methodology and replicated to find the 2011 full-time equivalent (FTE) jobs that the wireless industry contributed to the Canadian economy. Nordicity used the Ovum figures from the 2010 report to find the Canadian GDP: Jobs ratio that would be used to calculate the FTE jobs attributed to the wireless industry in each category. For example, for support service suppliers, the Ovum GDP: Jobs ratio was 3.34 jobs per million dollars. Nordicity used this 3.34 ratio and multiplied by the Canadian GDP total for support service suppliers to find how many FTEs in the Canadian economy were attributed to the expenditures in the support service suppliers' category of the wireless industry (93,572 direct, support and indirect FTEs). An adjustment factor was applied to the ratio to account for the changes in the wage rates of each category. For example, terminal component suppliers' wages fall into the Statistics Canada 'manufacturing' North American Industry Classification System (NAICS) codes. These wages saw a 2% increase between 2010 and 2011; therefore, the wage ratios were adjusted by 2% to compensate for the wage change and make the FTE totals comparable.

The calculation for the direct FTEs for wireless operators was calculated directly using data from the questionnaire. The Canadian wireless operators provided their own expenditure amounts on wages, salaries and benefits as well as providing the average wage paid to their employees ($65,558.11). Using a gross-up factor on the expenditure amounts to make the total reflective of all wireless operators, Nordicity was able to calculate that wireless operators employed 27,325 direct FTEs in the Canadian economy.

In addition to the calculations, keeping in line with Ovum's methodology, the induced FTE totals were based on the same upper and lower bound multipliers (1.1 and 1.7, respectively) provided in the previous 2010 report.

Figure 19 Average weekly earnings, by industry (2010, 2011)



Source: Statistics Canada, CANSIM, table 281-0027 and Catalogue no. 72-002-X.
Last modified: 2013-03-27.

v. Demand side analysis

Wireless telecommunications services also generate two key demand side impacts: (i) consumer surplus; and (ii) improved productivity.

Consumer surplus

Consumer surplus refers to the monetary value assigned to the benefits that consumers derive from the use of a product or service that exceeds any payment they make for the product or service. In other words, consumer surplus represents the difference between what a consumer is willing to pay and he/she actually pays.

The estimation of consumer surplus requires specification and modelling of the demand curve for a product or service. The value of consumer surplus is then represented by area between the demand curve and the average price paid for a product/service. This specification and modelling process is typically complex; that being said, we leveraged existing empirical work and modelling to estimate the demand curve and consumer surplus.

Improved productivity

Wireless telecommunications services also play an important role in improving economic productivity: that is, the capacity for the economy to produce more output for a given set of inputs/resources. Indeed, improved productivity is extremely important from a policy perspective, since economists consider it the only sustainable long-term source of improved standards of living in Canada.

CWTA's previous reports (2010-2012) addressed the issue of productivity by analysing value added per employee in the wireless sector and by demonstrating that it was higher than across the Canadian economy. Nordicity provides an update to this analysis. However, we also draw upon the analytical framework and results in the following Deloitte report: *What is the impact of mobile telephony on economic growth?* in order to better understand the data and trends. That report used data from a panel of 96 countries to estimate the relationship between mobile penetration and 3G substitution on a variety of productivity metrics, including GDP per capita growth and total factor productivity (developing countries only). By adapting the results of the Deloitte analysis to the Canadian market, we provide an estimation of the contribution that wireless telecommunications services make to growth in GDP per capita in Canada, which can also be used as an indicator of productivity.

Appendix A.4 Wireless Ecosystem

In the table below we describe the sources of information used in construction of our model and the sources of data for Figure 4 in Section 3.1 above.

Category	Financial amount reported	Source of data
Interconnect and leased lines	853.816 M	Nordicity Questionnaire: Q1.21 and Q1.22
Payments for voice and data services	19,123 M	CRTC Communication Monitoring Report 2012
Payments for apps and content	165.557 M	Nordicity Questionnaire: Q1.9
Payment for devices and accessories	1,441.724 M	Nordicity Questionnaire: Q1.1 and Q1.2
Suppliers of support services	4,188.576 M	Nordicity Questionnaire: Q1.19, Q1.24, Q1.25, Q1.26, and Q1.27
Network equipment suppliers	1, 847.898 M	Nordicity Questionnaire: Q1.11
Commission	556.495 M	Nordicity Questionnaire: Q1.15 and Q1.20
End users to app stores	675 M	ICTC. 2012
Device suppliers	4,066 M	Nordicity Questionnaire: Q1.17 and Q1.18
Hardware and component suppliers	123.8 M	Ovum Ratio
Wireline network operators	256.973 M	Ovum Ratio
Other suppliers of capital items	675.373 M	Nordicity Questionnaire: Q1.12 and Q1.13
Device component suppliers	3,670.850 M	Ovum Ratio
End user to dealers	619.549 M	Nordicity Questionnaire Average percentage of Q7.2 * (1.1+1.2)
Dealers to device suppliers	889.761 M	Ovum Ratio
MNO to content app developers	66.691 M	Ovum Ratio

Below we define each entity in the wireless value chain.

Entity	Definition
Dealers and application stores	Retail outlets which are independent of the wireless network operator. The dealers may be shops, franchises or online stores selling handsets, devices, terminals and accessories. More recently, online application stores have become established, selling applications and content (music, videos) for smartphones.
Wireless network operators	The companies which operate wireless networks and provide retail mobile voice, data and broadband communications services.
Support service suppliers (incl. n/w support)	This is a broad category. It includes two broad groups of suppliers: • professional service firms such as accountants, lawyers, advertising agencies and associated media, corporate IT services. • outsourcing companies providing network and customer support services, such as call centres, network management, operations support services. It should be noted that some of the services in this category may be provided by the network equipment supply vendors.
Wireline network operators	The companies which operate wireline networks and provide retail and wholesale services. It is the wholesale services, such as leased lines, and, if applicable, interconnect charges which are relevant to this study.
Other CAPEX suppliers	This is a broad category which includes office IT systems, vehicles and other non-network capital expenditure.

Entity	Definition
Terminal suppliers	The manufacturers and vendors of handsets, terminals, network cards/ dongles and smartphone devices.
Terminal component suppliers	The manufactures and vendors of components used in the terminals, such as displays, batteries, processors, chipsets, casings, keypads, operating systems and applications software.
Network equipment suppliers	The voice and data switching and routing systems used in the radio access network and core network, including ancillary equipment, such as frames, towers, power systems.
Network hardware and component suppliers	This is a broad category of systems and components which are supplied to the network equipment vendors. The category includes components used in the switching and routing systems, hardware platforms and base station equipment including towers, cables and power supplies.