

Levin, Stanford Lee; Schmidt, Stephen; Scott, Graham

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Broadband for all: Policies for a connected society

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Broadband for All: Policies for a Connected Society

Stanford L. Levin
Southern Illinois University Edwardsville

Stephen Schmidt
TELUS Communications Company

Graham Scott
St. Lawrence University and Dartmouth College

Presented at “The Intelligent World: Realizing Hopes, Overcoming Challenges,” ITS Regional Conference, Los Angeles, October 25-28, 2015.

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Broadband for All: Policies for a Connected Society

I. Introduction

a. Changes have taken place in society and with the Internet

Technological advances and consumer preferences are driving competition to provide the best, newest, and most efficient services to the public. As technology evolves rapidly in every field, so too has the technology used to deliver telecommunications services evolved. Consumers now have access to landlines, mobile phones, computers, tablets, and many more devices to connect online with friends, family, businesses, and the rest of society. People today have become so connected to their devices that one cannot imagine living without such. Particular to the telecommunications industry, basic voice and some ancillary services are often considered to be basic telecommunications services that should be available to everyone. However, in light of rapid technological and social change, regulators and governments worldwide are now reconsidering the issue of what constitutes this basic service necessary to participate in the connected economy as they take into account the changes that have taken place in society and with the Internet.

b. The Internet as a service necessary to participate in the connected economy

Broadband services are now undeniably necessary for consumers to participate in today's connected economy. Various technologies can deliver high-speed Internet. In addition to wireline Internet access, mobile wireless data services play an increasingly important role in meeting consumers' needs for Internet access, and satellite services provide broadband in some areas. Levin and Schmidt (2015, p. 1) indicate that "(t)he deployment of ultra-fast broadband networks [...] has risen to the top of so many government and regulatory agendas because of the material social and economic benefits that have been demonstrated to flow from the deployment and adoption of broadband services."

Winseck (2015, p. 5), citing reviews by the OECD (2012) and the Broadband Commission (2014), identified the following benefits of broadband services:

- (1) economic benefits for individuals and the economy in terms of greater productivity, economic growth, competitiveness, potential energy conservation, regional and rural development, and the development of new information

services; (2) network effects whereby the value of a network for all who use it increases the more people and services are connected; (3) greater access to education and informational resources; (4) mitigating social exclusion; (5) enhancing people's ability to exercise their social and political rights; (6) ameliorating the impact of income inequality, location, gender differences and physical ability on people's quality of life; and (7) ensuring contact with emergency services.

Given the many benefits of Internet access and the shift towards a more digitized world, people in more and more countries, particularly in advanced countries, require a high-speed broadband Internet connection to meaningfully participate in today's connected economy. Banking, government forms, health applications, email, search engines, and many more services are now available and accessed conveniently from almost anywhere. From computers to smartphones, wireline to satellite connections, people are connecting to the Internet over a multitude of devices and technologies independent of their location. Irrespective of the means by which a user connects to the Internet, broadband services are undeniably essential to everyone's daily life and are necessary for active participation in the connected economy.

c. Outline of paper

This paper is organized as follows. Section II reviews the minimum Internet speed needed to participate in the connected economy. This section outlines the difference between minimum, maximum, and average speeds, the particular services necessary to participate in the connected economy, the necessary speeds to use these services, and which technologies can deliver these services.

Section III discusses the three principle policies by which broadband is diffused: platform competition, state intervention, and monopoly and unbundling. Each of these policies is evaluated in terms of availability, adoption, and performance of broadband. The emerging evidence shows that platform competition is superior to monopoly and unbundling. Nevertheless, there will undoubtedly be pockets of households where platform competition does not provide adequate service. Therefore, this section will highlight how a bidding process or reverse auctions will hold down the cost of any required subsidies and how any subsidy for broadband should be funded from general revenues, or, failing that, from a broad-based charge on all telecommunications services.

Section IV discusses the adoption of broadband services. It is important to note that platform competition encourages adoption. Also, availability and adoption of broadband are not synonymous. The main barriers to adoption include age, education, and income. This section evaluates which policies and government agencies are best suited to address these barriers in order to successfully increase adoption.

Section V is the final section and summarizes the evidence that having access to a broadband connection at a 5 Mbps download speed and a 1 Mbps upload speed (“5/1 Mbps”) is required to participate in today’s connected economy. After discussing the necessary services and speeds to actively engage in the online economy, evidence shows that platform competition is preferable to either state intervention or monopoly and unbundling to efficiently distribute broadband services. Countries with a heavy reliance on platform competition, such as the U.S. and Canada, consistently outperformed those without in terms of broadband availability, quality, and price. The evidence also shows that platform competition leads to the increased adoption of broadband services. The paper concludes by showing that industry regulators are not well suited, nor are they often empowered, to address problems like adoption. Rather, education and digital literacy programs are most successful in increasing the adoption of broadband services.

II. Minimum Internet Speed to Participate in the Connected Economy

As the Internet becomes increasingly important, several key questions concerning broadband speeds emerge. What is the difference between minimum, average, and maximum speeds? What services are necessary to participate in the connected economy and at what speeds? What technologies can deliver the minimum required Internet speed?

a. Minimum, average, and maximum speeds are not the same

Currently, available broadband speeds range from dial-up to 1 Gbps. What is necessary to guarantee is the minimum speed needed for people to complete the online activities they require to participate in the connected economy. Neither the average speed to which people subscribe nor the maximum broadband speed that is available is as important a metric as the minimum required broadband speed. The evidence shows that a 5/1 Mbps speed is the minimum required broadband speed even though people may, and often do, subscribe to faster speeds and the average speed across all subscribers is higher than that.

b. What services are necessary to participate in the connected economy?

It is necessary to determine which services are required to participate in today's connected economy¹ and the minimum broadband speed required to support these activities.²

The Statistics Canada study (2013), "Individual Internet use and e-commerce, 2012," is a reasonable starting point to understand the types of online activities in which consumers engage. This represents the most recent study by Statistics Canada on this important and timely issue. Reproduced as Figure 1 below, among the most popular activities for Canadians are e-mail, browsing for goods and services online, electronic banking, reading or watching the news, and using social networking websites. These observations notwithstanding, the popularity of online content or web applications cannot inform regulators on what constitutes a basic use of the Internet any more than pervasive consumption of fast food can speak to the basic nutritional needs of consumers. The popular web activities identified by the Statistics Canada study serve only to identify Canadians' online behavior. They cannot and do not speak to the importance of these online activities in providing for the economic and social welfare of Canadians or their meaningful participation in the connected economy.

A number of the popular Internet activities identified in Figure 1 are most accurately characterized as satisfying the recreational and entertainment wants of consumers rather than representing a use of the Internet to actively engage in the connected economy. For example, downloading and streaming movies, television programming and music certainly allows individuals to be entertained through online services, but these do not rise to the level of being essential to the economic or social welfare of consumers. In other cases, it is not clear whether the popular services identified represent an individual's basic use of the Internet because communications needs today can be met through other online or telecommunications tools. These include accessing the Internet to make telephone calls and engaging colleagues and friends through social networking sites. In addition, while banking, interacting with government

¹ A 2012 OECD Report observes that "broadband availability is expected to become a necessity for meaningful participation in society." *Universal Service Policies in the Context of National Broadband Plans*, Working Party on Communications Infrastructures and Services Policy, OECD, 27 July, 2012, p. 21.

² A 2012 OECD reports observes that "broadband is not a uniform service and different technologies have different features, costs, and performance characteristics." *Universal Service Policies in the Context of National Broadband Plans*, Working Party on Communications Infrastructures and Services Policy, OECD, 27 July, 2012, p. 19. The key point is that while voice service is well-defined, broadband service frequently is not. A basic broadband service should be defined in terms of the basic activities that it is able to support.

websites and communicating through e-mail enhance the economic and social welfare of consumers, watching movies and downloading music are properly characterized as discretionary. . . a synonym for which is non-essential.

Figure 1 – Online activities from any location, 2012

Online Services	Internet users (%)
E-mail	93
Window shopping or browsing for information on goods or services	77
Electronic banking (e.g., paying bills, viewing statements, transferring funds between accounts)	72
Reading or watching the news	71
Using social networking sites	67
Searching for medical or health-related information	67
Travel information or making travel arrangements	66
Visiting or interacting with government websites	63
Researching community events	58
Downloading or watching movies or video clips online	54
Obtaining or saving music (free or paid downloads)	50
Making telephone calls online	43
Using an instant messenger	40
Downloading or watching TV online	39

Source: Statistics Canada, “Individual Internet use and e-commerce, 2012,” (October 28, 2013), <http://www.statcan.gc.ca/daily-quotidien/131028/dq131028a-eng.htm>

In addition, Crandall (2015, paragraph 47) assumes that “participation refers to [...] households using mass-market communications services, not to businesses, medical service providers, or educational institutions that may require more sophisticated services.”

c. What speeds are necessary for these services?

Having established the set of online activities that constitute a basic use of the Internet, while excluding discretionary entertainment and recreational uses, the next question is the minimum performance requirements necessary to support these activities. As Crandall (2015, paragraph 53) states, “... [a] 5/1 Mbps target speed [...] is likely to be sufficient for households to participate in the digital economy for the foreseeable future.” Crandall further concludes that for most basic uses of the Internet, even in households of up to 3 simultaneous users, the 5/1 Mbps speed is sufficient to support the majority of household uses. Crandall’s conclusion is based

partly on the FCC’s Household Broadband Guide as shown in Figure 2 and the FCC’s Broadband Speed Guide, reproduced in Figure 3.

Figure 2 – FCC Broadband Speed Guide

Activity	Minimum Download Speed (Mbps)
E-mail	0.5
Web browsing	
Job searching, navigating government websites	0.5
Interactive pages and short educational videos	1
Streaming radio	Less than 0.5
Phone Calls (VoIP)	Less than 0.5
Watching video	
Standard streaming videos	0.7
Streaming feature movies	1.5
HD-quality streaming movie or university lecture	4
Video Conferencing	
Basic video conferencing	1
HD video conference or telelearning	4
Gaming	
Game console connecting to the Internet	1
Two-way online gaming in HD	4

Source: Federal Communications Commission, *Broadband Speed Guide* (2014).

<https://www.fcc.gov/guides/broadband-speed-guide>

The available evidence, therefore, establishes that a 5/1 Mbps speed is sufficient to support the needs of multiple, simultaneous users of the Internet. This standard, however, is arguably higher than it needs to be because there is another dimension of consumer behavior that must be taken into account in determining the minimum speeds that are required to support basic Internet activities. Unlike basic voice telephony, consumer demand for Internet applications can be shifted across time and location. For example, children and young adults are able to utilize schools and libraries for Internet access, while their parents can access such services at work and at public locations. What is more, not all of these Internet applications are time critical. It is possible for children and young adults to shift their demand to different times of the day, for example, such as when their parents are at work. Similarly, parents can shift their demand to times when their children are sleeping or away from home.

The essential point is one that has long been recognized in the economics of public utilities, such as electric power, and that is the ability of consumers to shift demand from peak to off-peak

periods.³ In fact, so-called smart appliances, including dishwashers, clothes washers and dryers, now incorporate delayed start features for precisely this reason. Similarly, modern technology enables Internet users to schedule downloads and uploads for times of low demand when their usage does not impose congestion externalities on other members of the household. An assessment of basic use of the Internet does not necessarily mean that all family members should be able to simultaneously engage high-bandwidth applications within their domicile, necessitating faster broadband service speeds.⁴

Figure 3 – FCC Household Broadband Guide

	Light Use (Basic functions only: e-mail, web surfing, basic streaming video)	Moderate Use (Basic functions plus one high-demand application: streaming HD, video conferencing, OR online gaming)	High Use (Basic functions plus more than one high demand application running at the same time)
1 user on 1 device (e.g., laptop, tablet, or game console)	Basic	Basic	Medium
2 users or devices at a time	Basic	Basic	Medium/Advanced
3 users or devices at a time	Basic	Basic/Medium	Advanced
4 users or devices at a time	Basic/Medium	Medium	Advanced

Basic Service = 1 to 2 Mbps

Medium Service = 6 to 15 Mbps

Advanced Service = More than 15 Mbps

Source: Federal Communications Commission, Household Broadband Guide (2014).

<https://www.fcc.gov/guides/household-broadband-guide>

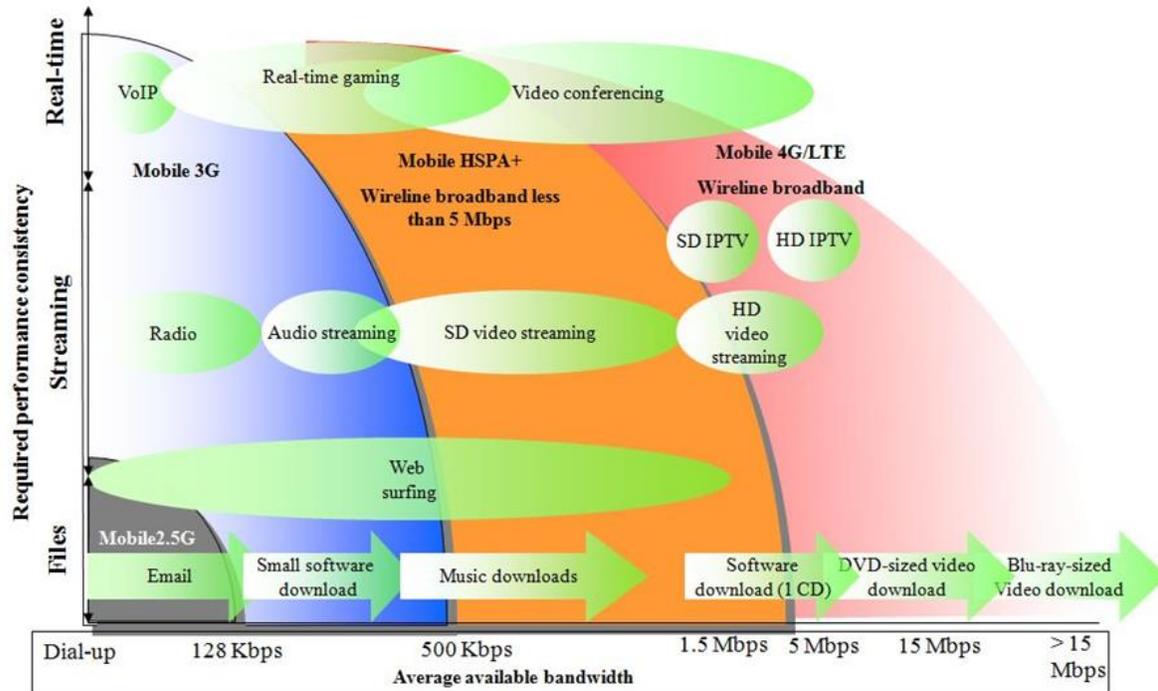
According to the *2014 Communications Monitoring Report*, Figure 5.3.8 reproduced as Figure 4, capacity requirements for the basic use of the Internet, including using e-mail, web surfing, audio streaming and video conferencing, require no more than a 5/1 Mbps speed. Therefore, a 5/1

³ See, for example, Sanford V. Berg and John Tschirhart, *Natural Monopoly Regulation*, New York: Cambridge University Press, 1988, chapters 5 and 6.

⁴ Another example is the use of the family car. There is no reasonable expectation that any family member should be able to travel anywhere s/he wants at any time s/he wants without coordination with other family members. Indeed carpools, ridesharing and public transportation are efficient resource-allocation mechanisms that families frequently employ to address automobile scarcity within the household. This example begs the question as to whether the requirements for basic Internet should differ markedly from the requirements for basic transportation with respect to the metric of simultaneous use.

Mbps speed for broadband is sufficient to permit consumers to participate in the connected economy.

Figure 4 – Figure 5.3.8 Popular Internet applications – Bandwidth requirements



Source: CRTC Technology Resource Centre, CRTC 2014 Communications Monitoring Report, (October 2014).

In fact, a 5 Mbps download speed has been endorsed in Canada, the U.S., and the UK. In particular, the Canadian federal government, through Industry Canada in its *Digital Canada 150* document, endorsed a 5 Mbps download speed as “a rate that enables e-commerce, high-resolution video, employment opportunities and distance education.”⁵ This is also the standard that has recently been proposed in the UK.⁶ It is noteworthy that the proposed UK standard of 5 Mbps is the highest standard of any country on the European continent. In addition, the FCC is currently evaluating the telecommunications services that should be considered basic and whether the universal service framework should be expanded to include a broadband offering. It

⁵ *Digital Canada 150*, Industry Canada, 2014, “Connecting Canadians,” p. 7. This report confirms that 5 Mbps broadband is sufficient for most popular applications, including e-mail, e-commerce, high-resolution video and distance education. See also CRTC 2014 Communications Monitoring Report, Figure 5.3.8.

⁶ In the context of the 2015 Budget, the UK government made the following statement: The government is committed to ensuring that every single household in the UK has access to the basic broadband needed to live and work in the modern world. So we will look to raise the Universal Service Obligation (USO) – the legal entitlement to a basic service – from dial up speeds to 5Mbps broadband. This commitment to all goes further than any other country in Europe. Once in place, a USO would mean that consumers gain a legal right to request installation of 5Mbps capable services at an affordable price.

is significant that the FCC has also found that 5 Mbps is sufficient to support a broad range of popular Internet applications as show in Figures 2 and 3.

d. Different technologies can deliver the minimum Internet speed

i. Wireline, fixed wireless, wireless, satellite

Platform competition has given rise to a multitude of technological platforms and service providers capable of supplying 5/1 Mbps broadband to consumers. These options include wireless, wireline and satellite. Hybrid technologies such as fixed wireless access technologies can also provide a valuable service to customers in rural and remote areas. What is not important, and is duly recognized as technological neutrality, is the particular technological platform that is used to provide this level of broadband service to consumers. Given that there are various mechanisms by which broadband Internet can be delivered, different technologies offer different advantages.

ii. Preferred technology or technologies depend on location

The preferred technology or technologies used to deliver broadband service depend on location. For example, in rural and remote areas of Canada's far north, and comparable areas in other countries, one cannot expect fiber connections to span from house-to-house. As a result, there are satellite dependent communities that may not be able to receive Gigabyte service found in some urban areas but are nevertheless able to connect to a minimum broadband speed necessary to operate services that are required to participate in the connected economy. To illustrate this point, Canada's Satellite Inquiry Report (2014, p. 37) shows that new high throughput satellite ("HTS") technology can be deployed on any frequency band and HTS on Ka-band can deliver ". . . Internet speeds in excess of [...] 5 Mbps [download speeds]."

Other companies, such as Oneweb and SpaceX, are developing systems capable of delivering high-speed broadband services to everywhere on earth, even the most remote areas, using multiple technology platforms.⁷ OneWeb's cluster of low orbit satellites should eliminate

⁷ Hughes news release, "Hughes announces partnership in OneWeb's innovative global satellite broadband initiative to close the digital divide," <http://www.echostar.com/NewsEvents/PressReleases/PressRelease.aspx?prid=21387> , last accessed August 31, 2015.

common service problems such as high latency, rain fade, and slower speeds associated with geosynchronous satellites.

iii. Relative cost of technologies depends on location

Given that the optimal type of technology to deliver broadband service varies depending on the location, so too must the cost of the service. In underserved and unserved areas, most of which are found in very remote or rural areas, demand is limited and the cost of providing 5/1 Mbps service is high relative to the price that service providers believe they could charge. As a result, the service provider will determine the least cost method of providing service to underserved and unserved households. What is important is if 5/1 Mbps service is available, not the technology used to provide it.

In addition, the case for action to address affordability related to geography is weak. In Canada, for example, while some provincial and territorial governments contend that the regulators should “ensure that rates are fair and just when compared to the other regions,”⁸ this is simply not realistic and is not in keeping with the prices of other goods and services provided in those areas. Food and transportation are also more expensive in remote and rural areas, such as in Canada’s far north; the prices of these goods and services are not the same as in other parts of the country. Rather, the government recognizes the higher cost of living in the North through the tax system and provides various subsidies and tax measures to compensate.

III. Policy Towards Broadband

a. Alternatives

There are three principal policies by which broadband can be deployed: 1) regulators can rely on platform competition, 2) there can be state intervention, or 3) regulators can encourage the unbundling of services. It is important to evaluate each of these alternatives in order to understand which policy is most efficient in delivering broadband service. Levin and Schmidt (2015, p. 3) indicate that “while arguments for and against any of these policies can be made, and have been made, on a theoretical basis, there is now an increasing amount of actual evidence

⁸

Telecommunication Policy Review Submissions, 2005, book 6, Government of Newfoundland Submission. See also Government of Northwest Territories Submission, paragraphs 40 and 52 which states a similar position.

weighing upon which of these policies are most successful, and are likely to be most successful, in facilitating the deployment of broadband services.”

i. Platform competition

Platform competition has given rise to a multitude of technological platforms and service providers capable of supplying 5/1 Mbps broadband to consumers. Technological advances and consumer preferences are driving competition to provide the best broadband services. Platform competition has proven itself in various broadband markets around the world by giving consumers numerous choices of providers, lower prices, higher quality services, and rapid innovation.

For example, the U.S. uses platform competition to deploy broadband services and exemplifies platform competition’s many benefits: low unit prices, high adoption rates, high usage, high standards, and high quality service. All of these results stem from strong competition in the marketplace, which in turn encourages investment and results in better overall service. For Example, Wallsten and Riso (2010) attempt to adjust for differences in download speeds as well discounts and promotional allowances in standalone pricing. Many of lowest broadband prices, as shown in Figure 5, are found in countries that have substantial platform competition and fiber-to-the-premise (“FTTP”) platforms such as the USA, France, and Japan.

Figure 5



Source: Wallsten and Riso (2010)

Canada also benefits from a high level of platform competition but also faces a certain degree of government intervention to encourage broadband distribution. This plurality of high quality, competing networks, reaching almost all Canadians, is the direct result of regulatory and federal government policies that have encouraged robust platform competition. Platform competition policies are working to bring world-class voice and broadband services to the vast majority of Canadians. Private sector investment has resulted in broadband deployment by the cable companies, the incumbent telephone companies, wireless carriers, fixed wireless providers, satellite providers and numerous new FTTP providers. Crandall (2015, p. 1) concludes that “the widespread availability of high-speed broadband in Canada is the result of strong platform competition among incumbent telecommunications carriers, cable television companies, and wireless carriers and extremely high rates of capital spending on these platforms.” He also states (2015, paragraph 12),

With strong capital investment from telecom companies and cable companies, high-speed access is available even in rural areas in Canada. Much of the reason

for this success lies in the Commission's reliance on platform competition between cable television companies and traditional ILECs.

As LTE services become more prevalent, these fixed wireless services, used in conjunction with satellite backbone, will provide broadband service to rural and remote areas. Crandall (2015, paragraph 13) finds a positive relationship between platform competition and LTE connections and states "Akamai's 2014 Q1 *State of the Internet* report shows that 60% of Canada's wireless connections provide greater than 4 Mbps speeds. In Europe, only 6 of 24 countries had a similar or greater share of 4 Mbps connections..."

ii. State intervention

Other countries have more substantial government intervention than in the U.S. or Canada in an effort to deploy broadband across their nations. The national broadband initiatives in Australia and New Zealand feature strong policy intervention and direction from the state to promote broadband deployment and adoption. Australia and New Zealand have embarked on the alternative of monopoly high-speed broadband networks. Beltran (2014) analyzes the early results of national fiber-to-the-home ("FTTH") initiatives in Australia and New Zealand. In Australia, a public company has struggled to meet its construction targets using the public sector to control essential facilities. New Zealand has instead relied on private partners to invest in broadband deployment but has experienced a very low uptake rate.

Howell (October 9, 2014) points out some of the problems and the expense of Australia's policy of a National Broadband Network ("NBN") fiber monopoly. Because the government wants to maintain nationwide pricing, it must prevent infrastructure competition in urban areas where broadband is priced higher relative to cost in order to subsidize the higher cost in rural areas. The government policy favors taxpayers as owners of the NBN in the short run over taxpayers as consumers benefiting from infrastructure competition in the long run (Levin and Schmidt, 2015).

Such government-owned or, in the case of New Zealand, public-private partnership national monopoly networks, require substantial subsidies. Even with a recent revision of Australia's NBN to permit the NBN to include cable and other assets to be acquired for the NBN (at the cost of infrastructure competition), Howell (December 26, 2014) reports that the NBN will cost almost US \$5 billion more than relying on industry to provide the service. New Zealand recently

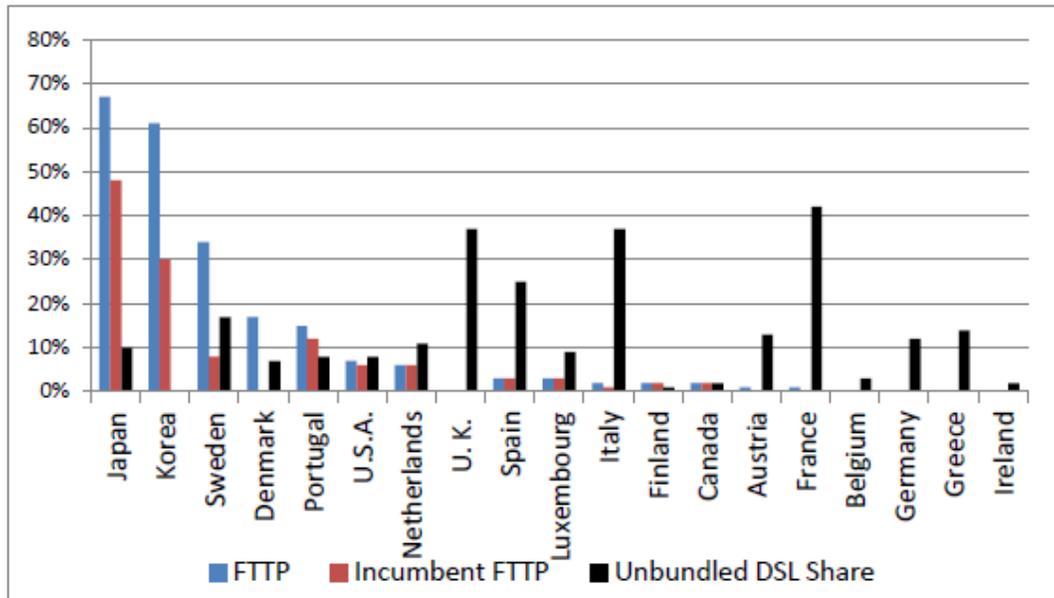
announced that it would increase its ultra-fast broadband (“UFB”) network to reach 80% rather than 75% of households at an additional cost of US \$112-155 million on top of the initial cost of the network. At the end of 2014, however, the UFB network had only 69,301 subscribers (Levin and Schmidt, 2015).

The broadband deployment programs in New Zealand and Australia have been very costly for the state and have not led to higher rates of adoption than in areas with platform competition. The evidence shows that such a state-based policy to deploy broadband is not as efficient as platform competition. Also, as the Australian case demonstrates, mandated access and state intervention has discouraged investment, whereas platform competition encourages investment and innovation.

However, other countries, such as South Korea and Japan, have also featured strong policy intervention and direction from the state but have been successful at promoting the deployment and adoption of broadband services. These East Asian countries boast some of the best quality FTTP networks in the world and have achieved a very high adoption rate. What is unique about the state intervention in these countries is that there is effectively no unbundling of services. While Japan, for example, seems to mandate unbundling, in practice they do not because of the multiple-line restrictions to get unbundled loops.

Although Japan and Korea do have a high number of FTTP subscriptions, Crandall (2014, p. 7) shows in Figure 6 that “...the countries with the largest share of DSL delivered over unbundled loops generally have little or no broadband service delivered over fiber.”

**Figure 6 – Shares of Broadband Subscriptions
FTTP, Incumbent FTTP, and DSL Unbundling**



Source: OECD, *Communications Outlook 2013*, in Crandall (2014, p. 8).

iii. Monopoly and unbundling

The third, and least preferable, policy towards broadband distribution is the unbundling of services, exemplified by the EU. It is quite evident from the empirical record of broadband regulation across countries that mandated network unbundling reduces investment by ISPs and therefore reduces network availability and broadband adoption by inhibiting investment in improved network quality. Crandall has tirelessly argued about the negative effects of network unbundling and has offered the following analysis (TELUS(FMCC)14Aug15-2, CRTC Telecom Notice of Consultation 2015-131).

Cambini and Jiang (2009) reviewed the early theoretical and empirical literature on the effects of mandated unbundling regulation on network investment. They concluded that “... most of the evidence shows that local loop unbundling based on forward-looking cost methodology discourages both ILECs and CLECs from investing in networks.”

More recently, a number of studies have focused on the relationship between “access regulation” (generally, network unbundling) and the deployment of Next Generation Networks (NGA) or fibre to the premises. Wallsten and Hausladen (2009) found that there is an inverse relationship

between the number of DSL connections provided through unbundled loops and the number of premises connected through fibre to the premises.

Briglauer, Ecker, and Gugler (2013) conducted a regression analysis of NGA (fibre) deployment in 2005-10 in 27 EU countries. They found that the share of broadband lines offered over wholesale facilities (unbundled lines, bitstream access, and resale) had a significantly negative effect on the subsequent deployment of fibre.

Briglauer (2014) provided a statistical analysis of the determinants of fibre (NGA) connections in 27 European countries in 2005-12. He found that wholesale regulation, measured by the share of broadband lines provided by competitors over facilities provided at wholesale by incumbents, was negatively related to the share of broadband connections provided over fibre. Briglauer concludes that this result “strongly supports our hypothesis . . . that the more effective broadband access regulation is, the more negative is the impact on the adoption of NGA services.”

Bacache, Bourreau, and Gaudin (2014) tested the hypothesis that firms using wholesale access to deliver broadband services climb the “ladder of investment” to deploy their own facilities in subsequent years. Using data from 15 European Union countries for 2002-09, they found that firms employing unbundled loops do not subsequently invest in their own infrastructure to deliver broadband service.

Yoo (2014) provided an extensive analysis of the differences between European and U.S. broadband development. As part of his analysis, he estimated a regression model of the determinants of NGA coverage in 28 EU countries in 2011-12. He found that the share of DSL lines offered by competitors over leased incumbent facilities was strongly and negatively associated with the deployment of NGA infrastructure.

In each of these studies, the deployment or take-up of NGA (fibre) was found to be adversely impacted by the legacy of mandated unbundled access to incumbent facilities. As a result, consumers may benefit in the short run from network unbundling, but they are subsequently denied the benefits of higher-speed facilities because unbundling retards the deployment of fibre-based NGA networks (Crandall, Eisenach, and Ingraham (2013)).

Furthermore, Nardotto, Valletti, and Verboven (2014, p. 28) show that the unbundling of services deters investment and does not increase penetration:

While unbundling is often described as a policy tool designed to increase adoption, we have found no strong evidence of this happening. Despite its widespread take up by entrants, the observed effect of LLU on total penetration turns out to be limited to the early years, and vanished as the market reached maturity. This is a remarkable result, and one which runs counter to many policy statements. The data instead reveal that inter-platform competition from cable always leads to market expansion.

b. Evaluation of alternatives

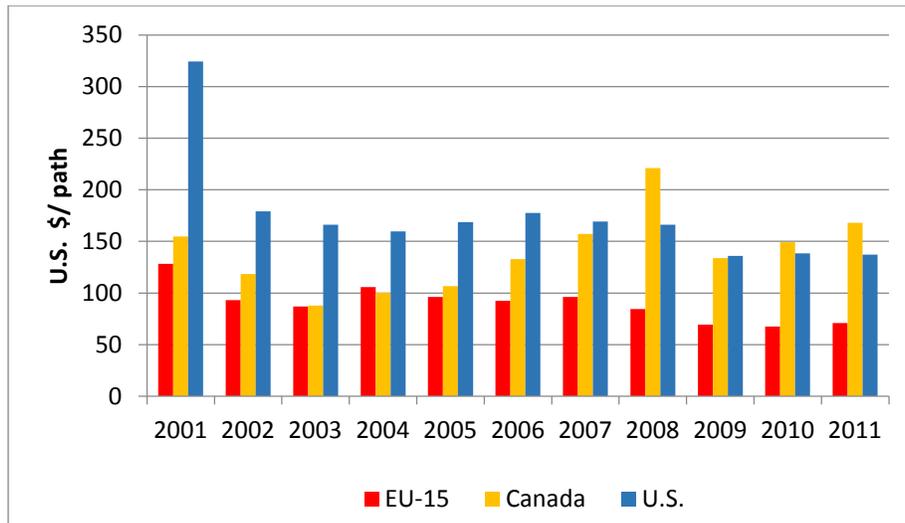
i. Outcomes in terms of availability, adoption, and performance

ii. Platform competition is superior to monopoly and unbundling

As the evidence shows, regulators and governments should maintain a robust commitment to platform competition policies by limiting the mandatory unbundling of networks. This will increase network availability and broadband adoption. Although state intervention has led to positive broadband deployments in some countries in East Asia, it has also been shown to significantly increase costs and deter investment in other countries like Australia and New Zealand. As Kahn (1990, p. 340) observes, where regulation continues to be necessary, “it should, to the greatest extent possible, be designed in such a way as to be compatible with competition rather than obstructive of it.”

As the evidence has shown, network unbundling is the least efficient policy towards broadband deployment. Crandall (2015) finds that where government policy has been more interventionist and myopic, as in Europe, there is traditionally less investment by incumbent telecommunications companies. As shown in Figure 7, total spending by telecom (including wireless), cable, and satellite carriers shows the difference between North American broadband providers and their European counterparts. With increased spending comes increased quality, greater competition, lower prices, and better performance of broadband networks.

**Figure 7 – Total Telecom Capital Spending per Communications Access Path
Canada, U.S., and EU-15**



Source: OECD, *Communications Outlook 2013*, in Crandall (2015, p. 9).

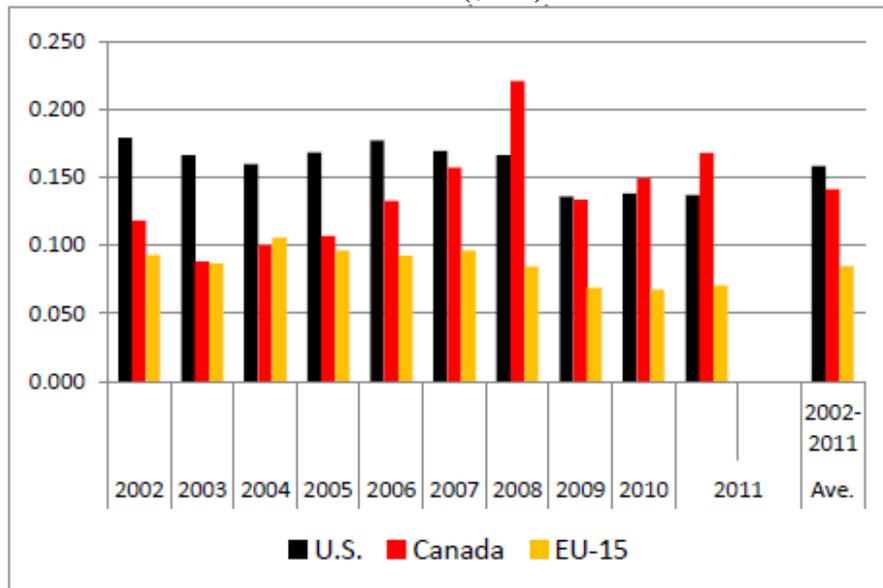
Crandall (2014) examines capital spending on communications in the U. S., Canada, and the EU-15. As Figure 8 shows, capital spending has been consistently higher per communications path in the U. S. and Canada than it has been in the EU-15. He attributes this difference in investment to the fact that there is much less network unbundling and line sharing in the U. S. and Canada than in the EU-15 and to the fact that there is no unbundling or line sharing of FTTP in the U. S., while FTTP unbundling or line sharing continues to be either a fact or a possibility in the EU-15 (Levin and Schmidt, 2015).

c. Pockets where platform competition does not provide adequate service

In the event that there remain pockets of households where platform competition does not provide adequate service and regulators determine that there is a need for rate assistance or for a subsidy, a bidding mechanism, either like Industry Canada has used for its Connecting Canadians program or like the U. S. Federal Communications Commission has used for certain programs, or a reverse auction, can be implemented to minimize the size of any subsidy. With either of these mechanisms, one-time subsidies would be offered for incremental builds by the supplier and not on an ongoing basis to end-users.

Any such subsidy should be funded out of general tax revenues. Failing that, a subsidy should be funded from a broad-based charge on telecommunications services.

Figure 8 – Incumbent Telecom Companies’ Capital Spending per Communications Path United States, Canada, and EU-15 (\$000)



Source: OECD, *Communications Outlook 2013*, in Crandall (2014, p. 5).

i. Bidding or reverse auctions will hold down the cost of subsidies

Industry Canada’s Connecting Canadians program has set a good precedent by putting the provision of broadband service in geographic areas out for bid. The program selects winning bids from ISPs based on various factors, one of the most important being the size of the subsidy required to serve a given region. Ireland is also using a bidding process to extend broadband services.⁹

A recent news release by Industry Canada states that “[t]he Government has exceeded its Economic Action Plan 2014 target by over 75,000 households in the first round of project approvals, bringing high-speed Internet access to more than 356,000 homes across Canada, and nearly 40 percent under budget.”¹⁰ Being 40 percent under budget demonstrates the benefit of bidding or reverse auctions to hold down the cost of these programs.

A reverse auction, in which service providers are able to lower their bid to serve a designated region in successive rounds of bidding, has the potential to result in even lower subsidy amounts

⁹ Ronan McGreevy, “Ireland’s broadband black spots,” *The Irish Times*, <http://www.irishtimes.com/life-and-style/ireland-s-broadband-black-spots-1.2103169>, accessed July 14, 2015.

¹⁰ “High-Speed Internet Coming to the Kootenays,” Recent Connecting Canadians announcement in the Kootenays, British Columbia, <http://news.gc.ca/web/article-en.do?nid=997839>, accessed July 9, 2015.

than a bidding process like the one that Industry Canada has employed. Reverse auctions are being used in other countries, for example in “the U.S. for the Mobility Fund auctions for broadband mobile licences for rural and tribal regions.”¹¹

ii. Funding should be from general revenues or, failing that, from a broad-based charge on all telecommunications services

Crandall (2015) also concludes that should a subsidy program be necessary, it should be funded from general tax revenues, not from a charge on telecommunications services.

“Contribution” payments by telecommunications providers to fund subsidies necessarily raise the cost of services provided by these carriers and, therefore, require higher prices for these services, thereby discouraging their use. The loss in economic value from such narrowly-targeted support regimes is much greater than the loss that results from taxes that are collected from a much wider tax base. Hausman (1998) has estimated that the taxes levied by the FCC on U.S. international and interstate carrier revenues to support universal service more than double the economic cost of providing the universal service subsidies because they substantially reduce subscribers’ use of international and interstate services (p.29-49). If they were funded from general tax revenues, the economic welfare loss would be much lower (paragraph 60).

If the first-best approach to generating the funds necessary to provide assistance proves infeasible, a second-best approach, so called because it is the next most efficient approach relative to the first-best approach, would entail a competitively neutral (non-distortionary) charge on all telecommunications service providers. This means that the regulator or government should not (i) impose under-funded asymmetric obligations on incumbent providers,¹² (ii) engage in inefficient and unsustainable cross-subsidization, or (iii) subsidize multiple, competing telecommunications networks that provide comparable functionality.¹³

There are several disadvantages to a broad-based telecommunications charge as compared to a subsidy funded out of general tax revenues. It necessarily follows from the above discussion that

¹¹ CRTC Consultation CRTC 2012-669-1, Review of Northwestel Inc.’s Regulatory framework, modernization plan, and related matter, Testimony submitted on behalf of the First Mile Community Consortium, by professor Heather E. Hudson, Institute of Social and Economic research, University of Alaska Anchorage.

¹² David E. M. Sappington and Dennis L. Weisman, “Regulating Regulators in Transitionally Competitive Markets,” *Journal of Regulatory Economics*, Vol. 41(1), February 2012, pp. 19-40. [**Recommendation 3.** Limit under-funded asymmetric obligations on incumbent suppliers.]

¹³ Jonathan E. Nuechterlein and Philip J. Weiser, “Digital Crossroads, Telecommunications Law and Policy In The Internet Age,” Cambridge MA: The MIT Press, Second Edition, 2013, pp. 304-306.

a narrow, telecommunications-industry based charge is inefficient because it discourages investment and the use of telecommunications services.^{14, 15}

IV. Adoption of Broadband

While the adoption of voice communication is high in much of the developed world, the adoption of broadband service lags behind. It is therefore important to understand the factors that explain the lower levels of broadband adoption.

a. Platform competition also encourages adoption

As explained in Section III, platform competition positively affects the availability, adoption, and performance of broadband services. In particular, platform competition leads to lower prices, higher speeds, and better service, which in turn leads to more consumers adopting high-speed Internet service.

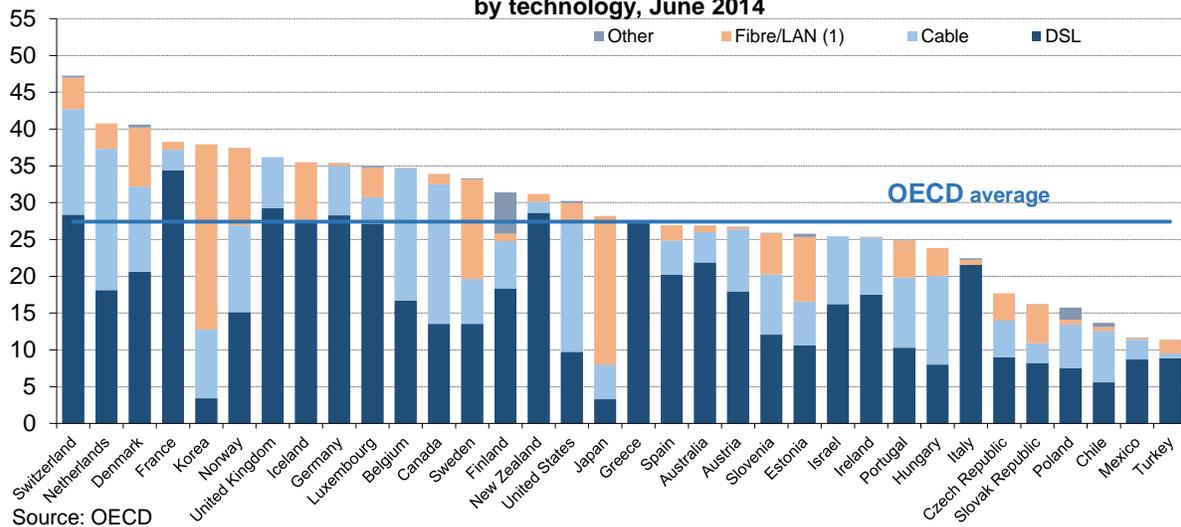
The most important action regulators and governments can take to increase adoption is to maintain a robust commitment of platform competition. Crandall *et al.* (2013) have shown that broadband adoption is greater in countries with platform competition.

For example, as a result of this competition, Crandall (2015) finds that Canadian broadband adoption per household is among the highest in the world, exceeded in only 7 other developed countries, most of which have much greater population density than Canada. Crandall also finds a positive relationship between cable companies' share of broadband subscriptions and penetration rate, as shown in Figure 9. For example, Crandall (2015, p. 9) indicates that "Canada's cable companies have a much larger share of broadband subscriptions than most other OECD countries and, as a result, Canada has achieved a subscriber penetration rate that is greater than in most OECD countries..."

¹⁴ Jerry Hausman, "Taxation by Telecommunications Regulation," *Tax Policy and the Economy*, National Bureau of Economic Research, 1998, Vol. 12, No. 1, pp. 29-49.

¹⁵ Jerry Hausman and Howard Shelanski, "Economic Welfare and Telecommunications Regulation: The E-Rate Policy for Universal Service Subsidies," *Yale Journal on Regulation*, Vol. 16, 1999, pp. 19, 30.

Figure 9
OECD Fixed (wired) broadband subscriptions per 100 inhabitants,
by technology, June 2014



b. Availability and adoption (use) of broadband are not the same

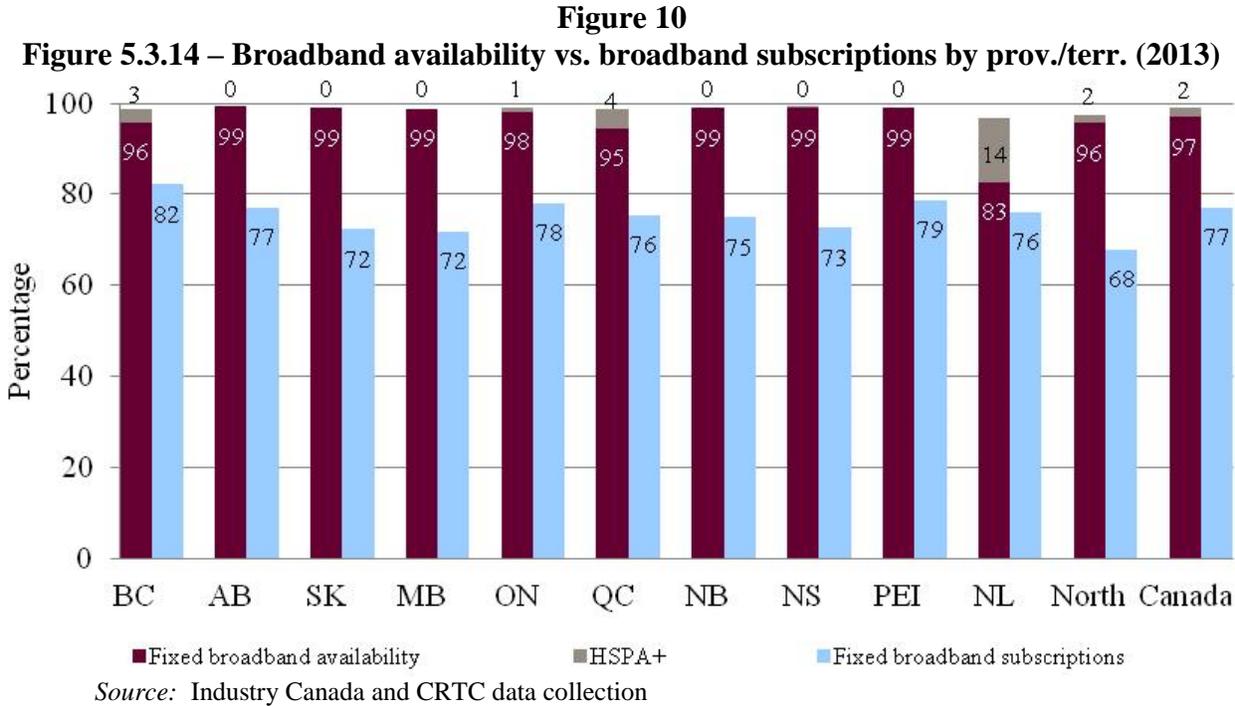
However, even when broadband services are available, that does not guarantee that they are being adopted. A high level of availability does not necessarily translate into a high level of uptake.

Not all consumers who have access to broadband service have adopted it. For example, in Canada, as shown in Figure 10, the CRTC’s 2014 *Communications Monitoring Report* identifies the gap between availability and adoption as approximately 20% nationally. Canadians who have not adopted broadband at home are limited in their participation in the connected economy. Key to increasing adoption, however, is understanding the reasons that prevent households from engaging in online activities and subscribing to broadband services.

c. Other characteristics, including age, education, and income, influence adoption

Age, education, and income are the greatest contributors to non-adoption of broadband services, at least in more advanced countries. Landry and Lacroix (2014) identify a number of trends in Canada, for example, that have contributed to the lagging adoption of Internet services. Using regression analysis to examine a set of socio-economic variables, the authors find that age, education and income are key predictors of an individual’s Internet use (p. 10). Citing statistics from both 2010 and 2012 Canada Internet Use Surveys, reproduced as Figure 11, the authors

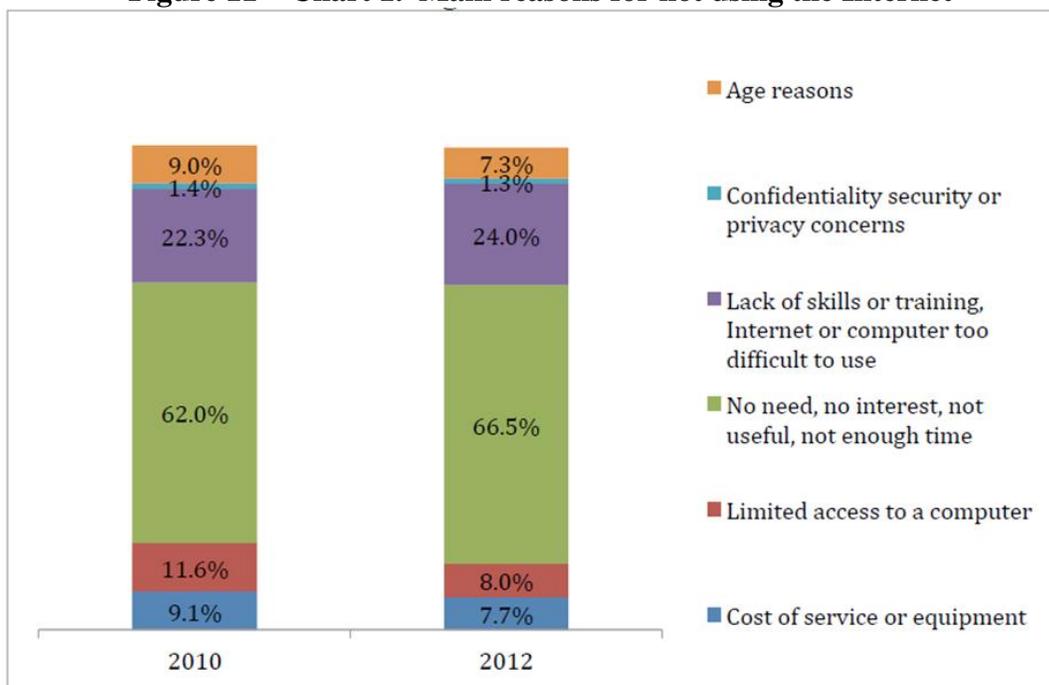
show that non-Internet users most often cite a lack of interest and a lack of skills or training as key reasons why they do not access the Internet (p. 13). The cost of service or equipment was cited as a reason by only 9.1% of non-Internet users in 2010 and only 7.7% of non-Internet users in 2012 (p. 13). The authors, citing Chaudhuri *et al.* (2005), suggest that consumer decisions to purchase an Internet subscription are “only modestly sensitive to price, thus rendering access subsidies only partially effective tools in bridging the digital divide” (p. 14). In another study Carare *et al.* (2015) surveyed households that do not subscribe to broadband. Two-thirds of those households “indicated that they would not consider subscribing to broadband at any price.”



The persistence of lagging digital skills among non-Internet adopters has been an on-going issue for ISPs and regulators. Atkinson (2009) identified skill deficits as contributing to non-adoption. Notably, Hauge and Prieger (2010) challenge the notion that supply-side regulatory responses alone can stimulate broadband adoption. They underscore the importance of focusing on demand-side policies to encourage adoption, including building knowledge, such as digital skills, about new technologies among potential adopters. Similarly, Atkinson (2009) shows how different rates of Internet adoption in Japan versus South Korea, two countries with wide-scale

broadband availability, can be explained by well-funded programs targeting usability and affordability, such as digital literacy programs that target Internet population groups that lag behind in terms of Internet adoption (p. 2-3). The biggest gains to advanced economies and to societies in these countries is likely to be from increasing adoption and not from marginal increases in already widely-available broadband. [

Figure 11 – Chart 1. Main reasons for not using the Internet



Source: Statistics Canada, Canadian Internet Use Survey (2010, 2012)

i. What government agencies are best suited to address these barriers to adoption?

Industry regulators are not well suited, nor are they often empowered, to address problems like adoption. For example, federal and state level organizations, and not regulatory institutions like the CRTC in Canada or the FCC in the U.S., are best suited to address any issues concerning adoption, especially with regards to income.

Significant barriers to the adoption of broadband Internet services include a lack of: interest, skills, and equipment to access the Internet. Hence, a multi-pronged approach that engages a cross section of government agencies at all levels is necessary. For example, in Canada at the

present time, this includes programs overseen by Industry Canada, Employment and Skills Development Canada, as well as by provincial Ministries of Education and Infrastructure or Technology. These agencies are funding initiatives to enhance digital literacy and address skill deficits that are significant barriers to broadband adoption.

Different government agencies have joined in an attempt to address these barriers of adoption. For example, in Canada, through Industry Canada (2015), there are various educational programs in place to help teach consumers about online safety and privacy when they engage in online activities (p. 12). Employment and Social Development Canada administers the Canada Job Grant skills training programs, and the Government of Canada provides grants for internships in high-demand fields (p. 15). The Business Development Bank of Canada supports digital technology adoption through its work with small and medium-sized businesses (p. 15). In addition, Industry Canada works with other government agencies and the private sector through the Computers for Schools program to provide students and interns with improved access to computer equipment and skills training (p. 15).

ii. What policies might be successful in increasing adoption?

As administrators of the education system in each province and territory, the provincial and territorial governments have the responsibility to include digital literacy in their curricula for all students. Such training will provide students with the skills to actively participate online in a safe manner, understand the benefits and challenges of Internet activities, and build the technologies of the future.

Companies can work with media literacy organizations and contribute to programs to ensure that consumers have greater access to computer equipment. Providing children and teens with the digital skills they require to work online in a safe and secure manner will be a successful policy no matter where in the world it is implemented. Also, investing in programs that deliver computer equipment to schools will help to improve the accessibility of students to computer equipment so that they can develop, at an early age, the computer skills they will need in the future. Also important are educational programs focused on Internet and smartphone safety to help keep families safe from online criminal activity such as financial fraud and cyberbullying.

Programs like these are made available to consumers in a variety of ways including in-person seminars, visits to schools and online activities.

V. Conclusions

The emerging evidence shows that the minimum Internet speed required to participate in the connected economy is 5/1 Mbps. A broadband connection of 5/1 Mbps will allow any consumer to engage in basic telecommunications services such as email, government forms, basic video streaming, etc. and to meet their daily online activities. Higher broadband speeds, while perhaps reducing wait times, are not required for consumers to participate meaningfully in the connected economy. This minimum Internet speed can be delivered over different technologies, including wireline, fixed wireless, wireless, and satellite. The preferred technology or technologies and relative costs for a given area will depend on location.

The evidence also shows that platform competition is preferable to either state intervention or monopoly and unbundling to efficiently distribute broadband services. Countries with a heavy reliance on platform competition, such as the U.S. and Canada, consistently outperform those without. The evidence also shows that platform competition leads to the increased adoption of broadband services. State intervention, although successful in countries like South Korea and Japan, has been equally ineffective in other countries, like Australia and New Zealand, where costs have been significantly higher and adoption rates have been lower than in countries with platform competition. Moreover, network unbundling, exemplified by many EU countries, has persistently deterred investment, has not increased adoption, and has never outperformed platform competition in the long-run.

Although platform competition is the most efficient policy by which to distribute broadband services, there will undoubtedly be pockets of households where platform competition does not provide adequate service. Therefore, a bidding process or reverse auctions will hold down the cost of subsidies. Any subsidy needed for extending broadband should be funded from general revenues, or, failing that, from a broad-based charge on all telecommunications services

Finally, industry regulators are not well suited, nor are they often empowered, to address problems like adoption. Given that age, education, and income are the most significant barriers

to the adoption of broadband services, education and digital literacy programs are policies that might be most successful in increasing the adoption of broadband services. All levels of government and various government agencies working together are best suited to address these barriers to adoption.

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