Understanding the Benefits of Broadband: Insights for a Broadband Enabled Ontario

A paper prepared for the Ministry of Government Services, Ontario

by

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Abstract

This paper reviews the international literature on broadband network developments and assesses the claims of social and economic benefits attributed to broadband initiatives. The paper reveals a current disconnect between societal level goals for increased citizen participation in the knowledge economy, and individual broadband usage that is centred around communication and entertainment activities. The paper points to the crucial, and often overlooked role that communal level broadband initiatives can play in extending services to citizens, and in improving interactions between governments and their constituents. It is noted that the clearest beneficiary of global broadband deployments is the commercial sector. Although broadband technologies are being widely adopted by consumers, and heavily promoted by governments, it is observed that their impacts to date are subtle, rather than spectacular. It is difficult to identify a set of applications or services that would be essential to a broadband enabled Ontario, but given the perceived importance of broadband as an enabler of competitiveness and productivity, it appears that an agenda to increase broadband capacity and services in Ontario is a reasonable one. The paper concludes by presenting a number of issues to be considered in the development of a strategic vision and agenda for 'broadband enabling' the Ontario economy.

Understanding the Benefits of Broadband: Insights for a Broadband Enabled Ontario

The Ontario Ministry of Government Services is creating a research agenda for the development of broadband infrastructure in the Province of Ontario. The process articulates a "future vision of Ontario as a leader in utilizing broadband access to promote economic and social development," and encourages engagement in policy development and "human and technological capacity building" that will result in widespread citizen access to, and participation in, a digital economy in Ontario (Ontario Ministry of Government Services, 2007). It is anticipated that this 'broadband enabled' Ontario will deliver positive social and economic benefits to the citizens, businesses and government of Ontario, but the exact nature of this broadband enabled province is unclear. Before developing policy initiatives, designing new applications and services, making technology decisions or making plans for encouraging citizen or business use of the networks, it is important to understand the potential that the continued development of broadband infrastructure could bring to the province. This paper reviews literature, case studies and best practices on broadband deployment in order to help Ontarians understand what a broadband enabled province might look like. This paper does not address the use of broadband by businesses or institutions (hospitals, schools, universities) in Ontario.

The paper focuses on identifying and assessing the benefits of broadband technologies. It begins with a discussion of the context for broadband initiatives, briefly outlining the history of consumer broadband development in Canada. The issues driving broadband development, deployment and adoption (referred to as the 'broadband cycle') are outlined from the perspectives of multiple stakeholders. The paper then outlines and assesses social and economic benefits of broadband infrastructure deployments, showing that evidence supporting the value of broadband initiatives is mixed. Broadband developments do support commercial interests, and there is evidence of increased efficiency in services delivered with broadband networks. Individuals are adopting broadband for its convenience and to access communication and entertainment services, but there appears to be a gap between the desired societal level outcomes (e.g. enhanced productivity, increased human capital) and current usage patterns. Access to 'e-services' (including e-health, e-learning and e-government) is being provided at a communal level, and efforts are being made to extend connectivity to underserved areas. Broadband networks are being used widely, but the paper reveals that existing deployments have not

achieved the transformative impacts often attributed to broadband. As the worldwide push toward a broadband enabled information society is likely to continue, the paper concludes with a list of issues to be addressed as Ontario develops a strategic vision and plan for 'broadband enabling' its economy.

Internet Adoption in Canada

In 1994, the Government of Canada initiated its 'Information Highway' strategy. Led by Industry Canada, the Canadian government articulated the need to develop "advanced information and communications infrastructure" that would have transformative effects on Canadian society, stimulating the diffusion of innovative technologies and services, increasing the competitiveness of Canadian businesses, and providing citizens with access to health care, education and social services. A key objective of this strategy was to provide Canadians with universal access to the Information Highway and its essential services, at a reasonable cost (Industry Canada, 1994).

The Information Highway Advisory Council was created to help implement Canada's Information Highway strategy. In its 1995 report, it recommended that the Information Highway be developed by the private sector, with government "set[ting] the ground rules and act[ing] as a model user" (Information Highway Advisory Council, 1995). By 1997, the Internet was recognized as Canadians' primary access point to the Information Highway, and its "potential to bring far-reaching benefits and changes to Canada's economic life and industrial structure" (Information Highway Advisory Council, 1997) was observed. The government developed a vision of a "Connected Canada," and established goals to become the most connected country in world (Manley, 1999). Programs like SchoolNet, VolNet, Smart Communities and Community Access Programs established a nation-wide information infrastructure to provide Canadians across the country with public Internet access.

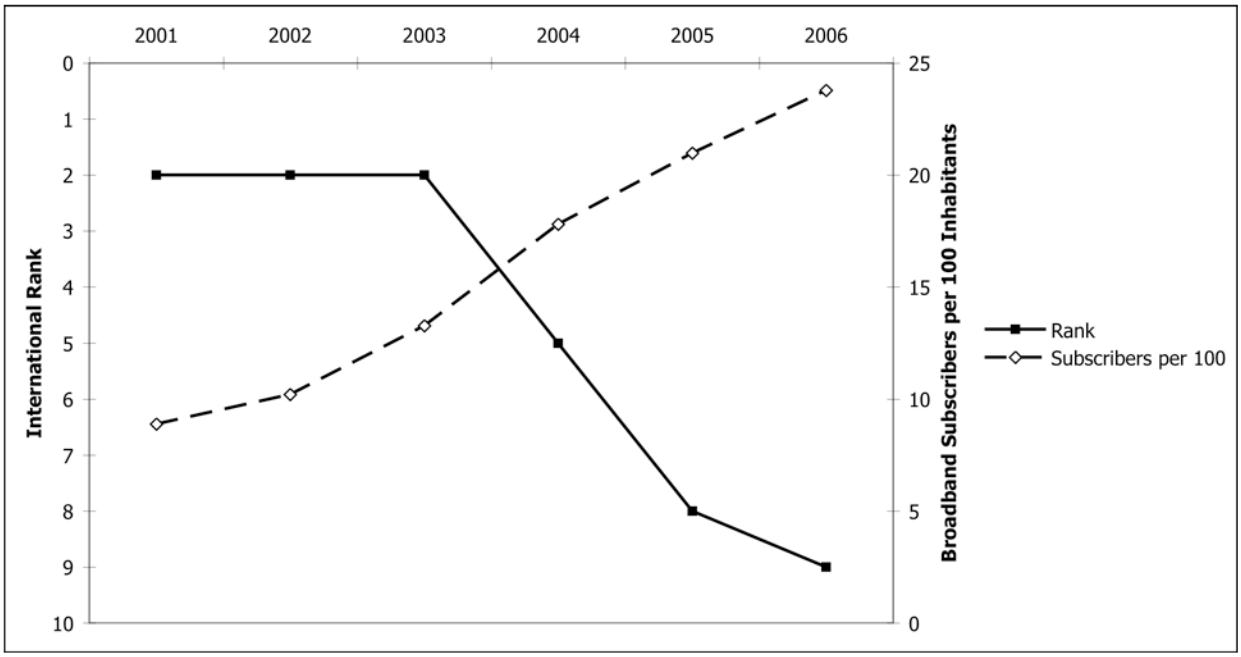
The Household Facilities and Equipment Survey (Statistics Canada, 1996) was the first to collect data on Canadians' Internet usage in the home. Statistics Canada reported that 7.4% of Canadian households were using the Internet from home in 1996, and that more than half of those who had computers with modems were not online (Mitchell, 1996). It was not until 2002 that the Internet was being used in the majority of Canadian households (Statistics Canada, 2002). Statistics Canada's most recent data indicates that 61% of Canadian households had

Internet connections in 2005, showing that growth in Internet access is slowing (Statistics Canada, 2006a).

Until 1996, dial-up Internet access was the only option for Canadian households. Saskatchewan's SaskTel became one of the world's first DSL (telephone-based high speed Internet) providers in late 1996, about the same time that Rogers Communications was introducing the world's first high speed cable Internet service in the Toronto region. Canadians were early adopters of broadband Internet services (Lie, 2003). In 2001, Industry Minister Brian Tobin created the National Broadband Task Force and championed its recommendations to extend high speed Internet connectivity to all Canadians by 2004 (National Broadband Task Force, 2001). Minister Allan Rock announced the Broadband for Rural and Northern Development program in 2002 (Industry Canada, 2005a) and the National Satellite Initiative in 2003 (Industry Canada, 2005b), to encourage the development of broadband infrastructure in underserved areas. A recent review of telecommunications policy in Canada (Telecommunications Policy Review Panel, 2006) recommends the development of "affordable and reliable" broadband connectivity to all citizens by 2010, acknowledging that the 2004 target date for universal broadband was not met.

Although Canada's status as an international broadband leader has eroded over time, it still leads the G7 in broadband penetration. Figure 1 shows that the number of broadband subscribers in Canada has been increasing steadily over the past five years, with 21 subscribers per 100 inhabitants in 2005. While not directly comparable, Statistics Canada data provide some context for this figure, noting that 6.4 million Canadian households, or 81% of households with Internet connections had broadband Internet access in 2005 (Statistics Canada, 2006a).

FIGURE 1: BROADBAND ADOPTION IN CANADA



Source: (Organisation for Economic Co-operation and Development, 2007b). 2002 and 2003 data were reported in June. 2001, 2004, 2005 and 2006 data were reported in December.

Defining Broadband

Encouraging the development of broadband Internet infrastructure has been a priority of governments around the world for many years. But what exactly is broadband Internet, and what can it do? Why has broadband become such a desirable technology for governments and citizens?

In the simplest terms, broadband Internet offers faster speeds than can be achieved with a dial-up telephone connection, allowing users an enhanced Internet experience. But for governments promoting broadband networks as a means of enhancing national productivity and competitiveness, 'faster than dial-up' is not a sufficiently precise definition on which to build a national broadband strategy. As a result, there have been many efforts to define 'broadband,' efforts that can be characterized by their technical or user-centric focus.

Technical definitions of broadband

Technical definitions of broadband focus on the speed of the connection. In the U.S., the Federal Communications Commission (FCC) defines a broadband connection as one that transmits data at rates of at least 200 kilobits per second (Kbps), in one direction (Federal

Communications Commission, 2006). Broadband connections can be symmetrical (with the same upload and download speeds), or asymmetrical (typically the download speed is higher than the upload speed). The OECD's definition is similar to the FCC's, considering any connection with download speeds in excess of 256 Kbps to be a broadband connection (Organisation for Economic Co-operation and Development, 2007b). In Ontario, services at these speeds are marketed by the telephone and cable companies as 'lite' broadband.

Technical definitions also note that broadband connections are 'always-on,' and that DSL (digital subscriber line) connections allow users to talk on the telephone while using their broadband connection. There are many technologies that provide broadband connectivity to users. (See Chapter 2 in International Telecommunication Union, 2003a for an accessible description of various broadband access technologies).

FIGURE 2: COMPARISON OF INTERNET ACCESS SPEEDS

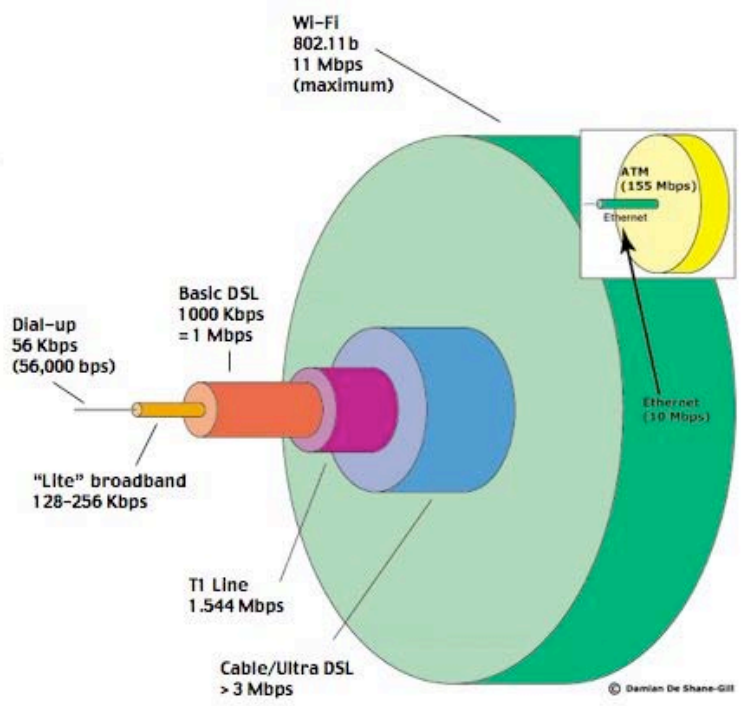


Figure 2 provides a schematic representation of the speeds provided by various access

technologies. As a point of reference, note that in 2007 many corporate and institutional networks offer gigabit ethernet speeds (1 Gbps = 1000 Mbps) to their users. Consumers in Japan can get 50 Mbps broadband connections at home for less than $40 U.S. per month (International Telecommunication Union, 2006). In Ontario, Cogeco Cable offers download speeds of up to 16 Mbps for $69.95/month. Rogers Cable offers 6 Mbps cable broadband service for $55.95/month, and Bell Sympatico offers 5 Mbps DSL service for $55.00/month.

These speeds indicate that what is available in the marketplace for consumers in Ontario (and elsewhere) is much faster than the minimum speed levels defined by the FCC and the OECD, and show that definitions of broadband are a moving target. What was considered to be broadband in 2001 (when the OECD started publishing broadband access data) is by most accounts narrowband for today's users[1]. Critics suggest that the FCC has maintained their definition of broadband at such a low speed so that the adoption rate in the U.S. appears higher, and contend that at a minimum a broadband network should enable its users to upload and download video (Turner, 2005). The Fiber-to-the-Home Council is (not unexpectedly) encouraging the U.S. Congress to take steps to ensure that Americans have access to 100 Mbps service (currently best provided by fiber connections to the home) by 2010, and a bill in the Minnesota legislature is proposing home access speeds of 1 Gbps (for downloading and uploading) by 2015 (Gubbins, 2007).

User-centric definitions of broadband

Canada's National Broadband Task Force (2001) adopted a user-centric perspective, arguing that defining bandwidth in numerical terms did not make sense in an environment of rapid technological innovation. Instead, the Task Force defined broadband as "a high-capacity, two-way link between an end user and access network suppliers capable of supporting full-motion, interactive video applications" (8). However, the Task Force then noted that a minimum speed of 1.5 Mbps (for both uploads and downloads) would be required to provide this capacity, with the expectation that higher speeds would be needed over time.

[1] Before the mid-1990s, broadband was defined in technical circles as greater than 45 Mbps. Services from 1 Mbps up to 45 Mbps were considered "wideband," a term that has disappeared from the current discussions of consumer broadband networks (Computer Science and Telecommunications Board, 2002).

Fransman (2006) argues that technical definitions of broadband reflect the perspective of those supplying and provisioning the networks, but that user-centric definitions are what really matters. Users will find value in broadband only if it allows them to do the things that they want to do. Demand for broadband networks is based on the networks offering sufficient capacity to meet users' needs. While technically, a network connection is simply a 'pipe' that enables data transfer, and a broadband pipe allows faster connectivity, broadband is now understood as a means of accessing 'content' and services. As Gault and Messinger (2002) note, "While ICT infrastructure is important, its impact depends on what is displayed, processed, stored, and transferred by the network. Electronic content is what matters to the people downloading music, games, videos, and software" (9). Today the term broadband effectively encompasses the network and the content/services accessed over the network, as reflected in the idea that broadband allows users to do the things that they want to do.

What is broadband for?

If broadband is defined as a speed that allows users to do the things that they want to do, what are these things? For users in Canada today, broadband networks and the Internet are synonymous. Although citizens could set up their own networks (using Internet protocols) to communicate directly with each other, this is not a common occurrence[2], so people have broadband service so that they can access the Internet.

In 2005, the majority of Canadian Internet users went online to email, pay bills and do their banking, check weather or road conditions, view news and sports, make travel arrangements and search for government and health information (Statistics Canada, 2006a), activities that could be carried out with fairly low bandwidth connections. Although the 2005 data showed that far fewer Canadians used the Internet for bandwidth intense activities like downloading movies or television, the prevalence of these activities is growing, especially among younger Internet users. Internet service providers are reporting much higher Internet traffic in the past year, driven by user-generated content ('Web 2.0' services) like YouTube and Flickr, as well as legal music and

[2] There are many organizations and institutions in Canada that do use Internet protocol based networks that are separate from the 'public Internet'. These 'closed' networks make use of broadband connections to provide services and applications that are not available publicly over the Internet, but are available to people with access to the networks.

television downloads (e.g. iTunes, CTV Broadband).

Assumptions about broadband

The definitions of broadband provided above are technology-neutral, meaning that broadband can be provided to people using various access technologies. Although not directly addressed by the literature on broadband deployment and adoption, the dominant way of thinking about broadband networks is not device-neutral. An unwritten assumption in most current conceptualizations of broadband networks is that broadband delivers a high bandwidth Internet connection to a personal computer, which is usually located in a fixed location in an individual's home or office. Newer devices also allow for broadband service to connect televisions or game consoles directly to the Internet.

The emergence of wireless (Wi-Fi) networks allows people to use the Internet in a portable manner, by connecting laptop computers or personal digital assistants (PDAs) to the Internet in various locations within the home, or outside the home at public locations including airports, hotels, cafés and parks. But portability is not the same as mobility. Mobile broadband (e.g. high speed connections that can be used in a moving vehicle) solutions are not yet readily available in North America, raising the question as to whether definitions of broadband that allow for users to do the things they want to do should be refined to recognize that users may want their broadband to be mobile, and available everywhere (ubiquitous). This recognizes the anytime, anywhere availability that consumers currently have with cell phone service, and suggests that a more appropriate definition for broadband in today's environment would be a service that allows users to do what they want to do, where they want to do it, on the device(s) of their choice.

This extension of the definition of broadband shifts the technological basis of the service from Internet-centric to Internet- *and* mobility-centric, providing opportunities for broadband service to be delivered through cellular phone networks as well as existing cable and telephone networks. It also reinforces the potential for new market entrants, who can establish Wi-Fi services in competition with existing Internet service providers (e.g. Toronto Hydro Telecom has entered the Internet market with its OneZone wireless Internet service in downtown Toronto). Also of note in this discussion is the popularity of low bandwidth Internet access devices like the I®. The rapid uptake of the I has shown that for some users, high bandwidth is not necessary for them to be able to do what they want to do, where they want to do it.

The International Broadband Picture

Prior to 2001, there was little discussion of broadband infrastructure among international policy making and advisory organizations like the Organisation for Economic Co-operation and Development (OECD), the International Telecommunication Union (ITU) or the European Union (EU). From about 2001 onward, international discussions of the information society began to mention broadband infrastructure as a means of promoting citizen access to information. These discussions noted that as broadband adoption increased, productivity benefits could arise, boosting economic growth, facilitating innovation and increasing national competitiveness. Broadband could deliver services like healthcare and education, providing social benefits to a country's citizens (International Telecommunication Union, 2003a; OECD Directorate for Science Technology and Industry, 2001).

Since 2000, the OECD has measured broadband adoption among its members. These statistics, released twice a year, are sometimes referred to as the broadband 'league table,' comparing the standings to sports scores. Changes in country positioning are closely watched by national governments and policy makers, reflecting the competitive nature of the rankings. Fransman (2006) notes that "Comparative national performance in broadband is seen as being almost as important as GDP as an indicator, not only of economic well-being but also of national pride" (1). Table 1 compares the December 2001 and December 2006 broadband rankings, measured in terms of subscribers per 100 inhabitants of each country[3]. The table tells many stories. In the five year time period, the United States is the biggest loser, slipping from 4th place to 15th (an occurrence that has sparked renewed calls for a national broadband policy in the U.S., Ellison, 2007). As broadband growth slows in South Korea[4], it has relinquished the lead, slipping a few points behind new leaders Denmark and the Netherlands. The United Kingdom has moved from a country with few subscribers to reside in the middle of the pack. With the exceptions of early leaders Korea and Canada, the top 10 is now dominated by Nordic and European countries.

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[3] Broadband penetration is measured in different ways by different agencies and it is difficult to compare figures across sources. The OECD rankings are used frequently in international comparisons, but penetration rates based on numbers of household subscriptions are somewhat more intuitive as broadband subscriptions are generally purchased at the household level.

[4] South Korea is hereafter referred to as Korea.

Broadband leaders have invested heavily in the development of infrastructure and have undertaken activities to promote broadband services (Fransman, 2006; Lindskog & Johansson, 2005; Miralles, 2006; Tadayoni & Sigurdsson, forthcoming, 2007; Whitman, 2004).

TABLE 1: OECD COMPARATIVE BROADBAND ADOPTION RATES AND RANKINGS

Country	2001: Subscribers per 100 inhabitants	2001 Rank	2006: Subscribers per 100 inhabitants	2006 Rank	Change
Denmark	4.5	5	31.9	1	+4
Netherlands	3.4	9	31.8	2	+7
Iceland	3.5	8	29.7	3	+5
South Korea	17.2	1	29.1	4	-3
Switzerland	2.2	12	28.5	5	+7
Norway	2.0	13	27.7	6	+7
Finland	1.3	14	27.2	7	+7
Sweden	5.3	3	26.0	8	-5
Canada	8.9	2	23.8	9	-7
Belgium	4.4	6	22.5	10	-4
United Kingdom	0.6	21	21.6	11	+10
Luxembourg	0.3	22	20.4	12	+10
France	1.1	16	20.3	13	+3
Japan	2.2	11	20.2	14	-3
United States	4.7	4	19.6	15	-11
Australia	0.9	18	19.2	16	+2
Austria	3.6	7	17.3	17	-10
Germany	2.4	10	17.1	18	-8
Spain	1.2	15	15.3	19	-4
Italy	0.8	19	14.8	20	-1
New Zealand	0.7	20	14.0	21	-1
Portugal	1.0	17	13.8	22	-5
Ireland	0.0	29	12.5	23	+6
Hungary	0.3	23	11.9	24	-1
Czech Republic	0.1	24	10.6	25	-1
Poland	0.0	26	6.9	26	0
Slovak Republic	0.0	28	5.1	27	+1
Greece	0.0	30	4.6	28	+2
Turkey	0.0	27	3.8	29	-2
Mexico	0.1	25	3.5	30	-5
OECD Average	3.0		16.9		

Source: (Organisation for Economic Co-operation and Development, 2007b)[5].

[5] Non-OECD countries with high broadband adoption rates include Hong Kong, Taiwan, and Israel (International Telecommunication Union, 2006).

It is estimated that more than half of the world's Internet users now have broadband connections. Although the broadband penetration rate is low in the U.S., the sheer size of the American population means that the U.S. has the largest number of broadband users in the world (estimated at close to 50 million in 2005), followed by China (37.5 million) and Japan (22.4 million). Broadband connection speeds are increasing in many countries, at the same time as the connection prices are decreasing (International Telecommunication Union, 2006). As service improves, and broadband networks are extended to markets that are currently unserved, it is anticipated that consumer demand for broadband will continue to grow.

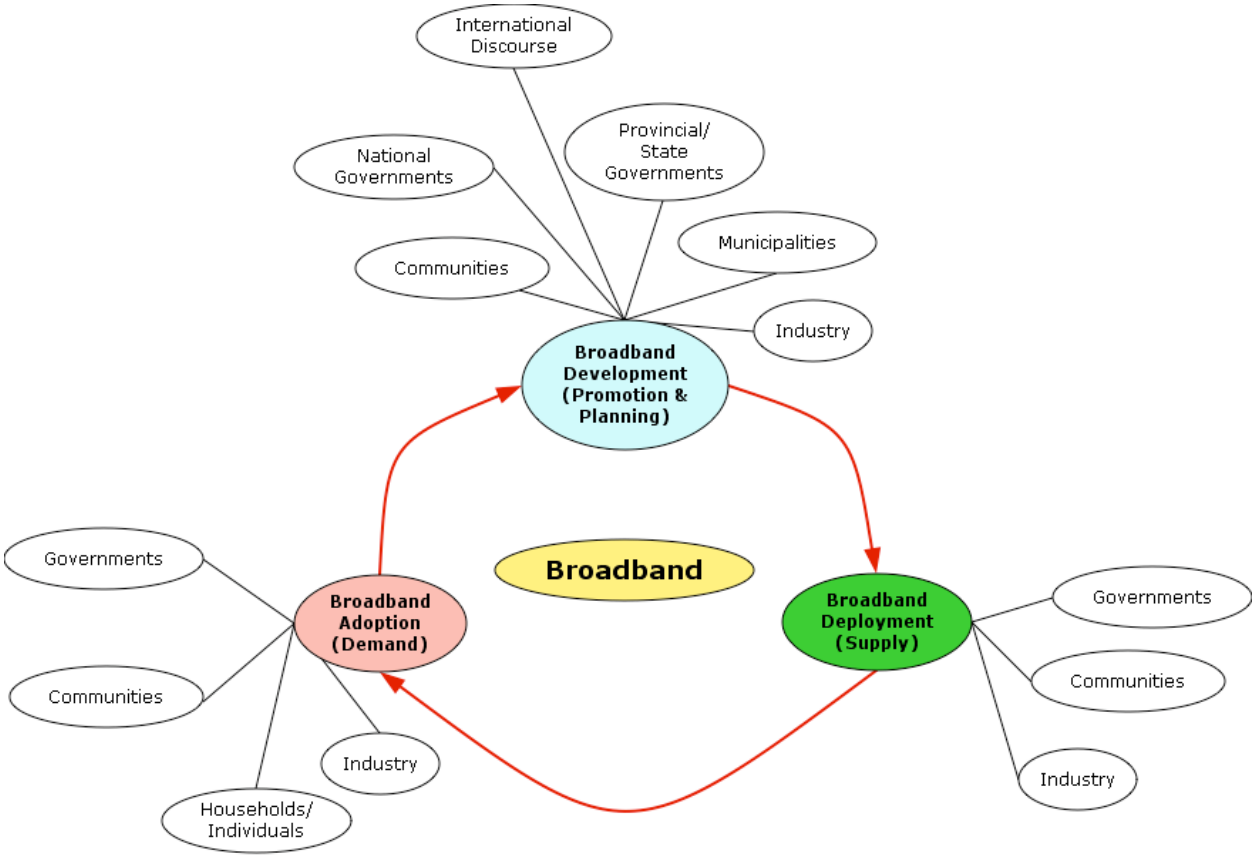
What are the Benefits of Broadband?

The objective of this paper is to investigate claims and evidence that attribute social and economic benefits to broadband communication technologies. There is no doubt that consumers are embracing broadband connections, and great efforts have been made at international and national levels to promote the development of broadband networks and services. In the section that follows, the benefits of broadband are outlined from the perspective of various stakeholders in the broadband 'cycle'.

To this point in the paper, the term broadband has been used in a technical sense, describing a combination of network and services. To understand the benefits of broadband technologies, it is useful to consider the stages involved in developing broadband technologies. Figure 3 illustrates a 'cycle,' showing three stages of broadband development. The cycle begins with a promotion and planning stage, influenced by international discourse on the benefits of broadband, and potentially involving various levels of government, communities and industry (e.g. telecommunications equipment manufacturers and consultants). After a planning process, broadband networks are deployed, creating a supply of broadband to meet the needs of broadband consumers. However, as the OECD broadband penetration statistics show, simply developing broadband infrastructure does not in itself result in broadband adoption. Adoption is a result of demand for broadband services. Demand can only be satisfied when broadband is supplied (the lack of supply is referred to as a broadband digital divide), but supply does not result in universal adoption. It is also noted that supply and demand can take place at different levels, and in different locations. Governments may develop, deploy and adopt broadband networks for use in delivering government services, without opening these networks for public

use. Individuals may access government services using their own home broadband connections, or they may benefit from the delivery of broadband services to their communities. As demand for broadband grows, the cycle is repeated, in order to increase the capacity of broadband networks.

FIGURE 3: THE BROADBAND 'CYCLE'



The question as to whether there are benefits from broadband is only meaningful by asking "benefits for whom?" Is broadband 'good' for the economy? for businesses? for individuals? Figure 3 shows various stakeholders in the broadband cycle[6]. The section below outlines the forces driving broadband development, deployment and adoption, from the perspective of various stakeholders. For each stakeholder group, the anticipated benefits of broadband are discussed.

[6] An assessment of the stakeholders involved in developing broadband in Korea is provided by Choudrie, Papazafeiropoulou and Lee (2003). The analysis in this paper includes multiple levels of government but does not consider policy intermediaries as stakeholders.

Forces Driving Broadband Development and Adoption

The International Discourse

At the international level, the promotion of broadband technologies can be understood as an element of a much broader movement supporting the development of 'information' or 'knowledge-based' societies. The World Summit on the Information Society (held in Geneva in 2003 and Tunis in 2005) recognized that "access to information and sharing and creation of knowledge contributes significantly to strengthening economic, social and cultural development" (World Summit on the Information Society, 2005, Item 10), and reaffirmed the importance of information and communication technologies (ICTs) as a means of providing access to information and creating knowledge.

Reflecting a shift in the foundation of post-industrial economies, information and knowledge are now central drivers of economic productivity, and ICTs are essential tools for converting raw information into valuable economic outputs. Investments in ICTs[7] can encourage innovation, facilitate 'knowledge-intensive employment' and enable individuals to become better educated, thereby improving 'human capital' in an economy (Organisation for Economic Co-operation and Development, 2000). While the linkages between ICT investment and overall productivity growth are highly complex, variable across nations, and influenced by a range of other economic factors, it is generally agreed that ICT investment fosters economic growth.

Further deployment of broadband networks is a means of reinforcing existing successes in making ICT accessible to individuals, and encouraging future economic growth (European Commission, 2002; Organisation for Economic Co-operation and Development, 2006). Organizations like the International Telecommunication Union (International Telecommunication Union, 2003b), the OECD (Business and Industry Advisory Council, 2003; Organisation for Economic Co-operation and Development, 2004) and the European Union (European Commission, 2002; i2010, 2006; Information Society Technologies Advisory Group, 2006) have been instrumental in encouraging the development of broadband as a means of promoting economic development.

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[7] The OECD measures ICT investment in three categories: information technology equipment, communications equipment and software. (Organisation for Economic Co-operation and Development, 2007c)

National Governments

The international discourse linking the development of information societies with ICT investment is echoed at the national level. Even before broadband was commercially available to citizens, Industry Canada (1994) was asserting the value of investment in ICT infrastructure, and stressing its competitive importance for Canadians:

> If Canada is to succeed in a global economy based on the creation, movement, storage, retrieval and application of information, our communications networks must be knitted into a seamless and powerful information infrastructure serving all Canadians. If Canada does not match the efforts of its competitors in accelerating infrastructure development, opportunities for network, product and service development -- and the resulting economic growth and new jobs -- will be seized by firms in other countries. (n.p.)

By the early 2000s, broadband was recognized as a key element of an information society, and governments around the world developed strategies to encourage the development of broadband infrastructures that would enable network access for all citizens. An underlying rationale for the deployment of broadband was as a means of improving national competitiveness (Broadband Advisory Group, 2003; Office of the e-Envoy, 2001), a fact that explains the importance given to OECD and ITU statistics on broadband penetration rates and ICT investments (International Telecommunication Union, 2007; Organisation for Economic Co-operation and Development, 2007b). In addition, more tangible benefits were outlined, primarily in terms of services that could be delivered using broadband network connections. Canada's National Broadband Task Force (2001) noted that broadband connectivity would enable access to health care (e-health), education (e-learning), business transactions (e-commerce), cultural and entertainment activities (e-content), as well as improving delivery of government services in general. Similar lists of benefits are found in documents outlining broadband strategies for other countries.

The OECD broadband penetration data suggest that some countries have been more successful than others in encouraging broadband adoption by their citizens. Fransman's (2006) case studies show that different types of government strategies and interventions have produced positive outcomes. For example, in Japan, the development of fast, cheap broadband was spurred by the incumbent telephone carrier's (NTT) decision to provide fibre to the home service in the face of potential competition in this area from electrical companies which also had the capacity to provide fibre connectivity. In Korea, the government was instrumental in promoting a competitive environment to encourage the supply of broadband, and in creating policies that

encouraged computer literacy and facilitated the purchasing of home computers (Kushida & Oh, 2006). In Canada, government policies explicitly encouraged the use of competitive market forces to provide broadband services to citizens (Industry Canada, 2005a), with government intervention only in "those communities where without government involvement the private sector is unlikely to deliver such service" (National Broadband Task Force, 2001, 11).

In a study of national broadband promotion policies, Cava-Ferreruela and Alabau-Muñoz (2006) identify three government intervention strategies. The market-driven policy favoured by Canada is a 'soft-intervention' approach, recommended by the OECD, and successfully adopted in countries including the United Kingdom, Switzerland, Denmark and New Zealand. Canada's actions to provide broadband service to areas not served by the private sector are more characteristic of 'medium-intervention' approaches, which focus on encouraging supply of broadband either through the construction of publicly funded and publicly owned networks, or through financial incentives to encourage broadband development in low revenue areas. The governments of Korea and Singapore have adopted 'hard-intervention' policies, intervening proactively to encourage broadband deployment, as part of broader economic development agendas.

Cava-Ferreruela and Alabau-Muñoz's analysis is relevant in the context of this paper because it offers policy advice to help encourage further development of broadband supply, demand and adoption[8]. They conclude that soft-intervention strategies should be used to promote competition among broadband providers (resulting in improved supply), combined with medium-intervention approaches to build networks for underserved areas. These supply initiatives, coupled with soft-intervention strategies to build demand, should work together to encourage further adoption of broadband in all regions, enabling a broader realization of the benefits of broadband. In many countries, however, national level policies promoting broadband have not yet resulted in good broadband service throughout the country. Local initiatives to develop broadband infrastructure have emerged, with provinces, states or regional areas developing their own infrastructure in order to extend the benefits of broadband to their local citizens.

[8] Other studies addressing various policy issues related to broadband development include Kim, Bauer and Wildman (2003), Wu (2004), Ishii, (2003), Frieden (2005), Castellano and Miralles (2006), Miralles (2006), Nunes (2006), and Tookey, Whalley and Howick (2006).

Provincial/State Level

In Canadian provinces, various public and private sector initiatives have resulted in increased broadband availability in underserved areas. The Alberta SuperNet is an example of a provincial-led initiative to bring broadband connectivity to communities throughout the province. The SuperNet has connected more than 300 communities that were not previously served by commercial broadband providers, and now delivers "access to the boundless benefits of high-speed broadband" to schools, libraries, hospitals, and provincial and municipal government offices in a total of 429 Alberta communities (Alberta SuperNet, 2005). The SuperNet provides benefits to Albertans by allowing them to participate in the knowledge economy, and partake in e-learning, e-government, e-health and e-business. In particular, the Government of Alberta benefits by increased efficiency and effectiveness in delivery of provincial services using the SuperNet. However, the SuperNet itself does not provide Internet connectivity to individual residences in the communities it serves. The provision of residential broadband access is left to commercial Internet service providers (ISPs) who can access the SuperNet's network. Only as a 'last resort' would the SuperNet become involved in providing residential Internet service to communities.

In Ontario, the short-lived Connect Ontario: Broadband Regional Access (COBRA) program was designed to help aggregate demand for broadband in underserved communities and to leverage investment for connectivity from the federal government and other partners, in order to enable the Ontario Government to benefit by being able to provide e-government services throughout the province. The province would also benefit from reduced costs of connectivity, and through increased economic activities resulting from the extension of broadband connectivity throughout the province (Connect Ontario, 2003).

In Saskatchewan, CommunityNet provides broadband connectivity to government offices, schools, libraries and health care facilities (CommunityNet, 2006). In British Columbia, the province partnered with Telus through the NetworkBC initiative to provide broadband connectivity throughout the province (Government of BC & Telus, 2006). The New Brunswick and federal governments worked with Aliant to develop broadband infrastructure through the New Brunswick broadband initiative (Infrastructure Canada, 2006). The government of Nova Scotia is aiming to make Nova Scotia "the most connected area in all of North America" (Province of Nova Scotia, 2007). The Smart Labrador Network provided connectivity to enable

the delivery of health and videoconferencing services through the region (Smart Labrador, 2003). Connect NWT offers a similar vision of connectivity for Canada's Northwest Territories (Connect NWT, 2007). There are many state-level broadband initiatives in the U.S., including ConnectKentucky (www.connectkentucky.org), the Vermont Broadband Council (www.vtbroadband.org) the Michigan Broadband Development Authority (www.broadbandauthority.org), and the recently announced plan to provide wireless broadband coverage throughout the State of South Carolina ("Wireless Technology and Communications Commission," 2007). All these projects share a fundamental belief in the value of broadband connectivity, as a means to enable citizens to participate in the knowledge economy, to access opportunities for lifelong learning, improved job training and employment options, and to provide a superior quality of life. Governments anticipate increased efficiency and reduced costs in delivering government services, and increased overall economic and social benefits for their regions.

Local Level: Municipal Governments and Regional Areas

In Canada and elsewhere, there have also been local initiatives to bring broadband connectivity to specific municipalities or regions. Recent initiatives often involve the deployment of wireless municipal broadband solutions, but earlier implementations focused on building fibre-based broadband networks to serve local communities. With access to a broadband network, the Ontario town of Tillsonburg was able to redesign its delivery of government services to the community. The town deployed information systems that improved accessibility and reduced costs of government services, resulting in increased citizen satisfaction and reduced property taxes (Dawe & Curri, 2003). The town's network was not used to provide connectivity to individual citizens, but provided benefits to them through improved e-government services. The City of Fredericton, New Brunswick, developed its own municipal fibre broadband network, providing connectivity to local government and to local businesses at a much lower cost than commercial service providers were charging (e-Novations, 2005).

There are now close to 400 municipal wireless (Wi-Fi) broadband networks, either deployed or in development in the United States (Vos, 2007). Many other Wi-Fi projects are being rolled out in cities around the world, including Toronto, London, Bologna, Singapore, Taipei and Perth. Initiated by municipal governments, private providers or public-private partnerships, these

networks are intended to serve the connectivity needs of local governments and residents, and may also serve tourists and business travellers if the network offers a public access component. There are many reasons that such networks are being built, but most are developed based on a fundamental belief that broadband Internet connectivity is becoming an essential service for municipalities today (New Brunswick Universities Research Consortium, 2006). With broadband networks, municipalities can develop and deliver new government services, and make it easier for citizens to access existing services. The infrastructure can also be used as a platform for public safety and security services (e.g. providing a network for use by police and fire services within a community). The availability of municipal wireless connectivity is believed to foster economic development and local innovation, increase citizen engagement and to improve the availability of broadband connectivity to local citizens (Middleton, Longford, Clement, Potter, & Crow, 2006).

Community Level

In addition to municipal broadband projects, there are community organizations, independent from municipal governments, that are providing broadband connectivity in local areas. These community led projects have somewhat different objectives than municipal ones, focusing on connecting individuals to each other, and to their local communities. Some provide access to government services, but most do not explicitly focus on economic development or efficiency outcomes. The main purpose of community networks is to provide broadband access to community members, for free, or at very low cost. There are many thriving community wireless networks, including the Champaign-Urbana Wireless Network (www.cuwin.net/projects/urbana), New York City Wireless (www.nycwireless.net), and Freifunk in Berlin (□reifunk.net). In Canada, Montreal's Île Sans Fil (www.isf.org) is a leader, providing Internet connectivity in more than 130 locations on the Island of Montreal. Community wireless networks provide benefits to citizens by empowering them through the use of technology. These networks provide access to local content, including arts, music and community news.

Across Canada, community networks also focus on skills development. Frequently building on the connectivity provided by federal funding (e.g. the Community Access Program), community organizations have been helping individuals gain the skills and confidence needed to navigate online applications and services. The Canadian Alliance for Community Innovation and

Networking has documented many community networking initiatives in Canada (www.cracin.ca).

Individual/Household Level

What are the benefits that encourage individuals to adopt broadband connections? While each household makes a decision to adopt broadband based on their own circumstances (including need for speed, ability and/or willingness to pay for broadband service, and perceived usefulness of the service), the convenience of a broadband connection and the new services it enables are the likely drivers for most households. In rural and remote areas, broadband provides easier access to services that are not available in local communities (including education, healthcare and employment services), and facilitates online shopping and access to entertainment. Broadband connectivity also benefits people with disabilities, providing them with improved access to services in their homes (Belcastro, 2004; McKinlay, Beattie, Arnott, & Hine, 1995). Urban broadband users are less reliant on connectivity to provide essential services, but still benefit from access to health and government information, educational materials, shopping and entertainment. For individuals and households, broadband provides a means of connecting with others, through email, chat, voice over Internet protocol (VoIP) telephone services, and file sharing. Broadband connections are beneficial because they enable access to a broader range of services than dial-up, without tying up the household telephone line, and also offer the added convenience of always-on connectivity.

Other Stakeholders: Industry and Organizations

The benefits of broadband adoption are often considered at the national and individual levels, with less explicit attention paid to other stakeholders. But the stakeholder group that likely benefits the most from broadband adoption is industry. 'Industry' is a broad label. In this context, it encompasses businesses in the telecommunications services and manufacturing sectors, as well as computer (hardware and software) manufacturers and service providers. Investments in ICTs are encouraged at a governmental level as a means of improving national productivity, and these investments contribute revenues directly to the telecommunications and computer industries. The rollout of broadband networks throughout the world has required (and continues to require) enormous investments in networking hardware and software. As revenues from traditional

telecommunication services (e.g. landline telephones) have dropped, telecommunications companies have benefited from the rollout of broadband services, which provide new ways to increase ARPU (average revenue per user). Higher bandwidth connections make it easier for users to share large files. As individuals and commercial services make entertainment content available online, consumers may find that their existing computer hardware is inadequate, triggering an upgrade cycle that benefits many companies in the industry. Upgraded computers require upgraded software, and allow for more sophisticated usage, which may further encourage bandwidth consumption. Increased demand for bandwidth then spurs investment by Internet service providers to provide faster services, benefiting equipment manufacturers.

Other industry sectors can also benefit from the widespread adoption of broadband networks, but in ways that are less direct than those in the computer and telecommunications sectors. In non-urban settings, companies may benefit from provincial or local initiatives that provide affordable bandwidth to organizations within local communities. (In urban settings, organizations typically have good access to broadband connectivity through commercial service providers.) Another way that broadband provides benefits for companies is by facilitating alternative working arrangements. As many workers in the modern economy are knowledge workers, broadband is an important tool for accessing and sharing knowledge. With home broadband connections, employees can work at home outside office hours, or can work exclusively outside the office. Employees can also use broadband connections to upgrade their skills, and/or to work for companies in other geographic locations. Non-traditional working arrangements that are facilitated by broadband connectivity can be highly favoured by employees, and can provide benefits to their employers with few or no additional costs.

Summary: Benefits of Broadband

This section has provided an overview of the stakeholders in the broadband arena. As summarized in Table 2, stakeholder groups promote, develop and/or adopt broadband for different reasons.

TABLE 2: BROADBAND DRIVERS AND ANTICIPATED BENEFITS

Level	Drivers	Anticipated Benefits
International	• Development of an information society, knowledge economy	• Citizen participation in e-society • Increased productivity through ICT investment, and economic growth

Level	Drivers	Anticipated Benefits
		• Increased innovation • Increased human capital
National	• Information society • National competitiveness	• Broadband access for all citizens • Development of ICT literacy • Access to information society services (e.g. e-health, e-learning, e-commerce, e-content, e-government) • Provision of e-government services, improved (i.e. more efficient) government service delivery mechanisms • Productivity growth
Province/State	• Information society • Bridging digital divide, lack of connectivity	• Access to information society services (e.g. e-health, e-learning, e-commerce, e-content, e-government) • Provision of e-government services at reduced cost • Provincial/state level economic development • Employment opportunities • Service to underserved communities, improved quality of life in remote/rural communities
Municipality/Region	• Local competitiveness • Broadband is an essential service • Efficiencies • Lack of connectivity	• Local economic development • Local innovation • Delivery of e-government services, achievement of efficiencies, cost savings • Connectivity for local government services (fire, emergency, libraries, government offices) • Service to underserved areas, extended access for citizens and travellers (not provided by all municipalities)
Community	• Lack of connectivity • Community Engagement	• Service to underserved groups • Community development, access to local content
Individuals and households	• Services • Communication • Convenience	• Access to information society services (e.g. e-health, e-learning, e-commerce, e-content, e-government) • Access to information and entertainment content • Easy to access email, chat, web, file sharing, VoIP, shopping • Improved service as compared to dial-up Internet
Industry: Manufacturers and Providers	• Economic growth	• Corporate revenues
Industry: Employers	• Flexible work	• Facilitation of tele-commuting, work from home

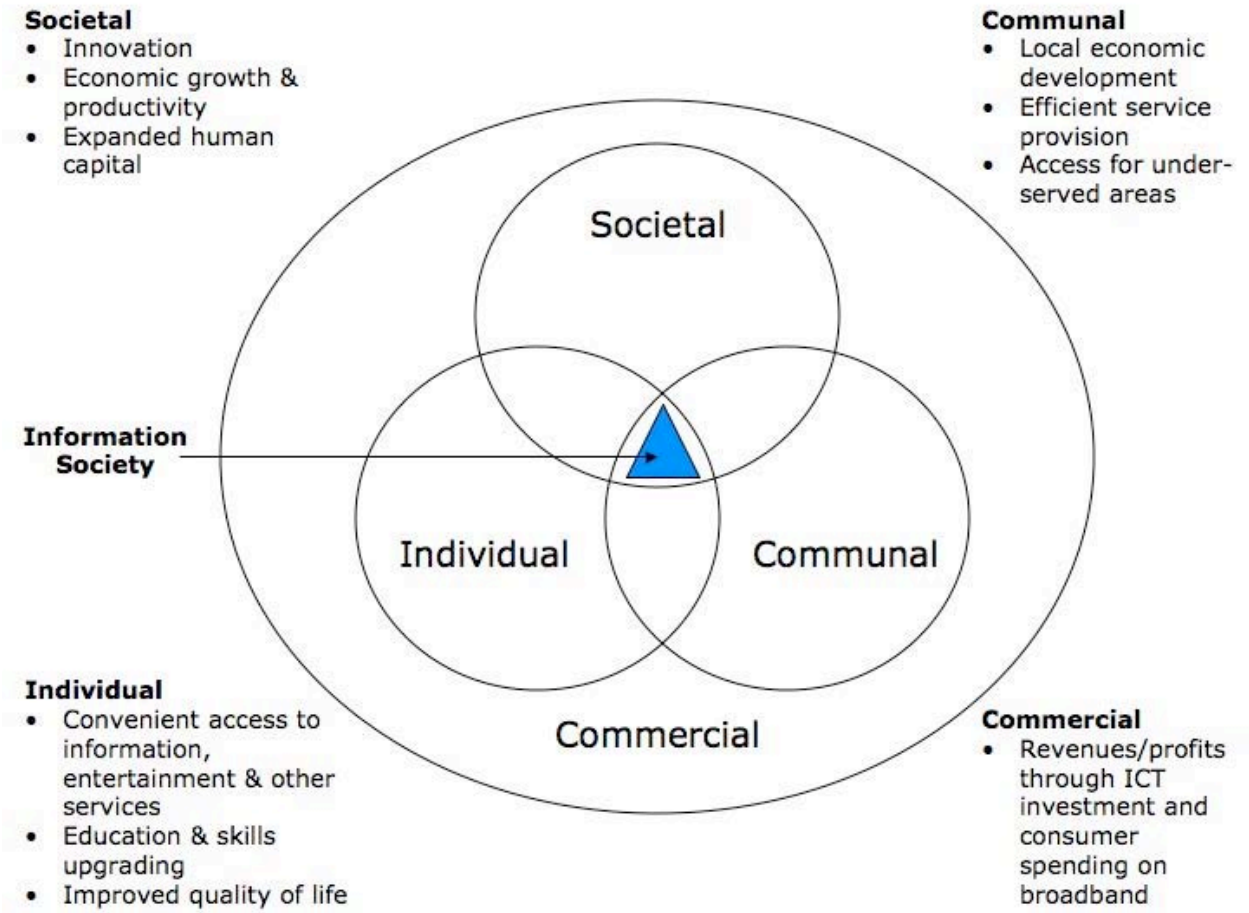
Level	Drivers	Anticipated Benefits
	arrangements • Skilled employees	or other alternative work arrangements • Skills upgrading through online education

There are commonalities among stakeholder motivations, but the benefits that are anticipated to accrue to specific types of stakeholders are realized in different ways and at different times (i.e. at different stages of the broadband cycle described in Figure 3). For instance, some benefits are realized upon the development of broadband networks (e.g. telecommunications hardware manufacturers generate revenues upon the sale of broadband networking equipment), whereas others are realized only upon individual or household adoption of broadband networks (e.g. convenience of access to information in the home). Broader economic benefits may not be measurable until some years after the deployment of broadband infrastructure, whereas individuals may benefit immediately from the availability of tele-medicine or other e-services in their communities. In addition, some benefits accrue to individuals as they adopt broadband in their homes, some benefits are realized within communities as broadband enables new services, and others accrue at a societal level as broadband is deployed by national, regional and local governments.

Assessing Broadband Benefits

To further assess the claims that broadband networks are beneficial, the anticipated benefits can be categorized into four groups. *Societal* benefits of broadband potentially extend to everyone in society. *Communal* benefits are realized within a specific community (e.g. province, city, rural area, community group). *Individual* benefits accrue primarily to individuals, within their households. *Commercial* benefits accrue to individuals and businesses involved in the commerce of broadband (e.g. Internet service providers, telecommunications equipment manufacturers, computer hardware and software providers, etc.).

FIGURE 4: BROADBAND BENEFICIARIES



As is seen in Figure 4, the benefits converge to create a broadband-enabled information society. The diagram suggests that various broadband benefits accrue at more than one level (e.g. providing access for underserved areas is beneficial for communities, but this access also directly benefits the households that adopt it), but the separation of benefits into broad categories facilitates their assessment.

The previous section showed that the espoused benefits of broadband are clear and numerous. What is less clear is the extent to which these benefits are actually being realized at the societal, communal or individual levels. It is difficult to assess many of the espoused benefits of broadband (Firth & Mellor, 2005). While the OECD and national statistical agencies measure broadband adoption at the individual or household level, the adoption figures alone are insufficient to assess the extent to which broadband adoption has benefited the adopter. At the communal level, many broadband initiatives are relatively new, and have not yet been assessed.

Another challenge is that it is difficult to isolate the specific impact of broadband investment in the development of e-government services. Such developments invariably involve process redesign and the implementation of new information systems, creating efficiencies that are not directly related to the investment in broadband technologies. At the societal level, direct linkages between broadband investment and increased human capital or citizen participation in the knowledge economy are very difficult to establish. Only at the commercial level are the impacts relatively clear, as seen in the financial performance of the information and communications technology sector in recent years. The benefits of broadband technologies anticipated at each level of analysis are discussed further below. The discussion focuses on the communal and individual levels, as these are most relevant for broadband infrastructure in Ontario.

Societal Level

There is mixed opinion as to the extent to which broadband technologies actually deliver the societal benefits attributed to them (Firth & Mellor, 2005). Fransman (2006) observes that:

> One of the most remarkable features of the Broadband Battle is the paucity of evidence supporting the assumption – implicit in many of the policies and actions taken in the broadband field – that broadband, at least as measured in the commonly used measures of performance [availability, penetration, speed, price, quality], is "good" for the economy. The absence of evidence exists as much in Asia as it does in North America and Europe. (51)

Gillett and colleagues (Gillett, Lehr, Osorio, & Sirbu, 2006) do provide initial evidence that the "assumed economic impacts of broadband are real and measurable" (3), showing how the availability of broadband connectivity in the United States led to increases in the growth rates for jobs and the establishment of businesses. Although these impacts were larger than they expected, they noted that their results should be interpreted with caution because of the preliminary nature of their research (based on data from 2002). More recent data from the U.S. Bureau of Labor Statistics show that job growth in the IT sector in Kentucky has outpaced that elsewhere in the U.S., a fact that is attributed to recent efforts by ConnectKentucky, a program providing broadband connectivity throughout the state (Government Technology, 2007). While direct causality between broadband availability and IT sector job growth cannot be established, this finding is consistent with Gillett et al.'s observation that the impacts of broadband are found "in conjunction with other IT" (6), complementing investments in other information and communication technologies.

Gillett and her colleagues discuss the difficulties inherent in measuring the economic impacts of broadband technologies, noting that there are likely to be lags between investments and measurable impacts, and that many of the anticipated impacts are not easily measured. While there has been little work to date measuring the impact of broadband technologies, the OECD has been developing measures of the information society for many years (Organisation for Economic Co-operation and Development, 2007a; Wyckoff, 2003). In Canada, the 'networked economy' is measured by the Science, Innovation and Electronic Information Division of Statistics Canada (Gault & Messinger, 2002) and by Industry Canada's ICT branch.

Pilat (2005) observes that:

> despite the widespread diffusion of ICT, questions remain about the impact of the technology on economic performance and behaviour. Thus far, only [a] few countries, including Australia, Canada and the United States, have clearly seen an upsurge in productivity growth in those sectors of the economy that have invested most in the technology, notably services sectors such as wholesale trade, financial services and business services. In many countries, including much of the European Union, these impacts have yet to become visible in the productivity statistics. (1)

Nevertheless, the overall value of investments in ICTs, and by extension, in broadband technologies, is asserted frequently, as in this example: "Digital technologies have been crucial in the distribution of knowledge and information, which many argue are at the core of power in society" (International Telecommunication Union, 2006, p. 19). Indeed, the rhetoric of the information society is insistent about the value of ICTs in creating knowledge and improving productivity (Information Society Technologies Advisory Group, 2006). This paper cannot resolve the questions of whether broadband technologies really do create the societal benefits attributed to them. It is clear that governments and international agencies are strong believers in the potential of broadband, and that even without extensive evidence as to its impact, remain willing to encourage increased broadband development.

Commercial Level

Although discussion of the commercial benefits of broadband technologies does not figure prominently in the literature, it is at this level that the benefits are most easily assessed. As noted elsewhere in the paper, commercial players are involved at each stage of the development, deployment and adoption of broadband technologies. The promotion of broadband technologies is beneficial to a wide range of companies, from multinational equipment manufacturers (e.g.

Nortel, Cisco, Corning, Motorola, Siemens, Alcatel) to telephone and cable companies worldwide (e.g. Bell, Rogers, Cogeco, Shaw, Telus in Canada), semiconductor manufacturers, consulting firms, software manufacturers, content and service providers (e.g. Google, Yahoo), hardware (personal computers and commercial servers) providers and others. Commercial revenues are generated at every stage of the broadband cycle, and increase as broadband penetration and usage increases. The OECD's *Information Technology Outlook* series provides detailed information on the ICT industry performance, and the 2006 edition clearly demonstrates strong growth across the industry (Organisation for Economic Co-operation and Development, 2006). Industry Canada's quarterly report on the ICT sector shows that the sector is very healthy:

> In the fourth quarter of 2006, Canada's ICT sector output (GDP) grew over two and a half times faster than the Canadian economy as a whole, that is, 1.1% compared to 0.4%. Since the fourth quarter of 2001, an upward trend in Canada's ICT sector has been observed. In fact, between the end of 2001 and the fourth quarter of 2006, the ICT sector's output grew by 28%, while the Canadian economy, as a whole, experienced a growth rate of 15%. Overall, ICT sector performance has been impressive this past decade. Specifically, it has grown by 112% since the first quarter of 1997. A value nearly three times the growth rate of the Canadian economy, as a whole, which grew 38% over this same period. (Information and Communication Technologies Branch, 2006, 1)

There is little doubt that the Canadian ICT sector is benefiting from the efforts to foster an information society, and that the promotion of broadband is beneficial at the commercial level.

Communal Level

The OECD, ITU and national statistical agencies collect data on broadband adoption and ICT investment at the national and individual levels. There is less systematic effort in place to monitor broadband projects at the communal level, yet this is a level where benefits may be more clearly articulated. At the communal level, broadband can be deployed in many ways that could benefit community members. As noted earlier, many infrastructure development projects devoted to bringing broadband connectivity to underserved regions are initiated at this level (e.g. by provincial, state or local governments, or by community groups). These initiatives benefit the communities they serve by encouraging increased participation in the information society, and benefit individuals directly by providing them with Internet connectivity. As the benefits are primarily at the individual level, the impacts of these projects will be discussed in the section that follows. Two types of broadband projects are discussed here, i) e-government, and ii) other 'e-services.'

E-government and 'Intelligent' Communities

Broadband networks can be adopted by local agencies or entire communities, to support the provision of government services, and to encourage local innovation and knowledge access. From the end user perspective, the use of broadband is transparent, meaning that the users may not be aware of the presence of a broadband network in the community, nor do they need direct access to a broadband network to use or benefit from its presence. It is the government that is the broadband user in this situation (Gillett, Lehr, & Osorio, 2004). (Government services accessed by citizens using broadband networks are considered in the e-services category below.) There are many broadband-enabled e-government projects taking place around the world. Canadian initiatives in Alberta (using the Alberta SuperNet), Tillsonburg, Ontario (Dawe & Curri, 2003) and Fredericton, NB (Canadian Information Productivity Awards, 2004) have already been mentioned. Other interesting examples include the City of Corpus Christi in Texas, the City of Westminster in London, England, and Tranås in Sweden. These examples are presented to show the diversity of broadband-enabled services but by no means provide a complete overview of the thousands of e-government projects operating around the world.

Corpus Christi deployed a wireless network to allow the city to carry out automated meter-reading. Over time, this network has evolved to serve emergency and police workers (e.g. providing video surveillance, information on locations of emergency calls, and access to criminal histories from a police car), provide building inspectors and other city employees with mobile access to file reports and to check data, and it also provides an Internet marketplace for local businesses (*Corpus Christi to Celebrate Completion of First Large-Scale Citywide Wireless Network*, 2006). In the City of Westminster, the broadband network enables extensive usage of closed circuit cable television (CCTV) to monitor and manage the city, allowing for noise reduction and enhanced community protection. It also provides connectivity to mobile workers, allowing for better management of parking services and traffic congestion, for example, as a dispatcher watching CCTV can send an enforcement officer to a specific location to move traffic along and ticket offenders (City of Westminster, 2006). In Tranås, a municipal area network provides connectivity to local schools, government offices, businesses and healthcare agencies, as well as to local citizens. An information portal supports secure information sharing by various local groups, including politicians, local government employees, as well as parents and teachers. The network allows government employees access to necessary documents to work from home,

and supports transactions for local businesses (Lindskog & Johansson, 2005).

Communities deploying information infrastructures can be considered 'smart' or 'intelligent' communities. Both the World Foundation for Smart Communities (www.smartcommunities.org) and the Intelligent Community Forum (www.intelligentcommunity.org) promote the deployment of ICTs to enable communities to participate more fully in the information society, encouraging the development of knowledge capital, and fostering innovation at a local level. These organizations' websites provide links to further examples of communities using broadband to improve service delivery and quality of life for their citizens[9]. Other useful resources outlining the benefits of community investment in broadband and other ICTs are provided by the Center for Digital Government (2005; 2006) (supported by IBM), Intel (2003), and MuniWireless (www.muniwireless.com).

Although there is a tendency among information systems vendors and broadband champions to oversell the benefits of broadband-enabled government services (e.g. with promotional materials that make far-reaching claims but offer little real evidence to support them), in many cases the benefits are tangible. The Tillsonburg case shows that costs can be reduced by redesigning government services. The City of Westminster can demonstrate measurable impacts as a result of its wireless network deployment. The City of Fredericton's broadband initiative won a Canadian Information Productivity Award. A comparison of two neighbouring communities in Iowa (Kelley, 2003) shows that the community with a municipal broadband network open to local residents and businesses demonstrated stronger economic performance than its non-networked neighbour. The availability of broadband in communities does provide a competitive advantage over those without broadband, although this competitive opportunity is diminishing as more communities deploy broadband networks.

E-services

Broadband can also bring benefits to communities by enabling the provision of specific services. These e-services (e-health, e-learning, e-justice, etc.) are frequently mentioned in discussions of the benefits of broadband, and are services that provide benefits at multiple levels.

[9] The Canadian Government also promoted the development of Smart Communities as part of the Connecting Canadians agenda. This project is no longer operational but the website remains at http://198.103.246.211/index_e.asp.

Often, individuals do not access such services at home, using them instead in community locations, resulting in benefits for both the individuals and the communities. For instance, tele-medicine/tele-health services connect a patient and his or her doctor in a remote or rural community with another doctor who can consult on the medical problem at hand. Keewaytinook Okimakanak Tele-health North Network has been a leader in Canada, serving 24 First Nations communities in Northwestern Ontario. Although the service had not reached a break even point when evaluated in 2005, more than 3000 tele-health sessions were logged from April 2003 - December 2005, approximately 40% of which involved a clinical consultation. The service was highly valued by patients. It provided an estimated $4.2 million annual savings in averted travel costs, but it was noted that in many case patients still needed to fly out of their communities to receive medical treatment (Hogenbirk, Ramírez, & Ibanez, 2006).

The Alberta SuperNet's broadband connectivity is used to provide many e-services. One example that benefits communities is a project by Alberta Justice that allows for videoconferencing between a remand centre in Edmonton and various court houses around the province, reducing the need to transport people accused of crimes to and from court. Videoconferencing can also be used to bring witnesses into the court room from various locations, saving the time and expense of travel, or allowing witnesses to testify in a situation that is more comfortable for them (Alberta SuperNet, 2006).

In Northwestern Ontario, the Keewaytinook Internet High School (kihs.knet.ca/pn) e-learning initiative allows students to attend high school classes in their own communities, rather than moving away to a city. Course content is online, but students go to class at a local community classroom, where they are mentored by a teacher or classroom assistant. Although many students still face challenges in attending high school courses through KiHS and graduation rates are low, it provides a community-based alternative that can benefit students and their families (Fiser, Clement, & Walmark, 2005). In Northern Saskatchewan, The Keewatin Career Development Corporation runs the Knowledge and Career Development Network, which uses video conferencing to deliver career training to multiple remote communities.

Another ambitious e-learning project is Scotland's 'Glow' (www.glowscotland.org.uk), the Scottish Schools Digital Network. Built on a broadband network connecting all Scottish educational authorities, it will support teachers, school administrators, parents and students, enabling communication and collaboration throughout Scotland, and providing extensive support

to learners with special needs. The full implementation is targeted for completion in 2008.

These are just a few examples of the many, many broadband-enabled e-services projects worldwide. Some of these might best be described as 'showcase' projects. Promoted heavily to funders and others interested in the benefits of broadband, they appear to deliver benefits to the community. But on closer examination, the e-services are not widely used by community members. For instance, tele-health projects can be beneficial in bringing expertise into remote communities electronically, but visitors to these communities may find tele-health equipment sitting in a corner of a clinic, ignored by local doctors who are not accustomed to its use. Developing projects that meet long-term community needs is a difficult task. As Ramírez notes, it is common for projects to demonstrate short-term benefits (and thus be positively assessed by evaluators), without achieving overall goals in the longer-term. In addition, ICT projects are complicated, and can produce unpredictable or unexpected results (Ramírez, 2007). Attributing longer-term benefits of ICT investments to the availability of broadband in communities is very difficult. However, broadband availability does enable communities to improve existing services, and to access services that would otherwise be unavailable or prohibitively expensive. If the communities are able to develop these services in ways that meet their needs, broadband can be beneficial.

Individual Level

Why do individuals adopt broadband services? This question is not easily answered, but it is easy to identify various services and activities enabled or ameliorated by broadband connectivity. The ITU's eighth Internet Report focuses on 'digital life,' explaining how central digital technologies (e.g. telecommunications, broadcasting and computing) have become in the daily lives of people around the world (International Telecommunication Union, 2006). Popular online activities made possible by access to broadband networks include watching videos on YouTube or through video on demand services, buying music and television shows from iTunes, or accessing entertainment content for free using file sharing services like BitTorrent. People keep track of their friends and communicate with them within social networking sites like Facebook or MySpace. Many Canadians now have home phone service that uses Voice over Internet Protocol (e.g. Rogers Home Phone, Vonage), or call around the world for free using Skype or other VoIP services. Others spend hours a day in virtual environments like Second Life, or playing online

games like World of Warcraft with people from around the world.

In Korea, online gaming has been a major driver of individual Internet usage. In the early days of broadband deployment in Korea, the popularity of 'PC Bangs' (Internet cafés) made it easy for those without home broadband connectivity to play games, and encouraged avid game players to adopt broadband connections (Lee, O'Keefe, & Yun, 2003). Whitman (2004) estimated that 90% of Koreans who use the Internet play games online, and in 2005 more than 50% of revenues from online gaming came from Korea, China and Taiwan (Organisation for Economic Co-operation and Development, 2006). Massively multiplayer online games (MMOGs) continue to grow in popularity, and newer game consoles can connect directly to the Internet using broadband connections.

Another driver of broadband adoption in Korea was education. The Korean culture values education highly, and many parents will do whatever they can to encourage their children to become high academic achievers. To promote broadband adoption, the Korean Ministry of Information and Communications provided specific Internet training to housewives (recognizing their influence on household spending), and then touted the educational opportunities broadband would afford them (Choudrie et al., 2003). In addition, computer literacy was included in university entrance exams, encouraging households to acquire PCs so as not to disadvantage their children (Kushida & Oh, 2006).

Market forces do not always bring connectivity to underserved areas (Nunes, 2006, demonstrates this issue in Portugal), but many initiatives to bring broadband connectivity to underserved areas are underway or have been completed. DjurslandS.Net is Europe's largest non-commercial wireless network, and provides broadband service to a rural area of Denmark where DSL and cable broadband were unavailable (Basu, 2007; Tadayoni & Sigurdsson, forthcoming). Recent infrastructure upgrades in Scotland ensure that "almost the whole of Scotland now enjoys access to broadband" (Tookey et al., 2006). Investments in Canada will bring connectivity to an estimated 91% of Canadians by the end of 2007, and further initiatives to provide broadband to all Canadians by 2010 have been recommended by the Telecommunications Policy Review Panel (2006). Broadband can help to overcome challenges of distance and high costs of service delivery for those living in rural or remote areas, and provide improved access for those with disabilities. Online shopping provides customers with access to products and services not available in their local communities, and use of the Internet

can reduce communication costs and extend access to information not available locally. The New Brunswick Universities Research Consortium report (2006) documents these benefits in rural New Brunswick.

Returning to the question of why individuals adopt broadband services, it appears that the most popular broadband-enabled activities are communication and entertainment based. For instance, the 2005 Canadian Internet Use Survey found that close to 40% of Canadians reported they use the Internet to play games, 37% use it to obtain music, and 26% listen to the radio online. Fewer than 10% of Canadians reported watching TV or downloading movies over the Internet, but it is highly likely this number has increased in the past year. While email and basic web browsing are the most widely reported online activities (used by 91% and 84% of Canadian Internet users in 2005 respectively), they can be accessed (albeit slowly) through narrowband connections (Middleton & Leith, 2007).

So what does the evidence indicate about how individuals benefit from broadband adoption? As noted above, when broadband is adopted by individuals who live in rural or remote communities they have access to services not available in their communities. However, accessing such services does not always require individual broadband adoption, as some services are available at community locations. Regardless of location, broadband does provide convenient access to shopping, communication and entertainment services, and it can only be assumed that because consumers are willing to pay for broadband connections they believe that the services available over these connections offer value.

A Broadband Enabled Ontario

TABLE 3: BROADBAND BENEFITS: SUMMARY OF CLAIMS AND EVIDENCE

Level	Anticipated Benefits	Evidence
Societal	• Increased productivity • Increased innovation and human capital	• Preliminary support for productivity argument, less evidence of information society outcomes resulting from broadband adoption (human capital, innovation)
Communal	• Access to information society services • Bridging digital divide, bringing connectivity to underserved areas • Efficiencies in delivering government services	• Many examples of information society services being delivered at communal level • Projects to extend connectivity to underserved communities are ongoing • Many examples of government efficiencies facilitated by government usage of broadband

Level	Anticipated Benefits	Evidence
Individual	• Improved service as compared to dial-up • Access to e-society, info, entertainment, communication services	• Broadband provides improved service • Individuals are accessing information, communication, entertainment services, less evidence of availability, use of e-services at household level
Commercial	• Corporate revenues	• Strong growth in ICT sector overall

Table 3 summarizes the claims and evidence regarding the benefits of broadband technologies, and provides a basis for a discussion of how such benefits could be realized in a broadband enabled Ontario. Evidence supporting claims that broadband investment can be directly related to overall economic productivity is weak, but the claims are persistent and firmly entrenched in international and national discourses about the value of broadband. It seems inevitable that the enthusiasm for broadband as a contributor to national productivity will continue, in step with broader claims about the value of ICT investments as a means of fostering an information society.

Governments have focused on individual broadband adoption rates as a measure of progress toward the information society, but this paper reveals a current disconnect between societal level goals for increased citizen participation in the knowledge economy, and individual broadband usage that is centred around communication and entertainment activities. The paper points to the crucial, and often overlooked role that communal level broadband initiatives can play in extending services to citizens, and in improving interactions between governments and their constituents. At the individual or household level, social and economic benefits are most easily identified for those who have limited access to services in their communities (including people living in rural or remote areas, or who are limited in their ability to participate in society through 'normal' means e.g. those with physical disabilities). Those in communities with easily accessible community services are less likely to realize the oft-cited 'e-society' benefits provided by access to e-health, e-learning etcetera, using their broadband connections more as a means to engage with others for social and entertainment purposes. These are perfectly legitimate activities and provide much enjoyment for Internet users, but are not directly contributing to the lofty societal goals of building knowledge capacity, fostering innovation and increasing human capital. The widespread uptake of broadband connectivity does provide the *potential* for future societal level benefits, and as citizens' comfort levels with broadband technologies increase, they

will be well-positioned to engage with governments and each other using ICT tools.

As is noted in Table 3, the clearest beneficiary of global broadband deployments is the commercial sector. Consumer adoption of broadband technologies contributes directly to the profitability of internet service providers (ISPs) (Statistics Canada, 2006b). Although their services are affordable for many, household expenditures on broadband, landline and mobile telephones, and television services (often bundled together in what ISPs call a 'quadruple play' package) continue to rise as the providers seek increased revenues. If broadband is to become an essential enabler of the information society, providing citizens with access to government services and contributing to increased productivity, should it continue to be part of a package sold to citizens by private enterprise? This is a question to be considered as the push for broadband connectivity continues.

In the short-term, it remains to be seen how broadband deployments will enable the realization of information society objectives throughout the population. The examples provided here highlight the potential for beneficial deployment of broadband at the communal level. But one of the interesting findings is that there really is surprisingly little concrete evidence of 'must-have,' revolutionary services enabled by broadband technologies, even among the OECD leaders. Broadband technologies are being widely adopted by consumers, and heavily promoted by governments, but their impacts are subtle, rather than spectacular. There is still a belief in a yet to be discovered broadband 'killer application' that will have dramatic impact, but the history of broadband deployments suggests this belief is at best optimistic (Middleton, 2003). In sum, it is difficult to identify a set of applications or services that would be essential to a broadband enabled Ontario. As noted earlier, the most promising applications seem to be at the communal level, where broadband can be deployed to improve service delivery to people in their communities, and to increase efficiencies in government services.

Some may view this conclusion as being overly pessimistic, arguing that without access to high quality, very high speed networks (e.g. 100 Mbps or more to the home), the true potential of broadband cannot be imagined or achieved. But the history of Internet and broadband evolution suggests that despite repeated calls for more bandwidth by industry leaders, governments and technology enthusiasts, average users have moderate demands for bandwidth (Middleton & Ellison, 2006) and are fairly slow to adopt new technologies and services. For example, a recent Pew Internet Project report concluded that only 8% of Americans are "voracious" participants in

cyberspace, and 49% are only "occasional users" of "modern gadgetry" (Horrigan, 2007).

Another point to consider is the ever-increasing popularity of mobile devices operating on cell phone networks. To date such devices have provided connectivity at much lower bandwidths than those considered necessary to deliver value to consumers, yet they are used throughout the rest of the world to perform many more services than in North America. Advances in 3G cellular technologies are increasing the capabilities of mobile phones, providing new opportunities for mobile broadband services (Lehr & McKnight, 2003). Over time, mobile and fixed broadband services are likely to converge, with improved devices that would deliver on broadband's promise of allowing users to do what they want to do, where they want to do it, on the device(s) of their choice. A focus on fixed broadband networks delivering high speeds to personal computers risks overlooking the value and importance of mobility in a digital economy.

This paper does not present a vision for a broadband enabled Ontario. It does provide an overview of broadband enabled services and applications that have proven to be beneficial at the communal, individual and commercial levels, but notes that their impacts are not transformational. Despite the lack of truly compelling arguments as to broadband's benefits, given the perceived importance of broadband as an enabler of competitiveness and productivity, it appears that an agenda to increase broadband capacity and services in Ontario is a reasonable one. In this context, there are a number of issues to consider in developing an agenda and vision for a broadband enabled Ontario.

- What are the essential elements of a digital economy in Ontario? How and by whom are they defined? How will a digital economy be assessed? What is the role of broadband in a digital economy?
- What e-services are essential for Ontario? What is the best way to build on existing infrastructure and service capacity to encourage increased uptake of e-services?
- Can the gap between societal level objectives for building an information society and individual level broadband usage patterns that focus on entertainment and communication services be bridged? What services would create value for individuals and encourage development of broadband enhanced social capital outcomes?
- What steps are needed to encourage the uptake of broadband services at the communal level? What are the appropriate policies to encourage development of municipal and community broadband infrastructures to meet local needs?

- What is the role of the private sector in providing broadband capacity for the information society? Should public broadband infrastructure be developed to meet societal needs? How can growth in the ICT sector be harnessed to benefit Ontarians?
- How important is mobility in a broadband enhanced Ontario? What infrastructures and services are necessary to support mobility in a digital economy, and how are these developed to meet the needs of multiple stakeholders?

This paper has outlined the context for broadband deployment in Ontario. Drawing on international experiences with broadband deployment, it has identified the stakeholders in the 'broadband cycle' of infrastructure development, deployment and adoption, explaining the factors driving the global push for broadband connectivity. The benefits of broadband adoption at the societal, communal, individual and commercial levels were identified and assessed, concluding that the case for broadband is mixed. Although broadband provides some benefits at all levels, evidence for the much-touted transformational effects of broadband is lacking. There are many examples showing how broadband can be adopted to improve efficiencies in service delivery, and it is clear that individuals are enthusiastic consumers of broadband for communication and entertainment purposes. The challenge going forward is to bridge the gap between the current realities of broadband usage and the societal goals for broadband to become an enabler of the information society and the digital economy.

It appears that the move toward an information society, enabled by broadband and other information and communication technologies, is unstoppable. But broadband initiatives have not yet delivered their much anticipated societal benefits. This paper does not offer a clear prescription for the Province of Ontario to develop a broadband enabled digital economy. To move forward, the Ontario process should consider its objectives for a digital society, and apply the understanding of the benefits of broadband initiatives presented here to the development of a strategic vision and an action plan.

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