Lagging or leading?

The state of Canada's broadband infrastructure

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Abstract

Countless statistics and rankings have been developed regarding the state of broadband networks in countries around the world. Yet, the sum total of all this work may have clouded the issues, and caused confusion among policymakers and other stakeholders.

Canada is no exception. While some paint a picture of crisis, others argue that Canada has enviable broadband infrastructure and is well-positioned for the future, despite facing unique geographic challenges.

One matter that is uncontested is that the stakes are high. Countries around the world see information and communication technologies (ICTs) like broadband as key to their economic futures. In Canada, as in other countries, these issues are important to the economic present as well. Canadian telcos, cablecos and wireless providers invest between $8B and $10B each year in advanced communications infrastructure. These investments support $54B in revenues[1] and provide jobs to more than 140 thousand Canadians.

ICT policy sets an enabling foundation for Canada's participation in a global knowledge-based economy. This report, commissioned by a group of Canada's largest internet service providers,[2] seeks to clarify the facts, dispel myths and provide the analysis needed to constructively move the issues forward and facilitate a more informed debate.

[1] CRTC, *Communications Monitoring Report 2009*, August 5, 2009.
[2] Bell Canada, Bell Aliant, Cogeco, Rogers, SaskTel, Shaw, TELUS.

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0 Executive summary

The keen interest in Canada regarding the state of its broadband infrastructure is part of a broader discussion around the world regarding information and communications technologies (ICTs), and Canada's ability to deploy, adopt, and leverage them throughout the economy.

Recognized as a key driver of economic prosperity, broadband and other information and communication technologies (ICTs) have become a focal point for political debate. Some are concerned that Canadians are not making the most of ICTs; that we are falling behind in broadband deployment and that we are going to be left behind as other countries around the world stake their claims to a piece of the digital economy. Headlines broadcast comparative statistics based on unquestioned sources; leaders run the risk of acting on the limited view provided by those few figures. The frame of the media narrative has been that Canada is not doing well; that we lag our international peers.

We are concerned that too much emphasis is placed on superficial headline numbers, without sufficient critical analysis of the meaning behind the data. It is the objective of this report to set the record straight regarding the state of Canada's broadband infrastructure relative to that in other countries. International comparative statistics have been conflicted on Canada's broadband performance. Based on our review, we have determined that this conflict arises in large part because of serious methodological errors that plague some of the research and bias the resulting rankings.[3]

When viewed through a critical and more comprehensive lens, Canada's performance is clearly stronger. Compared to our industrialized peers, Canada is consistently in the top ten or higher on numerous metrics, and performs equally well in multi-faceted indices that gauge connectivity.

Broadband services are available to virtually all Canadian households. Almost 70% of Canadian households already subscribe to broadband. Canada is particularly strong on the degree of

[3] These include focusing too narrowly on fibre-based services when measuring the availability of next generation networks, inconsistent sampling across countries, the use of unweighted averages to compare service prices and speeds, and the measuring of broadband penetration based on population rather than households.

competition among different platforms and service providers. Those living in urban areas often have a choice of at least 4 facilities-based alternatives – twisted pair, coaxial, wireless and satellite. Most other countries have far less consumer choice.

With its broad geography and dispersed population, Canada does not enjoy the benefits that other countries do in terms of population density and lower deployment costs. Yet, Canada still manages to achieve better broadband rankings than many countries that have these advantages.

Canadians also have access to among the most affordable entry-level services, ranking behind only the United States on this indicator, according to the International Telecommunications Union (ITU). This stands in contrast to the OECD's measures of price and price per Mbps which we found to suffer from methodological flaws.

When measured as a percentage of households (rather than the OECD's per 100 population metric), Canada's relative performance in terms of the adoption of broadband internet services is more accurately portrayed. Canada is surpassed by South Korea, Iceland, Netherlands and Denmark regardless of the measure of adoption. However, almost all of these countries have much higher population densities.[4]

In fact, we have found that Canada is doing very well in terms of availability, affordability and coverage. While Canadian adoption rates are top ten or better in most global rankings, we note that approximately 30% of households still choose not to adopt broadband. As will be seen in Figure 4.1.1, despite universal access to affordable wired broadband solutions in some parts of Canada, an adoption gap remains. What is constraining broadband subscription?

Broadband adoption requires the capability of carriers to supply service, as well as demand by users to subscribe to broadband internet. Canada has already reached a point where all Canadians have access to at least one facilities based supplier of broadband internet service and many Canadians can choose from suppliers using wireline, fixed and mobile wireless, and satellite-based technologies. As such, we believe there is too much attention on the supply

[4] Iceland is the one exception. Although Iceland has a population density similar to Canada overall, more than 60% of its population is concentrated in or around the capital of Reykjavik and the entire country is only about twice the size of Nova Scotia in terms of land mass.

side of the market. If we want to improve the state of broadband in Canada, more focus should be placed on the demand side of the broadband adoption equation.

As other countries announce plans to spend billions of taxpayers' dollars to improve broadband infrastructure in the name of economic stimulus programmes, there have been increasing demands for Canada to do the same. Each nation is seeking to improve the ability of its citizens to participate in a future world economy that moves intellectual property and information over advanced communications facilities.

A number of voices have called for Canada to develop a national digital strategy.[5] Part of that strategy will certainly include an examination of the infrastructure that provides the platform for Canadians to lead in a global digital economy. Canada's performance relative to its peers provides a useful backdrop to this exercise. However, there needs to be a better understanding of the available data and the methodologies used to measure our progress and position in the world. It is only once we have confirmed the facts that we can truly determine what needs to be done, if anything, to optimize Canada's position in the digital economy.

An integrated strategy will address all aspects of a next generation economy: the content and applications; infrastructure, including transport, software and equipment; and the legal, regulatory, social and commercial framework. The development of this kind of strategy requires a fulsome review of the facts and the issues.

Inspiration can be found in the research-intensive efforts of other countries: the Digital Britain Review, Digital France 2012, New Zealand's Digital Strategy 2.0, Germany's iD2010, and Australia's Digital Economy Future Directions Paper are a few examples.

0.1 Conclusion

A more studied approach to the issues provides a more accurate view of broadband in Canada. As a country, we are a broadband leader, scoring in the top ten or better for most international broadband rankings and measures, despite facing greater geographic challenges

[5] In June 2009, Industry Canada began a series of activities that helped stimulate a discussion on a national digital strategy. In the course of its determinations from its New Media proceeding, the CRTC issued an endorsement of calls for a national digital strategy. For the past year, we have called for the development of a national digital strategy that looks beyond communications infrastructure.

than most others. With regard to the few outlier statistics that suggest we are lagging, namely the OECD penetration and performance numbers, we, like others, have found significant methodological problems. The OECD broadband metrics suffer from inconsistent data sampling across countries and a bias in favour of countries with smaller household sizes. As a result, the validity of their broadband rankings is suspect.

Canadians benefit from a robust, diversified broadband infrastructure. All Canadians who want to subscribe and pay for broadband can obtain service. We have 100% availability when you consider all the technology choices available. The vast majority of Canadians benefit from a world-leading level of choice in access to broadband technologies, using twisted pair, coaxial cable, wireless (fixed and mobile) and satellite. Moreover, Canadians have access to some of the most affordable services, while also benefiting from some of the world's fastest connection speeds for both wireline and wireless broadband services. In terms of adoption, Canada continues to lead all G-8 countries in adoption of internet services, and ranks in the top ten for most international comparisons on broadband penetration. With almost 70% of Canadian households already subscribing, there remains a significant opportunity to expand broadband adoption even further.

0.2 Recommendations

- *As we go through the process of developing a national ICT strategy, recognize the true state of Canada's ICT infrastructure*

- *Continue policies focused on fostering facilities-based competition*

- *Build on the past success of private sector investment by removing current policy and regulatory uncertainty regarding investments in next-generation networks*

- *Shift more attention to adoption issues (including adoption of next-generation services) and encourage socio-economic research focused on better understanding the obstacles to, and inhibitors of, broadband adoption*

- *Consider programmes to improve digital literacy and the use of incentives (tax-based or otherwise) to target and overcome any barriers to broadband adoption*

1 Introduction

There has been a growing debate in Canada regarding the state of our broadband infrastructure. The public discourse on the issue is part of a broader discussion regarding information and communications technologies (ICTs), and Canada's ability to deploy, adopt, and leverage them throughout its economy.

Some are concerned that Canadians are not making the most of broadband and other ICTs; that we are falling behind in deployment and that we are going to be left behind as other countries around the world stake their claims to a piece of the digital economy. This concern has been heightened as other countries announce plans to spend billions of taxpayers' dollars to improve broadband infrastructure in the name of economic stimulus. Each nation is seeking to improve the ability of its citizens to participate in a future world economy that moves intellectual property and information over advanced communications facilities.

Public debate on any issue is a good thing. It is a healthy, necessary step in the development of social and economic policy for a country like Canada. But the public discourse on the issue of broadband has degraded somewhat in recent months. The media often cites comparative statistics from sources that go unquestioned and, as a result, we run the risk of acting on the limited view provided by those few figures without critically analyzing them. Consequently, the frame of the media narrative has been that Canada is not doing well; that we lag our international peers.

But before we sound the alarms and race off in search of a solution, we should confirm that a problem really does exist. We should check our sources and understand the available data and the methodologies used to measure our progress and position in the world. It is only once we have confirmed the facts that we can truly determine what needs to be done, if anything, to optimize Canada's position in the digital economy.

For the past year, we have called for the development of a national digital strategy that looks beyond communications infrastructure. An integrated strategy will address all aspects of a next generation economy: the content, including applications; infrastructure, including transport, software and equipment; and the legal, regulatory, social and commercial framework. The development of this kind of strategy requires a fulsome review of the facts

and the issues. Inspiration can be found in the research-intensive efforts of other countries: the Digital Britain Review, Digital France 2012, New Zealand's Digital Strategy 2.0, Germany's iD2010, and Australia's Digital Economy Future Directions Paper are a few examples.

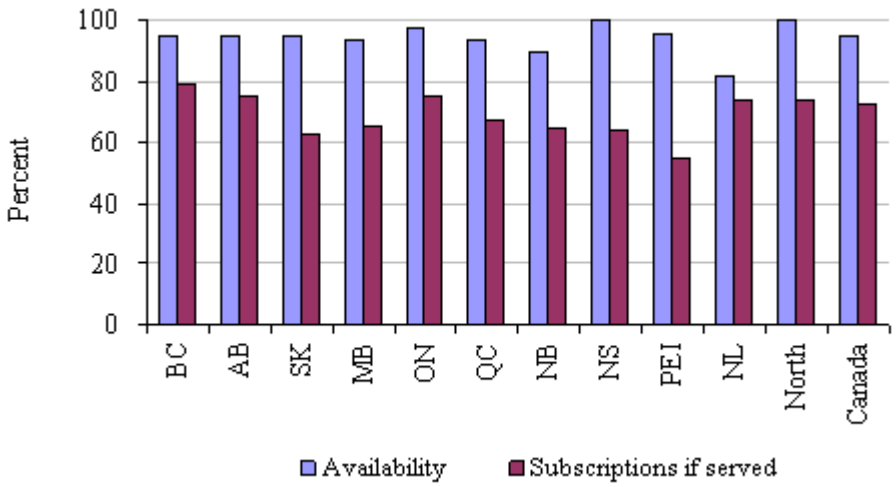
1.1 Canadian broadband investment

Despite a challenging financial environment, Canada's telecommunications industry has been planning and expending substantial sums for capital investment in infrastructure, laying a foundation for the nation's participation in the global information economy. The major carriers have plans to spend $8.5B in capital in 2009, including investment that broadens the reach of their networks and accelerates transmission speed.[6] This is in addition to the billions of private sector dollars that have already been invested since residential broadband services were first launched in the mid-1990s. New entrants in Canada's mobile sector have announced billions more in capital in 2009 and 2010, hiring thousands of new employees.[7]

In the past year, Canada's cable companies have introduced some of the world's fastest internet speeds, including commercially available 100Mbps services available in western Canadian communities.[8] Bell Aliant has announced plans to be the first communications company in Canada to build fibre optic connections to every home and business in two of its largest markets.[9]

[6] Individual company reports on fiscal guidance for 2009, supplemented by Scotia Capital, "Converging Networks," August 10, 2008 for Shaw and Videotron. Where companies provided a range for capital expenditures, the mid-point was used for the estimate.
[7] Globalive news release August 11, 2009; Globe and Mail September 5, 2008; Videotron October 22, 2008.
[8] Shaw Communications, February 17, 2009 press release.
[9] Bell Aliant, July 7, 2009 press release.

Figure 1.1.1: High-speed Availability vs. High-speed Subscriptions (2008)



Advancing broadband connectivity requires more than just internet access infrastructure. To date, the policy focus has tended to be on improving rural connectivity. There is much work to be done in increasing adoption rates. Figure 1.1.1 provides broadband service availability and service subscription data by province as the CRTC has found in its annual Communications Monitoring Report.[10] There is considerable diversity in adoption rates between the provinces, even between those served by the same telephone and cable companies.

1.2 Purpose

This report will review the available data from a variety of sources, with a particular focus on the methodological issues associated with various international comparisons. The goal is to confirm or disprove whether Canada faces a real problem in terms of its broadband infrastructure. To properly measure our relative ranking in the world, we need to understand a more complete picture of the state of broadband in Canada; one that draws upon the body of data and research available, rather than the few statistics often cited in the media. The hope is to move the discussion of broadband issues forward in a constructive manner and facilitate the broader debate surrounding ICTs and the need for a national digital strategy for Canada.

[10] CRTC 2009 Communications Monitoring Report, Figure 5.3.7.

2 Defining broadband

In 1996, Rogers first commercially launched its WAVE internet service in Newmarket Ontario, delivering "always-on" 500Kbps service. The service was adopted quickly, and was rolled out to other markets later that year, by Rogers and other cable companies. At that time, only 14% of Canadians reported having an internet connection at home.[11] By 1998, Bell Canada responded with one of the world's largest deployments of DSL, enabling capabilities in 100 of its switching centres to provide 1Mbps service to over 2 million households in Ottawa/Hull, the greater Toronto area, metropolitan Montreal, and Quebec City.

In the recent past, broadband internet service was a term used to describe any services that delivered transmission rates faster than those that could typically be achieved with dial-up services, i.e. 56Kbps. As such, some papers, including the OECD broadband studies, will refer to any "always on" connection delivering speeds from 256Kbps or above as broadband.

The CRTC distinguishes between "high speed" services and "broadband" services by having the latter refer to those delivering greater than 1.5Mbps while the former refers to services greater than 128Kbps.[12] This is consistent with Industry Canada having established a minimum of 1.5 Mbps for funding support of broadband projects. The National Broadband Task Force Report also selected 1.5 Mbps as the appropriate threshold for broadband service.[13] The FCC is also considering whether to use that measure in its deliberations regarding funding for broadband projects and recently conducted a public proceeding to define "broadband".[14]

As a technological service in its relative infancy, the definition of broadband is a moving target, as average broadband speeds today will be narrowband in the near future. For the purposes of this paper, we will generally refer to services of 1.5Mbps or faster as broadband. However, we also recognize that lower speed services are available in the market today. They are similarly capable of supporting most broadband applications and content, while still providing an economical entry level solution for consumers.

[11] Toronto Star, Smart Money: The Internet, November 7, 1997.
[12] CRTC Communications Monitoring Report 2009 at page 215.
[13] For more information, see http://en.wikipedia.org/wiki/National_Broadband_Task_Force.
[14] http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-09-1842A1.pdf.

A less conventional definition of broadband is found in a report by LECG/NSN, described in Appendix B.1.5.1, which introduces the concept of "useful connectivity" defined as: "connectivity that contributes to economic growth, especially through improvements to productivity"[15] and

> the ability of connectivity to contribute to economic growth, especially through improvements in productivity that are widely held to be the key to sustained economic prosperity. The concept of "useful connectivity" is first and foremost an attempt to recognise that the economic value generated by connectivity depends not just on conventional measures such as broadband lines or computers connected, but also on who is using those lines—businesses or consumers—and how well they are able to use the lines (captured by measures such as user skills, software assets, use of voice-over-IP and the number of intranet hosts per capita).[16]

A number of groups have observed that it is one thing to have access to extremely high download speeds, it is something else to actually make use of the capabilities. There is a chicken and egg dilemma between broadband performance and the applications that ride upon the connection. Applications that make use of very high speeds are not likely to develop if the required broadband performance is not available. To make the investments necessary for very high speeds and greater performance, network operators need to have some confidence that compelling applications are available to drive demand for the more costly, higher performance services.

In some cases, service providers are making premium connectivity available at prices that exceed the willingness of the mass market to pay. Others have observed that consumers tend not to subscribe to the fastest speeds available, even when price differences between tiers are small.[17] In Canada, despite the increasing availability of higher speed broadband services, many consumers still choose to adopt the slower broadband services. Based on the CRTC's Communications Monitoring Report 2009,[18] the proportion of residential internet subscribers that subscribe to services with at least 5 Mbps or faster remained almost unchanged between 2006 and 2008 at about 60%.

Taken together, this may be evidence that current popular applications do not require the fastest speeds available today in order for consumers to enjoy them. As in all markets,

[15] LECG/NSN Connectivity Scorecard 2009 at page 3.
[16] LECG/NSN Connectivity Scorecard 2009 at page 7.
[17] Technology Policy Institute, *Understanding International Broadband Comparisons*, Scott Wallsten, May, 2008, at page 4.
[18] CRTC Communications Monitoring Report 2009, Table 5.3.3, page 220.

consumers are choosing the service level and price that best balances wants, needs and cost. We fully expect that new, compelling, more demanding applications will emerge and become popular, thereby increasing the demand for premium connectivity. That in turn will provide greater economies and confidence for service providers, resulting in an eventual lowering of price for such performance,[19] and greater adoption. This dynamic cycle of supply (development and deployment) and demand means that our definition of what constitutes broadband will continue to evolve.

[19] It should be noted that broadband pricing often reduces in a value-adjusted manner. The consumer may be paying the same nominal price, but over time, the value provided (i.e. the Mbps or connection quality) has increased. This value adjustment is reflected in the current Canadian market dynamics where many network operators have announced speed increases with no corresponding price increase as a means of competition in the market.

3 Broadband technologies

The two most widely available forms of broadband connections in Canada are provided by the telephone companies using Digital Subscriber Line ("DSL") technology and cable companies using Data Over Cable Service Interface Specification ("DOCSIS") technology.

The telephone companies in Canada have connections into virtually every household in the country to deliver voice services. Since the late 1990s, these companies have been upgrading their networks to enable broadband internet services and there have been further upgrades to enable the delivery of TV over the same infrastructure. The cable companies have a footprint covering approximately 96% of Canadian households. Cable companies have been upgrading their networks to support voice and broadband internet, since launching high-speed internet services in 1996.

Cable has 1.4 times the number of residential subscribers as DSL.[20] To have this level of facilities-based competition is world leading, as can be seen in Figure B.1.3. According to one report, "the United States and Canada have more intermodal broadband competition than any other OECD nation."[21]

Facilities-based service providers using fixed wireless and satellite capacity have also found a niche in the Canadian market. They remain a small portion of the overall market, but are often concentrated in areas where telco and cableco services are unavailable.

3.1 DSL and FTTN

The telephone companies have wired virtually 100% of the households in their serving territories for purposes of voice services, and since the late 1990s, they have been upgrading their networks to enable broadband internet services. As a result, 84% of households can

[20] Derived from CRTC Communications Monitoring Report 2009 Table 5.3.2. Among residential broadband subscriptions, cable companies served 55%, versus telco DSL serving 39.5% and other service providers accounted for the remainder.

[21] The Information Technology and Innovation Foundation, "Explaining International Broadband Leadership," May 2008, page 33. Most other countries rely upon service providers that compete using the same single connection to the home; with that single connection being shared through a regulatory unbundling regime.

access broadband internet using DSL-based networks.[22] Telephone companies have reported DSL network coverage ranging from 74% in Atlantic Canada to 92% of Ontario and Quebec.[23]

DSL service runs over the phone company's copper wiring. It rides the very same wiring that is used for traditional voice and other services like alarm monitoring. The speed that can be offered is dependent on the wired distance from the DSL equipment, with faster speeds being available the closer you are. What really matters is the copper loop length, rather than the geographic distance from your home to the phone company's equipment. This technical issue often confuses consumers as the distance between home and the DSL equipment can be significantly less than the length of the copper wire connecting both points.

Currently, homes that are more than 4-5 kms from the DSL equipment (measured in copper loop length) will not be able to use DSL. Phone companies have also deployed additional equipment to improve the reach of their DSL services. Remote equipment is deployed deeper in neighbourhoods to reduce the length of copper being energized by the telephone company's DSL equipment, thereby enabling faster speeds to be offered to more customers. These remotes are connected to the telephone company central offices, with both the voice and data signals combined on the fibre umbilical.

More recently, some phone companies have begun deploying specialized fibre-connected remote nodes designed to carry data and video signals as an overlay to the existing copper infrastructure. This fibre to the node (FTTN) architecture retains the copper wiring for voice services while enabling fibre to be deployed to within 1000 metres of the premises. The design intent is for a node to serve approximately 500 homes and enables speeds in the order of 50-100Mbps with VDSL2 equipment.

FTTN architectures allow a more economically manageable transition to a network that delivers fibre to each premises or home (FTTP or FTTH). The reason FTTP can be economically prohibitive is because every fibre connection requires relatively expensive equipment on each end: an optical line terminal (OLT) on the service provider side of the connection and an optical network terminal/unit (ONT/ONU) on the customer side.

[22] CRTC, Communications Monitoring Report 2009, Table 5.3.4.
[23] Public financial reports of Bell Aliant (74% coverage), Bell Canada (92%), MTS Allstream (85%) and SaskTel (86.4%).

3.2 Cable – DOCSIS

The cable companies have followed a similar pattern to the telcos of upgrading their networks to support voice and broadband internet. Approximately 96% of Canadian households have access to basic cable television facilities. Among households with access to basic cable, approximately 97% have access to cable broadband internet, although this figure is virtually 100% in large urban communities.[24]

DOCSIS refers to Data Over Cable Service Interface Specification which is a standard developed by CableLabs, a non-profit research and development cooperative operated by members of the cable industry. The standard was originally released more than a decade ago and there have been two major updates that significantly improved download speeds for the end-user.

DOCSIS 2.0, released in 2001, improved upload speeds to help support voice over internet services. Most recently, DOCSIS 3.0 enhanced the service capabilities enabling download speeds of 100 Mbps to be offered commercially in Canada, equivalent to, and in some cases exceeding, the types of speeds being offered by fibre optic based suppliers in various jurisdictions.[25]

Canada's cable companies have been leaders in the deployment of DOCSIS 3.0 based services. In February 2008, Videotron rolled out commercial service offering download speeds of up to 50Mbps,[26] following a year of technology trials that demonstrated capabilities of 320Mbps.

In February 2009, Shaw launched its Nitro broadband service, delivering 100Mbps over a DOCSIS 3.0 platform.[27] Rogers launched its DOCSIS 3.0 broadband services in August 2009 with a 50 Mbps offering.[28] Cogeco also launched a 50 Mbps service offer in July 2009.[29]

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[24] Statistics Canada, "Cable, satellite and multipoint distribution systems, 2006," Cat. No. 56-100-XIE, Vol. 37, No. 2, Table 1.
[25] Verizon FiOS service advertises speeds of up to 50 Mbps [http://www22.verizon.com/Residential/FiOSInternet/Plans/Plans.htm viewed on July 13, 2009].
[26] Videotron, Cisco press release dated February 6, 2008.
[27] Shaw press release dated February 17, 2009.
[28] Rogers press release dated August 18, 2009.
[29] Cogeco Cable press release dated July 14, 2009.

Based on successful technology trials of substantially higher speed services, it appears that DOCSIS 3.0 provides cable companies with a cost effective technology platform to deliver broadband services that were generally perceived to require fibre to the home.

3.3 FTTH / FTTP

Bell Aliant has become the first company in Canada to cover entire cities with fibre to the home (FTTH) technology. Bell Aliant is investing $60 million to serve 70,000 homes and businesses in Fredericton and Saint John by mid 2010.[30] These markets were seen to have economic characteristics that enable all-fibre architectures to be deployed, such as the prevalence of aerial cable in these two markets.[31]

Aerial cable has a considerably lower cost of deployment when compared to buried cable; a recent study for the City of San Francisco found that the cost to use aerial cable to connect half of the homes in the city would be one-eighth the cost of using buried cable for the remaining half of the homes. Aerial cable would cost about $420 per home, while buried cable would cost in the order of $3270 per home[32].

Besides enabling higher speeds of internet connectivity, FTTH will support multiple high definition TV signals and voice over a common integrated connection, enabling telephone companies to compete more effectively against the higher speed offerings and bundles from cable companies.

There are a number of smaller companies that have deployed fibre to the premises in apartment buildings and residential developments. Among them, Novus operates in a number of apartments in Vancouver and there have been a few projects in Ontario and Quebec. As of year end 2008, fibre to the premises represents a negligible share of the Canadian residential broadband market.

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[30] Bell Aliant press releases dated July 7, 2009 and September 18, 2009.
[31] Most Canadian telephone companies use a higher prevalence of buried cable plant because of the risk of damage caused by ice storms and to conform to urban community aesthetics.
[32] Columbia Telecommunications Corporation, "Fiber Optics for Government and Public Broadband: A Feasibility Study", January 2007, at page 135. As cited in "Homes with Tails" (November 2008) by Derek Slater and Tim Wu, the study examined the cost to connect 200,000 homes in San Francisco with fibre, spanning 900 miles of streets. Assuming half aerial construction and half underground, the aerial portion was estimated at $41.9 million versus the buried costs estimated at $327 million.

3.4 Wireless broadband

Wireless broadband can refer to three types of technologies: fixed, nomadic and mobile. All three use radio waves instead of a wired connection. Like telephone companies' wired networks, wireless began as a strictly analog service. With the general move from analog to digital services in the late 1990s, wireless networks transformed from being a vehicle for voice into networks designed to carry data, only a few years later than the transformation that occurred over telco wired voice networks.

While DSL and cable broadband were growing in popularity in the late 1990s and early 2000s, wireless networks remained relatively capacity constrained such that the cost of wireless data service remained out of reach for the mass consumer market. With the advent of a number of new wireless technologies, improved handset capabilities, and a growing market appetite for wireless services, the economies of wireless data have significantly improved.

Wireless broadband services are no longer just a complementary service priced within the reach of business elites alone. Canadian consumers are increasingly using wireless technologies for a growing share of their data needs. In 2004, wireless represented about 1% of the total high speed internet access market of 7.4M subscribers. By year end 2008, wireless had increased to a 3% share of a market that had grown to 9.8M subscribers.[33]

The same trend towards using mobile broadband connections is playing out around the world, and is more firmly established in Asia.

3.4.1 Fixed wireless

Fixed wireless broadband involves an antenna mounted at the customer's premises to optimize the signal strength received from a base station. The wireless technology is called "line of sight" because the antenna at the customer location is aligned to directionally "see" the antenna belonging to the service provider. Various wireless technologies fall into this category and these technologies may use licensed or unlicensed spectrum. Fixed wireless broadband is deployed in Canada by a number of service providers delivering up to 100 Mbps services and it can be delivered symmetrically, enabling business grade broadband. The service is typically engineered by most service providers to be as reliable and secure as

[33] CRTC Communications Monitoring Report 2009, Table 5.3.2 and Figure 5.3.3.

wireline services. With the extremely high speeds that are possible, fixed wireless broadband is not only a substitute for DSL and cable modem services in lower density markets, the technology is also a substitute for fibre-based services in certain sub-urban areas.[34]

WiMAX and WiFi are commonly deployed wireless broadband technologies that differ in their technical execution. WiFi has been widely developed for nomadic connectivity to computing devices, such as laptop computers and in home and office LANs, but it is now increasingly used for more services, including Internet and VoIP phone access, gaming, and basic connectivity of consumer electronics including digital cameras. In a wide area network deployment, WiFi has been used for some city wide networks, including a city-wide municipal deployment in Fredericton and in Toronto's urban core, by Toronto Hydro Telecom (now Cogeco Data Services). WiFi uses unlicensed spectrum and therefore needs to interoperate with other unlicensed spectrum users of the same frequencies, such as cordless phones or other WiFi networks.

On the other hand, WiMAX was developed as a standards-based technology enabling the delivery of wireless broadband access as an alternative to cable and DSL. WiMax generally offers higher bandwidth and longer reach than a WiFi network, theoretically reaching 70Mbps and up to 50 kms from a base station transceiver. However, speeds degrade as distances are extended. WiMax is usually deployed using licensed spectrum, avoiding interference from other applications and other service providers.

Fixed wireless technologies provide an economic means of delivering broadband internet services in those areas that have greater than 4-8 homes per square kilometre. It continues to be more cost effective than cable or DSL for household densities of about 25 per square kilometre. [35]

3.4.2 Nomadic and mobile wireless

Nomadic wireless refers to a type of wireless access service that does not require line of sight connections to the service provider. There are a number of advantages to such systems in that the customer is able to self install the service, simply by plugging in their antenna/modem. The service frequently is configured in a manner that enables portability:

[34] http://www.terago.ca/fixed-wireless-technology.html.
[35] Barrett Xplore, speaking at The 2009 Canadian Telecom Summit, June 15, 2009, Toronto.

the customer can use the device anywhere in the service provider's network. Although first generation antenna/modems required a powered connection, there are new technologies that will enable some of this class of services to use a USB device for easy portable computer connectivity.

In Canada, 91% of households are within the footprint of a 3G mobile wireless network.[36] This is expected to increase in the coming years as existing service providers upgrade their networks and new wireless entrants deploy competing 3G networks.

Mobile wireless broadband refers to the type of broadband services and speeds that are now possible over the networks of the major wireless carriers in Canada. Broadband internet service can be delivered to most mobile handsets, smart phones and computers. Many smart phones use conventional operating systems, thereby enabling use of standard internet applications, such as browsers, email clients and gaming software. A number of the phones can be used as modems to be connected to personal computers and most of the mobile service providers offer USB mobile modems or built-in modems for computers and network equipment. With speeds of up to 7.2 Mbps having been widely deployed (in the same order as many DSL and cable modem plans) and aggressive pricing plans, mobile internet has become a viable option for some users. Rogers has recently become the first wireless operator in North America to deploy HSPA+ technology, enabling it to offer download speeds of up to 21Mbps to its users.[37]

Wireless broadband connections usually come with more restrictive usage caps than wired connections. Such caps usually range from 500MB to 6GB per month for the wireless data plans, while caps on average wired connections usually range from 25 to 150 GB per month. These limits are reflective of the overall higher costs still associated with wireless data relative to wireline. That differential has decreased significantly in recent months, and the trend will likely continue. As wireless usage caps grow, the services are increasingly becoming a substitute for wireline broadband connections. Such substitution is most compelling for consumers who value the mobile nature of the service and use less than 5GB of data per month. The rate of substitution is difficult to predict at this early stage, given the rate of change in relative performance and pricing. However, it is useful to keep in mind that about

[36] CRTC, Communications Monitoring Report 2009, Table 5.3.4.
[37] Rogers Wireless press release dated July 28, 2009.

8% of Canadian households already rely entirely on wireless services for their voice communications.[38] Having already shed their wired voice services, these users are more likely to adopt a wireless only service for broadband as well.

3.5 Satellite broadband

More than one million customers in North America are using satellite-based broadband internet connectivity. Because of its relative technological advantages and disadvantages, satellite broadband makes particular economic sense where terrestrial based services cannot be delivered.[39] Significant advantages of satellite are that it has the same cost per user regardless of where the customer is located, and every home in Canada is located with access to a satellite connection. While wired technologies make economic sense in urban and suburban areas and wireless technologies are more economic in many rural environments, satellite technology appears to be the most economic means to address the needs of households and businesses located in certain remote areas with extremely low population densities, such as those areas with single digit households per square kilometre.

In Canada, more than 1 million households are located in areas with a population density of less than 6 homes per square kilometre.[40]

The cost of satellite broadband has reduced significantly with each generation of the technology. Prior to 2005, Ku-band satellite technology had a retail subscriber price of about $100 per month with a $1000 start-up cost in order to deliver 128Kbps service. Telesat was the first company in the world to offer commercial Ka-band based internet, using the Anik F2 satellite, which was launched in July 2004.[41] Ka-band satellite services are currently priced at approximately $50 per month with a $400-500 start up cost for 500Kbps while 1Mbps services are about $80 per month.[42]

A major advantage of Ka-band over other forms of satellite internet is the smaller size of the customer dish: 67cm x 75cm, leading to lower cost installations. Ka-band uses spot beams

[38] Statistics Canada, Residential Telephone Service Survey, results reported in the Daily, June 15, 2009. The concentration of wireless only households is higher in large urban centres.
[39] Barrett Xplore, speaking at The 2009 Canadian Telecom Summit, June 15, 2009, Toronto.
[40] Barrett Xplore, speaking at The 2009 Canadian Telecom Summit, June 15, 2009, Toronto.
[41] Telesat press release, July 17, 2004.
[42] http://www.xplornet.com, viewed on September 8, 2009.

which allow improved use of available bandwidth compared to traditional Ku or C-Band satellite, meaning more users can enjoy a high level of performance. Ka-band has a signal only 15mm wide, compared to double that for Ku-band and 75mm for C-band.

Ka-band satellite is able to deliver service of up to 2Mbps to customers and typically, it is sold in packages delivering download speeds of .5Mbps. There is currently capacity for about 200,000 customers in Canadian coverage, available everywhere in Canada, including remote Northern locations. Software solutions have been introduced to accommodate issues associated with latency for most applications.[43] The supply of Ka-band satellite services exceeds current demand, such that any household in Canada unserved by wired providers could obtain satellite broadband.

In the next two to three years, there will be two new satellites launched that will deliver next generation broadband service, with the capacity to serve more than 500,000 households.[44] Download speeds of 10 Mbps are contemplated for residential users and next generation satellite will be able to deliver symmetric 25 Mbps service for business grade internet access.[45] Most importantly, the pricing for the next generation satellite services are expected to be comparable to terrestrial based DSL and cable services, enabling satellite to be a more affordable choice to deliver broadband access to all Canadians that cannot be reached with terrestrial based solutions.

[43] With adaptive software introduced by the satellite service providers, the user experience for VoIP over satellite broadband is not substantially different from voice over some mobile wireless networks.
[44] Ericsson Communications, speaking at The 2009 Canadian Telecom Summit, June 15, 2009, Toronto.
[45] Barrett Xplore, speaking at The 2009 Canadian Telecom Summit, June 15, 2009, Toronto.

4 Canada in the world

When you look at Canada's broadband infrastructure on its own and in an international context, the available research suggests that we are doing very well.

As described in more detail below, broadband service is available to every household in Canada that is willing to subscribe. While the price of service will vary by technology and by service provider, generally speaking, we have some of the lowest entry prices for broadband service in the world.[46] And, our infrastructure is being continually upgraded as service providers make the competitive investments necessary to roll out next generation technologies.

Lies, Damned Lies and Statistics

While not the original author of the phrase, Mark Twain popularized the statement: "There are three kinds of lies: lies, damned lies, and statistics." It was a reference to the persuasiveness of citing numbers, the practice of using statistics to support weak arguments, and the tendency to disregard statistics that do not support one's own position.

The use of statistics in international broadband comparisons is a case in point. Media reports are fond of citing a few statistics from a single source to enhance the drama of the story and its headline. The short news format of internet, TV or print media does not lend itself to a broader discussion of any issue. When citing broadband statistics, the research methodology used is rarely analyzed, and conflicting research is almost never referenced. To do so, would take away from the drama of the headline. Unfortunately, the power of the media is such that the headline sometimes becomes the quoted fact.

We all need to be cautious when conclusions are based on a few metrics from a single source; no matter how expert the source may seem. While this paper relies heavily on statistics, we try to avoid the "lies" and pitfalls of such reliance, by looking for commonality and inconsistency in numbers from a variety of sources. We believe that understanding the data and methodologies used will clarify the picture that develops from reviewing the broader research.

Our broadband performance is even more remarkable when you consider our challenging geography, the fact that significant government subsidy has not been required, and that Canada has a relatively low index of urbanicity. [47]

How do we reach such a positive conclusion regarding the state of broadband in Canada when the OECD ranks us so low in terms of speed, price and penetration? Quite simply, the OECD rankings are unreliable. In the sections below, we will show that the methodology and input data used to derive OECD statistics are flawed and should not be relied upon to gauge relative performance.

[46] ITU, "Measuring the Information Society, The ICT Development Index," March 16, 2009, Table 6.6.
[47] "Urbanicity" is defined as the percentage of the population in urban areas times the population density in urban areas.

4.1 Current statistics in Canada

4.1.1 Availability and coverage

All Canadians now have access to broadband services. Any household willing to subscribe for service can obtain service. We have universal coverage. This, of course, requires a willingness to consider all of the broadband technologies currently available to Canadians, not just wired solutions. And, it assumes that the price of services will be higher for the more rural and remote areas of the country, where the costs to provide services are also higher.

While much is written about closing the coverage gap, in fact, what people really mean is that wireline services do not reach everyone. In Canada, at least 94% of households can access a wired broadband connection; wireless and satellite service extend this capability to universal coverage.[48]

Broadband for all

As indicated in the CRTC's 2009 Communications Monitoring Report, 94% of Canadian households have access to wireline broadband internet.

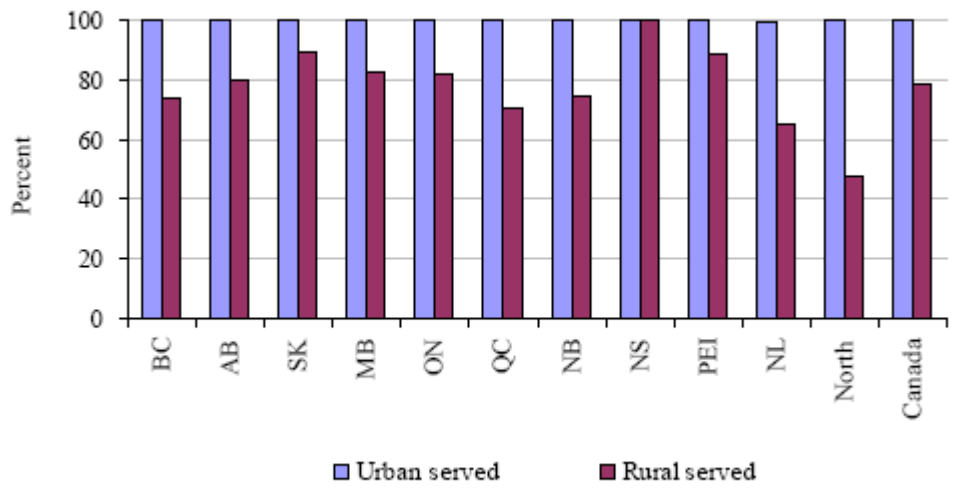
The report goes on to say that "Satellite facilities extend this reach to virtually all households and are only limited by capacity constraints." In fact, capacity constrains all technologies, not just satellite service. Telephone companies and cable companies would need to invest additional capital in order to handle 100% penetration in their service territories.

As indicated in Section 3.5, there are new satellites planned for launch that should provide sufficient capacity for anticipated demand in those parts of the country that cannot be economically served used terrestrial based broadband solutions.

The population density, terrain and economic circumstances in many of the smaller and more remote unserved areas present particular challenges to increasing wireline coverage. The CRTC reports that 22% of rural households did not have access to a wireline broadband connection in 2008.[49] Fewer than 20% of Canadians reside in rural areas.[50] Taken together, we conclude that approximately 30 million Canadians residing in 12 million households could access a wireline broadband connection.[51]

[48] CRTC Communications Monitoring Report 2009, page 213. This figure includes all high-speed Internet serving areas, including those where the service downstream speeds are below 1.5 Mbps.
[49] CRTC Communications Monitoring Report 2009, page 213.
[50] Statistics Canada 2006 Census. Statistics Canada defines urban areas to include Census Metropolitan Areas (CMAs) and Census Agglomerations (CAs) with a population density of at least 400 people per kilometre squared.
[51] Statistics Canada 2006 Census figures on total households, population and average household size by province projected to 2008 based on Statistics Canada estimates of 2007 population by province.

Figure 4.1.1: Broadband Availability – Urban and Rural areas (% households, 2008)



Source: Industry Canada and CRTC data collection

There is considerable variation among the provinces in terms of the percentage of the population in rural areas and the availability of wireline broadband, as shown in Figure 4.1.1.[52] Rural wireline broadband availability was the lowest in the Northern territories, followed by Newfoundland and Labrador.

Our conclusion regarding universal coverage is not meant to suggest that all Canada's work is done in building out. Broadband networks are in a constant state of flux as technologies improve, costs reduce, and other better performing technologies are deployed. Given the impending availability of next generation satellite services, we think rural and remote households in Canada can and should expect their services to similarly improve, cost reduce and eventually be replaced by a better technology. Building out networks and overlaying new technologies is a constant part of providing service in any area of the country. Wireless networks in particular are a good example of how just when a network build seems done, a new technology emerges and the process begins again.

[52] CRTC, Communications Monitoring Report, 2009, Figure 5.3.6, page 225.

4.1.2 Adoption and penetration

Canada's greatest challenge has moved beyond availability and coverage to a need to focus on improving service adoption rates. In 2007, more than 20% of Canadians indicated that they were non-users of the internet.[53]

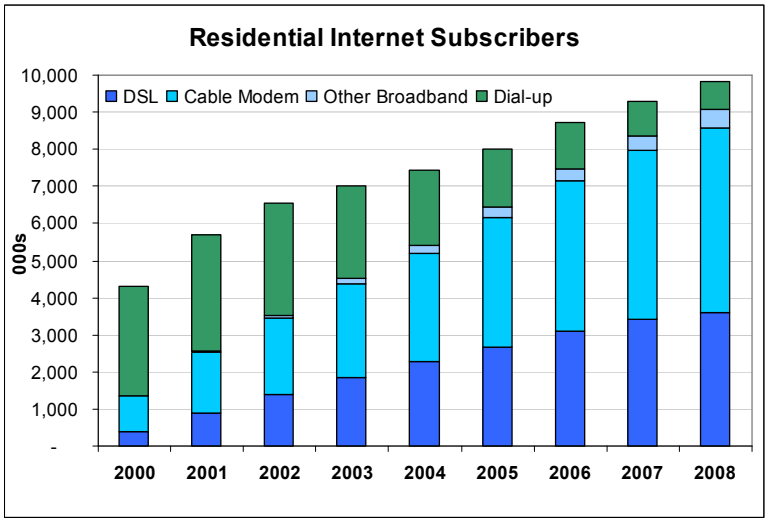
Why people aren't connected

A detailed survey of Canadians in 2007 reported that, among the 22% who reported not using the internet, lack of interest was the most common reason - cited by almost one-third of non-users. The survey found that non-users were disproportionately living in Quebec or Atlantic Canada, in small communities, were elderly or retired and had the lowest income and education levels.

CIP, "Canada Online!, Year Two Report, 2007,"

Three out of four households in Canada subscribe to internet services. The number of residential internet subscribers reached almost 9.8 million by 2008, of which more than 9.1 million had broadband connections. High-speed connections are present in nearly 70% of Canadian households, up significantly from 60% in 2006.[54] Residential subscriptions per 100 persons, another commonly cited measure of penetration, stood at 28 per 100 in 2008. Including business subscriptions, this indicator (used frequently by the OECD) edges up to 29 per 100.[55] Subscription levels for all forms of internet connections among residential users are shown in Figure 4.1.2.[56]

Figure 4.1.2: Residential Internet Subscribers



[53] Canadian Internet Project (CIP), "Canada Online! Year Two Report, 2007" September 2008, page 73.
[54] CRTC, Communications Monitoring Report, 2009, page 213.
[55] Based on CRTC Communications Monitoring Report, 2009 for residential subscriptions and an estimate of 500,000 business connections.
[56] CRTC, "Telecommunications Monitoring Report" published in 2005, and "Communications Monitoring Report 2009".

As Figure 4.1.2 indicates, a major shift has occurred in the type of connection as dial-up is both supplemented and replaced by broadband. In 2000, less than one-third of all internet subscriptions were broadband. As of 2008, high-speed connections accounted for 93% of all residential connections.

Broadband penetration is expected to continue to increase since the rate of growth in subscriptions is much higher than total household and population growth rates.

Adoption of internet services in general, and broadband internet in particular, has generally been higher in urban areas than in rural areas. A Statistics Canada survey in 2007 found that while 90% of internet users in urban areas were using broadband, only 70% of those in rural areas were doing so.[57] Among rural internet users without broadband connections, half reported that broadband via DSL or cable modem was not available in their area.[58] This equates to about 15% unserved households in rural areas, moderately better than was recently reported by the CRTC.[59]

4.2 International comparisons

As a country, Canada has done well in increasing the overall availability and adoption of broadband internet during the past decade. At the same time, many other developed countries have experienced similar improvements. International comparisons provide a gauge of Canada's performance relative to other countries, giving context to the progress made.

The challenge is to arrive at an appropriate basis for making the comparison – not only in terms of applying the relevant metrics but also what, if any, adjustments should be made to account for socio-economic, geographic or other differences. The results of different rankings and comparisons can vary significantly because of differences in definitions, the data sources, how the measures are weighted, the countries included and so forth. In undertaking any international comparison, one must be cautious not to fix on any one measure regardless of whether it provides good or bad news. Much more can be learned by considering a range of indicators and most importantly, understanding and taking into account the underlying factors that influence the results.

[57] Statistics Canada, "Canadian Internet Use Survey," Daily, June 12, 2008.
[58] Ibid.
[59] CRTC Communications Monitoring Report 2009, Figure 5.3.6.

4.2.1 Types of indicators

There are two indicators frequently used in international comparisons: rates of adoption of broadband internet services; and, indices of availability of infrastructure capable of delivering these services. Other indicators that are often correlated with these include price and speed of the services. A more complete discussion of these indicators can be found in Appendix B.1.1. Another approach to comparing broadband performance can be found in broader indicators of digital or electronic ("e") readiness that combine several measures to form an index. These are discussed further in Appendix B.1.5.

Not surprisingly, the different reports and approaches produce different rankings. A recent speech by Commissioner Robert M. McDowell of the Federal Communications Commission noted that various measures of connectivity ranked the U.S. anywhere between first and 17th.[60] The results for the U.S. are not unique - similar variations are found for Canada and most other countries.

4.2.2 Adoption of broadband internet

The OECD is a frequently cited source of statistics on broadband performance and has provided a range of indicators for 30 countries since 2000.[61] Among the many indicators reported over the years, broadband subscribers per 100 population is commonly used as a means of ranking countries, shown in Table 4.2.1.

According to this indicator, Canada has the 10th highest penetration level at 29 subscriptions per 100 people. Canada has previously ranked as high as 2nd place but in 2004 it was surpassed in penetration rates per capita by Denmark, Netherlands, Iceland and Switzerland. 2005 and 2006 saw Norway, Finland and Sweden advance.

However, measuring penetration based on "a per 100 population" basis is flawed when you consider that residential broadband subscriptions using fixed connections typically provide connectivity for a household rather than an individual. This per household effect has become even more prevalent as internet routers and wireless technologies like WiFi have become

[60] Robert M. McDowell, introductory remarks at the Phoenix Center Workshop, "Understanding Broadband Metrics, the Broadband Adoption Index," July 15, 2009.
[61] OECD Broadband Portal: http://www.oecd.org/sti/ict/broadband.

commonplace. In essence, multiple broadband subscriptions would be redundant in the vast majority of households.

Table 4.2.1: Broadband Penetration

	OECD Country	Broadband Subscriptions per 100 persons
1	Denmark	37.2
2	Netherlands	35.8
3	Norway	34.5
4	Switzerland	33.5
5	Iceland	32.8
6	Korea	32.0
7	Sweden	32.0
8	Finland	30.7
9	Luxembourg	30.0
10	**Canada**	**29.0**
11	United Kingdom	28.5
12	Belgium	28.1
13	France	28.0
14	Germany	27.4
15	United States	26.7
16	Australia	25.4
17	Japan	23.6
	OECD AVERAGE	***22.6***
18	New Zealand	21.9
19	Austria	21.6
20	Spain	20.8
21	Ireland	20.6
22	Italy	19.2
23	Czech Republic	17.2
24	Hungary	16.8
25	Portugal	16.0
26	Greece	13.5
27	Slovak Republic	11.5
28	Poland	10.5
29	Turkey	7.8
30	Mexico	7.2

Accordingly, if the objective is to understand consumer adoption of broadband services, the OECD's measure of broadband penetration per 100 population is inferior to measuring

broadband subscriptions per household.[62] The OECD measure has a design bias that favours countries with smaller household sizes. Slight differences in household size can change a country's ranking dramatically. The average household size in Canada is 2.5 compared to Denmark's 2. For Denmark to achieve 42 connections per 100 population, only 90% of its households need to adopt broadband, whereas Canada (with its larger average household size) would need to reach 105% household adoption.[63] In essence, given the difference in average household sizes, it is virtually impossible for Canada to beat a country like Denmark on this kind of flawed measure.

This measurement challenge raises another issue of how to count broadband access that occurs through means other than household-based subscriptions. Some individuals may find that accessing the internet through work or school is a sufficient substitute for a subscription at home. For example, the CIP Canada Online! 2007 survey of Canadians found that about 5% of internet users did not have any connection at home.[64]

In addition to this bias in favour of smaller household sizes, the OECD metrics contain a number of inconsistencies in respect of subscription counts (business versus residential) and technologies that are covered (e.g. subscribers to WiFi are excluded). A more complete discussion of these issues can be found in Appendix B.1.2.

There have been some recent studies of international rankings based on broadband penetration rates per household, a more meaningful measure since most users share broadband connections within a household. The OECD reported broadband penetration per household for 2007, with information from European countries based on surveys conducted by the EU Commission and other countries' results based on government sources.[65] A recent article by Scott Wallsten compared broadband penetration rates per household for several

[62] See for example: Scott Wallsten, "Understanding International Broadband Comparisons," Technology Policy Institute, June 2009; The Information Technology and Innovation Foundation, "Explaining International Broadband Leadership," May 2008; Robert McDowell, FCC Commissioner, Introductory Remarks for the Phoenix Center Workshop: Understanding Broadband Metrics: The Broadband Adoption Index, National Press Club Washington, D.C., July 15, 2009.
[63] Broadband statistics from OECD; household and population statistics from Statistics Canada and Statistics Denmark.
[64] CIP, "Canada Online! Year Two Report, 2007", September 2008, page 94.
[65] OECD, http://www.oecd.org/sti/ict/broadband. Results for Japan and Korea include mobile devices. Data for Australia and Switzerland are for 2006.

OECD countries, with most of the results taken from survey findings for 2007.[66] The Information Technology and Innovation Foundation (ITIF) included broadband penetration per household for 2007, with data sourced from the OECD.[67] Broadband penetration rates per household results for 2008 were also published by Strategy Analytics.[68]

These sources consistently found the highest broadband penetration among households in the following four countries: South Korea (referred to as "Korea" for the balance of this report), Iceland, Netherlands and Denmark. Canada's relative position ranged from a tie for fifth place in 2008, according to Strategy Analytics, to eighth place according to the OECD for 2007.[69]

The study by Wallsten included results for the U.S. based on a survey by the Pew Internet and American Life Project.[70] These results indicate the U.S. had achieved a household penetration rate of 63% in 2009, an increase of 3 percentage points above Strategy Analytics' results for 2008.

Canada's broadband subscription levels increased in 2008, which resulted in a corresponding increase in penetration to approximately 70% in Canada by the end of 2008.[71] The European Union's survey of households in 2008 also indicated increased penetration rates by several countries, including Norway (73%), Sweden (71%), and Finland (66%).[72] Australia's Bureau of Statistics provided updated estimates of broadband internet connections that point to

[66] Scott Wallsten, "Understanding International Broadband Comparisons," Technology Policy Institute, June 2009; available at: http://www.techpolicyinstitute.org/files/international%20broadband%20comparisons%202009%20update%20final.pdf.
[67] The Information Technology and Innovation Foundation, "Explaining International Broadband Leadership," May 2008, Table 1. There are some discrepancies between the results reported by the ITIF and those reported by the OECD.
[68] Strategy Analytics, "US Ranks 20th in Global Broadband Household Penetration,"press release June 18, 2009; available at: http://www.strategyanalytics.com Strategy Analytics included several non-OECD countries, many of which had reported high penetration rates (Singapore, Taiwan, Hong Kong and Israel) which altered the relative rankings. No results were provided for Iceland.
[69] OECD results for Canada taken from CRTC Communications Monitoring Report, 2008.
[70] Pew Internet and American Life Project, "Home Broadband Adoption, 2009," June 2009; available at: http://www.pewinternet.org/Reports/2009/10-Home-Broadband-Adoption-2009.aspx.
[71] Based on data in Figure 5.1.2 and Statistics Canada information on households.
[72] Commission of the European Communities, "Volume 2: i2010 - ICT Country Profiles," Commission Staff Working Document appended to "Europe's Digital Competitiveness Report," August 4, 2009.

substantial gains in penetration rates of up to 53%.[73] Based on these updated sources, the U.S. ranking would have remained at 10th place, while Canada would have been in 8th place, using the CRTC reported penetration of households.

Table 4.2.2: Broadband Subscriptions per Household

	OECD 2007		Wallsten 2007		ITIF 2007		Strategy Analytics 2008		Various 2008	
Australia	*17*	43%	*15*	47%	*9*	59%	*7*	72%	*15*	53%
Austria	*16*	46%	*16*	34%	*20*	45%	*20*	50%	*14*	54%
Belgium	*12*	56%	*12*	51%	*11*	57%	*13*	62%	*11*	60%
CANADA	***8***	**64%**	***6***	**64%**	***7***	**65%**	***5***	**76%**	***6***	**70%**
Czech Republic	*25*	28%	*19*	28%	*24*	30%	*27*	28%	*21*	36%
Denmark	*4*	70%	*4*	69%	*4*	76%	*3*	82%	*3*	74%
Finland	*9*	63%	*8*	58%	*8*	61%	*8*	69%	*7*	66%
France	*18*	43%	*13*	48%	*16*	54%	*9*	68%	*12*	57%
Germany	*15*	50%	*17*	33%	*18*	47%	*15*	58%	*13*	55%
Greece	*28*	8%	*27*	14%	*30*	18%	*22*	39%	*24*	22%
Hungary	*20*	33%	*21*	24%	*25*	29%	*24*	34%	*18*	42%
Iceland	*2*	76%	*3*	69%	*2*	83%			*1*	83%
Ireland	*22*	31%	*24*	20%	*19*	46%	*16*	58%	*17*	43%
Italy	*27*	25%	*22*	23%	*23*	41%	*19*	51%	*23*	31%
Japan	*5*	68%	*11*	51%	*13*	55%	*11*	64%		
Korea	*1*	94%	*1*	80%	*1*	93%	*1*	95%		
Luxembourg	*10*	58%	*10*	53%	*12*	56%			*10*	61%
Mexico	*29*	6%	*26*	16%	*29*	20%	*28*	28%		
Netherlands	*3*	74%	*2*	77%	*3*	77%	*2*	85%	*2*	74%
New Zealand	*21*	33%	*29*	0%	*22*	42%	*18*	57%		
Norway	*6*	67%	*5*	64%	*6*	68%	*6*	75%	*4*	73%
Poland	*23*	30%	*20*	26%	*26*	23%	*26*	32%	*20*	38%
Portugal	*24*	30%	*23*	22%	*21*	44%	*21*	40%	*19*	39%
Slovak Republic	*26*	27%	*25*	17%	*28*	22%	*25*	33%	*22*	35%
Spain	*19*	39%	*18*	28%	*17*	49%	*17*	57%	*16*	45%
Sweden	*7*	67%	*7*	61%	*15*	54%	*12*	63%	*5*	71%
Switzerland	*13*	53%	*28*	0%	*5*	74%	*4*	76%		
Turkey	*30*	0%	*30*	0%	*27*	23%	*23*	37%		
United Kingdom	*11*	57%	*14*	47%	*14*	55%	*10*	67%	*9*	62%
United States	*14*	51%	*9*	54%	*10*	57%	*14*	60%	*8*	63%

[73]Australian Bureau of Statistics, "Internet Activity, December 2008," released April 6, 2009; available at: http://www.abs.gov.au/ausstats. Based on estimate of 5.6 million households with broadband internet access of more than 256 kbps.

Figure 4.2.1: Broadband Subscriptions per Household

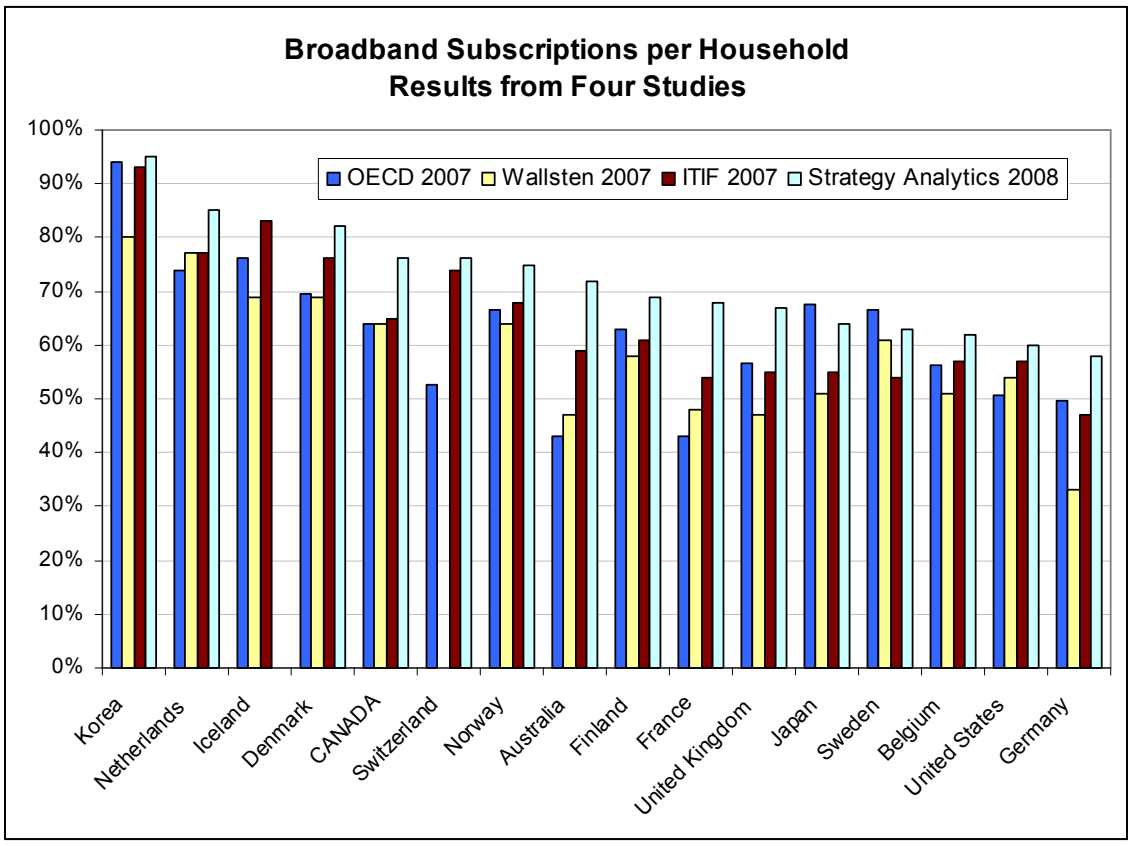


Table 4.2.2 provides detailed results for all OECD countries; Figure 4.2.1 highlights the relative rankings among those countries with penetration rates above 50%.[74]

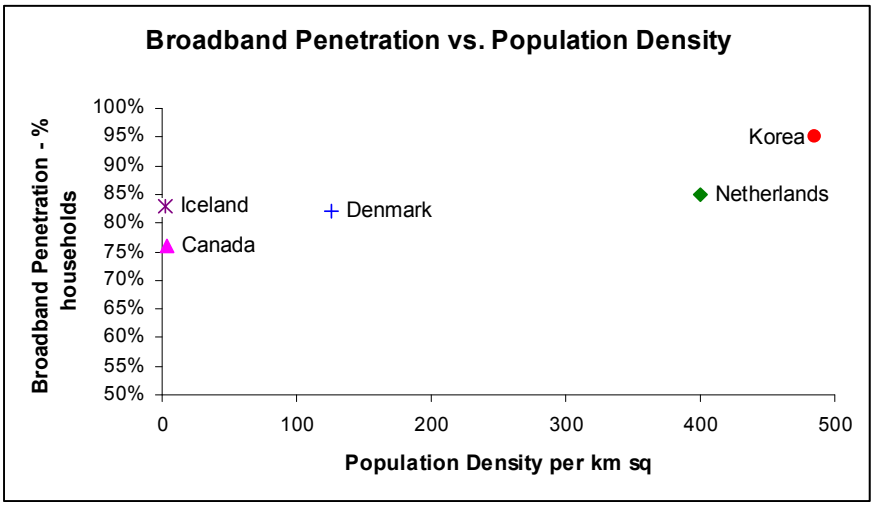
Canada's performance in terms of the adoption of broadband internet services is generally better when measured as a percentage of households rather than per 100 population. Canada is surpassed by Korea, Iceland, Netherlands and Denmark regardless of the measure of

[74] Table 5.2.2 statistics from the sources noted: OECD 2007: OECD broadband portal; Wallsten 2007: S. Wallsten, "Understanding International Broadband Comparisons," Technology Policy Institute, June 2009; ITIF 2007: ITIF, "Explaining International Broadband Leadership," May 2008, Table 1; Strategy Analytics 2008: "US Ranks 20th in Global Broadband Household Penetration," press release June 18, 2009; Various 2008: European countries European Union survey data available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/information_society/introduction; Canada from CRTC Communications Monitoring Report, 2009; Australia from the Australian Bureau of Statistics; United States – S. Wallsten (2009).

adoption. It should be noted that these countries have much higher population densities than Canada, with the exception of Iceland. Iceland has a population density that is nominally similar to Canada's, however, more than 60% of the population is concentrated in one region in or around the capital of Reykjavik and the entire country is only about twice the size of Nova Scotia in terms of land mass.

Figure 4.2.2 compares the relative broadband penetration (per household) with the population densities of Canada and these four countries.[75]

Figure 4.2.2: Broadband Penetration vs. Population Density



There are fewer challenges to delivering broadband internet in countries where the population is more densely concentrated in one or a few large urban areas. This will contribute to higher service availability and lower costs. Geography and population density are discussed further in Section 4.3.2.

4.2.3 Broadband availability and coverage

As noted above, wireline broadband internet service is available to 94% of Canadian households. This is relatively extensive coverage given Canada's relatively low population density and significant land mass. Fixed wireless and satellite-based technologies extend this

[75] Broadband penetration per household for 2008, as noted in Table 5.2.2. Population densities for 2006, as reported by the OECD.

coverage to virtually universal coverage. Wireless services based on mobile 3G technology can also deliver speeds of at least 2 Mbps, and already cover 91% of households in Canada. Canadian mobile carriers are also deploying HSPA+ networks delivering up to 21Mbps download speeds and are aggressively marketing mobile broadband access for computers, independent of voice service plans.

By comparison, a number of countries have achieved universal or near universal coverage based on their wireline networks. Belgium, Denmark, France, Korea, Luxembourg, the United Kingdom, and the Netherlands, all countries that have more highly concentrated populations than Canada, are all reported to have 99% or 100% availability of wireline broadband services. A comprehensive comparison is provided in the Appendix, Figure B.1.1.

Some countries are planning aggressive measures to deal with their persisting coverage gaps with the added hope of leapfrogging to next-generation services. For example, in April 2009, Australia announced a A$43B program to build a National Broadband Network, which seeks to provide 100Mbps service to 90% of the population. Despite the planned massive government investment, it is still expected that 10% of the population in Australia will have to continue to rely upon wireless and next generation satellite service.

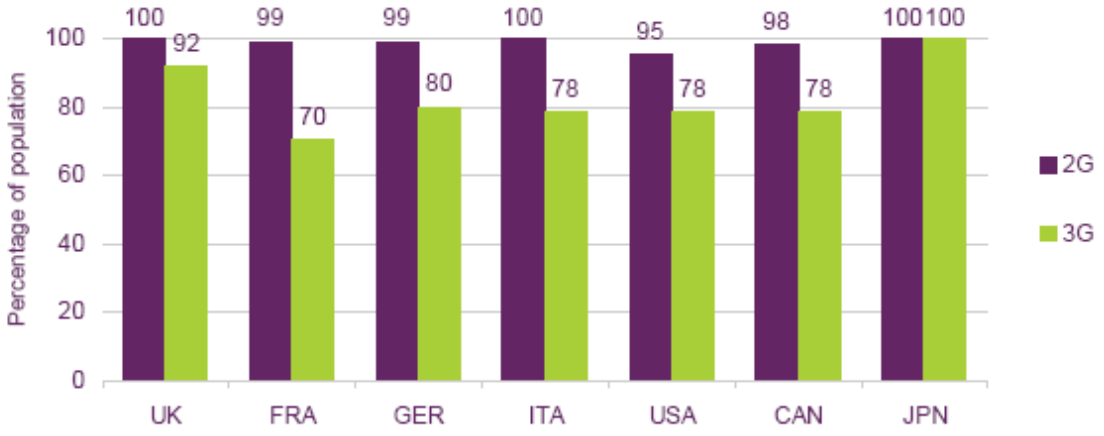
Similar to Canada, some European countries have a wireline gap between urban and rural availability. As discussed in section 4.1.1, virtually all of Canada's urban households have access to wired broadband while only 78% of those in rural areas had access to a wireline connection in 2008. The gap between urban and rural availability in European countries is shown in the Appendix, Figure B.1.2.

4.2.3.1 3G based broadband

As noted in Section 3.4, 3G mobile services can provide broadband connectivity and more advanced deployments are capable of supporting speeds that are competitive with some current DSL or cable modem technology. Availability of 3G networks, however, is frequently limited to more densely populated urban areas. Figure 4.2.3[76] provides a comparison of coverage availability for select countries based on data from 2007.

[76] Ofcom, The International Communications Market 2008, November 2008, Figure 5.63.

Figure 4.2.3: Mobile Broadband Network Coverage, 2007



Source: IDATE / industry data / Ofcom

The United Kingdom stands out as the only country to exceed 90% coverage, other than Japan. A report by Ofcom noted that the prices of mobile broadband in the UK (via data stick) are comparable to some wireline broadband connections and rates of adoption of mobile broadband are observed to be higher in countries with relatively low penetration of wireline broadband connections.[77] Ofcom attributed the higher coverage in the United Kingdom to regulatory obligations attached to the 3G licenses, consumer demand and competition.[78] Figure 4.2.3 indicates that coverage of 3G networks in Canada was comparable to that in the U.S. and most European countries in 2007. As noted elsewhere in this report, the CRTC reported 3G coverage in Canada had risen to 91% in 2008, suggesting coverage is approaching that found in the U.K.[79]

4.2.3.2 Availability of fibre / next generation networks

As countries resolve their respective issues regarding coverage or availability of basic broadband, more attention is being paid to the availability of higher speed broadband services, notably fibre to the home (FTTH) or premise (FTTP). A report prepared for the Fiber to the Home Council reported that approximately 13.9 million homes in North America have access to broadband services based on FTTH networks, of which 98% were based in the United

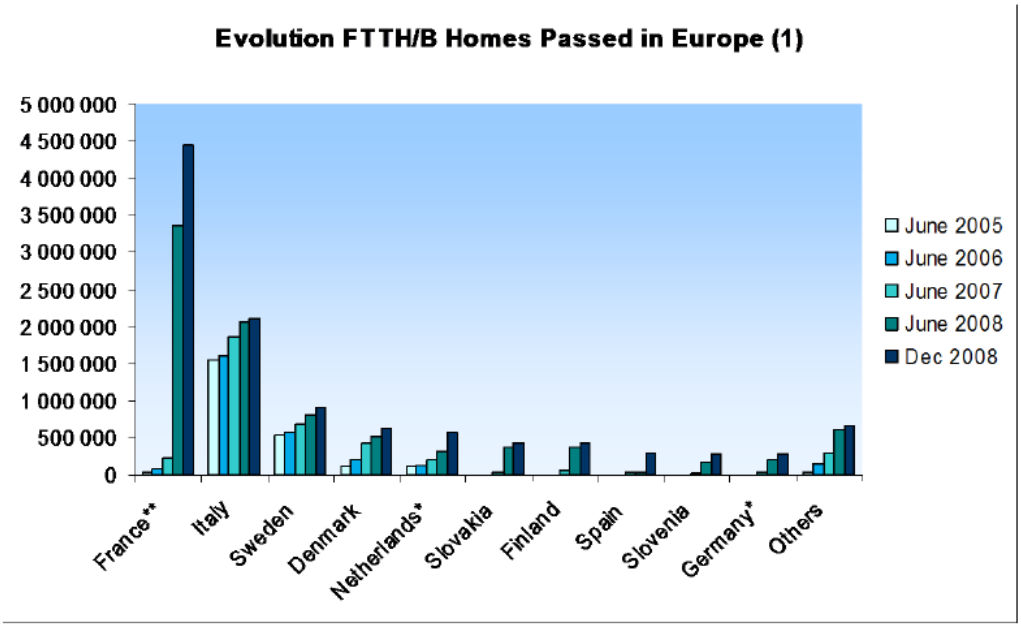
[77] Ofcom, "The International Communications Market 2008," November 20, 2008, pages 194-195.
[78] Ibid., page 239.
[79] Ofcom released 3G network coverage maps in July 2009 that indicate gaps in rural, less populated areas that some claim bring into question 90%+ coverage http://www.ofcom.org.uk/radiocomms/ifi/licensing/classes/broadband/cellular/3g/maps/3gmaps/coverage_maps.pdf.

States.[80] This suggests an average availability across North America of slightly more than 10%. Much of the FTTH network is attributable to Verizon, which reported that 13.2 million homes had access to its FiOS services.[81]

FTTH availability is also very low in Europe, with Italy reported to have 8% of the population with access and France with 2% as of 2007.[82] This is further illustrated by Figure 4.2.4 based on a report prepared by IDATE for the FTTH Council Europe Conference.[83]

FTTH networks are most widely deployed in Japan and Korea. Japan reported nearly 90% of households with access.[84] The Korean government announced in 2009 an initiative to bring one gigabit per second service to all homes by 2012, based on FTTH.

Figure 4.2.4: Fibre to the Home/Building in Europe



(1) Here FTTx means Fiber-to-the-Home or Fiber-to-the-Building or Fiber-to-the-Office or Fiber-to-the-Dormitory

* Excluding VDSL / VDSL2, FTTC, FTTN deployments by incumbents

** Including FTTB deployments form Numericable

Source: IDATE for FTTH Council Europe

[80] RVA LLC, "Fiber to the Home: North American Market Update," April 2009, based on "marketed-homes" as of March 2009, page 7.
[81] Verizon Communications, "Investor Quarterly Q1 2009," page 8.
[82] Ofcom, "International Communications Market 2008," page 240.
[83] IDATE, "FTTH European Panorama, December 2008" presented at the FTTH Council Europe Conference, Copenhagen, February 11, 2009, page 14.
[84] http://www.dosite.go.jp/e/pj/tele_com.html.

The OECD provided limited statistics on fibre-based subscriptions as a percentage of total connections. According to the OECD, Japan and Korea have the lead with 48% and 43%, respectively; figures that are consistent with the higher degree of service availability in these countries. Because these statistics are relative to total broadband subscribers, they are not directly comparable to those of the FTTH Council which are based on the percentage of total households with FTTH-based service. There is little difference for Korea because of that country's high overall penetration of broadband. However, for Japan, the FTTH Council reported a penetration rate of 27% per household, which reflects the lower penetration rate of broadband generally, as shown in Figure 4.2.1.

The OECD indicated that several countries had a penetration rate of zero for fibre-based connections, including Canada. However, elsewhere the OECD stated that it used this value in any instance where reliable data was unavailable. It should not be interpreted to mean that there are no fibre-based connections in Canada. In fact, there are some service providers operating FTTH networks already and these, as well as additional recent announcements, are not yet captured in the OECD's data.

In addition, Canada has numerous fibre to the node deployments that are delivering speeds of 25 to 100 Mbps. For example, ADSL2+ and VDSL networks of the telephone companies and DOCSIS 3.0 based networks of the cable companies are increasingly available in the larger urban markets in Canada. Including these in the OECD statistics on fibre-based connections would provide a more meaningful comparison of the availability of next generation services.

4.2.4 Broadband pricing and speed

Prices of broadband services reflect the speed of the service provided, with higher speed services, targeted to early adopters, typically commanding higher prices.

Price comparisons based on an average price per Mbps speed can provide some control against variations due to different service speeds. By contrast, metrics based on advertised service plans may not reflect actual subscription to services in a country. For example, actual subscriptions may be skewed towards lower speeds if the higher speeds are relatively newer offers or available on a more limited basis. Prices per Mbps based on average actual subscribed service price and speeds would be more useful but this data is more difficult to obtain on a consistent basis for many countries.

4.2.4.1 Price comparisons

The OECD provides information on prices based on average, minimum and maximum advertised price, as well as an average price per Mbps based on an average of the advertised speed. All prices are converted to U.S. currency and then restated in purchasing power parity (PPP).

The OECD data indicates that the average price in Canada in 2008 was $45.65 (U.S. PPP), compared to $45.52 in the U.S. This ranks Canada in 15th place among the 30 OECD countries. The five countries with the lowest average price were: Sweden, Greece, Japan, Finland and the United Kingdom.

Correcting the OECD's Price per Mbps – CRTC's Data are More Accurate

The CRTC Communications Monitoring Report published statistics on average revenue per subscriber and average download speeds that can be used to derive a proxy estimate of the price per Mbps. Revenue per subscriber is not a perfect substitute for price as this is affected by user activity and includes non-subscription related revenue (e.g., installation, equipment, etc.). However, the CRTC data suggests that the average price per Mbps in Canada has decreased from $9.19 in 2006 to $7.60 in 2008 (Canadian dollars, unadjusted for PPP), or a 17% decline. Converting this to U.S. PPP would suggest an average price per Mbps of $6.18. Canada's ranking relative to the other OECD countries would improve to 8th place using this method of gauging the average price per Mbps, assuming no change in the prices among the other countries.

The OECD's metric of price per Mbps adjusts the comparison to account for differences in service speeds underlying the average price in each country. On this measure, the OECD ranks Canada 28th out of 30 countries.

However, the OECD findings are fundamentally flawed because they are based on selective views of advertised offers that are not collected consistently across countries and have been averaged without any weighting to account for the relative subscription levels of the various offers. This issue is discussed in more detail in Appendix B.1.4.

Using data from the CRTC Communications Monitoring Report 2009, the average price per Mbps would be only $6.18 (U.S. PPP) [see box]. This would improve Canada's ranking to 8th place rather than the 28th position that was so widely reported.

It is also instructive to note that Canada's ranking in terms of the most cost-effective service would similarly have improved if the OECD had included in its analysis a broader range of ultra high-speed services offered in Canada. For example, as described in Section 3.2, a 50 Mbps service has been commercially available in Canada since February 2008. The price per

Mbps for this service is $1.32 (U.S. PPP).[85] If this offer had been considered by the OECD, a more accurate placement for Canada in terms of the most cost-effective service available in each country would have improved to ninth – similar to its ranking in terms of the average price per Mbps.

It would have been more accurate for the OECD to apply subscription-based weights to the offers to derive the average prices, speeds and price per Mbps. However, this would have required more detailed data for each of the countries indicating the percentage of subscribers using each service.

The OECD does not apply a rigorous and consistent methodology for sampling each country's advertised offers. As a result, there is significant variation among the countries in terms of the number and diversity of offers considered. For countries like Canada, where the sample data used was not fully representative of the available offers in the market, the OECD price comparisons are erroneous.

4.2.4.2 Speed comparisons

Canada's top speed offered commercially to residential subscribers is Shaw's Nitro service. Shaw's 100 Mbps service was considered to be the fastest cable internet service offered in North America, until Comcast released a 101Mbps service earlier this year. As discussed in Section 3.2, Videotron was the first cable company to trial even faster speeds over DOCSIS 3.0 technology.

Speed of broadband internet service can be compared based on average advertised speeds or maximum advertised speeds. In either instance, the data can be highly variable depending on which service providers' offers are included in the analysis. In addition, frequent improvements in top speeds can result in information being out of date by the time an international comparison can be compiled and published.

The OECD's information on the fastest advertised speed offered in Canada was 16 Mbps in 2008. This was only sufficient to rank Canada 19th out of 30 countries. While a top speed of 16

[85] Based on Videotron's Ultimate Speed Internet 50, which advertises up to 50 Mbps download speeds for a monthly price of $79.95 (under contract). Converting this to U.S. PPP would result in a price per Mbps of $1.32. The no contract price of $89.95 would equate to $1.50 (U.S. PPP).

Mbps was used for Canada in the OECD's charts released in May 2009, the OECD's comparisons found in its Communications Outlook 2009, released in August 2009, indicate Canada had a top speed in 2008 of 25 Mbps.[86] Furthermore, two Canadian companies launched commercial 50 Mbps service during 2008 and similar services have been announced by other providers since that time.

The OECD's data is a simple average of the advertised speeds observed for a select group of service providers, an approach that puts in question the reliability of the results. This issue is discussed further in Appendix B.1.4. The ITIF considered the advertised speeds offered by the three main technologies (DSL, one of cable modem and fibre), with the speeds weighted by their relative subscriber numbers. The CRTC Communications Monitoring Report 2009 also used a subscriber-weighted methodology to determine that average speed among residential subscribers of 4.9 Mbps in 2008.[87] Additional comparative data is provided in the Appendix, Table B.1.1 and Figure B.1.7.

4.2.4.3 Multiple indicator comparisons

A country's performance can also be gauged using indices that combine multiple indicators. This approach does not reward or penalize a country based on a single indicator. However, indices are designed with different goals, which dictates to large degree which indicators and weights are chosen. Some indices are focused more on connectivity to internet-related infrastructure and how this is used, such as the LECG/Nokia Siemens Networks Connectivity Scorecard. Others encompass all information and communication technologies (ICT), as is the case with the ITU's ICT Development Index. Other indices take into account general economic, business and government performance, as found in the Economist/IBM E-Readiness index.

Appendix B.1.5 provides a discussion of various other indices of broadband performance and digital readiness. In that section, we observe that LECG/NSN ranked Canada seventh and noted that "the Canadian market has many 'difficult' characteristics, and it is hard for Canadian firms to realise the same economies of scale and scope as their counterparts in larger, more densely populated nations."[88] That report suggested that Canada would benefit

[86] OECD Communications Outlook 2009, Figure 4.11, page 108 and Figure 4.12, page 109.
[87] CRTC, Communications Monitoring Report 2009, Table 5.3.3.
[88] LECG/NSN, "Connectivity Scorecard 2009: Canada," page 2.

from increased incentives for the deployment of next generation networks (e.g., FTTP and DOCSIS 3.0), and may wish to consider the U.S. example of deregulation and rural broadband stimulus initiatives.[89]

4.3 Additional considerations

4.3.1 Socio-economic factors

Section 5.2 discusses two frequently-cited indicators of broadband performance – adoption of service, typically indicated by subscription levels, and availability of service. Adoption of broadband internet can be influenced by a number of factors, besides the obvious one of availability. Price is generally considered to be highly influential. However, among those who have not taken up broadband internet, lack of interest is more frequently cited as the reason.[90]

Given the flaws in the OECD's averaging methodology and its reliance on unrepresentative sample data in countries like Canada, the OECD indicators regarding the price of broadband service – average price overall and average price per Mbps - are unreliable. It is necessary to seek out alternative statistics on price.

The ITU ICT index published in March 2009 included multi-country comparisons of the price for a basket for ICT services. The ITU also published prices for a sub-basket consisting of fixed broadband internet service, using the prices for an entry level service offered by major ISPs. The price data was converted to US PPP and also normalized for the countries' Gross National Income (GNI) per capita. According to this methodology, the price in Canada was the second lowest among developed nations, and the second lowest overall as a percent of GNI per capita.

The ITU analysis demonstrates the affordability of Canadian broadband service, contributing to Canada having one of the world's best rates of residential service adoption measured on a per household basis. Yet 30% of Canadian households have yet to adopt the service.

[89] Ibid., page 5.
[90] CIP, "Canada Online! Year Two Report, 2007," September 2008, Table 4-1.

This is consistent with the findings of the CIP Online survey that demonstrated that Canadians without broadband internet have reasons other than price or affordability for not subscribing. Moreover, the countries that were reported in Section 5.2 to have lower prices (in absolute terms or per Mpbs) do not necessarily line up with those that have the highest broadband penetration. Iceland stands out as an example of a country that has achieved a high penetration level (per population and per household) even though reported prices tend to be higher than in other countries. The price of entry-level service in Iceland was found to be more than twice that in Canada, yet Iceland has achieved a higher penetration level.[91]

Some socio-economic groups in Canada are less likely to adopt internet services than others. Statistics Canada found that Canadians with lower income and education, and older Canadians were less likely to have an internet connection than the average in 2007, although the gap has narrowed since 2005.[92] Canadians in these groups may be less interested or believe they lack the necessary computer skills to make use of a broadband internet service. These segments of the population may also include many who are late adopters of new technology.

To truly understand why certain groups lag others in adopting broadband, more research is needed. The available research suggests there are attitudinal demand-side barriers to increasing broadband penetration.

The proportion of households with a computer at home is another factor that has a strong influence on the adoption of broadband services. ITU statistics on this factor indicate more than 79% of Canadian households have a computer.[93] As shown in Table 4.3.1, countries with a higher penetration of computers in households include many of the same countries that also rank highly in terms of penetration of broadband subscriptions; notably, Denmark, Iceland, Korea, and Netherlands.[94]

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[91] ITU, "Measuring the Information Society, The ICT Development Index," March 2009, Annex 4.
[92] Statistics Canada, "Canadian Internet Use Survey, 2007," as reported in The Daily, June 12, 2008.
[93] ITU, "Measuring the Information Society, The ICT Development Index," March 2009, Annex 4. Data for 2007.
[94] Households with broadband based on European Union survey data for EU member countries, all other countries based on Strategy Analytics data for 2008, as indicated in Table 5.2.2, with the exception of Canada – CRTC Communications Monitoring Report, United States – S. Wallsten (2009), and Australia – Australian Bureau of Statistics.

Canada's performance on broadband metrics is also challenged by other socio-economic characteristics. As noted in the LECG/NSN Connectivity Scorecard 2009 discussion of Canada, the size of the Canadian economy makes it difficult for firms "to realise the same economies of scale and scope as their counterparts in larger, more densely populated nations."[95] The same analysis noted that Canada does not perform as well in terms of ICT investment because "the Canadian economy has a large natural-resource driven component."[96]

Table 4.3.1: Households with a Computer Compared to Households with Broadband

	Households with computers (%)	Households with broadband (%)
Iceland	89.0	83
Netherlands	86.0	74
Japan	85.0	64
Denmark	83.0	74
Sweden	83.0	71
Norway	82.0	73
Korea	80.0	95
Luxembourg	80.0	61
Canada	**79.1**	**70**
Germany	79.0	55
Switzerland	78.1	76
New Zealand	75.7	57
United Kingdom	75.0	62
Finland	74.0	66
Australia	73.0	53
Austria	71.0	54
United States	70.2	63
Belgium	67.0	60
Ireland	65.0	43
France	62.0	57
Spain	60.4	45
Slovak Republic	55.0	35
Hungary	54.0	42
Poland	54.0	38
Italy	53.0	31
Portugal	48.3	39
Czech Republic	43.0	36
Greece	40.0	22
Turkey	28.5	n/a
Mexico	22.1	28

[95] LECG/NSN, "Connectivity Scorecard 2009: Canada," page 2.
[96] Ibid., page 6.

4.3.2 Geography and population density

Canada encompasses the largest geographic area among all OECD countries. It also has the third lowest population density, with 3.3 persons per square kilometre, compared to 2.8 in Australia and 3 in Iceland. Only three other countries have population densities below 25 persons per square kilometre: New Zealand; Norway; and, Sweden.

Among those countries with relatively low population densities, Iceland with a broadband penetration among households of 83%, is the only one to have significantly exceeded the rate in Canada at about 70%. Two other countries - Norway with a penetration of 73% and Sweden at 71% - slightly outperformed Canada.

Another characteristic of geography and population that can lower the costs of delivering broadband service is the extent to which the population is clustered in urban areas, referred to as "urbanicity", defined as the percent of the population in urban areas times the population density in urban areas.[97] According to data collected by ITIF,[98] all of the countries with a level of broadband penetration higher than Canada (on a per household basis) were also reported to have a higher degree of urbanicity, as shown in Figure B.2.1.

For example, Iceland is distinct from Canada in that it consists of only 1% of Canada's land mass and has less than 1% of the population. More than half of Iceland's population resides within less than 2% of the country's small land mass. These characteristics make it less costly for service providers in Iceland to extend broadband service to the entire population.

Countries with dense populations, particularly those with a more urban oriented population, are more likely to have shorter local loops used in their telecommunications networks. The shorter loops reduce the costs of delivering DSL-based broadband services. The United States has particularly long loop lengths, relative to most other countries, leading to higher costs and greater challenges to expanding the availability of wireline-based broadband internet.

[97] ITIF, "Explaining International Broadband Leadership," May 2008, page 14.
[98] Robert Atkinson, "The OECD-ITIF Broadband Rankings," June 15, 2007; based on data from the OECD Directorate for Science, Technology, and Industry; United Nations, Population Division; Demographia and ITIF calculations; available at: http://www.itif.org.

Canada had the second longest loop length, as shown in Figure B.2.2,[99] an artefact that should be expected, given the high percentage of the population that lives outside urban areas.

Despite lacking the advantages of other countries in terms of urbanicity and short loop lengths, Canada managed to achieve more favourable broadband adoption rankings than many countries that enjoy these advantages.

4.4 Summarizing the current debate

Canada's broadband performance relative to other countries, as suggested by statistics reported by the OECD and others, has caused some observers to claim the country is in crisis.

> …the reality is that the Canadian telecommunications scene is in a state of crisis. … we now find ourselves steadily slipping in the rankings just as these issues take on even more importance for commercial, educational and community purposes.[100]

This statement made before the Standing Senate Committee on Transportation and Communications, was based in part on OECD statistics indicating Canada's relatively low ranking in terms of its broadband penetration, and the price and speed of available services. Other observers have also raised concern that Canada has been "falling behind" and "lost significant ground" when measured by these indicators.[101]

Similar concerns have been raised in the United States regarding its relatively low ranking using the OECD's statistics on broadband penetration. Federal Communications Commissioner Robert McDowell offered the following comment in response to these concerns.

> As I have discussed and written about several times, one of the many concerns with the OECD's study is that it does not rank on a per household basis, which creates a statistical disadvantage for countries with larger household sizes. As a result, those who tout the OECD's findings are doomed to fail at the hands of the very methodology they promote today – no matter what future U.S. policies may actually produce.[102]

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[99] ITIF, "Explaining International Broadband Leadership," May 2008, page 11.
[100] Professor Michael Geist, before the Standing Senate Committee on Transportation and Communications, May 26, 2009.
[101] See for example, the Consumer Groups' submission in response to Telecom Notice CRTC 2009-261, June 22, 2009, at para. 26-30; the Coalition of Competitors' submission in response to a Petition to the Governor in Council by MTS Allstream Inc., May 4, 2009, at para. 69-71.
[102] Robert McDowell, FCC Commissioner, Introductory Remarks for the Phoenix Center Workshop: Understanding Broadband Metrics: The Broadband Adoption Index, National Press Club Washington, D.C., July 15, 2009.

A critical assessment of the OECD statistics reveals that the rankings are not reliable. To avoid bias favouring countries with smaller households, residential broadband penetration should be measured based on per household metrics, rather than the number of subscribers per 100 population. The analysis in Section 4.2 explains that Canada has been unfairly penalized due to a significantly higher household size than its international peers.

Further, the OECD's method of presenting prices, speeds and prices per Mbps are based on country data that is inconsistently gathered. The flaws in the methodology lead to an apples to oranges comparison, rather than an objective ranking on price and speed. When using the CRTC's data, Canadian prices for broadband service are less than a quarter of the amounts reported by the OECD.

The evidence reviewed in Section 4.2 considers multiple sources respecting broadband penetration, prices and speeds, as well as broad-based indices. The body of research from sources other than the OECD is clear evidence indicating that Canada's situation is far from dire, and that in fact, Canada places within the top 10 of most rankings. When looking past the OECD metrics, Canada compares favourably to its peers. If consideration is given to Canada's geographic and demographic challenges, Canada has done remarkably well; better than should have been expected. This does not mean that we should sit on our broadband laurels. The evidence also suggests that there is room for improvement – notably, broadband adoption stands out as an area where we could focus our collective efforts.

5 The increasing politicization of broadband

As broadband services become increasingly important to the daily lives of Canadians, the issues surrounding broadband have become increasingly politicized. This section will enumerate the various issues so that the political context of the Canadian debate on broadband issues can be properly understood. Pages and pages of regulatory filings and other documentation already exist in the public domain to explain and illustrate each argument. There is no need to duplicate those efforts in this report. It is sufficient to understand that each stakeholder in the broadband debate has a particular lens through which they see the issues.

5.1 Economic prosperity

In its most recent competitiveness ranking, the World Economic Forum states:[103]

> Prosperity is determined by the productivity of an economy, which is measured by the value of goods and services produced per unit of the nation's human, capital, and natural resources. Productivity depends both on the value of a nation's products and services, measured by the prices they can command in open markets, and the efficiency with which these products can be produced. Productivity supports high wages, a strong currency, and attractive returns to capital—and with them a high standard of living. Competitiveness, then, is measured by productivity.

It is generally agreed amongst economists that a nation's prosperity is dependent on their citizens' ability to produce goods and services. The greater a nation's productivity, the more prosperous the citizens, as they will have more goods and services available to consume domestically or trade internationally. As a result, economists spend a great deal of time devising measures of productivity, and studying its drivers. Countries that are doing well will show productivity growth that outpaces their peers, and countries that are doing less well, will be losing ground to the productivity leaders.

Historically, Canada has done reasonably well in the productivity rankings,[104] when compared to other countries. Notwithstanding the recent financial crisis, the United States has in recent

[103] World Economic Forum, The Global Competitiveness Report 2008-2009, at p. 44. See http://www.weforum.org/pdf/GCR08/GCR08.pdf.

[104] Canada ranked 10th out of 134 countries studied by the World Economic Forum in 2008-2009, an improvement from its 13th place ranking in the previous report. The United States ranked 1st in 2008-2009 which was a continuation of its 1st place ranking in previous reports. Notably, Japan ranked 9th and Korea ranked 13th in the same competitiveness index. While it is difficult to draw precise

years led all other nations in its ability to grow its productivity. Some have suggested that investment in, and proper adoption of, ICTs is the reason why. Other reports suggest that there are other reasons why the level of ICT investment is low in Canada, including the large natural resource component.[105]

While the magnitude of effect varies depending on the research reviewed, it is widely believed that investing in ICTs and properly adopting them into business processes can significantly improve productivity. Broadband connectivity is a key, enabling technology within the basket of ICTs. So, the theory would suggest that deploying and properly using broadband technologies can help to improve a nation's productivity.

The World Economic Forum states:[106]

> In today's globalized world, technology has increasingly become an important element for firms to compete and prosper. In particular, information and communication technologies (ICT) have evolved into the "general purpose technology" of our time, given the critical spillovers to the other economic sectors and their role as efficient infrastructure for commercial transactions.

This kind of economic thinking is driving various political agendas on broadband. For example, for those citizens without broadband, they would argue the economic necessity of having it. Their arguments would parallel the reasons why voice telephony was made a universal service via regulatory imperative, notwithstanding the uneconomic cost of providing such service to the far reaches of Canada. Others would argue, not so much in opposition, but that urban environments are really the economic engines of the nation and that anything that can be done to improve the quality and speed of urban broadband should be encouraged or mandated.

In any event, no matter what the argument, the implicit concern is that Canada risks its own prosperity and quality of life, if we are somehow failing to take full advantage of ICTs, and by extension, broadband.

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conclusions from these scores, they do provide context to the relationship between the quality or performance of a nation's broadband infrastructure and its productivity level. Clearly, as the World Economic Forum's measurement methodology suggests, productivity is a complicated issue that is dependent on a host of other factors beyond ICT and broadband networks.

[105] LECG/NSN, "Connectivity Scorecard 2009: Canada," page 6.

[106] World Economic Forum, at p. 5.

5.2 Wholesale obligations on next-generation networks

Incumbent telcos and cablecos have been and continue to be subject to a regulatory obligation to wholesale their broadband services to other internet service providers who would then layer on their own applications, marketing and customer service, and resell the packaged service to the end consumer. The theory is that there are parts of the network that are essential to the service but not economically replicable by market entrants. And, given the historical incumbency and dominance of the telcos and cablecos, market entrants needed access to the existing networks so that they could build a business that is sizeable enough to eventually justify investment in the building of new broadband facilities to compete with the telco and cableco.

As the development of next generation networks continues, telcos like Bell and TELUS are arguing that such wholesale obligations should not apply to their next-gen investments. One of their key arguments is that such obligations significantly reduce the incentive to invest. Why would they invest if they will have to share the potential profits with reseller competitors? Companies like MTS Allstream on the other hand, which depend in part on the wholesale obligation, argue that duopolistic competition between the telcos and cablecos is not enough. They argue that consumers will not receive the benefits of competition (better service, lower prices and service innovation) unless companies like them are allowed to compete by buying and reselling access to "essential" telco and cableco broadband facilities through a mandated wholesale regime.

There are a myriad of nuances to each parties' arguments and this brief summary does neither side justice. However, Cabinet Appeals[107] are pending that will likely decide the direction of this issue if not the issue itself. Decisive action will be welcome either way, as continued regulatory uncertainty is perhaps the most damaging outcome since it tends to have a chilling effect on investment by all of the parties involved.

[107] Refer to Gazette Notice DGTP-004-09 – Petitions to the Governor in Council concerning Telecom Decisions CRTC 2008-117 and CRTC 2008-118, Telecom Regulatory Policy CRTC 2009-34, and Telecom Order CRTC 2009-111.

5.3 Closing the digital divide

As set out in Section 4.1.1 of this report, 6% of the Canadian population do not have wired broadband connections available to them. This have and have-not dichotomy is often referred to as the Digital Divide.[108] As more commercial, financial, governmental, health and educational services are being provided online, the importance of having a broadband connection increases. We have mentioned the "economic necessity" argument, but the political issue should be read more broadly to include matters of social policy and equity. It is the combination of these arguments that has led many to call on government and industry stakeholders to close and eliminate the wired coverage gap.

In response, there have been a number of government programmes mentioned in Appendix A and the more recent $225 million Broadband Canada initiative by Industry Canada.[109] The sufficiency and success of these programmes has often been questioned, but there is no doubt that they have provided some improvement in the overall availability issue.

The calls to action on closing the Digital Divide are usually made in isolation of detailed cost discussions, and with little attention to the practical issues of deployment, operation, maintenance and continual improvement of networks in rural and remote communities. When the issue of cost does arise, some are quick to declare broadband a necessity or an "essential" service that should be part of a "universal" service obligation and financed by subsidies from urban broadband users; similar to the universal service obligation for telephone service.[110] Any discussion of a subsidized universal service programme should consider whether urban broadband users, or Canadian taxpayers generally (if the subsidy were to be paid out of general tax revenues), think that goal of universal service can only be achieved through subsidies and that this goal is so worthwhile that they are willing to pay for it.

[108] Wireless solutions, including satellite, frequently are not counted when the Digital Divide is measured. This is likely due to technical characteristics of those specific technologies, although for most applications, the difference in the consumer experience would not be meaningful.
[109] See the Broadband Canada website at http://www.ic.gc.ca/eic/site/719.nsf/eng/home.
[110] It is important to note that amongst the 94% of Canadians who have wired broadband available to them, nearly one-quarter choose not to purchase it. While this raises questions regarding adoption rates, it suggests that the words "necessity" and "essential" may be overstated. They may be correct terms in the near future, but we have to question whether they apply today.

The competing view does not argue against the importance of broadband, instead the arguments focus on the high costs to provide a wired service to rural and remote households, the near-wired quality of wireless services like satellite as an available alternative, and the overall lack of incentive to deploy networks in such sparse communities. The wired service providers fear that a government subsidy program will distort the economics of urban broadband and layer on unneeded regulation and oversight. They point out that wireless is improving dramatically (particularly next generation satellite), the wired technologies are improving their reach, and that ultimately, everyone who wants service will be able to buy a form of broadband, or near-broadband, in the coming years, if not already.

Whether the latter point is true really depends on one's particular views regarding the acceptability of satellite and other wireless services. In our view, a pragmatic approach is needed. While such services are inherently different from wired services in respect of their limitations and features, the real issue is whether they can meet the needs of the consumer.[111]

5.4 New media and content control issues

Recently, there have been proceedings before the CRTC regarding "New Media" and "Network Management". The former was focused on the issue of whether traditional media regulation should apply to media content (e.g. film and other video, TV programming, music, etc.) that flows over the internet to consumers via broadband connections. Political issues in respect of the broadband connection come into play when proponents argue internet service providers are the logical point at which such content could and should be regulated. While there are a series of arguments for and against such regulation, the ultimate decision by the CRTC has been to continue not to regulate this issue for at least another 5 years.[112] Notwithstanding that decision, the political interests surrounding content issues on the internet continue to influence the public debate regarding broadband.

Similarly, the issue of network management has recently been before the CRTC and their decision is currently pending.[113] The key issue in this proceeding is whether the CRTC should

[111] See Section 3.5 of this report regarding the availability and cost of satellite-based internet services.
[112] See http://www.crtc.gc.ca/eng/archive/2009/2009-329.htm for the CRTC's Decision and reasoning.
[113] See http://www.crtc.gc.ca/ENG/archive/2008/pt2008-19.htm for the CRTC's public notice and links to the evidence submitted in the hearing.

regulate the way, shape and form of network management used by ISPs to provide broadband service. The political aspects of the debate are really a tension between corporate interest and those representing a public interest in internet usage.[114] Those in favour of regulation argue that ISPs have not been transparent enough regarding such practices, that management tools like deep-packet inspection can or are being used to favour the ISPs own content services, and that ISPs are violating consumers' privacy rights by employing such tools.

In response, the ISPs have argued that the insatiable demand for internet capacity cannot be satisfied by reasonable investment in network enhancements. Their analyses of network usage suggest that a minority of users is using a majority of the network capacity and that network management is necessary to ensure an equitable allocation of network resources to all broadband customers. They argue that regulation seeking to curb or prohibit the use of such techniques will be consumer unfriendly, in that it will lead to a lower quality of service and/or a higher cost for service. They argue that ultimately, the market will sort these issues out through competitive interplay and that ISPs will find the right balance of network management, investment and consumer transparency and protection.

5.5 Neutrality in the network

The network management debate mentioned above is the most recent iteration of a longer-standing discussion regarding the so-called principle of "Network Neutrality".[115] An unprecedented amount of rhetoric and emotion has been spent on this debate; perhaps more than any other internet or technology policy issue.

Wikipedia, a reference source authored by the online community, tends to support the notion of neutrality in the network:[116]

> Network neutrality (also net neutrality, Internet neutrality) is a principle proposed for residential broadband networks and potentially for all networks. A neutral broadband network is one that is free of restrictions on content, sites, or platforms, on the kinds

[114] This is often referred to as "network neutrality". We explore that issue more directly in Section 5.5.
[115] As many have pointed out before, the term "Network Neutrality" is laden with value judgements, and political bias. How could anyone be against neutrality? In essence, the term itself is not neutral. As a result, it is usually more helpful to avoid it entirely and focus on issues described more precisely. For example, in the CRTC's public notice for the proceeding on network management, the term "Network Neutrality" was not used. Yet, in the advocacy of their views, many parties freely made use of the term.
[116] As viewed at http://en.wikipedia.org/wiki/Network_neutrality on August 9, 2009.

> of equipment that may be attached, and on the modes of communication allowed, as well as one where communication is not unreasonably degraded by other communication streams.
>
> Though the term did not enter popular use until several years later, since the early 2000s advocates of net neutrality and associated rules have raised concerns about the ability of broadband providers to use their last mile infrastructure to block Internet applications and content (e.g. websites, services, protocols); particularly those of competitors. In the US particularly, but elsewhere as well, the possibility of regulations designed to mandate the neutrality of the Internet has been subject to fierce debate.
>
> Neutrality proponents claim that telecom companies seek to impose a tiered service model for the purpose of profiting from their control of the pipeline to remove competition, create artificial scarcity, and buoy their otherwise uncompetitive services. Many believe net neutrality to be primarily important as a preservation of current freedoms. Vinton Cerf, co-inventor of the Internet Protocol, Tim Berners-Lee, father of the web, and many others have spoken out strongly in favor of network neutrality.
>
> Opponents of net neutrality include large hardware companies and members of the cable and telecommunications industries. Critics characterised net neutrality regulation as "a solution in search of a problem", arguing that broadband service providers have no plans to block content or degrade network performance. In spite of this claim, certain Internet service providers have intentionally slowed peer-to-peer (P2P) communications. Others have done exactly the opposite of what Telecom spokespersons claim and have begun to use deep packet inspection to discriminate against P2P, FTP and online games, instituting a cell-phone style billing system of overages, free-to-telecom "value added" services, and anti-competitive tying ("bundling"). Critics also argue that data discrimination of some kinds, particularly to guarantee quality of service, is not problematic, but highly desirable. Bob Kahn, Internet Protocol's co-inventor, has called "net neutrality" a slogan, and states that he opposes establishing it, warning that "nothing interesting can happen inside the net" if it passes: "If the goal is to encourage people to build new capabilities, then the party that takes the lead in building that new capability, is probably only going to have it on their net to start with and it is probably not going to be on anybody else's net." However, he also said "by virtue of doing that, you tend to fragment the net. And anything that will tend to fragment the net I'm opposed to, provided it's not an incremental evolution of a new technology that's happening."

The telling aspects of advocacy within the Wikipedia description are the bold assertion of principle and the argument from authority through references to the forefathers of the internet. At the heart of the advocacy appears to be a mistrust of market forces and corporate interest.

The advocacy of network neutralists has been successful enough to engender the tabling of a number of bills in the U.S. and in Canada[117] as well as proposed new rulemaking to be

[117] On May 28, 2008, the New Democratic Party (NDP) introduced a private member's bill, C-552, to the Canadian House of Commons that sought to entrench "net neutrality" and enact rules to restrict network management practices by service providers. The bill died on the order paper after 1st reading on September 7, 2008, when Parliament was dissolved. On May 29, 2009, the NDP re-introduced the

proposed by the FCC.[118] While none have passed into law for a number of different reasons, such efforts are good evidence of how powerful the lobbying has become.

Critics of the notion however, point out that the reality of today's more commercially oriented internet is very different from the academic and governmental efforts that decades ago spawned the internet. The internet has evolved into a business that provides many things, including a platform for other businesses. Commercial interests play a key role in how the internet is managed, used and hopefully, enhanced. The view of network neutralists is premised on the idea that the internet is a public good in the economic sense, and that regulation, rather than market principles should take precedence. Corporate and more politically conservative commentators respond that the public interest is best served by competition in the marketplace and that the current "success" of the internet is largely due to the lack of governmental interference or restrictive regulation. Should regulation be enacted to enshrine neutrality in the network, they argue that the consumer will be harmed; as incentives to invest will be reduced, customer choice will diminish and the internet's progression will be halted.

The tension between the various parties yields a lively, and mostly healthy debate, but sometimes the hyperbole and impassioned advocacy degrades into a less than constructive discussion. In the politics of broadband, network neutrality has been a crucible for control of the broadband connection. How the issue resolves itself, if ever, will significantly influence how we build, manage, use and pay for our broadband connections.

5.6 International broadband stimulus plans

Prior to the recent financial crisis, some countries had embarked upon government efforts to encourage the build out of broadband networks. While these programmes were originally focused on closing the Digital Divide, in today's context, they could easily have been

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Network Neutrality private member's bill as C-398. On June 8, 2008, a private member's bill, C-555, entitled "The Telecommunications Clarity and Fairness Act" was introduced by a Liberal member of parliament. It sought, among other things, "an assessment of network management practices that favour, degrade or prioritize any packet transmitted over a broadband network based on source, ownership or destination". Like the NDP bill, this proposed legislation died after Parliament was dissolved by the Prime Minister.

[118] Remarks by FCC Chairman Julius Genachowski at The Brookings Institution, September 21, 2009 from http://openinternet.gov/read-speech.html.

characterized as broadband stimulus. In a few instances, governments have also attempted to stimulate consumer adoption of broadband services. For example, in 2006, the Danish government sought to promote broadband uptake by providing a tax incentive whereby employers pay for their staff's broadband connections, if the employees are working from home. Both employers and employees receive a direct deduction on their taxable income. It is difficult to discern the precise effect of such measures, but as the statistics suggest in Section 5 above, Denmark has emerged as a consistent leader in the penetration rankings.

Canada's programmes have historically focused on supply side stimulus aimed at extending coverage of wired broadband networks to rural and remote communities.[119] That focus continues today, as the government has provided $225 million to the newly established Broadband Canada: Connecting Rural Canadians.[120] The money will be spent over a 3-year period (beginning 2009-2010) on the development and implementation of a plan to extend coverage to as many unserved and underserved households as possible.

A number of other countries have sought to introduce broadband stimulus as part of their overall economic stimulus packages in the belief that such measures can mitigate the recent financial decline and stimulate growth as the economic cycle bottoms. Below is a list of some of the broadband stimulus initiatives in other countries:

1. United States – The American Recovery and Reinvestment Act (ARRA) will spend $7.2 billion USD on improving the US broadband infrastructure. The stimulus plan's goals are to expand broadband access to unserved and underserved communities across the U.S., increase jobs, spur investments in technology and infrastructure, and provide long-term economic benefits. Two departments of the government have been tasked with channelling the stimulus funds, and they have set up the RUS Broadband Initiatives Program (BIP) and the NTIA Broadband Technology Opportunities Program (BTOP). BIP will make loans and grants for broadband infrastructure projects in rural areas. BTOP will provide grants to fund broadband infrastructure, public computer centers and sustainable broadband adoption projects.[121]
2. Australia – In April 2009, the Australian government announced a plan to build the National Broadband Network based predominantly on Fibre to the Home (FTTH) technology. It will be an Open Access network and will provide download speeds of up to 100 Mbps to 90% of Australian homes and businesses. The initial cost has been set at approximately $31B USD. The remaining homes and businesses will be served using

[119] For example, the Broadband for Rural and Northern Development (BRAND) programme managed to connect over 900 communities that would not otherwise have had access to broadband.
[120] See Industry Canada's website for the program at http://www.ic.gc.ca/eic/site/719.nsf/eng/home.
[121] See http://broadbandusa.sc.egov.usda.gov/ for more details.

wireless and satellite technologies that will provide download speeds up to 12 Mbps. The network will be built as a public private partnership. To fund the build, the government will initially invest $4.7B and will issue infrastructure bonds to allow private investment in the network (to be capped at 49%). The government will hold a 51% ownership share and will operate the network for five years once it is completed. The government intends to sell down its interest "within 5 years after the network is built and fully operational, consistent with market conditions, and national and identity security considerations."[122]

3. United Kingdom – The recent Digital Britain report from the UK government recommends a digital strategy that is meant to provide stimulus in the short term, and lay the groundwork for the longer term transformation of their economy and culture. For broadband stimulus in particular, it recommends:
    a. Establishment of a Universal Broadband Commitment at 2 Mbps by 2012 – "The Universal Service Commitment will be delivered by a mix of technologies: DSL, fibre to the street cabinet, wireless and possibly satellite infill. It will be funded from £200m from direct public funding, enhanced by five other sources: commercial gain through tender contract and design, contributions in kind from private partners, contributions from other public sector organisations in the nations and regions who benefit from the increased connectivity, the consumer directly for in-home upgrading, and the value of wider coverage obligations on mobile operators arising from the wider mobile spectrum package."[123]
    b. Next Generation Final Third project – The report states that two thirds of Britain will be well-served by next generation networks in the near future. To avoid a new disparity where the population is split between current generation and next generation, the report is recommending a subsidy programme to ensure that the 'final third' is not left behind as next generation deployments take place. To fund this project, they are establishing the "Next Generation Fund, based on a supplement of 50 pence per month on all fixed copper lines. The Fund will be available on a tender basis to any operator to deliver and will provide a part subsidy for the deployment of next generation broadband to the 'final third' of homes and small businesses, bringing the cost of the initial deployment to the same level that operators face in the commercially economic parts of the market."[124]
    c. To facilitate the deployment of next generation wireless infrastructure, the report proposes "to make the existing operators' 3G licences indefinite rather than term licences (though AIP will be payable to reflect the economic value of the licence) in order to provide certainty for investment and an incentive towards greater roll-out towards universality.[125]
4. The Korea Communications Commission announced in February 2009 an initiative valued at 34.1 trillion won (USD$24.6 billion) to upgrade the country's infrastructure over the next 5 years, with targets set for broadband wireline and wireless services of

[122] See http://www.dbcde.gov.au/funding_and_programs/national_broadband_network for more details.
[123] See the Digital Britain – Final Report at page 12, available at http://www.culture.gov.uk/images/publications/digitalbritain-finalreport-jun09.pdf.
[124] See the Digital Britain – Final Report at page 14.
[125] See the Digital Britain – Final Report at page 15.

1 GB and 10 Mbps, respectively.[126] Previous government initiatives by the Korean government are discussed further in Section 5.6.1.2.

In the context of the Australian, Korean and UK government plans, the efforts in the United States, and especially Canada, seem to pale by comparison. When the Australian plan was announced there was an immediate stream of media reports questioning why Canada and the United States have not been so bold.[127] However, such comparisons may be too facile. The complexion of each domestic market is different and notably, the UK and Australia lack strong cable-based competition. In North American markets, such intervention could distort the existing facilities-based competition and lead to unintended economic consequences. Also, it should be noted that grand strategies such as those being proposed in the UK and Australia do come with risks – the costs are often underestimated, the time horizons can be incorrect and the technology can change quickly.

That being said, this is not an argument to say that a national ICT strategy is a bad idea. In fact, we believe it is a very good idea.[128] But, in respect of the politicization of broadband, there are those that would use the grand efforts of other countries as the template for Canadian action. We would argue that the idiosyncrasies of our industry and market should strongly inform the development of any made in Canada ICT strategy.

5.6.1 Government measures and initiatives

In most rankings, Japan and Korea[129] regularly top the list in terms of speed and performance of broadband. It is widely believed that government involvement played a significant role in the development of their respective networks. In summarizing the similar approaches of both countries, some commentators have written that: "Both had a strong lead bureaucracy that compartmentalized the sector, orchestrated competitors and micromanaged the terms of

[126] As described in the article at: http://joongangdaily.joins.com/article/view.asp?aid=2900490.
[127] See for example, "Australia's National Broadband Initiative – Biggest Broadband Driven Stimulus Yet" at http://www.govtech.com/dc/638235.
[128] For example, see our call for all levels of government to set out an innovation vision in a blog posting dated November 19, 2007 and opening remarks at both The 2008 Canadian Telecom Summit and The 2009 Canadian Telecom Summit.
[129] Much of this material is synthesized from "Understanding South Korea and Japan's Spectacular Broadband Development: Strategic Liberalization of the Telecommunications Sectors" and from the ITIF Japan Appendix.

competition. In short, the regulatory regimes of both countries were geared towards 'managing' competition."[130]

In the Canadian debate of the issues, the details of Japanese and Korean government involvement are not well understood. This section will provide some of those missing details and explore whether government involvement is indeed the "silver bullet" for broadband performance.

5.6.1.1 Japan

While it is difficult to determine precise dollar figures for the Japanese government's initiatives in this area, it is clear that such initiatives have been part of a series of successive national ICT strategies (e.g. e-Japan, e-Japan strategy II and ubiquitous-net Japan or U-Japan). As part of these successive strategies, the following measures have been used:

1. Subsidies
    a. Guarantees (by the state-owned Bank of Japan) on service providers' debt, which allowed such companies to cheaply borrow money in public markets
    b. Direct subsidies covered one-third of the cost of FTTH initiatives in rural Japan
2. Tax incentives
    a. Accelerated depreciation schedules that allowed providers to depreciate one-third the cost of broadband investments in year one rather than normal 22 years for telecom equipment.
    b. Income tax deferrals[131]
3. Low or zero-interest loans to service providers

It is important to note that Japan has relatively little facilities-based competition. The cable TV industry is fragmented and has faced some difficulties in upgrading their networks for broadband service. As well, despite reports that NTT has been privatized, the government of Japan remains a one-third owner in NTT, the holding company that owns the telecom incumbents and other related businesses.[132]

[130] Kushida and Oh, "Understanding South Korea and Japan's Spectacular Broadband Development: Strategic Liberalization of the Telecommunications Sectors" at page 14.
[131] Ebihara ppt slide 19.
[132] See http://www.ntt.co.jp/ir/shares_e/digest.html as accessed on July 20, 2009.

5.6.1.2 South Korea

Like Japan, Korea has had a succession of national ICT strategies (e.g. Cyber Korea 21, e-Korea Vision 2006 and IT839) and some special programmes focused on rural coverage (e.g. KII-Public) and the deployment of advanced networks (e.g. the Broadband Convergence Network or BcN). To support its various ICT policies, the Korean government created special agencies that employed a number of different measures including:

1. A variety of backbone building efforts including KII-Government where $24B was spent to construct a national fibre optic public network
2. Financial incentives to firms who were building networks
    a. Government loans to encourage private sector investment
    b. Preferential tax treatment
    c. Direct underwriting of loans for the deployment of networks
3. R&D facilitation programmes (e.g. KII Testbed supported R&D to bring technologies to market)
4. Incentives to stimulate demand for broadband
    a. Small and medium-sized businesses received a 5% tax break for broadband investments
    b. Subsidies for Digital Literacy Projects like the "Ten Million People Internet Education Project", the "One Million Housewife Digital Literacy Education Project" and "Cyber 21"
    c. Special financing for personal computer purchases (e.g. the "PC for everyone" programme and other initiatives to help low-income families buy PCs and broadband)

The majority shareholder of Korea Telecom (now known as KT) was the Korean government up until KT was privatized in 2002. But, even while it remained a shareholder of KT in the late 1990s, the government encouraged seven Korean conglomerates (referred to as "chaebol" which included well-known firms like Samsung, LG and Daewoo) to jointly fund the start up of Hanaro Telecom. The financial health of non-incumbent Korean ISPs has faltered in recent past (e.g. Thrunet went bankrupt in 2003), however Hanaro has grown to be the 2nd largest provider in Korea. Hanaro began by leasing facilities from incumbents and eventually transitioned to being primarily a facilities-based provider over hybrid fibre-coaxial infrastructure. Hanaro's tentative financial health strengthened when it was acquired in 2008 by SK Telecom and it now operates as SK Broadband.

5.6.2 Is government involvement the "silver bullet"?

It is tempting to think that government involvement can resolve all issues associated with broadband. Many point to the Japanese and Korean outcomes as reasons why government should be the means to achieving the ends of ultra-fast ubiquitous broadband. But, it should not be forgotten that both Japan and Korea have a policy-orientation that is significantly different from our own. Politics and business are so intertwined that prescriptive government direction is more the norm, and private interests often give way to public policy.

The success of this kind of government action should be assessed in the context of its real costs. The billions of dollars deployed by the Japanese and Korean governments to foster broadband services should be understood as a public cost borne by every citizen. Those costs are in addition to the monthly subscription fees paid. Given that, pricing metrics based on advertised offers will never fully explain the true cost of broadband in these countries.

Also, it should be noted that the development of Japanese and Korean broadband networks was not a smooth progression, without conflict or regulatory dispute. Japan's experience in particular was fraught with power struggles initially amongst ministries and later with the incumbent.[133] Neither government can be said to have "orchestrated" the advancement of their respective broadband networks in the fullest sense of the word. As Kushida and Oh point out, "the governments were far from omniscient nor monolithic; they were sometimes taken by surprise by actual market developments..."[134] Both countries were operating in a period of financial crisis. Korea had been so badly hurt by the Asian financial crisis of the late 1990's that it was one of a few Asian countries whose currency had to be stabilized by the International Monetary Fund. Japan continues to suffer from a more than decade long period of economic stagnation that began in the 1990s with the bursting of the "Japanese asset price bubble".[135] The government programmes from those eras were part of strategies to remedy the economic issues of the time and prepare for the future. In that latter regard at least, they may have in part succeeded.

Does that mean Canada should adopt their strategies in a quest for broadband leadership? It is too simplistic to think that Canada can or should mimic these countries' broadband policies.

[133] See Kushida and Oh at page 9.
[134] See Kushida and Oh at pages 6-7.
[135] See http://en.wikipedia.org/wiki/Japanese_asset_price_bubble for more detail.

The unique interplay of business and politics in each of Japan and Korea cannot be replicated in Canada. The cooperation of the *keiretsu*[136] of Japan and the *chaebol*[137] of Korea with their respective governments would be unfathomable in the North American political context.

Moreover, unlike Japan and Korea, Canada is fortunate to have had competing broadband networks from the beginning. By contrast, both Japan and Korea have spent their money and efforts encouraging resale competition and the build out of fibre-based competition. This key difference in industry configuration is fundamental and ought to be considered before undertaking any governmental effort.

[136] Defined as a set of companies with interlocking business relationships and shareholdings; see http://en.wikipedia.org/wiki/Keiretsu.
[137] Defined as a government-supported family-controlled multinational corporation; see http://en.wikipedia.org/wiki/Chaebol.

6 Summary

Much ado has been made about Canada's fall in the OECD penetration rankings over the last five years. In a recent briefing given to Canada's Senate, it has been declared that the Canadian telecommunications environment is in "crisis, lacking in competition and gradually declining in comparison with peer countries around the world."[138] This conclusion was based in part on Canada's position in the recent OECD broadband rankings on penetration, speed and pricing. This of course led to a news cycle that was peppered with headlines like: "Canadian telecommunications sector "in state of crisis", Senate committee warned."[139]

We believe that this conclusion is incorrect, and that it was based on flawed research, namely, the OECD rankings. As we have discussed in Sections 4.2 and B.1 of this paper, the OECD statistics on broadband are not infallible, and there is good reason to believe that their approach should be reviewed and corrected. The difficulty of conducting a 30-country international comparison in a rigorous scientific manner should not be underestimated. The OECD analysis is highly dependent on per country sampling data used[140] and its penetration metrics are biased in favour of countries with smaller household sizes. Moreover, the OECD makes no allowances for the vast differences in geography and urbanicity that have a very significant impact on the cost of building, operating and enhancing broadband networks.

But we should not dwell on the OECD rankings. They should not be discarded entirely, but such rankings need to be read with their biases in mind and in the context of the vast amount of research available from other learned sources.

To be constructive in our own analysis, we have focused on the broader issues rather than any particular piece of research. In that regard, to help simplify the overwhelming amount of research that is available, we want to focus on answering a few simple, yet key questions:

[138] See Michael Geist's Appearance before the Senate Standing Committee on Transport and Communications, May 26, 2009 at http://www.michaelgeist.ca/index2.php?option=com_content&do_pdf=1&id=4037&task=view.
[139] See http://www.techmediareports.ca/reports/content/9629-canadian_telecommunications_sector_%E2%80%9Cin_state_of_crisis%E2%80%9D_senate_committee_warned.
[140] As noted in Appendix 8.2.4, some OECD rankings rely on an unweighted average of a sampling of advertised pricing and speeds for only a few carriers per country.

1. Is broadband available to Canadians? If not, why not?
2. If it is available, do Canadians adopt the technology? If not, why not?

International comparisons can help us understand whether we lag or lead in terms of availability or adoption, but it is these questions that should be the focus of debate.

6.1 Universal availability of broadband in Canada

While some may challenge the assumptions, we think that Canada has 100% broadband availability; that every Canadian household willing to pay for broadband can have broadband. This assumes that the remaining 6% of "unserved-by-wired-connection" households can subscribe to fixed wireless or satellite connections. We are also assuming that a percentage of those households will still choose not to subscribe, thereby ensuring the availability of sufficient satellite capacity for those who are willing to pay for it. The price differential and capacity concerns associated with current generation satellite service will reduce significantly when next generation service is available in the next 2 to 3 years, as was described in Section 3.5.

Some would take issue with our assertion of universal service because of the price differential alone. Is it wrong to think that rural and remote communities would have to pay more for their broadband connection? The reality is that prices of many products and services are higher in rural and remote areas.[141] It is really a function of the higher cost of providing goods and services to those areas. There is no reason to think that broadband should be any different.

This raises the broader issue of which technologies should count when measuring a country's connectedness. We think that the concept of broadband needs to be technology agnostic. This is particularly true in a country like Canada where the vast geography and low population density pose a unique challenge. Each technology will have its relative advantages and disadvantages depending on the geography, topography and other unique characteristics of each community. We should not measure availability and coverage based only on wired technologies. The exclusion of wireless alternatives might have been appropriate when they

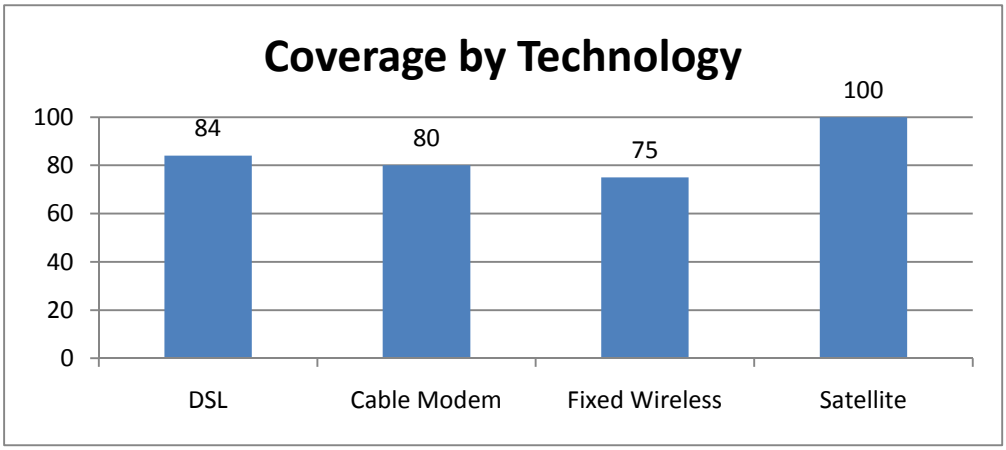
[141] There are positives and negatives to living in any locale, and a price differential is not always a negative. When considering the "fairness" of rural and remote households paying more for broadband than their urban counterparts, we should also remember that some large budgetary expenditures like housing are generally less expensive in non-urban areas.

were in their relative infancy, but with each new technology generation, the services improve and the relative disadvantages mitigate. With the mass market availability of 3G data connections, and the advent of next generation satellite, it makes less sense to distinguish between flavours of broadband based on twisted pair, coaxial cable or various wireless formats.

Not including wireless and satellite services, Canada has broadband available to 94% of households. With $500M about to be invested in expanding broadband coverage ($200M from Broadband Canada and approximately $300M from the various deferral accounts), availability will become even better.

The vast majority of Canadians have a choice of multiple facilities-based competitors, a degree of intermodal competition that is rarely found in other countries.

Figure 6.1.1: Broadband Availability by Technology



With 3G wireless reaching farther and farther, the vast majority of Canadian households now has a choice of at least 4 broadband technologies (cable, DSL, 3G wireless or satellite), being offered by a number of different suppliers (a cableco, a telco, a mobile carrier, a satellite provider and a number of competing resellers). As shown in Figure 6.1.1,[142] for most Canadian consumers, the relevant question is no longer about broadband availability; instead, their challenge is to determine which offering provides them the best service at a price point affordable to them.

[142] CRTC, 2009 Communications Monitoring Report, at page 223.

How does Canada compare internationally on the issue of availability? Countries (like Belgium, Denmark, France, Korea, Luxembourg, the United Kingdom, and the Netherlands) that have 99% or greater availability tend to be smaller, more densely populated than Canada. In fact, the same holds true for countries with comparable wired coverage levels to Canada (like Sweden, Germany, Portugal, Iceland and Italy). When comparing Canada to similarly large countries like the United States and Australia, Canada clearly remains a leader in broadband availability.

Australia has announced plans to spend A$43B (C$40B) over the next 8 years to build a network capable of delivering 100Mbps services to 90% of its population.[143] The remaining 10% will be served by next generation wireless and satellite based services. Without relying on significant government support, Canada's infrastructure will easily exceed these coverage and performance targets.

6.2 The availability of next-generation broadband

As more and more countries reach 90+% broadband availability, it is becoming less of a differentiating point. Continued attention remains on closing that final availability gap in many countries, but the focus is starting to shift to the availability of next-generation broadband. A relatively new set of metrics in broadband leadership are developing around performance and quality. Network operators have been investing in upgrades to current technologies to squeeze out incremental performance gains, but the next generation of technologies will provide multiples of today's average speeds.

Canadian carriers have been criticized for being slow to roll out next generation technologies like FTTH. The often-cited OECD statistic is that Canada has 0% penetration of fibre connections as compared to leaders like Japan with 48%, Korea with 43% and Sweden with 20%. What is missing from that discussion is recognition of the degree of FTTN and DOCSIS 3.0 deployments in Canada, not to mention the number of competing next generation wireless networks that are set to launch in 2010. Again, we believe the thinking on this issue needs to be technologically agnostic. A metric that focuses on a single technology, rather than the capabilities of the service, will mislead and poorly represent the true state of development in many countries. For example, Canada has a number of service providers who are or have been

[143] April 7, 2009 press release from Australia government "New National Broadband Network".

offering 25, 50 and 100 Mbps services for over a year now, but these are not captured in the international comparison from the OECD.

Our best explanation for this bias is a telco-centric OECD methodology, reflecting the dominant role that DSL networks, operating on incumbent phone company facilities, play in European markets as seen in Figure B.1.3; while Canada's highest speed services are currently based on the DOCSIS 3.0 standard operating on cable networks. So, even though we have services that equal or exceed many of the fastest FTTH-based services available in other countries, Canada is criticized for having close to 0% fibre connection penetration. This criticism leads to an overly pessimistic view of Canada's broadband status that is too often cited in the media coverage of this issue. We should instead be looking to cultivate a more constructive dialogue in the industry.

Canada, like all countries, has work to do in maintaining an investment environment that is conducive to next generation network deployments (including but not limited to FTTH or FTTN). As discussed more fully in Appendix B.1.5.1, we note the recommendations of the LECG/NSN report that suggests that Canada would benefit from increased incentives for the deployment of next generation networks.[144] Private investment has taken the country very far in the broadband race, and with Bell Aliant's recent FTTH announcement and near universal adoption of DOCSIS 3.0 technology by cable companies, the private sector appears committed to the race. Existing policy and regulatory uncertainties need to be resolved to eliminate any confusion around the incentives for investment in next generation networks. The elimination of such uncertainty could be the most profound incentive that government can provide.

6.3 Adoption and the unexplained gap

With broadband generally available to all households, do Canadians choose to adopt the technology?

As discussed above in Section 4.1.2, approximately three out of four households in Canada subscribe to internet services. The number of residential internet subscribers reached almost 9.8 million by 2008, of which more than 9.1 million had broadband connections. Essentially, 93% of all residential internet connections are broadband connections. High-speed

[144] LECG/NSN, "Connectivity Scorecard 2009: Canada," page 5.

connections are present in nearly 70% of Canadian households, up significantly from 60% in 2006.

In terms of international rankings on penetration and adoption, for reasons discussed in Section 5, we have to be careful to look beyond any statistic to its underlying methodology in order to truly understand what is being measured. Also, we need to take note of how broadband connections are in fact used. Consumer broadband routers and WiFi-capable hardware are so commonplace that households sharing a single broadband connection are more the norm than the exception. Popular metrics based on connections per 100 population ignore this reality and as a result, give a skewed view that favours countries with smaller household sizes. For example, Denmark, the OECD penetration leader, only needs 90% household penetration to hit 42 connections per 100 population, while Canada with its larger average household size would need 105% household penetration to achieve the same OECD scoring.

Household penetration is the more accurate measurement of a country's performance in broadband adoption. On that measure, looking at a number of different studies done in 2007 and 2008, Canada ranks somewhere between 5th and 8th depending on which study you find more compelling (as described in Section 4.2.2). Countries with higher adoption levels tend to be smaller, and more densely populated than Canada. The fact that Canada keeps pace with countries that face lesser geographic and density challenges is clear evidence that Canada is doing well in terms of broadband performance.

However, we still have an adoption gap that could be improved. To make further progress on penetration, we need to determine why approximately 30% of households choose not to buy broadband services even when they are available. While many would suggest affordability is the reason, survey evidence suggests that is not necessarily the case.[145] In fact, when we look at affordability metrics like the ITU's cost as a percentage of per capita gross national income, Canada is a leader in affordability, second only to the United States.

Other research has looked at PC penetration as a possible obstacle. Approximately 94% of Canadian households with a computer have an internet connection; in order to increase

[145] CIP, "Canada Online! Year Two Report, 2007," September 2008, Table 4-1.

internet penetration in Canada, we need to also consider how we might increase the number of households with computers.

As well, some evidence suggests that certain demographic groups are less likely to buy broadband than others. Statistics Canada observed that a digital divide "persists among certain groups of Canadians, specifically on the basis of income, education and age," although the divide was somewhat less in 2007 than in 2005.[146]

The reality is that we do not have a good understanding of why 30% of households are not adopting. More local research is required. We suspect that better segmentation of the non-adopters would help understand the overall picture. For example, affordability is likely an issue for some households, particularly those who might have to pay more in rural and remote Canada, and also among lower income groups in urban centres.

For urban non-adopters who have lower priced broadband options available to them, it may be that they do not see sufficient value in broadband services. This may be because of a lack of digital literacy, or perhaps their ability to use the internet at work is sufficient such that they do not feel the need to buy it for home. As well, while popular applications may appeal to the majority, there remain people out there who do not want Facebook, YouTube or even email in their lives.

Finally, as next generation broadband becomes increasingly available, we need to understand why increases in adoption have been slow, particularly for the higher speeds. According to the CRTC's most recent statistics, less than 9% of residential internet subscribers had a service offering 10 Mbps or greater speeds in 2008, up only a few percentage points from the level in 2006[147]. The percentage taking service with speeds of at least 5 Mbps has not changed during the three year period. Again, affordability may be the issue as the premium 50 and 100 Mbps services are also premium priced. Or, it may be a general lack of compelling content and/or applications that really require that level of speed and performance.

In any event, we believe that more attention should be focused on the demand side of the equation, to develop a better understanding of why some households choose not to adopt, or

[146] Statistics Canada Daily, June 12, 2008.
[147] CRTC Communications Monitoring Report, 2009, Table 5.3.3.

why Canadian broadband consumers seem satisfied with 5Mbps service or less, when 50Mbps service is increasingly available. Instead of focusing so much on penetration rankings, we should concentrate on identifying and eliminating the barriers to adoption. If we succeed, better penetration will be the natural result.

6.4 International comparisons and lessons

International rankings and comparisons are meant to inform us regarding our relative position with other countries. What they do not do is help us understand why a country is doing better or worse than its peers.

So, when we look at the leaders in various rankings, the real lessons to be learned are buried in how they got there. This paper does not include an exhaustive review of the state of broadband in other countries. As a result, we will not attempt to explain each country's respective successes and shortcomings. However, in doing the research on Canada's situation, we had occasion to look deeper at research regarding some other countries. From that research, a few lessons and issues arise.

First, of all the lessons learned from our review of international comparisons, the clearest is to approach them with a healthy skepticism. We have a tendency to simply accept research findings from foreign institutions at face value, as if the international cachet of the organization provides a guarantee of accuracy. If a ranking includes Canada, we should be questioning how the data specific to our market was gathered. We should be investigating the methods or metrics used to develop the conclusions. If we fail to exercise critical thought in the interpretation of the research, we risk reliance on flawed data and faulty conclusions. Such blind reliance could lead us to actions that are ill-advised and could ultimately diminish our relative position.

Second, the role of government varies dramatically across jurisdictions and it is not obvious that government involvement is the key to success. It is clear that South Korea and Japan have a history of government intervention in broadband infrastructure, and that they have an enviable fibre-based broadband infrastructure. As a result, some commentators are fond of using these countries as proof that government involvement is needed to ensure that Canada catches up with these broadband leaders. As discussed in Section 6, the correlation is not so

simple. If government involvement is indeed the cure-all, countries like Sweden and France would be in a similar position to Korea and Japan. Also, any performance lead once held by Japan and Korea is quickly eroding as Canadian service providers roll out 50 and 100Mbps services to 90+% of households. Of particular note is that Canada has reached this level of performance in the absence of significant government involvement.

Finally, it appears that some countries have successfully employed demand-side measures to stimulate adoption. Enhancing demand may also help alleviate any nagging supply side concerns. For example, in rural and remote areas increased demand would help improve economies of scale and give service providers greater confidence in making network investments in those areas. Similarly, enhanced demand could stimulate interest in next generation network services, thereby improving the business case for such investments. While we do not propose copying any international initiatives outright, there may be some Canadian adaptation of those ideas that could help close the adoption gap we are experiencing.

Canada, for the most part, has been supply-side focused in its policy efforts. From BRAND-like initiatives to spectrum auction policy, we have a tendency to pursue our objectives through the supply side of the industry. On the other hand, countries like Denmark and Korea who are penetration leaders no matter what ranking or methodology used, have focused to some extent on demand side issues. Denmark offered significant incentives to spur adoption. Korea had a strong focus on digital literacy.

Canada could, for example, provide a tax break to stimulate consumer and small business broadband adoption, similar to the benefit currently available to small businesses purchasing computers and related software. The incentive could be structured to target affordability for lower-income households, as well as for those in rural and remote areas facing higher service costs. A similar approach, among other incentives, could be designed to encourage adoption of next generation services in a manner that is both technology and service provider agnostic.

With Canada beginning the process of developing a national ICT strategy, and broadband availability diminishing as a dominant concern, perhaps it is time to focus on demand-side policies.

A Appendix A: How did we get here?

Since Confederation, one of the great challenges for Canadians has been building infrastructure to enable communications between its communities and the rest of the world.

Canada's population characteristics

Canada's population of 33 million people resides in 9 million square kilometres of land. While this results in an average population density of about 3.5 per square kilometre, in Canada's large census metropolitan areas ("CMAs"), average population density is 238 inhabitants per square kilometre. Most of the population centres are in the southern part of the country. The three northern territories (Nunavut, Yukon and Northwest Territories) represent 39% of Canada's land area but only 0.3% of its population.

The transcontinental railroad project of the 1800's helped to connect the Pacific to the eastern provinces and provided a commercial link for the exchange of goods from coast to coast. That rail line provided a corridor for early telegraph connections, leading as well to the birth of voice communications.

Canada's telephone industry achieved some of the world's highest penetration rates, overcoming the geographic challenges to succeed in building a universally accessible, affordable network, delivering phone service to virtually all of the population.

Canada's cable TV industry was born as a result of the population characteristic that keeps so many Canadians within a two hour drive of the US border. Entrepreneurs saw opportunity in establishing community master antennae to redistribute TV signals from nearby American communities, such as Buffalo, Cleveland and Detroit. Such was the beginning of Canada's cable TV industry.

For nearly 60 years, Canadian homes have had two sets of wires delivering communications services, laying the foundation for facilities based competition in converged communications services. To a lesser extent, the United States shares this history of two wires into the home. Outside of North America, this degree of wired competition does not exist.

Today, cable companies have transformed their networks from one-way broadcasting distribution networks to two-way broadband communications networks, expanding services to include voice telecommunications and broadband internet access services. In 2007, landline

telephone service and internet services represented approximately 40% of cable company subscription revenues.[148]

At the same time, technological developments have enabled telephone companies to transform their wired analog voice networks into broadband networks capable of providing a suite of digital services. Most telephone companies in Canada offer broadcasting and broadband internet access services, competing vigorously with cable companies to offer a bundle of services to the digitally connected home.[149]

With its vast landmass and challenging topography, Canada poses some challenges that are not found in many other countries in the world. In light of those challenges, the availability of universal telephone service and near ubiquitous cable television service is remarkable, especially in comparison to many smaller, developed countries where obtaining a home phone line even in urban centres was an expensive process that often took months to arrange.[150]

Other aspects of Canada's broadcasting industry also overcame the same geographic challenges by deploying innovative technologies to reach their customers. In 1958, CBC's national microwave network was extended from Victoria to Sydney, creating the world's longest television network. In 1972, Telesat's launch of Anik I represented the world's first domestic communications satellite.

It is this very history that led to Canada's early leadership in broadband. By leveraging the established footprint of phone and cable networks, Canada was able to deploy DSL and cable broadband more quickly than most other countries. This momentum was helped in part by early government initiatives that recognized the importance broadband connectivity. The Telecommunications Policy Review (TPR) Panel recognized these historical efforts in its final report:[151]

> Canada was among the first countries to recognize the potential for information and communications technologies (ICTs) to transform and enrich economic and social life. Since 1993, it has been the policy of the federal government and most provinces to

[148] Statistics Canada, "Cable and Satellite Television Industry – 2007," Catalogue No. 56-209-X, page 6.
[149] CRTC Communications Monitoring Report 2008.
[150] For example, up until the advent of VoIP services and cellular phones, it was quite common for Japanese households to not have their own home phone line. Banks of pay phones lined the streets and prepaid calling cards were a daily consumer item.
[151] See http://www.telecomreview.ca/eic/site/tprp-gecrt.nsf/eng/rx00062.html for the full text.

> increase the level of electronic "connectedness" of Canadian consumers and businesses to each other and to the world. Over the past decade, the federal government has made investments of close to $600 million toward advancing the connectivity agenda.
>
> As a result of one of these investments, the federal government's SchoolNet program, Canada became the first country in the world to connect all of its schools and libraries to the Internet. Industry Canada's Community Access Program (CAP) now provides Internet access in a public setting to some 100,000 Canadians each day, and it has provided training to 19,500 community volunteers through its cross-Canada network of public Internet sites.
>
> In 2000, the federal government set a policy goal of ensuring that broadband networks and services would be available to businesses and residents in every Canadian community. The National Broadband Task Force was established to recommend how the federal government's broadband access goal could be achieved. In response to the 2001 task force report, Industry Canada launched the Broadband for Rural and Northern Development (BRAND) pilot program in 2002 and the National Satellite Initiative (NSI) in 2003. In addition to the BRAND program, other federal government departments, provinces and territories have sponsored broadband access programs in various parts of Canada.
>
> While these public sector investments were important, market forces played an even more significant role in making Canada a global leader in broadband deployment. By the mid-1990s, a vigorously competitive broadband market was developing in Canada. Both cable and telephone companies began offering high-speed access over upgraded facilities in urban centres in the mid- to late 1990s. Canadian cable companies were global pioneers, providing cable modem services as early as 1996. The subsequent large-scale deployment of broadband over DSL (digital subscriber line) technology by the incumbent Canadian telephone companies propelled Canada to the second-highest level of broadband service penetration in the world by 2003.

Following its review of the state of broadband in Canada, the TPR Panel went on to recommend that "a specific, targeted government subsidy program, the Ubiquitous Canadian Access Network/Ubiquité Canada or U-CAN program, should be established to ensure that broadband access is made available to Canadians in areas where commercial operators are not providing service and are unlikely to do so for economic reasons." Notably, the Panel found that given the social and economic policy goals behind such an effort, the costs of such a program should be shared by all Canadians using federal government tax revenues, rather than existing regulatory funding mechanisms like the contribution regime administered by the CRTC.

Since the TPR report was released in 2006, government action has focused on the regulatory reform recommendations, rather than the Panel's broadband recommendations. This inaction can also be explained in part by the change in government that took place in early 2006, with the Conservatives winning a minority that was later strengthened in a 2008 election.

As part of the Conservatives' re-election platform in 2008, it was announced that they would spend $100 million per year over a five year period toward completion of Canada's broadband networks. The election promise was made under the title "Ensuring a modern economy throughout rural and remote Canada."[152] Little detail was provided at the time, but in July 2009, it was officially announced that, as part of Canada's Economic Action Plan, the Government is investing $225 million over three years for Industry Canada to develop and implement a strategy to extend and improve broadband coverage. The stated goal of the investment is to extend broadband service to as many remaining unserved and underserved Canadian households as possible.[153]

[152] See http://www.conservative.ca/EN/1091/107195 dated October 11, 2008.
[153] See http://pm.gc.ca/eng/media.asp?id=2703 dated July 30, 2009.

B Appendix B: Rankings and statistics

The following section provides supplementary statistical information. It is worth noting that survey results, such as those cited from Statistics Canada, may be only loosely comparable to results obtained from service providers' data, which is the basis for CRTC statistics. This is because surveys track usage as reported by individuals which can include use at any location, whereas service providers' results are based on records of subscriber accounts with access to the internet at home.

The frequently cited OECD statistics are fundamentally flawed. The penetration metrics that are produced are an outcome of a methodology that suffers from a design bias in favour of countries with smaller household sizes. Further, the sampling process for gathering information used to derive the OECD's pricing and performance statistics is arbitrary and inconsistent. As discussed in Section 4, the OECD statistics are therefore not representative of the average prices, speeds and prices per Mbps available to consumers and cannot be relied upon to gauge relative performance.

B.1 International comparisons

As we observed in Section 4.2.1, the different reports and approaches produce different rankings. In undertaking any international comparison, one must be cautious not to fix on any one measure regardless of whether it provides good or bad news. Much more can be learned by considering a range of indicators and taking into account the underlying factors that influence the results.

B.1.1 Types of indicators

There are two indicators that are frequently used in international comparisons: rates of adoption of broadband internet services; and, indices of availability of infrastructure capable of delivering these services.

Indicators of the rate of adoption typically measure the number of subscribers as a percent of the overall population or households. Using population or households as the base for subscriptions does not take into account any gaps in the availability of services. Countries that have areas without access to broadband service will obviously be at a disadvantage in adoption rates. Other factors that can influence adoption rates include prices, access to personal computers or other internet-capable devices, and general socio-economic factors such as age, income and educational background which can affect consumers' ability to use or interest in broadband services, as discussed in Section 4.3.1.

Wireless Broadband Measurement

Because the OECD's count of broadband subscribers does not include 3G handsets or data cards (mobile modems) as broadband connections, countries with high levels of subscription to these devices may see overall penetration levels increase when they are included. For example, Japan and Korea are known to have significant numbers of 3G handsets in use, as shown in the following table. However, only those 3G mobile handset subscribers that also have reported monthly data usage will be counted as broadband connections.

	Japan	Korea
Broadband subscribers (Current OECD definition, Dec 2007)	28,749,525	14,709,998
Fixed wireless (included in OECD broadband, Dec 2007)	12,824	381
3G mobile subscribers (Dec 2007)	88,097,400	37,783,514
Mobile WiMAX/WiBro (Dec 2007)	NA	106,118

By including mobile broadband devices in the count of total broadband subscribers, there is some potential to double-count individual users who may use their mobile devices to supplement a fixed broadband connection. This could result in some countries reaching penetration levels that exceed 100%, as seen in the case of some European countries respecting the penetration of mobile voice subscriptions.

Availability of broadband infrastructure is based on the percentage of households that can connect to broadband service providers, regardless of whether they actually subscribe. Accurate measures of the coverage of broadband-capable networks can be complicated by technical factors, such as loop length or signal strength. Deployment of broadband networks is likely to lag where the cost is high and the potential customer base is relatively small. As a result, countries with populations widely dispersed among numerous rural or remote communities tend to have higher deployment costs and, thus, gaps in broadband availability, as discussed in Section 4.3.2.

Other than adoption and availability, international comparisons sometimes consider the average price of broadband service. The price is usually converted to a common currency or purchasing power parity. Comparisons are more meaningful if they account for variations in

the price due to different service levels; normalizing, for example, the price per Megabit per second (i.e., price per Mbps). The speed of the service itself can be another important indicator.

Another approach to comparing broadband performance can be found in broader indicators of digital or electronic ("e") readiness that combine several measures to form an index. Indices include statistics related to business and government, in addition to the consumer side of internet usage. The decision as to what indicators to include and what weights to assign to each indicator influence a country's ranking. The variation among the indices in terms of the indicators and weights make it difficult to compare country rankings. That said, these can still reveal some useful insights as to a country's performance by highlighting other areas of strength or weakness.

B.1.2 Adoption of broadband internet

The OECD is a frequently cited source of statistics on broadband performance and has provided a wealth of information on 30 countries since 2000.[154] Among the many indicators reported over the years, broadband subscribers per 100 population is commonly used as a means of ranking countries. Other indicators tracked over the years include advertised speeds in Mbps and price.

The OECD's measure of broadband includes all wireline and fixed wireless broadband lines offering download capacity of at least 256 kilobits per second (kbps), but does not include 3G mobile or Wi-Fi connections.[155]

The number of broadband subscribers will depend on the minimum service level that is considered to be capable of delivering "broadband" capacity. While the OECD uses 256 kbps as the minimum cut-off, other countries are moving to higher standards, such as 1.5 Mbps or higher. For the purposes of the comparisons in this section, the analysis necessarily relies on the definition of broadband applied by the source of the data. Virtually all deployments of DSL and cable modem service are capable of delivering at least these speeds, although lighter versions are offered and chosen by some subscribers.

[154] OECD Broadband Portal: http://www.oecd.org/sti/ict/broadband
[155] Wireless 3G and Wi-Fi lines may be included in rare circumstances where this is the transport mechanism used by a fixed wireless internet service provider.

Broadband penetration as measured by subscriptions per 100 population has come under criticism as inferior to measuring broadband subscriptions per household.[156] Residential broadband subscriptions using fixed wireline connections typically provide connectivity for all household members. Additional subscriptions are unnecessary given advances in consumer technologies that facilitate the sharing of broadband connections.

The OECD's measure of broadband subscribers includes both residential and business subscribers. The OECD states that the "vast majority" of subscriptions are residential.[157] A better indicator of broadband subscriptions per household would be based on an adjusted count that excludes business broadband lines from the total. Otherwise, the total penetration per household will be overestimated. Since there is likely to be variations among countries in terms of the business lines included, the amount of overestimation will not be consistent and the relative rankings will be distorted.

In the case of Canada, the OECD estimated 9.6 million broadband subscriptions as of December 2008 and 8.7 million the previous year. CRTC data indicate total residential broadband subscribers of 9.1 million in 2008, up from 8.4 million in 2007. These data suggest approximately 500,000 business broadband subscriptions were included in the OECD totals for Canada.

Including business broadband subscriptions in the measure of penetration on a per household basis is estimated to overstate Canada's household penetration by 3 to 4 percentage points. However, the potential for overestimation may be more significant in countries that have a higher penetration of DSL-based broadband subscriptions because these are more common among business users than cable-based subscriptions. Since Canada and the United States have the lowest proportion of DSL-based broadband subscriptions, failure to exclude business broadband subscriptions is less likely to result in overestimation than in other countries.

[156] See for example: Scott Wallsten, "Understanding International Broadband Comparisons," Technology Policy Institute, June 2009; The Information Technology and Innovation Foundation, "Explaining International Broadband Leadership," May 2008; Robert McDowell, FCC Commissioner, Introductory Remarks for the Phoenix Center Workshop: Understanding Broadband Metrics: The Broadband Adoption Index, National Press Club Washington, D.C., July 15, 2009.
[157] OECD Broadband Portal, FAQs, available at: http://www.oecd.org/faq/0,3433,en_2649_34225_41541640_1_1_1_1,00.html.

This data measurement challenge raises another issue of how to count broadband access that occurs through means other than household-based subscriptions. Some individuals may find that accessing the internet through work or school is a sufficient substitute for a subscription at home. For example, the CIP Canada Online! 2007 survey of Canadians found that about 5% of internet users did not have any connection at home.[158] These forms of access will tend to be underrepresented in the total number of broadband subscriptions. The potential underreporting due to this factor could more than offset overestimation caused by the inclusion of some business broadband subscriptions.

Businesses and universities may be counted as only a single broadband connection, even though their single connection provides connectivity for a large number of individuals. Surveys have the ability to measure users of broadband internet on an individual basis, rather than subscriptions per dwelling or office that may be shared among members of a household or employees of a business. However, survey results may suffer from sampling errors, or reporting errors, for example, a participant's perception of whether an internet connection is truly broadband.[159]

Surveys have been used in several countries to indicate broadband penetration among individuals and households. Statistics Canada's biennial survey found that, in 2007, 94% of Canadians aged 16 and older had internet access at home, of which 88% reported a broadband connection.[160] This suggests that almost 83 percent of survey participants had a broadband connection at home. The same survey reported 9 out of 10 urban home users had broadband, while 7 out of 10 rural home users had broadband; further indicating a penetration of broadband among households north of 80%. This level of penetration is high compared to other reported data. The CRTC reported broadband penetration among households at 64% in 2007.[161]

See Section 4.2.2 for further discussion of broadband adoption in Canada and internationally.

[158] CIP, "Canada Online! Year Two Report, 2007," September 2008, page 94.
[159] Ibid., page 94, footnote 7: "It is not always clear to the average survey respondent whether they have a full broadband connection into the home. The results tell us that among those surveyed, 91% of those who subscribe to cable for Internet connections, 89% of those with high-speed telephone service and 92% of those with satellite/wireless services claim to have a broadband connection."
[160] Statistics Canada, "Canadians Internet Use Survey, 2007," The Daily, June 12, 2008.
[161] CRTC, Communications Monitoring Report, 2008, page 207. Based on high-speed defined as at speeds of least 128 kbps. Broadband services providing speeds of at least 1.5 megabit per second (mbps) were taken by 48% of households.

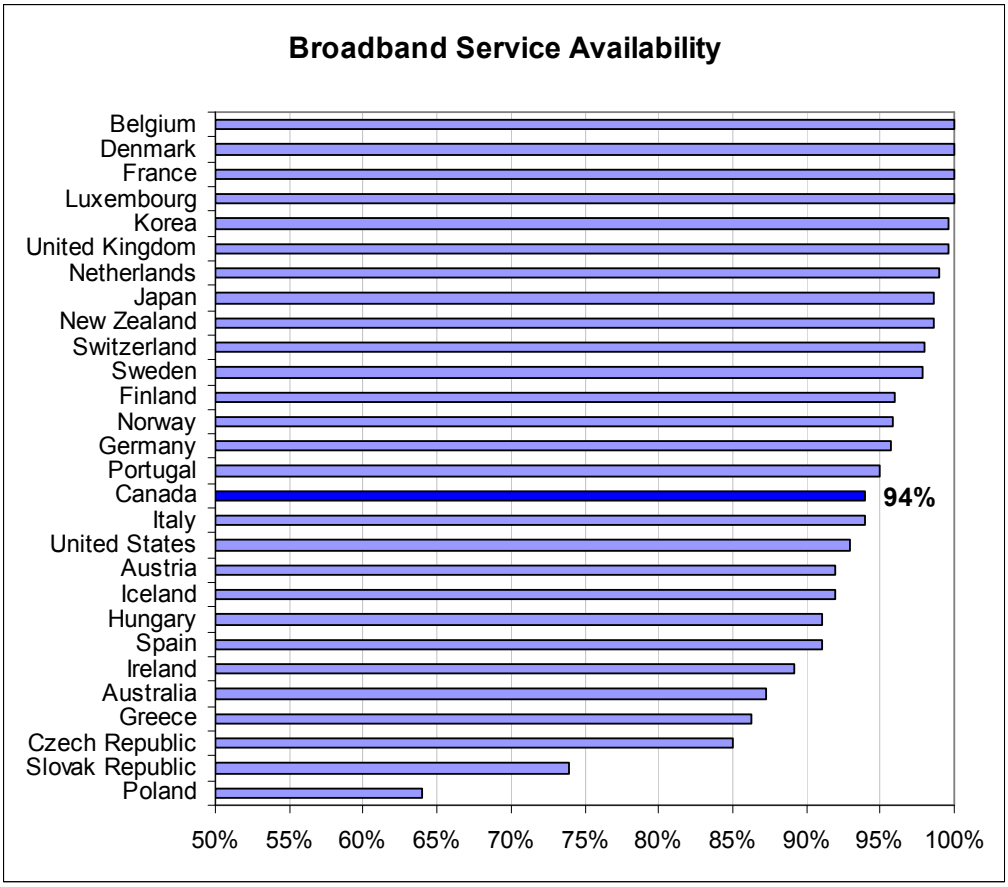
B.1.3 Broadband availability

The availability of broadband service in many countries is based on the availability of DSL, as that is the predominant form of service in Europe and certain Asian-Pacific countries. The current state of DSL-based service supports at least 1.5 Mbps downstream, and increasingly supports speeds of at least 5 Mbps and up to 20 Mbps. However, the length of the copper loop serving the customer's premise can limit the connection to lower speeds or, in some cases where the loop is too long, the line may not support DSL at all. If such loop length limitations are not taken into account, it can result in overestimation of service availability. For example, the CRTC's Communications Monitoring Report published in 2009 reported lower service availability for DSL-based internet services in 2008 than in the previous year's report.[162]

As noted in Section 4.1.1, wireline broadband internet service is available to 94% of Canadian households. This is relatively extensive coverage given Canada's low population density and significant land mass. Fixed wireless and satellite-based technologies are extending this coverage to virtually universal coverage. Wireless services based on mobile 3G technology can also deliver speeds of at least 2 Mbps, and already cover 91% of households in Canada. Canadian wireless carriers are already deploying 3G networks delivering 20Mbps download speeds and are aggressively marketing broadband access for computers, independent of voice service plans.

[162] CRTC, Communications Monitoring Report 2009, Table 5.3.4, reported availability of DSL to 84% of households based on detailed coverage maps, as noted at footnote 235. Previously, the availability was reported at 89%, based on whether service was available in a postal code.

Figure B.1.1: Broadband Availability

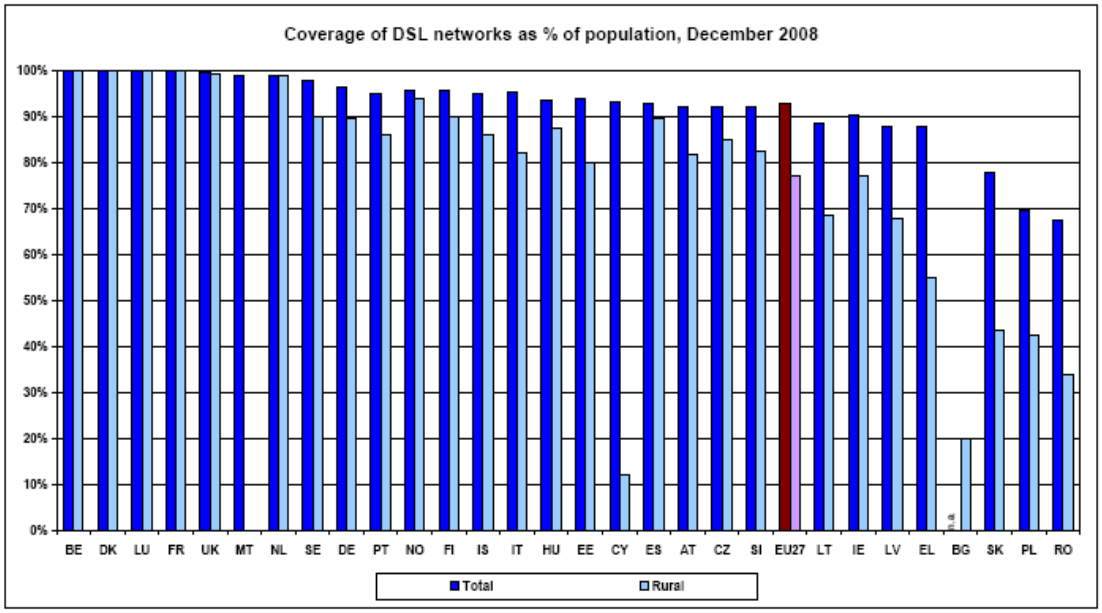


A number of countries have achieved universal or near universal coverage with wireline based broadband services. Belgium, Denmark, France, Korea, Luxembourg, the United Kingdom, and the Netherlands, countries that have more highly concentrated populations than Canada, are all reported to have 99% or 100% availability of wireline broadband services. Figure B.1.1[163] provides a comparison of the availability of broadband service.[164]

[163] Information shown as a percentage of households in Canada, the US, Australia and Japan; percentage of population for other countries.

[164] Data Sources: Canada - CRTC, Communications Monitoring Report, 2009; the U.S. - estimated from the Federal Communications Commission and the National Cable Telecommunications Association; Korea – http://www.point-topic.com as of July 2009; Japan - http://www.dosite.go.jp/e/pj/tele_com.html; European Community Members: "Study on Broadband Coverage in Europe: Survey 2009" by iDATE Consulting and Research, http://ec.europa.eu/information_society/eeurope/i2010/benchmarking/index_en.htm; Australia – ACMA Communications Infrastructure Services and Availability Report 2007-08 Report, http://www.acma.gov.au/WEB/STANDARD/pc=PC_311168; and New Zealand – New Zealand

Figure B.1.2: Broadband Availability in Urban versus Rural Areas in Europe



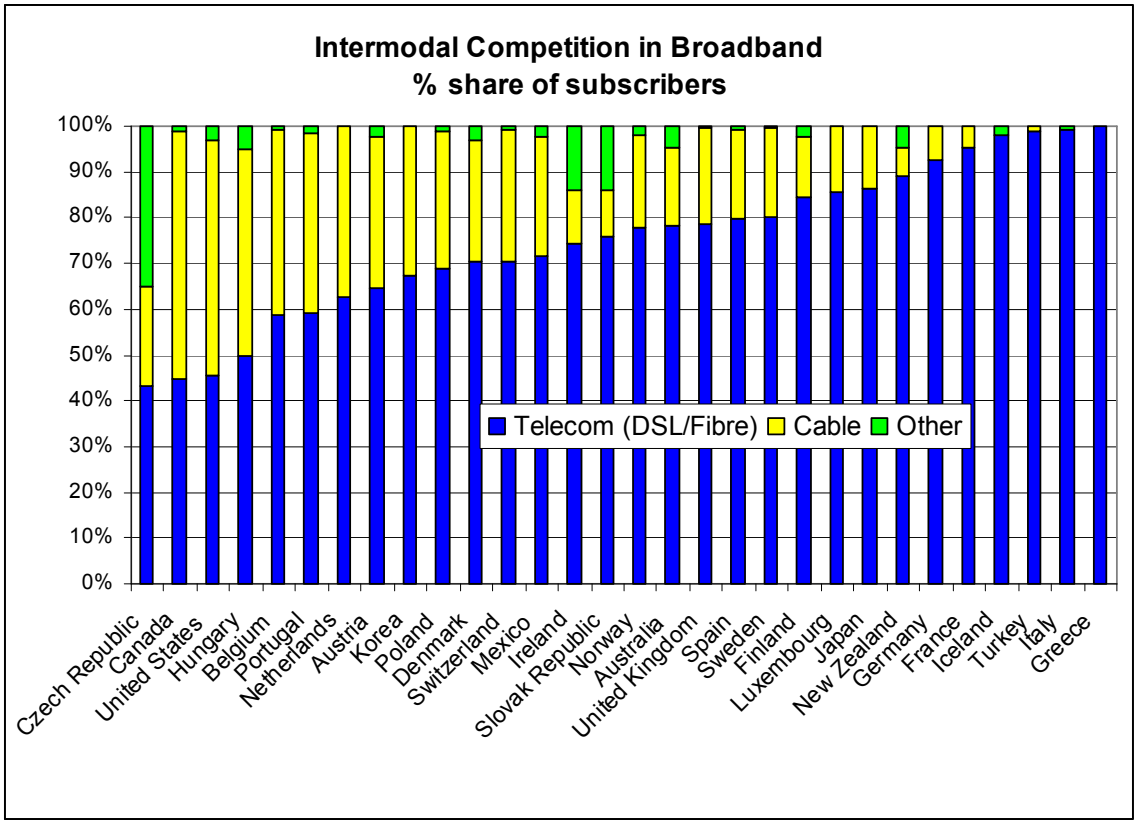
Some European countries have a wireline gap between urban and rural availability, similar to Canada. As noted in section 4.1.1, virtually all of Canada's urban households have access to wireline broadband services while only 78% of those in rural areas had such access in 2008. The gap between urban and rural availability in European countries is shown in Figure B.1.2, taken from Europe's Digital Competitiveness Report, Benchmarking i2010.[165]

Sweden (SE), Germany (DE), Portugal (PT), Iceland (IS) and Italy (IT) are among those countries where the availability levels are comparable to the level in Canada, and where availability in rural areas is also lagging behind.

Government Broadband Investment Initiative Proposal, Appendix, March 2009, http://www.med.govt.nz/upload/63958/Final-broadband-initiative-consultation-document.pdf.

[165] European Commission, "Europe's Digital Competitiveness Report – Annual Information Society Report 2009 Benchmarking i2010: Trends and main achievements," August 4, 2009.

Figure B.1.3: Intermodal Competition in Broadband



Canada and the U.S. have been observed[166] to enjoy the highest levels of intermodal broadband competition, based on market shares of subscribers using telecom (DSL and fibre) versus cable broadband, as seen in Figure B.1.3[167]. Figure B.1.3 may overstate the degree of intermodal competition in certain countries, such as Denmark and Australia, where the incumbent telephone company also provides cable broadband services.

B.1.4 Broadband pricing and speed

B.1.4.1 Price comparisons

The OECD provides information on prices based on average, minimum and maximum advertised price, as well as an average price per Mbps based on an average of the advertised

[166] For example, Robert Atkinson, "The OECD-ITIF Broadband Rankings," June 15, 2007; based on data from the OECD Directorate for Science, Technology, and Industry; United Nations, Population Division; Demographia and ITIF calculations; available at: http://www.itif.org.
[167] OECD broadband subscribers by technology, as of December 2008.

speed. All prices are converted to U.S. currency and then restated in purchasing power parity (PPP). The OECD data indicates that the average price in Canada in 2008 was $45.65 (U.S. PPP), compared to $45.52 in the U.S. This puts Canada in 15th place among the 30 OECD countries. The five countries with the lowest average price were: Sweden, Greece, Japan, Finland and the United Kingdom. However, upon review of the underlying sampling methodology used by the OECD in developing its figures, we have determined that the input data was not representative of the Canadian market, and therefore the rankings produced are inaccurate. This issue is discussed further in the context of the price per Mbps.

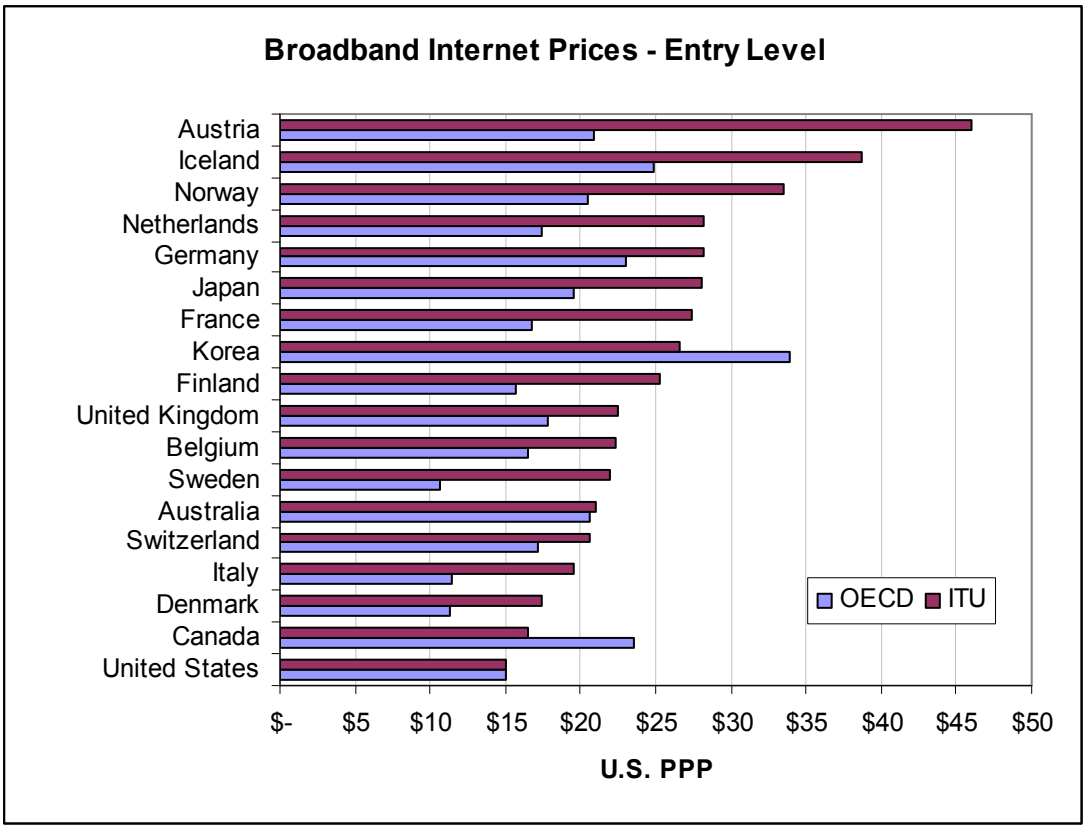
The International Telecommunications Union (ITU) reported broadband service prices as part of its analysis for its ICT Development Index.[168] It measured the average price of an entry level broadband service plan that provided a minimum download speed of 256 Kbps. In that analysis, the United States had the least expensive service among OECD countries at $15, followed by Canada at $16.50 (U.S. PPP).[169]

The ITU also compared the price of broadband service as a percentage of each country's monthly Gross National Income (GNI) per capita. The United States and Canada ranked first and second on this basis as well, at 0.4% and 0.6%, respectively. Expressing the price as a percentage of income provides an indication of the relative affordability of service. For example, the ITU found the price of an entry level broadband service to be slightly less expensive in India than in Canada in terms of U.S. PPP dollars but this equated to 7.7% of per capita GNI in India.

The OECD is similarly inaccurate in its assessment of minimum prices for broadband. Although both the OECD and ITU reported prices converted to U.S. PPP terms, the two sources gave somewhat different results. Canada was reported to have the second lowest price according to the ITU, but the OECD data indicates that the minimum price in Canada was among the most expensive, after Iceland, Spain and Korea. In many cases, particularly for European countries, the ITU prices were higher than the OECD prices. However, for Canada and Korea, the ITU assigned significantly lower prices. Figure B.1.4 highlights the variations.

[168] ITU, "Measuring the Information Society, The ICT Development Index," March 16, 2009. The price basket for broadband internet excludes mobile broadband services. The price includes taxes but excludes fees for the installation or modem. A more detailed description of the methodology is provided in Annex 2 of the ITU report.
[169] Ibid, Table 6.6. Three non-OECD countries had prices of less than $15, and India had a price lower than Canada's.

Figure B.1.4: Broadband Prices – Entry or Minimum Price Levels



The variation in prices obtained by the OECD and ITU bring into question the reliability of another benchmark – price per Mbps. The OECD and ITIF each provided measures of the price per Mbps. The ITIF's approach differed in that it used the lowest monthly price per Mbps of generally available advertised offers to reflect the fact that higher-speed services tend to be less expensive on a per Mbps basis. Because the ITIF focused on the least costly per Mbps service, it results in different rankings than the OECD which used simple averages.[170]

[170] ITIF, "Explaining Broadband Leadership," Table 1 and page 9, and footnote 6.

Figure B.1.5: Broadband Prices per Mbps

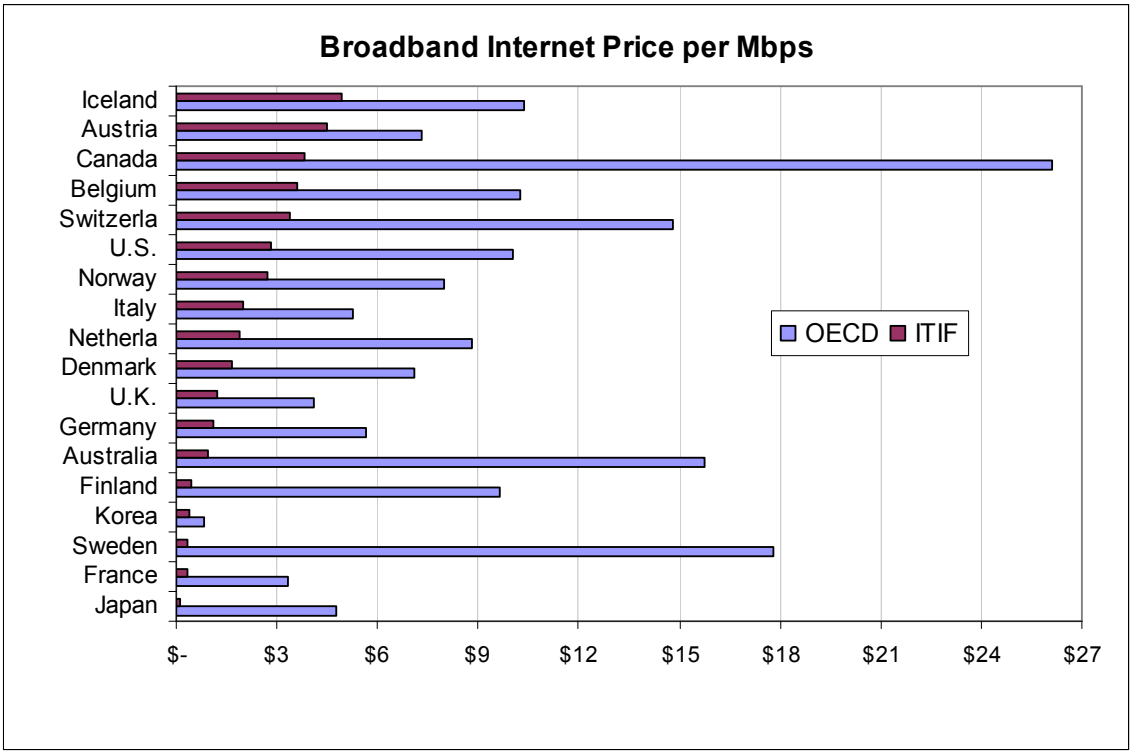


Figure B.1.5 provides a comparison of the price per Mbps reported by the OECD and ITIF. While the OECD data would rank Canada 28th out of 30 countries, the ITIF results place Canada in 21st position at $3.81 (U.S. PPP).

However, as was discussed in Section 4.2.4.1, the OECD figures are based on selective views of advertised offers that are not collected consistently across countries and have been averaged without any weighting for the relative subscription levels of the various offers. The resulting data are fundamentally flawed due to these serious methodological practices. For example, the 50 Mbps service from Videotron has been commercially available in Canada since February 2008. As such, it should have been considered in both the mid-year and year-end 2008 reports by the OECD. The more accurate placement for Canada in terms of the most

cost-effective service available in each country would have been in 9th position – similar to the ranking for average price per Mbps.[171]

Unlike the ITIF, the OECD data on price per Mbps did not apply any weights to the selection of advertised service offers used to calculate the average price, speed or price per Mbps. The OECD Communications Outlook 2009 provided the raw input data used to derive the averages.[172] For each country, there is a list of the advertised services included in the calculations.

The OECD averages are derived on an unweighted basis. As a result, countries will have a lower average price per Mbps if the advertised offers studied include a greater number of higher speed services than lower or 'lite' speeds.

The calculation of Canada's $26.11 (US PPP) average is based on 16 offers: five ADSL-based offers from Bell Canada, three WiMax-based offers from Bell Canada, and four cable modem-based offers from each of Rogers and Shaw. It is not clear why the listed offers for Canada included a disproportionate number of WiMax-based offers – which is almost unique among all of the advertised offers considered for the 30 countries. Given the mobility features of these services, and the cost differential as compared to wireline services, these services are priced at a premium. As a result, including them in the sample data drives up the average price; the WiMax offers increase the average by almost $3.

It would have been more accurate for the OECD to apply subscription-based weights to the offers to derive the average prices, speeds and price per Mbps. This would have required more detailed data for each of the countries indicating the percentage of subscribers using each service.

In the case of Canada, the CRTC Communications Monitoring Report provided information on the percentage of subscribers taking services within six speed ranges.[173] The six categories do not line up with the speeds of the advertised offers considered by the OECD, making it

[171] Based on Videotron's Ultimate Speed Internet 50, which advertises up to 50 Mbps download speeds for a monthly price of $79.95 (under contract). Converting this to U.S. PPP would result in a price per Mbps of $1.32. The no contract price of $89.95 would equate to $1.50 (U.S. PPP).
[172] OECD, Communications Outlook 2009, Table 7.14.
[173] CRTC, Communications Monitoring Report 2009, Table 5.3.3.

difficult to use these as weights to derive an average. That said, less than one-quarter of subscribers in Canada used a service with speeds of less than 1.5 Mbps, and less than 5% used a service at 256 Kbps or less. The subscription level to WiMax probably had even lower penetration. Excluding the 256 Kbps and WiMax offers (reducing the total offers considered to 12), would result in an average unweighted price per Mbps in Canada of $16.

Analysis of the advertised service offers considered for other OECD countries brings to light another serious source of distortion in the OECD's averages. In a number of countries, the listed offers for a country include duplicate services offered by the same company providing the same download speeds, where the only differences (if any) occur in the name of the service, price, upstream speed or bit cap. The duplication most commonly occurs for higher speed services that have lower prices on a per Mbps basis. For example, the OECD included 71 offers for Australia, compared to 16 in Canada. This included for one service provider - Bigpond - eight offers at 20 Mbps and 10 at 30 Mbps where the only difference is the bit cap and price. Including multiple offers at the same download speed that are then averaged on an unweighted basis substantially lowers the average price per Mbps, relative to an average based on one or two representative offers. This artificially assigns a higher weight to the duplicated offers and lowers the price per Mbps.

To further demonstrate the effect of duplicate offers, if the offers used to calculate the average for Canada had included a second set of advertised offers for each of the three companies' two fastest offers, and dropped the WiMax offers for the reasons noted above, the average price per Mbps in Canada would have been cut by a third to $17.52. A third set of these companies' fastest offers would further lower the average price per Mbps to $14.51.

The OECD does not use a rigorous and consistent sampling methodology for selecting advertised offers in each country. There is significant variation among countries in terms of the number and diversity of offers considered. This undermines the comparability of the average price per Mbps to such an extent as to render the rankings unusable.

B.1.4.2 Speed comparisons

Broadband speeds can be compared based on actual connection speeds, but sampling issues can result in skewed results. For example, MBA students from the Said Business School at Oxford University (with the support of Cisco) have recently released their second annual

report on Broadband Quality Score (or BQS). In that report, 66 countries were assessed using the results from individual users who applied the Speedtest.net online speed test. While Canada scored in the middle of the pack in terms of broadband quality, download and upload speeds and 17th overall for broadband leadership, we question the validity of the assessment.

The conclusions are based on an analysis of over 24 million test records. While this seems like a lot, it is only a fraction of the more than 440 million broadband subscribers worldwide.[174] The Said/Oxford report doesn't indicate how many of the 24 million test results were repeat versus unique users, or how they were distributed across countries, time of day, distance to server test site, and other variables that could affect the test. The BQS results reported for a country will also differ depending on several aspects of the individuals participating in the Speedtest.net site during the sample period. The report does not indicate what, if any, steps were taken to normalize the results for these differences.

An objective sanity check on the results of the Said/Oxford report can be found in another publicly available source of information from Akamai Technologies Inc. Each quarter, Akamai's State of the Internet includes findings on the average download speeds achieved by users in dozens of countries. The results are based on data that Akamai collects from its globally distributed network of servers with connections to more than 400 million unique IP addresses.

Both Akamai and Said/Oxford put the same three countries – South Korea, Japan, and Sweden - at or near the top. However, the results for many other countries were quite different. For example, Akamai's report for the second quarter of 2009 found Hong Kong had an average achieved download speed of almost 7 Mbps but the report from the Said/Oxford report put this country's speed at just under 5. The Netherlands did well according to Said/Oxford at about 12 Mbps but according to Akamai the speed was only 5.1 Mbps. Denmark was similarly boosted according to the Said/Oxford results. These examples demonstrate the dramatic differences that can occur when service speeds are measured using different methodologies. In the case of the Said/Oxford report, the results are based on user-selected testing where the selection of participants was not random or adjusted to be representative of the population. Compare this to results from Akamai's data which encompassed almost 425 million

[174] World Broadband Statistics, Q2 2009, Point Topic Ltd., September 2009.

of the 440 million unique IP addresses worldwide. Based on this, we suggest that the Akamai methodology and results are more representative and compelling.

In contrast to the middling performance portrayed in the Said/Oxford results, Akamai's report for the second quarter of 2009 provides some positive news for Canada in terms of higher speed broadband service. The percentage of connections achieving speeds of 5 Mbps or greater has reached 27%, representing a 50% increase over the previous year and moving the country into 10th place overall, as shown in Figure B.1.6, a table from that report.[175]

Figure B.1.6: High broadband connectivity, speed distribution

	Country	% above 5 Mbps	5-10 Mbps	10-15 Mbps	15-20 Mbps	20-25 Mbps	>25 Mbps
1	South Korea	69%	35%	14%	6.7%	3.9%	9.2%
2	Japan	56%	36%	13%	4.1%	1.6%	1.9%
3	Romania	44%	31%	7.3%	2.3%	1.1%	1.9%
4	Sweden	43%	31%	6.5%	2.5%	1.2%	2.2%
5	Hong Kong	39%	31%	6.4%	3.5%	2.1%	3.6%
6	Netherlands	34%	23%	2.8%	0.7%	0.4%	1.6%
7	Czech Republic	33%	29%	3.7%	0.9%	0.5%	1.3%
8	Denmark	32%	27%	2.8%	0.6%	0.3%	0.5%
9	Belgium	31%	28%	2.0%	0.2%	0.1%	0.4%
10	Canada	27%	23%	2.6%	0.7%	0.3%	0.7%
...							
12	United States	24%	20%	2.5%	0.7%	0.4%	1.0%

Speed of broadband internet service can also be compared based on average advertised speeds or maximum advertised speeds. In either instance, the data can be highly variable depending on which service providers are included in the analysis. In addition, frequent improvements in top speeds can result in information being out of date by the time an international comparison can be compiled and published.

According to the OECD's information, the fastest advertised speed offered in Canada was 16 Mbps in 2008. This was only sufficient to rank Canada 19th out of 30 countries. Contrary to its past reports, the OECD's recent comparisons found in its Communications Outlook 2009,

[175] Akamai, "The State of the Internet, 2nd Quarter 2009," October 1, 2009, Figure 17.

released in August 2009, indicate instead that Canada had a top speed in 2008 of 25 Mbps.[176] In fact, two Canadian companies launched commercially available 50 Mbps service during 2008 and similar services have been announced since that time. Speeds of 50 Mbps were the fourth fastest speeds among OECD countries in 2008.

Table B.1.1: Broadband Service Speeds

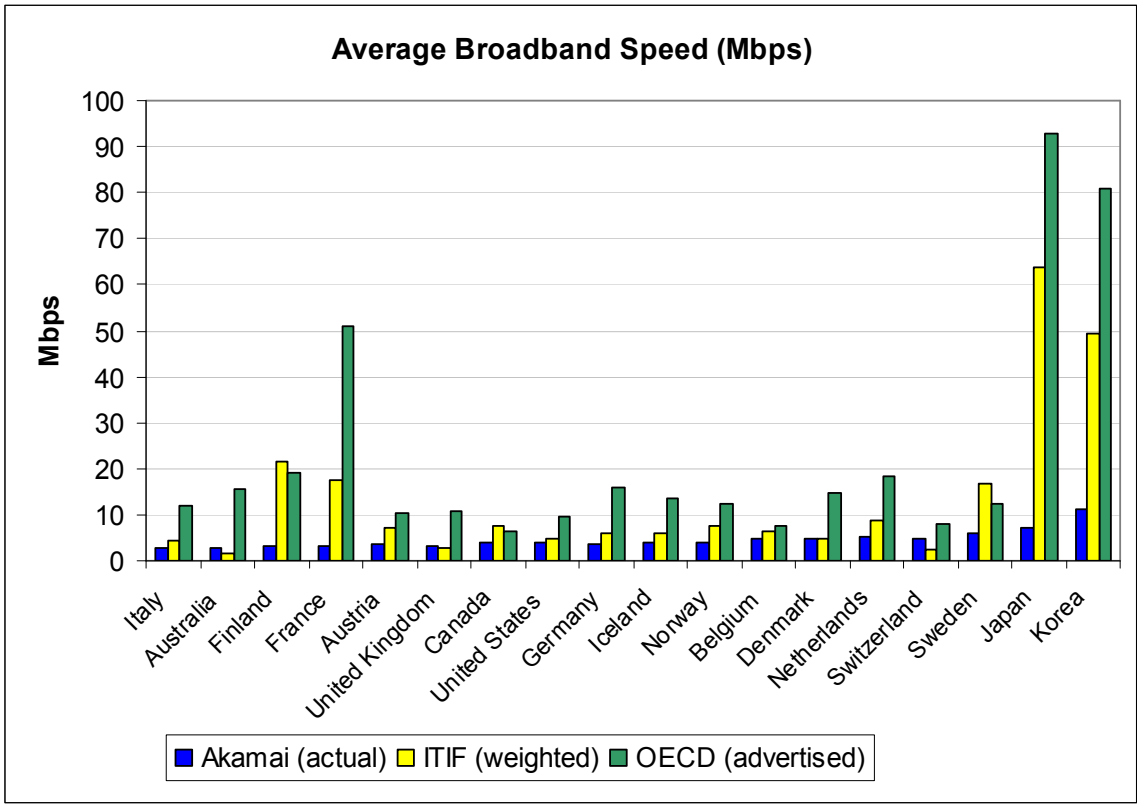
	Akamai (actual)	Rank	ITIF (weighted)	Rank	OECD (advertised)	Rank
Australia	2.70	18	1.70	18	15.54	7
Austria	3.65	13	7.20	9	10.29	14
Belgium	4.58	7	6.30	10	7.54	17
Canada	3.98	9	7.60	8	6.24	18
Denmark	4.69	6	4.60	14	14.63	8
Finland	3.31	15	21.70	3	19.23	4
France	3.20	16	17.60	4	51.00	3
Germany	3.68	12	6.00	12	15.92	6
Iceland	3.88	10	6.10	11	13.69	9
Italy	2.73	17	4.20	15	11.94	12
Japan	7.32	2	63.60	1	92.85	1
Korea	11.31	1	49.50	2	80.80	2
Netherlands	5.13	4	8.80	6	18.18	5
Norway	4.17	8	7.70	7	12.36	10
Sweden	6.04	3	16.80	5	12.30	11
Switzerland	4.96	5	2.30	17	7.95	16
United Kingdom	3.36	14	2.60	16	10.67	13
United States	3.81	11	4.90	13	9.64	15

The actual service speeds achieved differ from the advertised speeds offered in the market or those actually subscribed to; and tend to be slower due to factors such as distance from network switches and congestion on shared networks. There are various tools that individuals can access over the web to test their speeds. However, a more consolidated and uniform view of actual speeds achieved by internet subscribers across a number of countries can be found in quarterly reports published by Akamai.[177]

Canada ranks 10th according to the ITIF data, 14th on Akamai's list based on 25 of the 30 OECD countries, and 25th according to the OECD. Table B.1.1 and Figure B.1.7 provide comparisons of the average speeds, as reported by Akamai, the ITIF and OECD.

[176] OECD Communications Outlook 2009, Figure 4.11, page 108 and Figure 4.12, page 109.
[177] Akamai, "The State of the Internet, 2nd Quarter 2009," October 1, 2009, Appendix.

Figure B.1.7: Broadband Service Speeds



The relative speeds vary considerably, due in large part to the different methodologies used to collect the data. The OECD's data is a simple average of the advertised speeds observed for a select group of service providers, an approach that puts in question the reliability of the results. This issue is discussed further in the context of the price per Mbps. The ITIF considered the advertised speeds offered by the three main technologies (DSL, one of cable modem and fibre), with the speeds weighted by their relative subscriber numbers. The CRTC Communications Monitoring Report 2009 also used a subscriber-weighted methodology to determine that the average speed among residential subscribers was 4.9 Mbps in 2008.[178] This is slower than the speeds reported by the ITIF and OECD, but faster than the average achieved speed of 3.98 Mbps reported by Akamai.

Table B.1.2 provides Akamai's findings for select countries during 2008 and second quarter 2009.

[178] CRTC, Communications Monitoring Report 2009, Table 5.3.3.

Table B.1.2: Percentage of Broadband Connections Above 5 Mbps

	Q1 2008	Q2 2008	Q4 2008	Q2 2009
Korea	64%	64%	69%	69%
Japan	48%	52%	54%	56%
Hong Kong	35%	37%	38%	39%
Sweden	29%	32%	38%	43%
Belgium	20%	26%	31%	31%
US	20%	26%	25%	24%
Romania	21%	22%	44%	44%
Netherlands	20%	22%	28%	34%
Canada	**13%**	**18%**	**20%**	**27%**
Denmark	15%	18%	27%	32%
Switzerland	11%	15%	22%	20%
Czech Republic	14%	15%	21%	33%
Norway		17%	21%	20%
Singapore		14%	22%	19%
Taiwan		8%	14%	20%

The findings of Akamai are influenced by the different service speeds or tiers offered in each country. In the case of Canada, consumers can choose from tiers starting at 256 Kbps, and ranging up to 100 Mbps in some markets. With more than 40% of Canadian residential internet subscribers continuing to choose a service tier that provides less than 5 Mbps, it is not entirely unexpected that the actual average download speed achieved would be in the range of 4 to 5 Mbps.

ISPs in other countries may no longer offer or promote the lower speed services, and as a greater percentage of subscribers use higher speeds the actual average download speeds have increased.

B.1.5 Indices of broadband performance and digital readiness

A country's performance can also be gauged using indices that combine multiple indicators. This approach does not reward or penalize a country based on a single indicator. However, indices are designed with different goals, which dictates to large degree which indicators and weights are chosen. Some indices are focused more on connectivity to internet-related infrastructure and how this is used, such as the LECG/Nokia Siemens Networks Connectivity Scorecard. Others encompass all ICTs, as is the case with the ITU's ICT Development Index. Other indices take into account general economic, business and government performance, as

found in the Economist/IBM E-Readiness index. The indices and country rankings from these three sources are reviewed in the following sections.

B.1.5.1 LECG/NSN Connectivity Scorecard

The LECG/NSN Connectivity Scorecard was first published in 2008 for 25 countries, expanding to 50 countries in 2009. The objective of the Scorecard is to provide a measure of connectivity that moves beyond counting telephone lines or internet connections to a broader perspective on "useful connectivity" that takes account of how connectivity is linked to the economy.

> The concept of "useful connectivity" is first and foremost an attempt to recognise that the economic value generated by connectivity depends not just on conventional measures such as broadband lines or computers connected, but also on who is using those lines—businesses or consumers—and how well they are able to use the lines (captured by measures such as user skills, software assets, use of voice-over-IP and the number of intranet hosts per capita).[179]

The 50 countries in the Scorecard were divided into two categories: innovation driven economies and resource and efficiency driven economies, and ranked separately within each category. This separation allowed LECG/NSN to rely on different indicators that may not have been useful for all countries. Each country's score was worked up from scores on six components: consumer infrastructure and usage, businesses infrastructure and usage, and government infrastructure and usage. The overall score depended on weights assigned to each of the six components, with the weights varying by country based on how each of the six components contributed to that country's economy. In addition, the score for an individual indicator depended on how a country's values compare to the highest value achieved by any country.

The LECG/NSN Scorecard methodology generally assigned higher weights to indicators in the business sector and particularly so for countries where business activity has had a greater impact on a country's overall economic output and productivity. A country that scored highly on residential broadband infrastructure would only do well if it also had a strong performance on business infrastructure and other business-related indicators. This was cited in the report as one of the reasons why Korea, which usually scores highly, did not perform as well

[179] LECG/NSN 2009, page 7.

according to the Scorecard.[180] Conversely, the U.S. ranked first in both 2008 and 2009, despite having a lower placement in other stand-alone indictors. Canada placed 7th in the Scorecard in 2009, down from 4th place in the previous year.

Table B.1.3 provides the results for the innovation-driven economies in 2008 and 2009.

Table B.1.3: LECG/NSN Connectivity Scorecard

Scorecard 2009 25 countries)	Scorecard 2008 16 countries
United States (7.71)	United States (6.97)
Sweden (7.47)	Sweden(6.83)
Denmark (7.18)	Japan (6.68)
Netherlands (6.75)	**Canada (6.56)**
Norway (6.51)	United Kingdom (6.13)
United Kingdom (6.44)	Finland (6.10)
Canada (6.15)	Australia (5.90)
Australia (6.14)	Germany (5.52)
Singapore (5.99)	France (5.07)
Japan (5.87)	Korea(4.73)
Finland (5.82)	Hong Kong SAR (4.46)
Ireland (5.70)	Italy (3.85)
Germany (5.37)	Spain (3.56)
Hong Kong SAR (5.33)	Hungary (3.18)
France (5.22)	Czech Republic (3.10)
New Zealand (4.85)	Poland (2.33)
Belgium (4.65)	
Korea (4.17)	
Italy (3.99)	
Czech Republic (3.71)	
Spain (3.49)	
Portugal (3.02)	
Hungary (2.72)	
Greece (2.62)	
Poland (2.49)	

LECG/NSN reported that Canada's performance in 2009 was adversely affected by the following factors: the addition of metrics on the deployment of fibre networks and "ultra-broadband" services; additional countries (Denmark, Netherlands and Norway) that outperformed Canada on advanced infrastructure; and the exclusion of main fixed telephone lines. These changes in methodology resulted in a lower score for consumer infrastructure. Canada's score in 2009 was also weaker due to a low score on 3G penetration. The summary

[180] LECG/NSN 2009, page 10.

noted that, "the Canadian market has many 'difficult' characteristics, and it is hard for Canadian firms to realise the same economies of scale and scope as their counterparts in larger, more densely populated nations."[181]

LECG/NSN noted that Canada did well on other components of the Scorecard, particularly business and government infrastructure and government usage. The report suggested that Canada would benefit from increased incentives for the deployment of next generation networks (e.g., FTTP and DOCSIS 3.0), and may wish to consider the U.S. example of deregulation and rural broadband stimulus initiatives.[182]

Announcements in 2009 by a number of Canadian service providers indicate that investments are being made to expand the availability of advanced networks, both wireline and wireless, as described in Section 4. As these initiatives are fully implemented, Canada's results on the LECG/NSN Scorecard should improve in future years.

B.1.5.2 Economist-IBM E-Readiness Index

The Economist Intelligence Unit and IBM have teamed up annually for the past several years to rank 150 countries according to their "e-readiness". According to the most recent report, this is a "measure of the quality of a country's ICT infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit."[183]

The rankings, set out in Table B.1.4, are based on 100 indicators that are scored and weighted according to their relative value within a country and importance to its information economy. The numerous quantitative and qualitative indicators are assigned to one of six categories: connectivity and technology infrastructure, business environment, social and cultural environment, legal environment, government policy and vision, and consumer and business adoption. The two categories that carry the most weight are: consumer and business adoption at 25% of the overall score, and connectivity and technology infrastructure at 20% of the overall score. The remaining four categories are weighted at 15%, with the exception of legal which carries an overall weight of 10%.

[181] LECG/NSN, "Connectivity Scorecard 2009: Canada," page 2.
[182] Ibid., page 5.
[183] Economist/IBM, "E-readiness rankings 2009," June 2009.

Table B.1.4: E-Readiness Country Scores and Ranks

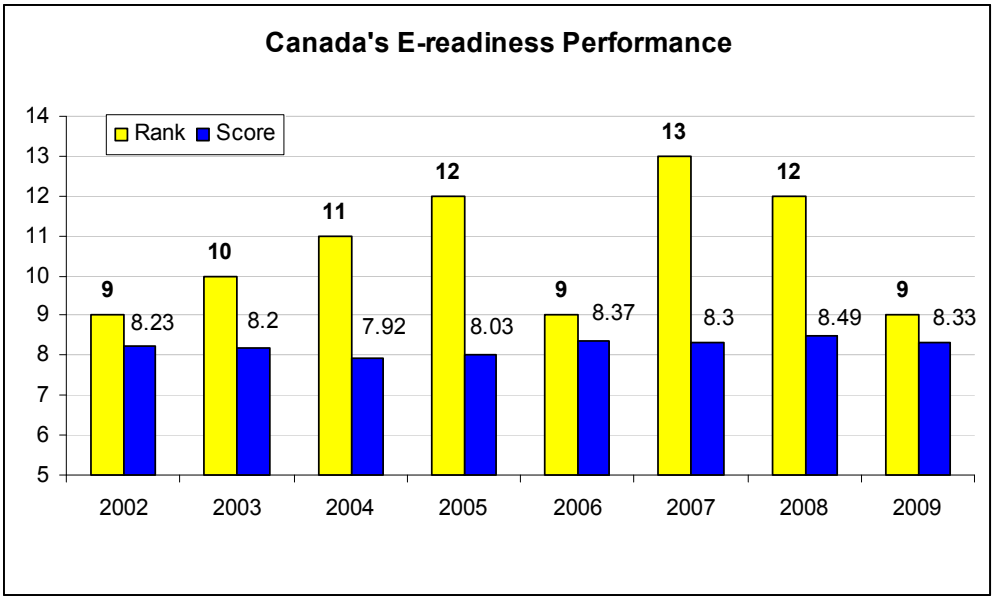
	2009 Score	2009 Rank	2008 Rank
Denmark	8.87	1	5
Sweden	8.67	2	3
Netherlands	8.64	3	7
Norway	8.62	4	11
United States	8.6	5	1
Australia	8.45	6	4
Singapore	8.35	7	6
Hong Kong	8.33	8	2
Canada	**8.33**	**9**	**12**
Finland	8.3	10	13
New Zealand	8.21	11	16
Switzerland	8.15	12	9
United Kingdom	8.14	13	8
Austria	8.02	14	10
France	7.89	15	22
Germany	7.85	17	14
Korea	7.81	19	15
Japan	7.69	22	18
Spain	7.24	25	26
Italy	7.09	26	25

Indicators important to the consumer and business adoption category include: consumer spending on ICT per person, use of the Internet by consumers, including the types of features used and e-commerce activities, use of online public services by consumers and business. Key indicators for the infrastructure category include: broadband penetration and affordability, mobile phone penetration, Internet user penetration, and international internet bandwidth.

The E-readiness index shares some characteristics with other indices in terms of its focus on measures related to Internet infrastructure and usage. The E-readiness and Connectivity Scorecard also share in common the inclusion of several indicators for business and government – factors that are not evident in the ITU's ranking.

The E-readiness rankings for 2009 placed Denmark first, followed by Sweden, Netherlands, Norway, all of which have leapt past the U.S. which fell to fifth place from first in 2008. Canada improved somewhat in the rankings, rising to 9th place in 2009 from 12th place in the previous year.

Figure B.1.8: Canada's E-readiness Performance



Canada's placement among the top ten countries marks its return to that status for the first time since 2006. Canada's poorest showing came in 2007 when it ranked 13th. These general trends are further illustrated in Figure B.1.8.

While Canada's overall score in 2009 was lower than in 2008, this did not result in a lower ranking since, like several other countries, it experienced lower scores due to some deterioration in broad economic indicators. Canada's strongest gains in 2009 were found in the connectivity category, where its score improved from 7.9 in 2007 to 8.45 in 2009. This was offset somewhat by falling scores in consumer and business adoption where Canada's score fell to 8.35 in 2009 from 8.85 in 2008, following an improvement from 8.60 in 2007.

The Economist-IBM report provides only limited information on specific indicators used and their values for individual countries so it is not possible to comment further on the precise factors that accounted for shifts in Canada's score and ranking. However, it is interesting to note that there are similarities in several countries' rankings on E-readiness and the LECG/NSN Connectivity Scorecard. Notably, the same countries are in the top five, although in different order, while Canada is ranked 9th and 7th, respectively.

B.1.5.3 ITU ICT Development Index

The ITU ICT Development Index (or IDI) has as its main objective, "to provide policy makers with a useful tool to benchmark and assess their information society developments and to monitor progress that has been made globally to close the digital divide."[184] It is based on three main elements: communications infrastructure, use and educational skills. Although there is some overlap with the Connectivity Scorecard and E-readiness in terms of measures related to infrastructure and usage, the ITU also incorporates measures of traditional wireline and wireless infrastructure. In addition, the ITU is more heavily focused on consumer usage indicators, with almost no measures related to business or government, such as those included in the other two indices. Conversely, the educational and literacy skills-related indicators in the ITU IDI were not factors included by LECG/NSN.

Interestingly, the ITU IDI relied on a number of indicators of access and usage as a percent of 100 persons, rather than per household. This can introduce some bias in measuring broadband internet subscribers for countries with larger households, for the reasons discussed in Section 5.2.2. Conversely, the LECG/NSN Scorecard's indicator for broadband internet was based on household penetration.

The ITU IDI results were based on 11 indicators: five for the access category, and three each for the use and skills categories. The value for each of the indicators in a country was compared to an ideal or reference value. The indicators within a category were weighted equally for each country, with individual weights adjusted according to the results of Principal Component analysis as to the relative importance of each indicator. There was no variation in weights between countries.

The results of the ITU IDI placed Sweden first in 2007, retaining top spot from 2002. The other countries in the top five in 2007 were: Korea, Denmark, Netherlands and Iceland. These were mostly unchanged from 2002, with the exception of the Netherlands which replaced Norway. Canada placed 19th out of the 154 countries studied, down from 9th place in 2002. With respect to the three sub-components, Canada ranked 15th in terms of access, 21st for use and 20th for skills. Table B.1.5 provides the values used for Canada for each of the 11 indicators in 2002 and 2007, and the reference or ideal score.

[184] ITU, "Measuring the Information Society, The ICT Development Index," March 16, 2009, page iii.

Table B.1.5: Canada's Performance on the ITU ICT Development Index

	Reference Value	Canada 2007	Canada -2002
Fixed telephone lines/100 population	60	55.5	65.9
Mobile cellular subscribers/100	150	61.7	37.9
International Internet bandwidth per Internet user (bits/s) (log value)	100,000	22,250	4,628
% households with a computer	100	79.1	64.0
% households with Internet access at home	100	72.1	54.5
Internet users/100	100	73.0	61.6
Fixed broadband Internet subscribers /100	60	27.6	11.2
Mobile broadband Internet subscribers /100	100	1.5	-
Adult literacy rate	100	121.9	108.5
Secondary school enrollment ratio	100	65.7	60.2
Tertiary enrollment ratio	100	99.0	99.0

Canada's relatively low ranking under the ITU IDI can be attributed largely to four indicators on which Canada had values that were less than 50% of the reference value: mobile cellular subscription levels, international Internet bandwidth, and both fixed and broadband subscribers per capita. Canada has frequently been reported to have a relatively low level of mobile subscription compared to most European countries. This is a reflection of differences in the market that tend to inflate the number of subscriptions in European countries.[185] It follows from that low penetration that mobile broadband subscription would also be low. However, mobile data use in Canada is growing rapidly with the deployment of more advanced smartphone devices. With respect to broadband penetration, Canada could not achieve broadband penetration per 100 population at the level of even 40 per 100 population unless every household subscribed.[186]

Canada's international internet bandwidth per internet user is quite low, compared to the reference value, but not as low as reported for the US. The ITU noted that a country such as the U.S. may have a low level if it has a large domestic market or is a major generator of local content such that its domestic bandwidth fulfills most of its needs. These factors may also underlie Canada's results. Alternatively, it could be the result of having traffic from Canada to the U.S. not captured as "international," which may also include traffic originating from Canada that is routed to other countries through the U.S.

[185] Subscriber counts in European countries consider as unique subscribers each SIM (subscriber identity module) in use. European users frequently have multiple SIMs, whereas North American users more commonly have only one. As a result, penetration of mobile services per 100 population in many European countries exceeds 100%.
[186] See Section 5.2.2 for a more detailed explanation of this issue.

The ITU IDI results suggest Canada is neither lagging nor leading relative to the 154 countries studied. Based on this index Canada scores lower than many European and Asian-Pacific countries. Yet, Canada performs similarly to the United States (17th) on this index. This similarity with the U.S. may result from the same issues noted above. Namely, penetration for mobile services tends to be overstated in countries outside North America, and the ITU index uses the problematic metric of "broadband subscriptions per 100 population" instead of the more accurate per household measurement. Both of these factors cause Canada and the U.S. to underperform in this index.

Canada's performance on the ITU IDI may also be lower because, unlike the other indices discussed above, the ITU IDI does not put great emphasis on business and government indicators, which clearly influenced the different outcomes. More significantly for this report, the measures of infrastructure and use employed in the other two indicators focused more on broadband internet indicators.

B.2 Additional considerations

B.2.1 Geography and population density

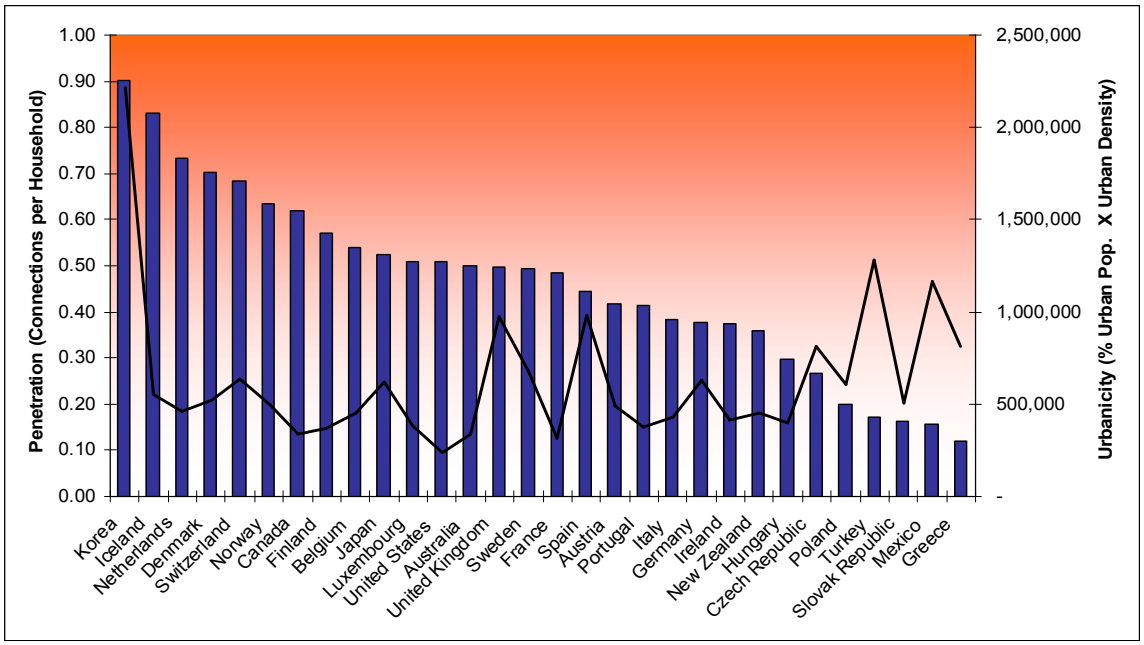
As discussed in Section 4.3.2, a characteristic of geography and population that can lower the costs of delivering broadband service is the extent to which the population is clustered in urban areas. Analysis by the ITIF found that broadband penetration was strongly correlated with a country's "urbanicity", defined as the percent of the population in urban areas times the population density in urban areas.[187] Figure B.2.1[188] provides the analysis based on 2006 data on these indicators. According to the data presented in the chart, all of the countries with a level of broadband penetration higher than Canada (on a per household basis) were also reported to have a higher degree of "urbanicity".

Countries with dense populations, particularly those with a more urban oriented population, are more likely to have shorter local loops used in their telecommunications networks. The shorter loops reduce the costs of delivering DSL-based broadband services. The ITIF noted

[187] ITIF, "Explaining International Broadband Leadership," May 2008, page 14.
[188] Robert Atkinson, "The OECD-ITIF Broadband Rankings," June 15, 2007; based on data from the OECD Directorate for Science, Technology, and Industry; United Nations, Population Division; Demographia and ITIF calculations; available at: http://www.itif.org.

that the United States has particularly long loop lengths, relative to most other countries, leading to higher costs and greater challenges to expanding the availability of broadband internet. Canada had the second longest loop length, as shown in Figure B.2.2.[189]

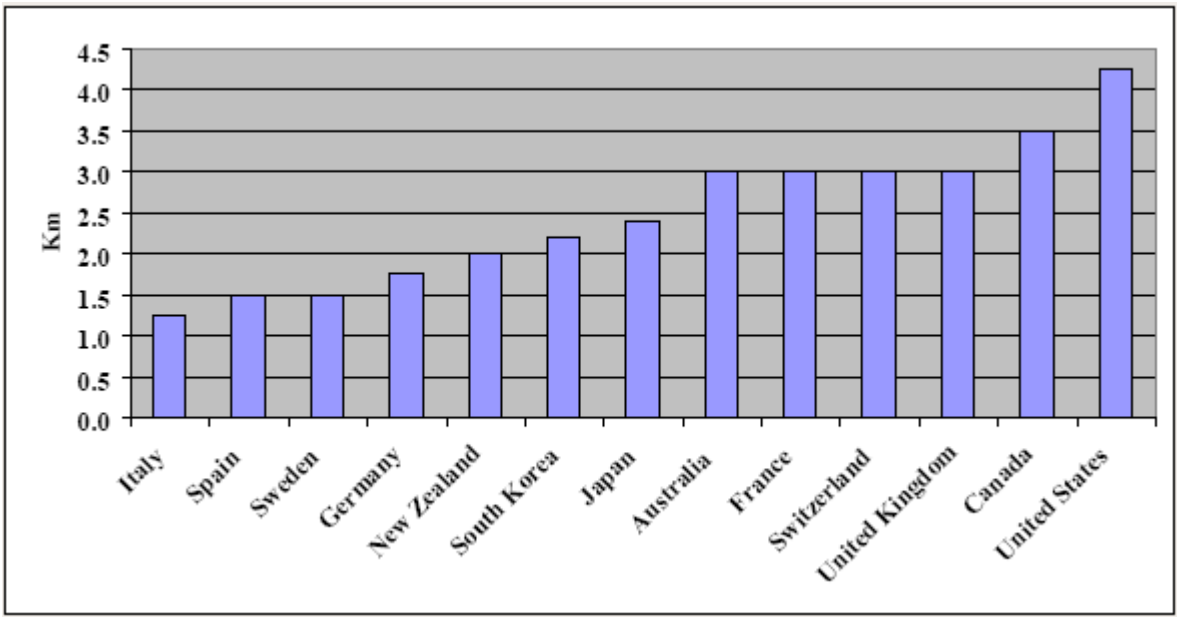
Figure B.2.1: Penetration vs. "Urbanicity"



Taken together, a country with lower costs to deliver broadband will tend to have higher availability of the service and lower costs for delivery of wireline broadband service. These characteristics enable a country to achieve higher broadband penetration levels.

[189] ITIF, "Explaining International Broadband Leadership," May 2008, page 11.

Figure B.2.2: Average Loop Lengths in Selected OECD Countries



The above figures indicate that Canada lacks the advantages of other countries in terms of urbanicity and short loop lengths. Yet, Canada managed to achieve more favourable rankings than many countries that have these advantages.