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THE ADOPTION OF BROADBAND INTERNET IN AUSTRALIA AND CANADA

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ABSTRACT
Broadband internet connectivity is seen as a means to increase the efficiency and competitiveness of an economy. But despite ongoing efforts to promote broadband in Australia, uptake has been much slower than expected. This paper aims to identify areas that have been holding up the broadband development in Australia. In examining multiple areas for attention (competition, user characteristics and behaviours, applications, network characteristics, and pricing), we refer to the experience of Canada, a leader in broadband deployment, to show the differences in each area. The paper outlines objectives for the development of a more user-friendly broadband environment in Australia, which would encourage broadband adoption. Although both countries discussed here have their own policy agendas and some unique circumstances related to broadband deployment, the paper provide valuable insights for policy makers and industry leaders in Australia, and in other countries which are struggling to develop widespread broadband deployment.

KEYWORDS
Broadband Internet, Canada, Australia, Broadband Supply, Broadband Demand, Facilities-based competition, ADSL, Cable modems

INTRODUCTION
Broadband has been considered as a key to enhancing competitiveness of an economy and sustaining economic growth (International Telecommunication Union, 2001, 2003c; OECD Directorate for Science Technology and Industry, 2001, 2002). The Commission of the European Communities (2006) states that broadband is "crucial for fostering growth and jobs" (i2010, 2006, n.p.). Gillett, Lehr, Osorio and Sirbu (2006) provide some preliminary evidence to show that broadband access does result in positive economic benefits, but Fransman (2006) notes that there is very little evidence to justify the claimed benefits of broadband adoption. Nevertheless, there is no doubt that governments around the world are committed to extending broadband networks to their citizens (Broadband Advisory Group, 2003; Office of the e-Envoy, 2001; Task Force on Broadband Communications, 2002). The extent and speed of broadband adoption has varied widely across nations.

The Australian Government has been keen to deploy broadband across the country, to build a foundation for the information society or knowledge economy, and thereby enhance Australia's national competitiveness (Broadband Advisory Group, 2003). When compared to other countries, however, Australia is far behind in this race of broadband adoption[1], despite strong government support for broadband development over the past decade (Australian Information Economy Advisory Council, 1999; BSEG, 1994; DCITA, 2004). The latest OECD figures (2006b), shown in Table 1 below, ranked Australia in 17th place for broadband subscriptions, among the 30 OECD countries. This is an improvement from 21st place in 2004, and a move above the OECD average for the first time.

[1] Note that there are multiple sources of data on broadband adoption worldwide. Frequently cited statistics come from the OECD (www.oecd.org/sti/telecom) and the ITU (www.itu.int/osg/spu/statistics. Not all sources contain information on all countries. Some statistics measure broadband adoption by numbers of subscribers (e.g. subscribers per 100 inhabitants), others by numbers of households (e.g. percentage of national totals), and these numbers are not necessarily comparable.

However, countries like Australia and the USA continue to lag behind Korea, Canada, and Scandinavian and European countries (e.g. Iceland, Netherlands, Denmark). It is noted that in 2006, Australia remained in the lower half of the ranks while Canada is being superseded by a number of other nations in the rankings. The United States' poor performance has been subject to much scrutiny, with Bleha (2005) suggesting that consumers there have broadband services that are "among the slowest, most expensive, and least reliable in the developed world" (p. 111).

Table 1: Broadband Subscription Ranking of OECD countries (excerpt)

2002-2006 June	2002	2002 Rank	2003	2003 Rank	2004	2004 Rank	2005	2005 Rank	2006	2006 Rank
Denmark	6.7	4	11.11	4	17.0	2	21.8	3	29.3	1
Netherlands	3.9	10	9.2	6	15.6	4	22.5	2	28.8	2
Iceland	4.7	7	11.22	3	15.5	5	21.7	4	27.3	3
Korea	19.1	1	23.17	1	24.4	1	25.5	1	26.4	4
Canada	10.2	2	13.27	2	16.7	3	19.2	6	22.4	9
United Kingdom	1.3	19	3.63	18	7.4	15	13.5	13	19.4	10
United States	5.6	6	8.25	10	11.2	11	14.5	12	19.2	12
Australia	1.3	18	2.65	20	5.3	21	10.9	17	17.4	17
OECD average	**3.8**		**6.06**		**8.6**		**11.8**		**13.55**	

Source: Organisation for Economic Co-operation and Development (2006b): Broadband access per 100 inhabitants, annual figures measured in June of each year.

Despite the fact that up to 7 million Australian homes, housing 91% of the population, are ADSL[2]-enabled (meaning that broadband access can be provided over existing telephone lines) (Houghton & Morris, 2001), the one million subscriber milestone was reached only at the end of June 2004 (ACCC, 2004). It is reported that Australia is two years behind other developed countries like USA and Canada (Riley, 2004), a comparison that only considers the number of subscribers. When the quality of services (i.e. speed) is considered, the gap is even larger. Whereas access speeds of 1 Mbps (megabits per second) or above are the norm in leading countries (with speeds in excess of 50 Mbps available in countries like Japan and Korea) (International Telecommunication Union, 2006a), standard broadband plans in Australia provide speeds of only 256 Kbps (kilobits per second). Furthermore there is a strict download cap applied to Australian broadband services which discourages users from becoming active surfers. Although the number of broadband subscribers in Australia is increasing steadily, a 2004 report by IDC predicts that Australia will remain in the broadband 'backwater' when compared against other developed countries (IDC, 2004).

The purpose of this paper is to explore the conditions for broadband adoption in Australia, to better understand why Australian consumers have not adopted broadband as rapidly as consumers elsewhere in the OECD. The focus on *residential* broadband users is appropriate because the anticipated societal benefits of broadband networks can only be realized if such networks are widely adopted by consumers. The paper draws on the experiences of

[2] DSL is an abbreviation for digital subscriber line. The acronym xDSL is used to represent generic DSL service, for example asymmetrical DSL is ADSL. Throughout the paper, references to DSL service in Canada and Australia describe ADSL service, but the simpler DSL acronym is used.

broadband deployment in Canada, offering a point of comparison for the Australian situation. On a cultural and geographic basis, Australia and Canada are similar, allowing for valuable insights to be gained from considering broadband adoption patterns in Canada. The paper outlines the differences between the two nations, illustrating how different contextual factors impact adoption. The paper provides a starting point for discussion of how to encourage increased broadband uptake by Australians, and by those in other countries where broadband adoption has been slower than anticipated.

Previous research on national broadband diffusion shows no clear determinants of broadband uptake (e.g. Kim, Bauer, & Wildman, 2003), and highlights the complexities of trying to conceptualize factors that contribute to broadband rollout (Bouwman, Fijnvandraat, & van de Wijngaert, 2006). While various factors are thought to be important, no clear outcomes are drawn when compared on a statistical basis. This paper takes a less quantitative focus, drawing on lived experiences with broadband in the countries being compared.

The paper begins with a review of literature that addresses the determinants of residential broadband supply and demand. The literature review is followed by a discussion of why studying broadband diffusion in Canada can provide useful insights to help advance broadband adoption in Australia. Broadband development in each country is described, followed by a discussion of differences in terms of the determinants we have identified in the literature review. In the final section, we conclude and present implications for Australia and other countries.

LITERATURE REVIEW

The uptake of any technology is dependent upon both supply of, and demand for, that technology. Much research has been done in the past few years to better understand the determinants of broadband network supply and demand. As this section shows, however, it is difficult to draw conclusions about the relationships among various supply and demand variables such as price, regulatory policy and characteristics of the potential adopters, especially when attempting to compare adoption patterns across countries (Kim et al., 2003). Data on broadband supply and demand is frequently proprietary, and publicly available data (e.g. International Telecommunication Union, 2006b; Organisation for Economic Co-operation and Development, 2006a) do not offer sufficient detail to investigate individual supply and demand determinants.

Determinants of Broadband Supply

With some exceptions (e.g. LAN-based broadband in Sweden, fibre to the home and fixed wireless service to remote areas, see International Telecommunication Union, 2003a), most residential consumers who have access to broadband get this access using a telephone line (DSL service) or a cable modem. Theoretically, most urban homes in developed countries can get either DSL or cable modem broadband service (or both), but in practice the actual availability of broadband service is dependent upon a service provider making a decision to offer the service. Supplying consumers with broadband requires substantial infrastructure investment, and while such investment has been ongoing for some time now (Fransman, 2006; Shelanski, 1999), providers still need to consider whether or not they will offer broadband services in a particular area. The availability of broadband is influenced by the nature of the marketplace (defined below as ‘user characteristics’) and by regulatory policy.

User Characteristics. In a study conducted in the US state of Ohio, Grubesic (2003) found that household density, location (rural or urban), education and income levels were

determinants of xDSL supply. He also found that regions with more older residents were less likely to be supplied with broadband. Prieger (2003) reports similar findings for supply of DSL and cable broadband services in the US, noting that income alone was not a reliable indicator of broadband supply. The ITU (2003a) and Cava-Ferreruela and Alabau-Muñoz (2006) also report that the supply of broadband is related to national income, urbanization and population density. These findings are not surprising, as they indicate that providers consider the potential demand for broadband services when determining whether or not to supply a particular market.

Regulatory Policies: Local Loop Unbundling and Open Access. Local loop unbundling requires that the incumbent telephone provider allow competitors access to its existing network infrastructure (OECD Directorate for Science Technology and Industry, 2003a, 2003b), and it is frequently mandated by telecommunications regulatory agencies. Unbundling allows competitors to offer broadband services over existing infrastructure. There is mixed opinion as to the impact of local loop unbundling (LLU) on the supply of broadband (Ure, 2003). OECD research (2001) suggests that the presence of LLU in a market promotes intramodal competition (i.e. competition among xDSL providers), but Howell's (2002) analysis of the OECD data does not support this contention. More recent OECD research (2003b, p. 6) observes that "arguments that structural separation of the local loop is necessary are inconclusive."

The presence of LLU regulation does not guarantee that potential competitors will actually use the unbundled loop to provide broadband, meaning that the presence of LLU in a broadband market does not necessarily increase the supply of broadband to consumers in that market. One instance where LLU has increased price competition is Japan, where YahooBB! offers a competitive DSL service by accessing the unbundled local loop (International Telecommunication Union, 2003a).

In the cable broadband market, open access or "third party internet access" rules operate analogously to local loop unbundling, allowing new entrants to purchase broadband capacity from existing cable providers and resell it to consumers. To date there appears to be little evidence of open access to cable networks increasing broadband supply.

Rather than the intramodal competition that would result from LLU or open access to cable networks, increased supply more often comes as a result of intermodal, facilities-based competition. Intermodal competition is competition between DSL and cable providers within a single market, and is frequently mentioned as a primary reason for the development of extensive broadband capacity in South Korea (Lee, O'Keefe, & Yun, 2003).

Summary. In high-income countries around the world broadband is widely available (International Telecommunication Union, 2003a), although it is noted that the speed of service supplied does vary dramatically (see International Telecommunication Union, 2006a, especially Table 7, on this point). Although many small remote communities in countries with low population densities (e.g. Canada and Australia) are not yet served by commercial broadband providers (Industry Canada, 2002; Sale, 2001), in general, broadband supply is not constrained. As broadband networks are generally accessible to consumers, differences in broadband uptake rates are likely explained by differences in demand for broadband, not supply.

Determinants of Broadband Demand

Five major determinants of demand for broadband networks are i) the nature of competition, ii) characteristics of the users (on an individual and national basis) and user behaviours, iii) broadband pricing, iv) the availability of broadband-specific applications and v) the characteristics of the broadband network.

Competition. Using US data, Aron and Burnstein (2003) studied the impact of intermodal competition on broadband adoption rates, concluding that the presence of intermodal competition increases demand for broadband in a given region. García-Murillo and Gabel (2003) also found that the presence of competition in a market is a significant predictor of demand for broadband. While it is obvious that broadband supply to a region is a necessary precursor to adoption, Aron and Burnstein's results indicate that the type of supply (i.e. DSL-only, cable-only or DSL and cable) has an impact on broadband demand. Howell (2002) also notes that intermodal competition promotes increased broadband uptake, a finding replicated in Distaso, Lupi and Manenti's (2006) study of broadband platform competition in the European Union. Polykalas and Vlachos (2006) argue that bitstream (wholesale) access to incumbent infrastructures can provide competition among DSL providers when inter-platform competition is not present. It is noted that when the incumbent telco in a country also owns the cable network, broadband adoption rates are slower than in countries where this is not the case (International Telecommunication Union, 2003a). For incumbent telcos who also own cable companies, there is less incentive to invest in broadband cable infrastructure that would compete with their existing broadband DSL offerings, unless mandated directly by the government or anti-competitive boards, such as in Australia.

User Characteristics and Behaviours. Adoption research generally considers individual characteristics of the potential adopter when investigating adoption behaviours (Rogers, 1995). Individual characteristics that are thought to have an impact on broadband adoption are income, education level, age, and family structure. For example, Kridel, Rappoport and Taylor (2002) found greater uptake of cable modem-based broadband among higher income and better-educated groups. Varian (2002) found that the best predictor of an individual's willingness to pay for broadband was his or her occupation, a factor that may be correlated with individual income. Choudrie and Dwivedi's work (2005) also suggests that income is an important determinant of broadband demand. In addition, although Cameron's (2004) study does not directly discuss income, many of the factors she found to be significantly associated with broadband take-up (e.g. education level, occupation level, home ownership, type of housing and other ICT equipment in the household) are arguably correlated with income.

The impact of the age of the potential adopter upon the decision to adopt a broadband network is less clear. Rappoport, Kridel and Taylor (2002) found that older people were more likely to adopt broadband than younger people, but commented that this could be an income effect (i.e. older people have more money, and people with more money are more likely to have broadband). In their cable modem adoption study (Kridel et al., 2002), the same authors note that cable modem adoption generally declines with age, but also note that among internet users, a higher proportion of older users have adopted cable modems. Madden, Savage and Simpson (1996) found that being over the age of 55 decreased the likelihood of broadband adoption, but their study was based on intention to adopt in a population that did not have access to broadband at the time of the study. Recent work by Choudrie and Dwivedi (2006a) suggests that older people are less likely to use broadband internet than younger people, arguing that older people do not have the skills or the technology necessary to make use of broadband connectivity.

Another factor that may be somewhat correlated with age is household structure. Howell (2002) observes that the large proportion of Koreans aged 18-30 living with their parents may have had an impact on demand for broadband in that country. These Korean youths may have high disposable incomes to spend on broadband connectivity, or may simply encourage their parents to adopt broadband for their households. Madden and colleagues (1996) found that the presence of children in a home increased the likelihood that a family would adopt broadband, a finding supported by Kridel et al. (2002) and by Cameron (2004). However, Madden and Simpson's (1997) study presented contradictory results, reporting that households with more people were less likely to demand broadband access. As with other individual characteristics, the impact of household structure on demand for broadband is still not well understood.

In their 2003 study (using the 2001 OECD data on broadband penetration rates), Kim, Wildman and Bauer considered population level determinants of broadband uptake, and concluded that the most significant determinants of broadband penetration were preparedness (the "attitude of a nation towards advanced information technology" p. 12, and the availability of computers in the country) and population density. The ITU's Digital Access Index (2003b) provides a measure of country preparedness.

Gardner (2003) also considered user behaviours when investigating 'success drivers' for broadband uptake. Using data from 14 countries in North America, Europe, Scandinavia and the Asia-Pacific region, she found that "hours spent online offered the most definitive explanation for the rate of broadband take-up" (p. 14).

Stern, Gregor, Martin, Goode and Rolfe (2004) confirmed all the previous findings when comparing the relative importance of factors affecting broadband uptake in Australian households. They found that the main factors, in order of importance, were frequency of internet use, location of households, technophilia and experience with pay TV. Frequent internet users were more likely to adopt broadband technology although it is unclear if households use the internet more because they have broadband, or if they adopt broadband because they are frequent users. Stern et al. also found that households in metropolitan locations were more likely to adopt broadband technology, a finding replicated by Cameron (2004), who notes that metropolitan areas have easier access to broadband than rural ones. Stern et. al suggested that technophilia is a factor in broadband adoption. Technophilia referred to the extent to which households have a tendency to consume technology and may be related to how technologically savvy the households are. This view is supported by Chang, Ahn and Lee (2006a) in their study of family decision making processes in the purchase of broadband technology in Australia. Chang et al. found that the role of the "technology champion," who is generally the technology savvy family member, is crucial in driving the decision to purchase broadband technology for the home. Adams's (2006) work supports this finding, noting that a lack of understanding of broadband technology and its benefits is a barrier to adoption.

Price. Rappoport and colleagues (Rappoport, Taylor, & Kridel, 2003, p. 84) suggest that a "significant increase in broadband penetration rates will most likely require large price reductions for access." While this observation is consistent with economic theory, it is not clear that broadband deployment is always encouraged by lower broadband prices. Kim et al. (2003) found that the price of broadband was not a significant predictor of broadband uptake across OECD countries. They also found that higher dial-up prices did not lead to increased

broadband uptake, suggesting that broadband is not necessarily a substitute for dial-up. Rappoport and Kridel (2003) note that the price elasticity of broadband access (through DSL or cable modem) is high in instances of low broadband penetration, but lower at higher broadband penetration levels. In the Japanese market, ADSL service was found to be price inelastic, but fibre-to-the-home service was price elastic (Ida & Kuroda, 2006). García-Murillo and Gabel (2003) did find that price was significant when considering broadband uptake rates across the 135 countries included in ITU data (2002). Stern et al. (2004) found that higher income was related to broadband adoption in Australian households. It is likely that cost is an inhibitor to adoption for low income families, a point noted by Choudrie and Dwivedi (2006b). In some countries, the price of broadband is impacted by the presence of download caps that effectively result in a tiered pricing structure. ITU research (2003a) suggests that the presence of download caps does result in lowered demand for broadband networks.

Applications. Varian (2002, p. 52) suggests that "the problem with broadband is not access but applications." This is the 'killer application' argument, which suggests that "unless new compelling applications are forthcoming or the price of broadband connectivity falls significantly, a surge in demand for broadband in the United States should not be expected" (p. 54). Owen (2002, p. 20) supports this argument, commenting that the most obvious reason for low broadband demand is the "lack of any – much less attractive – products and services that require broadband media for their delivery." While broadband specific applications like online games and viewing time-shifted TV content (Lee & Choudrie, 2002; Lee et al., 2003) are popular in high broadband penetration countries like Korea and Japan, there are other high broadband penetration countries like Canada where a broadband specific killer application is less obvious, if it is present at all. Counter to Varian's and Owen's arguments, Middleton (2003) argues that there is not a single killer application that will drive broadband demand. However, it is widely noted that broadband connectivity must be perceived to be useful it if is to be adopted by consumers (Adams, 2006; Oh, Ahn, & Kim, 2003).

Network Characteristics. The primary feature that differentiates broadband networks from narrowband ones is the network speed. While there are various definitions of what constitutes broadband (Sawyer, Allen, & Lee, 2003), the US FCC's specification that broadband requires a minimum network speed of at least 200 Kbps is widely accepted. It is noted however that "broadband lite" services are offered in some countries, providing speeds of only 128 Kbps. While such services are not fast (only twice as fast as dial-up), they offer the always-on network access that is characteristic of most broadband networks.

Crandall and Jackson (2003, p. 163) note that always-on access "substantially increases the value of connections from the home or office to the internet." While there is not much specific research that considers the impact of network speed on demand for bandwidth, it is reasonable to assume that those who frequently use applications that are facilitated by high bandwidth (e.g. file sharing) will be most likely to adopt higher bandwidth offerings (providing that the price for such offerings is consistent with users' assessment of the value provided by higher bandwidth). Varian (2002) does report that demand for speed was related to user occupation, with only certain groups of users finding sufficient utility in higher speed access to merit a premium price. Rappoport et al. (2002) note the opportunity costs of low speed internet access, suggesting that those whose time is more valuable will reduce their opportunity costs by adopting broadband network access.

It is also noted that for many users, broadband adoption is driven by factors other than network speed. For instance, only 25% of respondents to a Japanese survey indicated that speed was a reason for choosing their current internet service, but more than 55% indicated that always-on connectivity was important (Ida & Kuroda, 2006). In an unpublished survey of Canadian university students (Morris & Middleton, 2005), more than 40% of respondents indicated that the most valuable feature of high speed internet was something other than speed (e.g. always-on connection, free phone line, provision of shared connection within household).

Summary

The section above outlines five key determinants of broadband demand, as described in the literature. These demand drivers are very similar to the "success factors" for broadband deployment identified by the ITU (2003a), which include competition, innovation, applications, pro-competitive regulations, pricing, speed, marketing, high ICT usage, and urban demographics (e.g. population density). The ITU also notes that in the absence of success factors, broadband adoption is inhibited.

Neither the ITU's list of success factors, nor the discussion of the five key determinants of demand provides an indication of the relative importance of various demand determinants. It does appear that pricing is not the most important determinant of demand, and that a simple price-quantity relationship (i.e. lower price leads to higher demand) does not hold with respect to broadband pricing. This observation is supported by Gardner's (2003) work, which offers a hierarchical ranking of the importance of various demand drivers.

BROADBAND ADOPTION IN AUSTRALIA AND CANADA

Rationale for Comparison

On a cultural and geographic basis, Australia and Canada are similar, so it is expected that valuable insights can be gained from considering broadband adoption patterns in Canada. Until recently, Canada was close to the top of the OECD ranks, with an adoption rate that was more than triple that of Australia in 2004 and close to double Australia's in 2005. The 2006 numbers show that Australia's adoption rate is catching up to Canada's, but Australia remains in 17th position among OECD countries, compared to Canada's 9th place rank.

As shown in Table 2, although Australia is smaller than Canada, the economic indicators of the two countries are similar, as is their multicultural nature. In addition, both countries have a comparable geographic mix of large urban centres (found along the coast in Australia, and along the Canada-US border in Canada) and smaller, geographically isolated communities. Given these similarities between Australia and Canada, it is suggested that studying the Canadian deployment of broadband may provide a useful indication for Australian policy makers. Although Australia's broadband adoption rates trail Canada's, its overall internet adoption rate is higher, as is the mobile phone adoption rate.

Table 2: Australia and Canada Comparative Fact Sheet[A]

	Australia	Canada
Population (millions)	20.4	32.3
Land area (km^2)	7 682 400	9 970 610
Population Density (per km^2)	3	3
Culture	Multicultural	Multicultural
Currency rate (US $1)	1.28 AUD	1.16 CAD

(December 2006)		
GDP per head (USD, purchasing power parity)	33 100	34 053
Internet subscribers per 100 inhabitants (2005)	70.4	63.0

[A] All figures 2006 unless otherwise noted.
Sources: *The Economist* Country Profiles (www.economist.com/countries), www.oanda.com/convert/classic, and International Telecommunication Union (2006a).

Broadband in Canada. More than 64% of Canadian households have internet access. Of these households, 80% have broadband internet access. In total, more than 50% of Canadian households (6.4 million households) have broadband. Market share data collected by the telecommunications regulatory agency, the CRTC, suggest that approximately 42% of Canadian broadband connections are provided by DSL through incumbent telecommunications companies, with 54% using a cable modem connection. It is noted that these figures include "lite" broadband services (<256 Kbps) which make up just over 10% of broadband subscriptions in Canada (CRTC, 2006).

Competitive services included fixed wireless or satellite provision (generally found in remote areas), as well as independent internet service providers who resell DSL or cable access. In addition, wireless internet services are becoming available in some Canadian municipalities. For example, the City of Fredericton, in New Brunswick, offers free WiFi in the downtown area (www.fred-ezone.com), and Toronto Hydro Telecom is developing a commercial WiFi service that will provide broadband to Toronto residents (www.onezone.ca). To date, these sorts of services are primarily viewed as supplements to existing broadband connections (to allow users access away from the home), rather than as direct competition to services provided by telcos and cablecos. Another new service is marketed as "portable internet," and provides a wireless internet connection at a stated speed of 1.5 Mbps in more than 20 Canadian cities, using "pre-WiMax" technologies (Inukshuk, 2006). Less than 5% of Canadian broadband connections are provided by facilities-based or intramodal competitors (CRTC, 2006), indicating weak competition for the DSL and cable modem services provided by market incumbents.

Urban areas in Canada are well-served by broadband providers, meaning that more than 90% of Canadian households have broadband access. However, given the geography of the country, it is still the case that almost 50% of Canadian communities still have no DSL or cable access (CRTC, 2006). Current government initiatives are focusing on extending broadband access to rural and northern communities in Canada (see www.broadband.ic.gc.ca/pub/index.html?iin.lang=en), using satellite and wireless technologies. Industry Canada, a federal government department, has actively promoted the development of broadband infrastructure across the country, and supported initiatives to develop CANARIE, the cross-Canada fibre backbone network that provides connectivity to schools, universities, libraries, hospitals and other organizations (CA*net Institute, 2001). This infrastructure has benefited many Canadians, but it does not provide residential broadband access.

Broadband in Australia. In Australia, the picture of broadband take-up is somewhat different. Despite a high proportion of computer users where up to 70% of households had access to a

home computer (60% with access to the internet), only about 28.8 % of Australian house holds have broadband internet access (Australian Bureau of Statistics, 2006).

The latest figures from the Australian Competition & Consumer Commission (2006) show the take-up of broadband services is at 3.5 million (households and non-households) as at June 2006. 1.4 million services were connected over the previous 12 months (June 2005 - 2006), representing a 67% increase from same time last year. Of the estimated 3.5 million broadband subscribers in Australia in June 2006, 17% used cable, and some 80% used DSL (ACCC, 2006). Yet, as indicated previously, despite the rapid growth in the past year, Australia's broadband penetration is lagging behind not only Canada but also behind most other developed countries according to the OECD rankings (17th position).

The KPMG (2004) Report on Australia's broadband future suggested that the three main reasons for Australia's lagging position were the lack of competitive infrastructure, the slow roll out of services and the initial relatively higher cost of broadband in comparison with dial-up services.

On the surface, Australia may appear to have encouraged competition as there are more than 246 internet service providers, many of whom provide broadband services, with a wide variety of broadband plans and options for subscribers to choose from. (see www.whirlpool.net.au). However, the Australian market is in reality dominated by two main wholesalers, Telstra and Optus. Access to fixed line broadband telecommunications is provided mainly by Telstra's ADSL network which is available to about 71% of the population (including virtually all population centres with greater than 4,000 people). In addition, the alternative fixed line broadband networks in Australia are the Telstra and Optus cable networks. Whereas there are many retailers of broadband technology and services, the prices they charge and the coverage they can offer are largely determined by Telstra and Optus, and are therefore only marginally cheaper than those of Telstra and Optus. Competitors such as TransACT, Bright Telecommunications and Neighbourhood Cable developed cable modem access services (Broadband Advisory Group, 2002). Telstra's BigPond brand also offers Wireless Broadband "in most places across Australia" using 3G technology (BigPond, 2006), but to date, wireless internet infrastructure has provided limited competition to DSL or cable services (Budde, 2006).

The need for a more responsive and cohesive strategy on broadband connectivity within Australia resulted in the Broadband Advisory Group's (BAG) (2003) report to the government, Australia's Broadband Connectivity, which outlined key strategies for the government including broadband take-up within key sectors (demand side), key performance indicators (KPI) for the incumbent (supply side competition), and monitoring. Since that report, a number of successive projects have been undertaken by the Australian Government (through the Department of Communications, Information Technology and the Arts (DCITA)), to improve supply, especially in rural and regional areas, and service quality. The latest program is Broadband Connect, an "$878 million initiative of the Australian Government to support equitable access to high quality, sustainable broadband services across regional and rural Australia." (DCITA, 2006) In addition, through its Community Connectivity program, DCITA is starting to address the demand issue by focusing on sectors of the community where there might still be socio-cultural and economic barriers to the take-up of broadband.

COMPARATIVE ANALYSIS: BROADBAND ADOPTION IN AUSTRALIA AND CANADA

Framework for Analysis

In this section, the five key determinants of broadband demand are assessed, using Gardner's (2003) hierarchical model of demand drivers as a framework for the comparative analysis of broadband markets in Canada and Australia. Accelerating factors include a strong competitive market for broadband, widespread availability of broadband-specific applications, consumer propensity to spend time online, and the availability of high speed network access. Pricing has the potential to stimulate the broadband market but will not necessarily accelerate broadband take-up. Threshold factors, such as the number of households with PCs, and sufficient population density, are necessary preconditions for the deployment of broadband, but on their own are not sufficient to stimulate or accelerate its uptake by residential consumers. Because the threshold factors for Canada and Australia are relatively similar (Table 2), the focus here is on the roles of accelerators and stimulants in the Canadian and Australian broadband markets (where there are marked differences). Table 4, at the end of this section, summarizes the findings.

Accelerators

Competition. Healthy competition plays a pivotal role in the deployment of broadband internet (OECD Directorate for Science Technology and Industry, 2001). As noted earlier, there are two ways to promote competition in the network industry (Christodoulou & Vlahos, 2001; Michalis, 2001). One is competition between infrastructure networks (e.g. cable modem, DSL), also known as facilities-based or intermodal competition. The other is intramodal competition, within each network technology (e.g. among DSL providers). In infrastructure competition, new entrants have to build their own network; in intramodal competition (enabled by local loop unbundling), new entrants can use the incumbent's network and resell capacity on it.

In Canada, broadband competition primarily occurs between infrastructure networks, with cable modem access having larger market share than DSL (54% as compared to 42%). In most urban areas there is only one cable modem provider and one major DSL service provider (the incumbent telco), so most consumers perceive that their choice for broadband service is between cable and DSL.

As broadband adoption has become widespread and growth in the market has started to slow, the basis of competition appears to have shifted. Now rather than attempting to convince new users of the superiority of one platform over the other, both cable and DSL providers are focusing on diversifying their product lines, to make broadband more appealing to a wider range of customers. Intense rivalries between providers have subsided, and the industry has settled into an environment where there is little difference in price or service between cable and DSL offerings. Competition now occurs at a more macro level, as both telcos and cablecos try to entice customers with "bundles" of services that include high definition television, mobile telephones and broadband internet. Efforts are also made to increase broadband penetration by offering "lite" services that are priced almost on par with dial-up services.

Some companies have taken advantage of local loop unbundling to establish competing DSL services. This has resulted in some customer "churn" as people move from one provider to another to take advantage of introductory subscriber offers. To date, there is little evidence of

competing services being offered via existing infrastructure in the cable sector, so there is effectively no competition within the cable sector. Service providers have divided the market based on geography, and each geographic area has only one cable provider.

In summary, the Canadian market looks quite competitive on paper, given the local loop unbundling and open access policies. In reality however, the market is dominated by a few key players who offer very similar services at similar prices, in a situation of moderate rivalry. In 2005, only 3.4% of residential broadband internet access revenues were earned by companies other than incumbent telcos or cable providers, although 40% of dial-up revenues were earned by competitors to the incumbents (CRTC, 2006). There is healthy intermodal competition, but this has not come about as a result of local loop unbundling.

In Australia, it appears that there are many broadband connection providers, particularly in DSL. However, DSL and cable networks are dominated by Telstra and to a lesser extent, by Optus. Many ISPs selling DSL are resellers of Telstra's DSL capacity. Local loop unbundling (LLU) is seen as crucial to competition. In Australia, the local loop unbundling would enable the incumbent's (Telstra's) competitors to install infrastructure in local exchanges to provide broadband services such as DSL. However Telstra initially argued consistently that the simultaneous challenge of rolling out both DSL and LLU was a major impediment to growth, citing Australia as the only place where simultaneous DSL and LLU rollout has been in place, due to pressures from the Australian Competition and Consumer Commission (ACCC). The ACCC is the government body responsible for monitoring competition in industries. Since the near completion of DSL roll out, the delay now is in the debate between the ACCC, Telstra and its competitors around the issue of the LLU pricing (ACCC, 2006). Until the LLU pricing levels are clear, the ability of competitors to deploy their own infrastructure will be slowed down. LLU is clearly a contentious area for incumbents as can be seen by the New Zealand example where Telecom (New Zealand's incumbent) is opposed to LLU, while its Australian subsidiary (AAPT) is keen to take advantage of unbundling in Australia (Watson, 2002).

In summary, comparing the impact of competition within the industry on the rate of speed of take-up of broadband services Canada and Australia, it may be surmised that competition is a key determinant of i) how well and quickly broadband infrastructure may be rolled out, ii) the level of service quality and iii) pricing and choice for consumers. It is important to reiterate that the Canadian broadband market is dominated by competition *between* DSL and cable, and that competition *among* DSL providers has been less evident. In addition, the growth of cable broadband in Canada was likely facilitated by the widespread uptake of cable television services by Canadians, with 75% of Canadian households subscribing to cable in 2001 (CRTC, 2002). With an existing relationship with both the cable company and the incumbent telco (the DSL provider), Canadians could easily choose between the two broadband platforms.

User Behaviours. For Canadian internet users, popular applications include email, web browsing and information searching, as well as general leisure and entertainment activities (e.g. playing games, downloading or listening to music) (Statistics Canada, 2004). More than 55% of Canadians go online for at least seven hours a week, and more than 60% have been using the internet for more than five years (Zamaria, Caron, & Fletcher, 2005). More recent data show that Canadians are still wary of online financial transactions using credit cards (Statistics Canada, 2006), but close to 60% now use the internet for banking. For many Canadians, especially those in younger age groups, the internet has become an integral part of

their daily lives. 59% of university students surveyed indicated that they strongly agreed with the statement "it would be very hard for me to stop using the internet," and 85% of them chatted online with their friends daily. Only 2% of these students had a dial-up connection at home, 97% had either DSL or cable broadband (Morris & Middleton, 2005). For Canadian youth, the internet plays a large role in maintaining social networks (Shade, Porter, & Sanchez, 2006).

In Australia, Chang and colleagues (2006a) found in their interviews with Australian households that they were still relatively reluctant to use the internet for recreational and online gaming purposes. In a separate study, Chang, Lee and Oh (2006b) found that young Australians were not active participants in online discussions and reviews. They mostly preferred to use online interaction as a supplement rather than a substitute for face to face communication. Additionally, Cameron (2004) also found that people who live in regional Australia were also less likely than their metropolitan counterparts to take up and use broadband technology and applications.

In summary, it appears that Canadians have embraced the internet as part of their daily lives in ways that are not so prevalent in Australia. A possible reason for this difference is that Canadian surfers do not generally face quotas on their internet use, allowing them to access the internet without fear of facing restricted bandwidth or being charged for excess usage.

Applications. Government policy documents frequently identify the benefits of broadband service for access to e-learning, e-government and e-health (e.g. National Broadband Task Force, 2001; Office of Technology Policy, 2002). But Bauer et al. (2002) argue that the majority of such services can be delivered to consumers using relatively low bandwidth. There are efforts by governments to promote demand for broadband (see www.itu.int/osg/spu/ni/promotebroadband/ for activities in this regard), and it is frequently argued that unique and interesting content and applications are needed to create demand for broadband, leading to a search for so-called "killer applications" (International Telecommunication Union, 2001; Smith & Leung, 2002). Middleton (2003) suggests that the search for a content-based killer application overlooks the value broadband internet users find in being able to connect with each other and generate their own content (a point reinforced by the increased popularity of peer-to-peer applications like Flickr, YouTube, MySpace, Facebook, etc.).

In Canada, it is difficult to identify specific broadband applications that led users to broadband services. Consumer demand for broadband in Canada seems to have grown independently of government initiatives[3]. As noted above, Canadians use broadband for communication (e-mail, messaging), for information gathering (web searches), to create and share content (e.g. photos, blogs), and for entertainment (e.g. games, downloading music and video files). Some users do partake in online learning activities (e.g. accessing course materials), access government information and conduct various transactions (e.g. renewing parking permits), and search for health care information online, but it is not clear that these are their primary activities.

Analysis of Statistics Canada's Household Internet Use Survey data on broadband adoption shows that more than half of the broadband households in Canada are not high intensity

[3] For instance, less than 15% of Canadian students agreed with the suggestion that they used the internet because the government promoted internet usage (Morris & Middleton, 2005).

internet users, meaning that they accessed the internet less than seven times per week, and used the internet less than 40 hours a month. Furthermore, as recently as 2003 (the last year the survey was conducted), more than 55% of broadband households did not use the internet for banking, online purchases, work or education (Middleton & Ellison, 2006). These data suggest that broadband may be adopted as much for the convenience of always on access as for a need for a high speed connection to support intensive, varied internet activities (consistent with Ida and Kuroda's [2006] findings among Japanese broadband users).

Similarly, there are no applications identified as a broadband drivers in Australia. Rather the current discourse asks whether there is sustainable consumer demand for broadband. Awareness and experience of broadband among the public appears to be low in Australia, as highlighted by the BAG (2003) report which consistently recommends public education on the benefits of broadband technologies. Wales (2002) suggested that even some Australians who have been exposed to the use of broadband do not have a full appreciation of its potential, and lack awareness about comparative costs of broadband and dial-up. Adams (2006) found that potential broadband users are confounded by the complexity of the technology and the pricing plans. As noted by Wales (2002), there are few compelling applications for which broadband is essential in Australia. Both Wales (2002) and Sacks (2002) indicated that there might be more interest amongst Australian users in the attributes of broadband rather than its applications for two main reasons. First, it seems that connectivity (always on) and capacity to network (within households and organisations) are still more attractive than specific broadband-related applications or content. This has also been the mainstay of advertising for broadband services. Second, Wales (2002) and Sacks (2002) both argue that the lack of importance placed on applications in Australia may be due in part to factors such as capped speed and charging by download volume. These constraints mean that for users, applications that are heavily reliant on broadband capacity are still not attractive to Australian users both within households and organisations. However, since those earlier studies, new applications such as YouTube have meant that increased broadband capacity is now becoming more important for households who want to access these newer applications, and may have contributed to the more recent increase in uptake of broadband services in Australian households.

Network Speed. Definitions of "broadband" speeds vary widely around the world. At the highest end of the scale, consumers in Japan and South Korea can get 50 Mbps service over fibre networks for about $40 USD per month (International Telecommunication Union, 2006a). In contrast, Canadian cable companies now offer "Ultra Lite Broadband," which is an always-on, 128 Kbps service, for under $20 USD per month (www.shoprogers.com/store/cable/internetcontent/ultralite_RCI.asp?).

Canadian consumers have a choice of four tiers of service. An "ultra" or "pro" package is available that offers upstream bandwidth in excess of 5 Mbps, plus extras like a wireless router. The "standard" package now offers bandwidths of up to 5 Mbps, and the 1 Mbps service (the original "high speed" service in Canada) has been rebranded as basic/lite. As noted above, "ultra lite" offerings provide access speeds in the 128 - 256 Kbps range.

In terms of network speed, Australia now assumes the definition of broadband as an "always on," internet connection with an access speed equal to or greater than 256 Kbps (Australian Bureau of Statistics, 2004). The KPMG (2004) report on Australia's Broadband Future suggested that "Broadband is sufficient data transmission speed to utilise applications services or content effectively relative to the user's access device capabilities." There seems

to be an implication in Australia that network speed is not a major determinant of broadband take-up. However, it is unclear whether this is due to the fact that Australians do not understand the potential value of faster network speed or if they do not see it as a factor to be concerned with. In either case, it is difficult to assess Australian understanding of faster network speed because of the lack of exposure to the types of speed available in countries such as Canada and Korea.

Stimulants

Pricing. Pricing is a more complicated element than it would appear, since price can represent the clear cost of broadband access, or the cost as compared to dial-up service. In Canada, there is little price competition for broadband services, but the tiered structure provides access to broadband at several price points. For the standard offering, both DSL and cable providers charge ~$45 (CAD) per month (~$39 USD), with introductory offers that reduce the price for the first months of service, free product giveaways (e.g. 19" computer monitor for customers who sign up for two years) and package deals (bundles) for subscribers who get other services from the provider (e.g. cable television, mobile or landline telephone services). For many early adopters of broadband, this pricing structure was attractive as it allowed Canadians to dispense with the expense of a second phone line that had been acquired for internet access. Broadband providers are now converting dial-up customers to broadband by offering the lower tiered services at prices comparable to dial-up.

Canadian broadband providers have implemented, removed and now re-implemented bandwidth caps. The bandwidth caps are different for DSL and cable service. For instance, the ultra lite DSL service provided by an incumbent telco is capped at 1 Gb (gigabyte) per month, compared to a 60 Gb per month cap for ultra lite cable access. For the "pro" service, DSL caps are set at 30 Gb, compared to 100Gb for cable service. Both DSL and cable charge a per Gb fee for data transfers over the caps, the DSL fees are higher than the cable fees. Most Canadian internet users are unaware of the download caps, but with the popularity of bandwidth-intensive applications like video sharing (e.g. using YouTube or BitTorrent) and with distribution of television shows over the internet, the caps will place restrictions on some users.

In Australia, the government maintains that Australia's broadband prices are comparable to the rest of the world (DCITA, 2006), although these contentions are not supported by the data presented in Table 3. In Australia, there has admittedly been increased competition amongst ISPs which has led to current prices for monthly packages dropping to about A$29.95 for 0.2GB of free downloads. As KPMG (2004) notes, the reality remains that Canadians can download much more data on a monthly basis, more cheaply, than Australians can.

Table 3: Comparison of Broadband Pricing - Sorted by Price per 100 Kbps

Country	Speed (Down)[B]	Subscription/month (US$)	Price per 100 Kbps (US$)	Value Factor[C]
Japan	51.2 Mbps	$38.19	$0.07	28.13
Korea (Rep.)	51 Mbps	$40.59	$0.08	9.49
USA	4 Mbps	$20.00	$0.49	1.69
Canada	4 Mbps	$41.26	$1.01	3.75

Iceland	6.1 Mbps	$91.39	$1.49	-
Australia	1.5 Mbps	$53.30	$3.45	0.40

[B](International Telecommunication Union, 2006a)
[C](Saunders, 2005)

Yet, perhaps the issue here is not the relative price of Australian broadband services in comparison with that of Canada, but the relative difference between the price of broadband services and dial-up service. In Canada, pricing for lower tier broadband services is now the same as for dial-up access. Australia has among the lowest dial-up internet prices in the world (slightly lower than those in Canada). Therefore, it is difficult to convince consumers to switch away from dial-up to more expensive broadband unless there are greater perceived benefits to using broadband. This situation is comparable to that in New Zealand, where Howell (2002) found that consumers, despite having access to a well-developed broadband infrastructure, did not perceive any benefits great enough to justify the comparatively higher cost than their dial-up services. In addition, as seen in Table 3, the price of bandwidth per 100 Kbps in Australia is still relatively expensive.

These arguments are compounded by the fact that in Australia, the download cap is relatively low compared to Canada. The download caps represent a potential obstacle for switching to broadband from dial-up. It negates a main relative advantage of broadband over dial-up services which is the ability to use more advanced applications that require greater download capacity. Therefore, as competition drives ISPs to start introducing plans with increased free downloadable bytes for higher prices, the trade off for the Australian household is between downloads and price. This is yet another consideration that Australian subscribers have to make when compared to Canadian counterparts who do not generally have this concern and treat broadband as an unlimited service at a fixed price.

In light of issues already mentioned, Saunders (2005) proposed an alternative way of comparing broadband benchmarks between countries by proposing a 'Value Factor'. The Value Factor includes considerations for upload and download speeds (weighted to reflect the importance of downloads as compared to uploads), and the metered nature of broadband plans (including download caps). In effect, the study provided a Value Factor that compared the service and price, with the higher factor indicating greater value (see Table 3).

Summary of Comparative Analysis

Table 4: Summary of Comparative Analysis

	Canada	Australia
Accelerators		
Competition	Moderate (strong DSL and cable services)	Weak (dominated by Telstra and Optus)
User Characteristics and Behaviour	The internet is becoming a part of daily life for many Canadians, especially the young who rely on it heavily for interaction with friends.	Less understanding of technology capabilities. Initial research indicates high use of internet but less likelihood to interact online.
Applications	Few broadband specific applications	Few broadband specific applications, download caps constrain adoption of applications
Network Characteristics	Fast connectivity available, multiple platforms	Slow connectivity and limited choice

Stimulants		
Pricing	Cheap, download caps not a major concern	Expensive, plus download caps
Threshold Factors		
ICT usage	High	High
Urban Demographics/ Population Density	Low density	Low density

In summary, despite the similarity in threshold factors such as low density population and per capita income between the two nations, there are some key factors in Australia which may explain why the diffusion of broadband access is relatively low. These factors include i) the lack of competition in the broadband industry, ii) less likelihood to engaged in prolonged online interaction amongst Australians, iii) slower connectivity and iv) download caps and pricing.

DISCUSSION

As Fransman (2006) demonstrates in *Global Broadband Battles: Why the US and Europe Lag while Asia Leads*, the answers as to *how* to achieve increased broadband adoption are complex, and require far more consideration than is possible in a single book chapter. But what this chapter does is provide insights into tangible objectives for achieving a more "user-friendly" broadband environment in Australia. These objectives can be summarized as follows:

1. Reduce constraints on users and usage. It appears that many Australians are somewhat afraid to surf the internet. They are worried about exceeding download caps, and about the cost of their broadband service. This environment is not conducive to experimentation with new types of internet content (e.g. user generated videos), file sharing or using the internet to access music or television content. Most Australians do not experience broadband internet in the same way that Canadians do, as simply an always-on, fast, convenient, easy to use service, without constraints. Efforts to increase broadband penetration in Australia must address the issue of constrained internet usage. As progress is made on reducing the constraints on usage, then it is possible to focus on promoting broadband access among current non-users.

2. Articulate the benefits of broadband internet service. This paper noted that there are many Canadians who have broadband internet service but do not consider speed to be its most important attribute. Australian consumers should understand that broadband's "value proposition" goes beyond faster internet, providing ease of access through always-on connectivity, enabling access to new services (e.g. voice over internet protocol), allowing multiple users to share a connection within a residence (using wired or wireless networking), and freeing up the telephone line.

3. Improve the price/speed equation. In Canada, the lower tiers of broadband service are available at about the same price as dial-up service. Given the benefits noted above, it is a very simple proposition to convince people of the value of abandoning dial-up for broadband. In Australia, the cost of entry level broadband is higher than in Canada, and given the constraints on usage, people are not so willing to pay a premium for a limited service.

4. Consider alternatives to local loop unbundling to increase market competition. It is frequently argued that local loop unbundling is necessary to improve the broadband environment in Australia. But in the Canadian context, even with local loop unbundling there is little competition among DSL providers, and cable and DSL connections have fairly equal market shares. Local loop unbundling may result in more competitive services available to Australian consumers, but it will not increase cross-platform competition. The market for cable broadband in Australia remains limited because cable television networks only serve approximately 20% of the population (Breznick, 2005). Because the prospects for higher uptake of cable broadband are not strong, competition among DSL providers seems attractive. But it is noted that wireless internet access infrastructure can provide robust connectivity to Australians in urban and rural regions (see International Telecommunication Union, 2006a, and OECD Directorate for Science Technology and Industry, 2006, for a discussion of the possibilities afforded by WiMAX and satellite services), and may prove to be a better means of increasing competition in the internet access market than increasing the number of DSL providers in the market.

CONCLUSION

In closing the paper, we suggest paying attention to the following two facts. First, Canada became a leader in broadband in a short time frame (three to four years). Second, 91% of Australian households are within DSL reach, but among these 7 million homes there is only a 30% take-up. Fast penetration is feasible and possible in Australia if, and when, momentum is created. We have identified five areas for attention in the development of broadband internet: competition, user behaviours, application availability, network characteristics, and pricing. We maintain that deploying broadband access is not a matter of building networks. Rather, it has more to do with the context in which such networks are deployed, and whether the environment is friendly to consumers or not. The paper identifies elements of the user friendly broadband environment in Canada, and we encourage further work to determine appropriate social, governmental and regulatory initiatives to create a more user friendly broadband climate in Australia.

Increased broadband deployment should be possible in Australia, if policies encouraging supporting the provision of knowledge and the persuasion of consumers are put in place, and if accelerating market drivers, as opposed to merely threshold drivers, are the focus of policy. To date in Australia, government efforts to encourage broadband uptake have centred on suppliers and providers of broadband services. The focus needs now to switch from the supply side to the demand side as it becomes increasingly evident that despite available infrastructure, the demand for broadband in Australia continues to be “sluggish” (Firth, Longstaff, & Mellor, 2002). As the DCITA (2006) correctly pointed out, it is important to understand the context of country when analysing broadband diffusion. This paper draws on the Canadian context to illustrate a way forward for broadband development in Australia.

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KEY TERMS

Local loop unbundling. The term "local loop" refers to telephone infrastructure used to provide DSL (Digital Subscriber Line) broadband internet access to consumers in their homes. In many countries, the local loop was built and operated by a monopolist telephone company, referred to as the "incumbent" carrier. In order to increase competitive provisioning of DSL service, "local loop unbundling" policies have been developed. These policies force the owners of the local loop infrastructure to make their infrastructure available to other providers (for a fee), so that competitors can provide DSL service without building new infrastructure. There is no consensus as to whether such policies have been successful in promoting broadband up-take.

Open access. "Open access" policies are similar to local loop unbundling policies, but apply to the cable industry. Also known as "third party internet access" rules, existing cable operators are required to make their network capacity available to competitors in an open access environment.

Facilities-based competition. This term, also known as "intermodal competition" refers to competition between DSL and cable providers. There is high intermodal competition in the U.S. and Canadian consumer broadband markets, and it is believed that intense intermodal competition stimulates demand for broadband access. In countries where the cable company was/is owned by the telephone company, inter-modal competition has been less fierce.

Download caps. Many broadband service providers offer tiered pricing schemes for broadband connectivity. Common to such pricing schemes are restrictions on the volume of data that can be downloaded within a given period. For instance, in Australia, some broadband packages allow 0.2 Gb of "free" downloads monthly, compared to packages in Canada that offer 30 - 60 Gb of downloads monthly. When download caps are low, they can reduce demand for broadband connectivity. Depending on the provider and the service package chosen, consumers may have to pay for excess downloads, or may have their connection speeds reduced to dial-up speeds.

Broadband Success Drivers. Gardner (2003) argues that success factors for broadband growth (which include favourable pricing, competitive market environment, and population readiness among others) have differential impacts on growth in demand for broadband services. Her research identifies 1. *Accelerators for Broadband Demand*, 2. *Stimulants for Broadband Demand*, and 3. *Threshold Factors for Broadband Demand.* Recognition of this hierarchy of success factors is important in developing policies and taking actions to increase broadband adoption.

Accelerators are the factors that most significantly increase demand for broadband services, and include the establishment of a competitive marketplace, user comfort levels with the technology, and network characteristics (e.g. speed, multiple platforms).

Stimulants have a moderate impact on increasing demand for broadband services. Stimulants include pricing and the sophistication of marketing broadband services.

Threshold factors are necessary, but not sufficient, to encourage broadband demand. They include penetration of PCs in households, narrowband internet adoption, and adequate development of broadband infrastructure.