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Is broadband the future? An analysis of broadband technology potential and diffusion

Zizi Papacharissi*, Anna Zaks

Broadcasting, Telecommunications and Mass Media, Temple University, Annenberg Hall Rm. 6, Philadelphia, PA 19122, USA

Abstract

This paper examines the policy issues surrounding residential broadband technology, discusses how broadband extends Internet capabilities and at what cost, and makes recommendations for future applications of broadband. It focuses on residential broadband access, and in examining the future of broadband, it identifies three areas of concern: regulatory tendencies and tensions in the US, international diffusion of broadband, and the overall consumer appeal of broadband content. Specific policy recommendations center on providing regulation that guarantees open access, enforces reasonable pricing plans, and encourages innovative content.

Keywords: Broadband; Policy; Regulation; Pricing; Access

1. Introduction

Broadband technology has emerged as the natural next step in Internet evolution and diffusion. With dial-up connections limiting bandwidth and therefore, Internet applications, broadband technology promises high speed and opens up a seemingly limitless gamut of possibilities (Langdale, 1997). The future of the Internet is intertwined with broadband capabilities, involving the public, the industry and regulatory bodies. This paper examines the policy issues surrounding residential broadband technology, discusses how broadband extends Internet capabilities and at what cost, and makes recommendations for future applications of broadband. The focus here is on residential broadband access, and in examining the future of broadband, we identify three areas of concern: regulatory tendencies and tensions in the US, the international diffusion of broadband, and the overall consumer appeal of future broadband content.

The regulatory mentality in the US favors market self-regulation and views government involvement as a danger to technological innovation (e.g., Castells, 2000; Schement & Curtis, 1995). Broadband diffusion is currently halted at the regulation crossroad between the market, government and consumer lobbyists, especially with regard to opening up the broadband infrastructure to third parties. Controlling access to the broadband infrastructure could potentially create an oligopoly and threaten the variety and diversity of services available. These regulatory tensions influence the future of residential broadband diffusion in the US.

*Corresponding author. Tel.: +1 215 204 5181.
E-mail address: zpapacha@temple.edu (Z. Papacharissi).

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It focuses on broadband diffusion in the US because it represents a large market for new technologies that could influence global trends, once regulatory hurdles in the US are eliminated to provide broadband diffusion with speedier technology deployment. Internet penetration is the highest in the US, with 143 million users currently online (http://www.nua.ie/surveys, September 2004). Moreover, concentrating on the US permits the examination and critique of self-regulation as a framework suitable for technological innovation. Therefore, the first section of this analysis addresses regulatory tendencies and tensions in the US, as they relate to broadband diffusion.

Nevertheless, since the Internet is a global medium, the manner in which countries other than the US address broadband diffusion could influence broadband service and future cooperation with the US. The differences in regulatory mentality between the US and the European Union have already left their mark on consumer privacy protection online, with the US advocating pure self-regulation and the EU advocating a regulatory framework established by governments (Maxwell, 1998). Specifically, European Union member countries follow regulations that protect consumer privacy, as dictated by the Directive on Data Protection of 1998, which guarantees individual control over consumer data and insists that foreign trading partners adhere to the same level of equal protection (Lee, 2000). Such differences in regulation create conflict among companies seeking to establish business on a worldwide basis, and similar issues are expected to surface with broadband diffusion. Government involvement in the diffusion of broadband abroad can suggest some innovative regulatory approaches and help to avoid past mistakes. Thus, the second section of this analysis reviews examples of regulatory intervention in other countries, so as to inform policy recommendations for the US.

Finally, the future of broadband depends on whether it will deliver content different from that available through other media, thus creating motivation for public adoption. If broadband becomes just another TV or radio, there will be little incentive for the average consumer to pay the extra cost to acquire it. The third section of this analysis then, addresses content issues that prohibit prompt broadband deployment. These three areas are of vital importance to the future of broadband diffusion, as they determine the profitability, compatibility and appeal of broadband content. They are employed to inform policy recommendations presented in the final section of this analysis. Based on this rationale, the paper begins with a review of current broadband technology and capability.

2. Technologies for broadband

Broadband access includes all technologies that enable the high-speed transfer of multimedia and high bandwidth information. According to Kirstein, Burney, Paxton, and Bergstrom (2001), broadband can be defined as: "all flavors of high-speed digital voice, data and video services, as well as the underlying infrastructure, clients and technologies that enable these services" (p. 3). Specifically, the content of broadband is digital, the data transmission rate is at least 384 Kbps, the level of interactivity allows the control and selection of content and packet-switched technology is used. The six most prevalent modes of high-speed, or broadband, connection to the Internet are presented in the following paragraphs.

2.1. Cable

In the residential market, the cable modem is the most popular access device to high-speed Internet (Platt, 2001). The maximum speed of a cable modem is 30 Mbps, however, most are connected at about 1 Mbps. Because the cable networks are shared by users, access speeds may decrease, depending on the number of people accessing the network. In addition, network sharing raises concerns over the security of the connections employed. More than 6 million people subscribe to the high-speed cable modem services in the US and it is likely to remain the most popular mode of high-speed Internet access because cable television services are almost ubiquitous in the US (Broadband backgrounder: Public policy issues raised by broadband technology, 2000; Kirstein et al., 2001). Nevertheless, several of the cable providers need to have the entirety of their facilities upgraded in order to offer broadband Internet connection. A newer system should allow for two-way transmission, or interactivity, and higher capacity to carry analog video signals, digital video and data signals (Platt, 2001).

2.2. Digital subscriber line (DSL)

This technology uses existing copper wires for high-speed data service. High-speed data connections can be maintained over the existing phone line, which allows for simultaneous use of the phone and Internet. In other words, voice and data signals can be transmitted at the same time (Backgrounder, 2000). According to Kirstein et al. (2001), DSL technology is mostly deployed by business users because it provides "always-on" access to the Internet. Connection speeds do not decrease as more users enter the network, but the major drawback of this technology is that the quality degrades the farther the user is from the central switching office. The FCC recently removed the provision that required the regional phone companies to lease their high-speed lines to competitors at significant discounts with the hope that would spur higher growth and investment in the DSL technology (Dreazen, 2003). Combined with competitive pricing, these developments have rendered DSL a viable cable access competitor, especially for neighborhoods that carry DSL capability.

2.3. Fixed wireless

In 1998, the FCC authorization to use Multichannel Multipoint Distribution Service (MMDS) for two-way services allowed the wireless industry to provide Internet service (Broadband backgrounder: Public policy issues raised by broadband technology, 2000; Kirstein et al., 2001). Wireless broadband is referred to as Local Multipoint Distribution Service) (LMDS) and operates in the 28 and 31 GHz bands. The data transmission rates can reach 1.5 Gbps, but actually average at 38 Mbps. MMDS operates in the 2.5 GHz band and can reach speeds up to 27 Mbps. In the past few years, the popularity of these services has increased, but fixed wireless broadband is lagging behind cable modems and DSL access. Further development of this service is also hindered by the lack of common technological standards (Kirstein et al., 2001). Other potential drawbacks of implementation include network security and protection issues, so that outside users cannot enter or hack into existing wireless networks. Nevertheless, wireless presents the most promising avenue for providing universal access without spatial confines and is frequently employed within educational institutions and other organizations or to provide free Internet access to the general public.

2.4. Satellite

The satellite broadband connection is a solution for users otherwise unreachable by cable or DSL providers. The maximum speed advertised by high-speed Internet satellite service providers approximates 400 Kbps. The receiving equipment is quite costly and the speed is much lower compared to cable and DSL, but the satellite services are expected to grow at a fast rate since this is the only option for many that cannot be reached by other broadband providers. Nine million homes worldwide are expected to have high-speed satellite Internet access by 2005 (Broadband backgrounder: Public policy issues raised by broadband technology, 2000; Kirstein et al., 2001).

2.5. 3G wireless

Third-generation wireless refers to current and future telecommunications innovation that mobilizes broadband access, with the ability to support several different cellular standards and provide multimedia services. The largest potential of this type of wireless technology is that it is not computer-centric, and that it presents the convergence of several 2nd generation (2G) wireless telecommunications systems. Japan's NTT DoCoMo launched the world's first official 3G system in 2001, while in Europe, Vodafone and several local independent carriers have established 3G systems. The major advantage lies in the possibility for high-speed Internet access through mobile devices. 3G wireless promises speeds at above 2 Mbps, however, it remains to be seen how fast this technology will be fully developed and deployed in the market.

2.6. Fiber-to-the-home

Fiber-optic lines that go directly into users' homes and businesses present another alternative to broadband access. This initiative is considered economically non-viable, because it is expensive to run fiber into each home. However, there are some that challenge this view and claim that fiber optics carry the promise of universal access to broadband services, suggesting that more innovative approaches be developed (Oram, 2001). For example, Salt Lake City and 17 other cities in Utah are planning a very ambitious project of building the largest high-speed network in the US, which could possibly provide direct fiber optic networks to almost two hundred fifty thousands homes. The speed of Internet connection over fiber optic lines far exceeds the speed of broadband available today via DSL or cable modem. Cities involved in this project see this as a necessity to bring more technology businesses into the state, and while the cost of wiring each house is high (more than a thousand dollars per house), the agency in charge hopes to recover these costs in a few years from usage fees paid by residential and business customers (Richtel, 2003).

To sum up, cable modems and DSL have the highest penetration rates among high-speed Internet subscribers. The reasons for the overall low penetration rate of high-speed Internet services include high cost, limited availability and small number of high-speed service providers. Still, according to the *Wall Street Journal* (Berman, 2004), more than twenty two million households (21 percent of all households) in the US presently subscribe to broadband at home, while it is expected that in 5 years half of all residents will obtain high-speed Internet services at home. This development marks a significant change, especially when considering how the availability of broadband could alter individual habits and behavior. People with broadband access are much more likely to make transactions online than people with dial-up, as well as to download movies, music and visit the television shows' web sites while watching TV. Broadband users are also more likely to pay for online content, such as watching baseball games, for example. High speed users report downloading almost three times the number of music files, movies or software over regular dial-up users, thus testifying to how high speed access changes the range of activities available online (Hagerty, 2003).

Despite its growing popularity, broadband diffusion is characterized by a markec distinction in the services enjoyed between those residing in urban as opposed to rural areas. Because it is easier and cheaper to wire densely populated areas, broadband diffusion figures are higher in such areas and countries, thus misrepresenting the true state of technological adoption (so far, Broadband's race goes to the small and urbanized, September 2002). Beyond the simple issue of statistical misinterpretation, lies the more important issue of providing reliable broadband access to both rural and urban areas. While metropolitan high-speed access expands at an accelerated rate, with the top five urban areas experiencing widest broadband penetration including New York, Los Angeles, Philadelphia, Boston and San Francisco, rural broadband access proceeds at much lower rates (Biggest Broadband cities get bigger, May 2002).

The primary reasons behind stalled broadband access for rural America include the absence and cost of installing the appropriate technological infrastructure (Ewalt, 1998; Hausman, Sidak, & Singer, 2001) and a subsequent lack of demand for broadband by rural customers (Freshwater, 1998). Even though the need for regulatory incentives that aid rural diffusion of technologies is asserted repeatedly, and as early as 1991 by an Office of Technology Assessment (OTA) report, legislation has been slow to address these issues. The inability of local governments to become involved in diffusion efforts merely aggravates the problem. Specifically, FCC regulations and federal telecommunications law routinely direct and regulate local involvement in installing and running technological infrastructure, including cellular phone towers and satellite dishes (Freshwater, 1998). Nevertheless, some grassroots efforts have focused on mobilizing local leaders to incite action, with the notable example of the Televillage model developed by the Kentucky Science and Technology Council (Ray, 1998). Municipal systems are not always financially able to support such efforts, however, which underscores the necessity for federally provided initiatives. While local leaders frequently cooperate with organizations to respond to technological advancement, federal mandates could greatly support and augment these efforts (Dunn, 1998). The quickly evolving technological landscape serves to merely compound this problem, as rural areas barely have enough time to catch up with technological development before updated technologies appear (Ewalt, 1998). While the necessity of achieving universal broadband access is recognized by FCC Chairman Michael K. Powell (2002), his rhetoric focuses on doing so in a sound economic manner and does not address the complexity of providing rural broadband access.

Some claim that wide deployment of broadband services will provide additional opportunity for revenue through the provision of a greater variety of services, both for rural and urban areas. Content alone, however, is not enough to spawn the broad diffusion of the technology. Implementing broadband technologies on a grand scale involves building the required infrastructure, the absence of which has scaled back broadband content and initiatives. Modernizing the network is related to several regulatory issues explored in the following section.

3. Regulatory issues

Broadband diffusion in the US is subject to the prevalent telecommunication regulatory philosophy. According to Schiller (2000), deregulation tendencies within the US prevented industry consensus on various telecommunications initiatives, including broadband. Specifically, the 1984 division of the telecommunications industry into two separate markets, local and long distance, barred several telecommunication giants from developing residential broadband networks. Subsequently, the removal of market barriers brought on by the 1996 Telecommunications Reform Act allowed both sectors to dabble in broadband more freely. Nevertheless, the local carriers were confronted with the cost of upgrading the local infrastructure, which they updated on a selective basis. The long-distance carriers, on the other hand, could either create a parallel local infrastructure or consider cooperating with the local carriers. Updating the residential infrastructure to permit broadband capability was a costly venture, with limited or ''fuzzy'' profitability prospects.

The technological upgrade issues are further complicated by conflict between the two prominent providers of residential broadband services, phone and cable companies. Cable companies possess a greater share of the broadband market (more than 50 percent) than phone companies (about 30 percent) and offer higher connection speeds (Latour, 2003). Therefore, the policy debate presently plaguing broadband involves the efforts by the cable industry, incumbent local exchange carriers (ILECs) or local telephone companies, and DSL providers and Internet service providers (ISPs), to offer services over the existing infrastructure mostly controlled by ILECs and cable companies. The debate is aggravated by the absence of a unified regulatory framework that applies to all broadband service providers, phone, cable, or wireless (McGregor, 1994). Two regulatory differences between the cable and telecommunications infrastructure award cable companies tighter control over their assets. First, cable companies are not common carriers and are not required to behave in this manner. Therefore, they are not obligated to provide transmission capacity to any other carrier. Second, open access rules that allow for the equipment owned by a third party to be connected to the networks apply only to telecommunications carriers (Gillett, 1995).

The central concern for cable-specific issues is whether Internet access over cable should be treated as cable television service, which is mostly unregulated; or as telephone service, which is highly regulated. The debate takes place between cable companies opposing any additional regulation in the cable industry and ''open-access'' supporters claiming that regulations similar to those of the phone industry should be applied to the cable industry in order to ensure growth in the broadband industry. Local phone companies argue that the regulation of the phone services should be reduced and be similar to that of the cable-based Internet services, so that all can compete equally (Broadband backgrounder: Public policy issues raised by broadband technology, 2000).

The issue of ''third party'', or alternative carrier access to the broadband cable infrastructure, complicates the policy debate further. Since some cable television companies made a significant investment to upgrade their system to provide two-way high-speed Internet service, they prefer to also be the sole content providers for all their customers. Many ISPs, as well as consumer and public interest groups claimed that cable companies should be required to open their infrastructure to multiple, third-party ISPs, which could offer high-speed Internet access and content. Even when the infrastructure is open to third party carriers, however, the charges imposed by the incumbents are too steep to allow for a reasonable profit margin, as was the case with the fairly recent Excite financial mishap. Specifically, subscribers paid about $46 for monthly access, with only $16 of the monthly fee going back to Excite; the remaining amount was paid to the cable operators (Richter, 2001). These restrictions made it increasingly difficult for the third party, in this case Excite@Home, to remain a competitor in the market.

Without open access of multiple ISPs to the cable infrastructure, a few cable-affiliated companies, such as Roadrunner, can dominate broadband Internet access easily. Should cable companies maintain this practice, they could establish monopoly power over broadband access and act as "gatekeepers," restricting content diversity. Other concerns over such monopoly practices involve price fixing, stifling innovation in content and technology, providing certain advertisers or merchants preferred access to broadband users, and selecting preferred content providers while excluding others. Congressional debate revolves around rewriting the specific provision of the 1996 Telecommunications Act to allow the regional Bell operating companies (BOCs) to transmit data over long distances without having to open their local systems to competitors. Supporters of such legislation argue that it would allow the BOCs to compete equally with owners of cable TV systems, it would boost the high-tech sector and it would offer more choices for consumers (Congressional Digest, March 2002).

The opposing argument by cable companies is that the broadband market is still very small and should be allowed to grow unconstrained by government regulation. This camp claims that providing high-speed Internet services requires significant investment and therefore, those upgrading the physical infrastructure should be allowed to enjoy the benefits of this investment. Cable companies deny the lack of competition in the broadband services market and point to other options for obtaining high-speed Internet access, like DSL, wireless and satellite providers. Cable providers and supporters also point out that this legislation would grant an unwarranted advantage to BOCs, allowing them to gain a monopoly on long-distance Internet service thus limiting consumer choices (Congressional Digest, March 2002).

Similarly, in the related third party debate, most of the issues are not technological, but issues pertaining to competition. There are three sides to this debate: those who push for regulation that will ensure open access, those who support voluntary open access, and those who oppose any regulation and/or open access on a voluntary basis. The central concept is open access, and whether it will be mandated and enforced by regulation. To this point, some attempts have been made by local and state governments to impose third party access on cable companies (e.g. Portland, Oregon case against AT&T), but court rulings and the FCC all stipulate that this should be a matter of federal regulation. The issues raised today in the third party access debate echo the claims made in the 1990s about the relations between cable companies and video programmers. As a result, the regulation of the cable industry has not been consistent over the years and the cable industry has never been subject to many rules imposed on telephone companies. Such regulation would allow a cable network to carry more that one ISP; a policy which has been enforced in Canada and led to the highest cable modem penetration per capita (Broadband backgrounder: Public policy issues raised by broadband technology, 2000).

Despite differences in the regulatory framework applied to cable and telecommunications carriers, the phone companies are equally reluctant to provide third party access or otherwise surrender any market advantages they maintain. The main policy issues pertaining to DSL services involve the rivalry between competitive local exchange carriers (CLECs) and incumbents. According to the Telecommunications Act of 1996, the incumbents are required to open up their infrastructure to CLECs to enable competition in the local telephony and Internet services markets. Therefore, the debate centers on whether the incumbents are opening their infrastructure to competitors on fair terms. Specific competition issues that CLECs and incumbents are dealing with involve the provision of collocation space, or space inside central switching office to install DSL equipment; fair access to local loops or telephone wires that run into homes and businesses; sharing the wires to provide both the regular phone service (by local phone company) and DSL service (by CLEC) and separation of business units of facility ownership and Internet access operations (Broadband backgrounder: Public policy issues raised by broadband technology, 2000). Similar anticompetitive concerns are voiced in the domain of the broadband content, offered both via DSL and cable, particularly with preserving the diversity of Internet content, its position as a democratizing agent and its service to the public interest (Chester & Larson, 2000).

Selecting the most promising technological standard and subsidizing it through government intervention can influence the diffusion of communication technology significantly. The European Union decision to enforce and support the GSM standard for cell phones led to accelerated cell phone diffusion in Europe, at a rate and quality of services that far surpassed those witnessed in the US. Similarly, a favorable regulatory regime for building alternative broadband infrastructure was successful in Canada and other countries,

including Australia, consider it a valuable avenue of promoting competition in broadband infrastructure (So far, Broadband's race goes to the small and urbanized, September 2002). In the US, on the other hand, competing carriers are forced to use expensive fiber from an existing carrier. The examples reveal how creative state intervention frequently serves the purpose of solving technological and legal hurdles, rather than augmenting bureaucracy. Specifically because new media technologies, like broadband and the Internet, test the validity and applicability of existing regulation and market power, it is vital that governments are able to define how such information systems are applied and employed (Stein & Sinha, 2002). Even for countries which tend to favor the paradigm of self regulation, like the US, this process should involve government and citizen consultation to produce effective standards (Verhulst, 2002).The following section presents how some other countries have addressed similar issues, through state intervention, or through the cooperation of the industry sector, local government and consumers.

4. Broadband worldwide

The provision of broadband residential services stumbles on technological and regulatory problems worldwide. Diffusion of broadband access is slow, and far from justifies the enthusiastic reception of broadband as the future of the Internet. South Korea is the world leader in broadband services, with 21.3 high-speed Internet subscribers per 100 residents, followed by Hong Kong (14.9), and Canada (11.2). The United States stands eleventh in worldwide broadband diffusion (6.9), following several European Union countries. In terms of the numbers of households with high-speed Internet connection the US stands fourth, while South Korea still holds the fist place with 75 percent. On the other end of the spectrum, Arab countries in the Middle East and in North Africa are experiencing a significant shortage of bandwidth. In the Middle East, especially, the increased number of phone calls and increased bandwidth intensive services created congestion on this information superhighway, thus significantly hindering the deployment of broadband services in the region (Dreazen, 2003).

Broadband diffusion unfolded more quickly in Korea in part because of competition between the incumbent Korea Telecom and several new companies, and in part because of the availability of attractive content. As a result, Korea is the world's most developed country in terms of broadband technology, with over 8.5 million broadband Internet subscribers, and the number of Internet users increasing to more than 60 percent of the population (Broadband induces openness, globalization, June 2002). New constructions equipped with fiber-optic wiring and older buildings have been rewired with fiber optic over the past few years. The government played an important role in broadband diffusion, by promoting these services with low fees. Broadband subscription rates are affordable in Korea, with consumers paying an average of approximately $25 (Kirk, 2001). Korea Telecom also encouraged diffusion by investing heavily in the training of DSL technicians. Finally, the population of South Korea is highly concentrated, which made infrastructure upgrades cheaper and easier (Dreazen, 2003).

For several European countries, a large problem lies in supplying DSL and cable modems. Tellingly, in 2001, Deutsche Telekom signed up to 630,000 subscribers for DSL, but only managed to connect one sixth of them, while Britain is experiencing a similar shortage of cable modems (Broadband Blues, 2001). The shortage of technicians to install the technology is an additional problem, which Belgium overcame by making greater use of "plug and play" hardware. Belgium has enjoyed increased rates of broadband adoption as a result of intensive promotional strategies employed by Telecommunications companies, who are able to take advantage of the infrastructure already in place. By contrast, broadband adoption in the neighboring Netherlands is lower, because telecommunications companies focus on promoting free Internet services over broadband access (Broadband Business Report, 2002). Nevertheless, even after promotional discounts, the monthly charge for cable or DSL still averages 40 euros, which is comparable to US rates and not affordable for everyone. Market analysts estimate that in order for broadband to be economically appealing across Europe, its price will have to fall somewhere in the 25–30 euro range (Flynn, 2002). Moreover, while it is easy to lay out the necessary infrastructure in the smaller and more densely populated European countries, wiring a country with more anomalous and spread out population distribution like the US becomes a complex issue.

In several European countries, the infrastructure is owned by incumbent telecommunication firms, some of which may even be state-owned. Although this practice was set in place to guarantee that the interested public

is served, it may occasionally lead to additional bureaucracy and tardy adoption of technological standards. Even though most OECD countries have adopted policies that encourage or force incumbents to allow other firms access to their residential wiring, this has been a slow process. Sweden was one of the first OECD countries to adopt such policies, which explains its higher diffusion rate, whereas Britain was one of the last. For example, increased broadband penetration in Sweden is attributed to the fact that the country liberalized its local loop early on, and that the government subsidized computer purchases and broadband connections (Flynn, 2002). Liberalization of the local loop telecommunication infrastructure allowed the firms involved to behave more competitively and dropped broadband monthly fees to the lowest around Europe, at 30 euros. At the same time, state subsidy of technology adoption, both for consumers and operators, in the form of tax-related paybacks and direct government subsidies, aided broadband penetration further. Specifically, the Swedish government offered direct subsidies to local councils to build local fiber grids and encouraged state utilities to build competing national fiber-optic backbones (Flynn, 2002). Canada, where the government has supported broadband deployment by actually building public backbone infrastructure links to remote communities (So far, Broadband's race goes to the small and urbanized, 2002), has enjoyed increased broadband diffusion, too. This is an especially important form of government subsidy in countries like Canada, which are less compact and densely populated. Conversely, in the UK, where the government has not adopted such policies, British Telecom has prioritized offering services to urban, densely populated and more profitable areas over rural and remote areas and the monthly costs of broadband access remain higher (Access to all areas, June, 2002).

Without creative regulation that sparks market competition while combining state-related support of technology diffusion, broadband diffusion is stalled. Specifically, several European countries face problems between telecommunication incumbent firms and third parties similar to those encountered in the US. Third parties can frequently not afford the cost of using incumbent copper wires running into the home, and are often forced into bankruptcy. In Europe, Oftel, Britain's chief telecommunications regulator, has often been criticized for being lenient with British Telecom. National differences in the adoption of broadband appear to be a result of regulatory, political and technical matters. Specifically, geography, state-intervention and telecommunications regulation account for varying levels of broadband penetration across country. A remaining issue, however, lies in the inability of broadband providers to offer content different from previous media, in a more convenient and affordable mode. For the telecommunication firms, traditional cable and phone services are easier and more profitable to provide on a residential basis. On the consumer side, there is little incentive to tack broadband fees on top of already costly cable or phone charges, especially when the content and delivery are not substantially superior to what is already available through traditional media. What is even more important, however, is that content is expensive to produce, and paying for content runs counter to the prevailing consumer philosophy online: information for free. The costs associated with residential broadband access and content production oppose this mentality. As Platt (2001) quipped in a *Wired* article evaluating the business future of broadband, "The future will be fast but not free. You want broadband. You'll get it. You'll pay for it. You'll like it" (p. 120).

5. Broadband content

The diffusion of technological innovation rests on traditional economic principles, ironically not applied to any activity associated with the new economy. Nevertheless, the recent Nasdaq downturn revealed that old economy rules and principles still govern new economy transactions. Shapiro and Varian (1999) focused on the principle of product lock-in and switching costs in analyzing why some new technologies diffuse broadly while others do not enjoy such popularity. The term switching costs refers to the cost the consumer has to pay to switch from one technology to the other. In this case, it applies to the cost of upgrading from narrowband to Internet access to broadband. The higher the cost, the more difficult this switch is. It should be noted that if the new technology does not significantly improve the quality and convenience of the previous one, then this switch is even further challenged. If the cost, which does not just have to be financial, of upgrading to the newer technology is not affordable for the average consumer, then the consumer is forced to continue using the previous technology, or be "locked-in."

Lock-in occurs when the switching costs forbid the adoption of the newer technology. It certainly appears that the costs of providing residential broadband have locked in not only consumers, but also access providers. Broadband service is not only costlier, but under the present system, consumers have to pay up to three times for broadband service: first for regular phone or cable access, then for broadband capability, and then possibly pay a third fee to retain ISP access to a content provider that does not offer broadband access.

And still, one does not need to look outside the communication discipline to understand the economics of technology adoption. The principle of relative constancy, articulated by McCombs (1972), establishes that over time, the percent of household income spent on mass media consumption remains constant. Therefore, the only way to get consumers to adopt a newer medium is to give them reason to abandon an older one, since they are not likely to spend over a certain fraction of their income on mass media expenditures. The principle of relative constancy, and the concepts of lock-in and switch costs help us understand just how deep the consumer pocket is, when it comes to the adoption of mass media. They also raise less obvious implications for broadband content, specifying how challenging it can be to break a technology that does not offer substantially different content to the mass market. Not only is the cost of broadband residential access unappealing to both consumers and providers; the present broadband content is not substantially different from what consumers already receive through cable services or traditional dial-up access. Content for broadband can be a crucial factor in persuading more users to switch to this service and pay higher monthly fees for their Internet connection. There are several companies providing music, movies, sports, games and news online for broadband users using a pay-per-content pricing plan. These content fees are accrued on steep connection fees paid to phone or cable companies, but these services are gaining popularity, especially those providing sports content (Grant, 2003). To really feel that the broadband experience is worthwhile, users must perceive that they are exploiting the benefits of the additional bandwidth (Nolde, 2002).

It is still more convenient for consumers to watch high bandwidth content, including movies or video-clips on television rather than the smaller computer screen. Broadband delivery may be faster than dial-up, but actual speed still depends on the local infrastructure, network traffic, and file size. Broadband still does not provide higher quality, greater convenience, and different content at a comparable price. While consumers initially responded to residential broadband access, the growth is now leveling off, according to the FCC (King, 2001). The slowdown in broadband proliferation has forced content providers to scale back efforts to provide broadband content, like streaming video or audio, thus providing consumers little motivation to upgrade their connections.

6. The future of broadband

Useful as economic principles may be, it is important that some forms of telecommunication information services are not treated like traditional commodities, particularly those that promise universal service to the public, like the Internet. Individual choice should not be the sole determinant of technology adoption. As Hadden and Lenert (1995) remarked, telecommunication networks are not VCRs, adding that if it is left up to the individual consumers and specific corporations to decide when and how such services should be available, inadequate demand might cause underinvestment in the technology . To this point, Calabrese and Jung (1992) advocated adopting the principle of open network architecture that was applied to narrowband networks such as simple telephony. They claimed this would lead to increased competition among infrastructure and content providers and added that broadband (as a two-way cable that basically carries video signals) should be treated as universal service. Still, it is important to note that limiting the debate about broadband communication and broadband services to video content and cable services is emblematic of a tendency to be locked in the current situation and not anticipate subsequent changes the digital and computer technologies could institute in coming years.

The view that broadband be treated as a universal service implies government involvement that will facilitate innovative content, affordable cost and the guarantee that the public interest will be served. This prospect is alarming to those concerned that regulation will bring about unnecessary bureaucracy and thus stifle technological innovation (Patek, 1992). Industry representatives are also concerned that regulation might impose business terms that do not encourage competition or discourage profit maximization. These attitudes usually stem from the misconception that all regulation is harmful to a competitive market. This

oversimplification of the concept of government involvement is prevalent in the US, where the slightest attempt at government intervention tends to be viewed as a threat to the foundation of capitalism. While it is true that ill-devised regulation can have catastrophic effects on the market, it should be understood that inspired government regulation can encourage and support technological innovation and has done so in the past and in other countries.

Furthermore, this point of view ignores the fact that technological innovation is rarely generated within the market. Innovation requires extensive focus on research and development and being willing to take financial risk. Corporations that have to answer to stockholders and operate under product quotas and strict profit margins are rarely eager to allocate funds to projects with no immediate pay-off. The Internet was a product of such government and education-related efforts, aided in its diffusion by the state's commitment to improve the infrastructure and provide universal access. The private sector, namely AT&T, viewed the Internet as an unwanted competitor and an expensive venture in the early 1960s. The parallel efforts of the Defense Department and several educational institutions, together with the National Science Foundation's creation of a nationwide backbone that allowed regional networks to develop and connect to each other in the early 1980s were pivotal in developing the connectivity of today. Similarly, academic institutions were among the first to take advantage of and invest in this technology. Internet2 and Next Generation Internet (NGI), broadband versions of the Internet currently in progress are also sponsored by universities and the government respectively.

Nevertheless, as Lawrence Lessig (2000) appropriately points out, regulation can also have detrimental consequences for innovation. Specifically, it was regulation that gave AT&T the power to decide how its network would be used and thus to prevent a competitor, like the Internet, to develop on its own network. This regulation is not all that different from the present power vested in cable or broadcasting corporations, wherein the law allows these firms power over conduit and content. The present architecture of broadband networks, combined with the regulation in place, gives extraordinary control to broadband providers, making it possible to discriminate against third party content in order to favor sponsor, partner or the company's own content. The regulatory framework for narrowband and copper local access is simply not flexible enough to accommodate the spurring evolvement of broadband access (Solomon & Walker, 1995).

In response, the open-access movement, led by the Media Access Project and several cities and counties in Florida, Massachusetts, Missouri and Oregon, has requested that local incumbents open up the network to third party ISPs as an articulation of public demand for diverse content (Chester & Larson, 2000). Had it not been for the open-access rules the government imposed upon telephones, the telephone companies would have tried to protect their market and shut out competing Internet service providers. However, as this analysis already demonstrated, simply opening up the network will not guarantee diversity and might impose high fees on third parties utilizing the network, especially for cable providers. Cable has never been held to the standard of universal service, and its operating principles run counter to providing broadband Internet access for the public interest. This practice leads to a technology that is still priced beyond the reach of most households and allows content discrimination. Relying on a technology that is affordable and impervious to regulatory tensions might lead to a more promising solution.

7. Conclusion

A solution that involves relying on an architecture that ensures fairness, rather than relying on regulatory bodies and the industry to come to accord might be worth considering. Lessig (2000) made the case for "competitive neutrality," whereby the design of the network allows users immediate control of the service, thus not allowing the network providers much control. This design principle is referred to as "end-to-end," and purports that no service, feature, or restriction is imposed on the consumer. The network itself does not make choices over content, remaining "stupid," whereas intelligence is to rest at the consumer end (Lessig, 2000). Even though end-to-end was initially conceptualized as a technical principle, it could be applied to enforce a "competitive neutrality" on broadband residential access. The principle regulates the power to discriminate, and requires that the network have none. This principle also promotes innovation, placing greater power upon content and technology developers and consumers. End-to-end cannot be used alone, but must be enforced hand in hand with open access, to ensure that competitors are allowed to interconnect and

access the consumer. Lessig (2000) argued that by enforcing open access on a neutral end-to-end network, the FCC enabled Internet-related innovations. These principles helped keep the service price down and the content appealing to a variety of consumers.

Applied to the issue of broadband accessibility, a fair architecture does not discriminate between access to urban and remote areas. Wireless access in urban areas carries the promise of open architecture combined with affordable or free access. Several US cities, including New York, Philadelphia, Chaska, Minn., a suburb of Minneapolis, Cleveland, are installing wireless or wi-fi networks and transmitters to provide broadband Internet access to their residents. The advantage of this technology is that it could deliver Internet access anywhere, including poor neighborhoods where high-speed Internet access is now rare. The main drawback to wireless access is that the signal can only travel several hundred feet, so cities would have to commit to wiring the disadvantaged neighborhoods and rural areas, too. However, wiring these neighborhoods is less complicated, frequently only involves installing transmitters at public spots, such as city lampposts, and is more affordable than upgrading the telecommunications infrastructure. But the architecture of wireless access enables universal access and ascribes the responsibility of providing that access to the public sector –even though the public sector might eventually assign wireless installation to private firms. While wireless access is not yet a perfect incarnation of fair and open architecture, it presents a promising response to the broadband question.

Applied to the issue of broadband content, a fair architecture permits diverse content and empowers the consumer to make those choices. Nevertheless, while a fair network architecture facilitates access to the technology and diverse content, it cannot be put in place and to work without the presence of some form of regulation. Even though this regulation would be costly and a severe burden to maintain, it might be necessary to retain the public service and access features of the medium. Government intervention in other countries that have implemented broadband networks more successfully should serve as an example. End-to-end, enforced with open access regulation that not only frees up the network, but does so at a reasonable cost are necessary to ensure the future of broadband, and to take the next step in Internet evolution. Because the architecture of the network remains open, coordination with international applications, business and residential, is easier to attain. Countries like Korea and Canada have shown how regulation can be applied to boost innovation. Enlightened approaches to regulation that protect innovation and universal service can ascertain the diffusion of broadband access.

In conclusion, any approach to broadband should be informed by the regulation of past innovations and the study of how regulation propelled or stalled innovation. In the case of the Internet, government involvement helped launch an innovation that was initially viewed as alien and unprofitable to the industry. The case of broadband has similar characteristics, as it too competes with current cable and phone services, is costly, and the content needed to make it appealing to the mass market is still not in place. Regulation that guarantees open access, enforces reasonable pricing plans, and encourages innovative content could help establish the identity of this new technology and kick start its diffusion.

References

Access to all areas. (2002, June 6). *New Media Age*.

Broadband Business Report. (2002, July 16). *Belgium puts up impressive broadband numbers*. Available at http://www.telecomweb.com (accessed 9/04).

Berman, D. (2004, October 13). Profiting from the broadband revolution. How consumers, sellers and investors can make the most of the high-speed Internet. Wall Street Journal, p. R1, R4.

Biggest Broadband cities get bigger. (2002, May 20). PR Newswire, Financial news section.

Broadband backgrounder: Public policy issues raised by broadband technology (2000). Center for Democracy and Technology. Available at http://www.cdt.org (accessed 9/04).

Broadband blues (2001, June 23). *The Economist*, 359, 62.

Broadband induces openness, globalization (2002, June 5). Korea Times.

Calabrese, A., & Jung, D. (1992). Broadband telecommunications in rural America: Emerging infrastructure for residential services. *Telecommunications Policy*, *16*(3), 225–236.

Castells, M. (2000). *The rise of the network society*. Oxford: Blackwell.

Chester, J., & Larson, G. O. (2000). End of the open road? How cable may strangle the Internet. *The American Prospect*, *11*(5), 42–45.

Dreazen, Y. (2003, Oct 13). What's slowing us down? *Wall Street Journal*, p. R4.

Dunn, W. (1998). Electrifying rural economies. *Forum for Applied Research and Public Policy*, *13*(4), 87–89.
Ewalt, J. (1998). Rural America online. *Forum for Applied Research and Public Policy*, *13*(4), 84–86.
Flynn, B. (2002, May 1). Europe's broadband Lag: hi-speed makes slow progress. *Multichannel News International*.
Freshwater, D. (1998). Rural America's Information Age. *Forum for Applied Research and Public Policy*, *13*(4), 70–79.
Gillett, S. E. (1995). Public policies to encourage cable and ISDN residential access. Prepared for *INET'95: The Internet Society's 1995 International Networking Conference*. Available at: http://info.isoc.org/inet95/inet95.html (accessed 9/04).
Grant, P. (2003, Oct 13). You have broadband. Now what? *Wall Street Journal*, p. R8.
Hadden, S. G., & Lenert, E. (1995). Telecommunications networks are not VCRs: The public nature of new information technologies for universal service. *Media, Culture & Society*, *17*, 121–140.
Hagerty, J. R. (2003, Oct 13). The fabric of our lives. *Wall Street Journal*, p. R8.
Hausman, J., Sidak, J., & Singer, H. (2001). Cable modems and DSL: Broadband internet access for residential customers. *The American Economic Review*, *91*(2), 302–307.
King, B. (2001, November 5). Whither the broadband revolution? Wired.com. Available at http://www.wired.com (accessed 9/04).
Kirk, D. (10-29-2001). In Korea, broadband is part of the culture. New York Times.
Kirstein, M., Burney, K., Paxton, M., Bergstrom, E. (2001). Moving towards broadband ubiquity in U.S. business markets. Cahners In-Stat Group. Available at http://www.instat.com/catalog/downloads/whitepaper_bbubiquity.asp (accessed 9/04).
Langdale, J. (1997). International competitiveness in East Asia: Broadband telecommunications and interactive multimedia. *Telecommunications Policy*, *21*(3), 235–249.
Latour, A. (2003, Oct 13). It's not over yet: The cable firms are winning the race to sell broadband services. For now. *Wall Street Journal*, p. R4.
Lee, L. T. (2000). Privacy, security, and intellectual property. In A. B. Albarran, & D. H. Goff (Eds.), *Understanding the web: Social, political, and economic dimensions of the internet* (pp. 135–164). Ames: Iowa State University Press.
Lessig, L. (2000). Innovation, regulation, and the Internet. *The American Prospect*, *11*(10), 26–29.
Maxwell, E. (1998). The Internet and electronic commerce: A tale of three cities. In: *The emerging Internet* (pp. 109–127). Washington, DC: Institute for Information Studies.
McCombs, M. E. (1972). Mass media in the marketplace. *Journalism Monographs*, 24.
McGregor, M. A. (1994). Toward a unifying regulatory structure for the delivery of broadband telecommunications services. *Journal of Broadcasting & Electronic Media*, *38*, 125–143.
Nolde, K. E. (2002). Broadband in the home. *BT Technology Journal*, *20*(2), 39–48.
Oram, A. (2001). The hard questions in broadband policy. http://Webreview.com, (accessed 9/04).
Patek, V. (1992). Broadband convergence: A view of the regulatory barriers. *Telecommunications Policy*, *16*(2), 98–104.
Platt, C. (2001). The future will be fast but not free. *Wired*, *9*(05), 120–127.
Powell, M. K. (2002). Government's role in broadband access: Remarks by FCC Chairman Michael K. Powell. *Congressional Digest*, *81*(3), 72–75.
Ray, W. (1998). Power to the people. *Forum for Applied Research and Public Policy*, *13*(4), 80–83.
Richtel, M. (2003, Nov 17). In Utah, public works project in digital. *The New York Times* (pp. C1, C4).
Richter, M. (2001, December 1). Excite@Home wins ruling about cable. *The New York Times* (pp. C1, C14).
Schement, J., & Curtis, T. (1995). Tendencies and tensions of the information age: The production and distribution of information in the United States. New Brunswick: Transaction.
Schiller, D. (2000). *Digital capitalism: Networking the global market systems*. Cambridge, MA: MIT Press.
Shapiro, C., & Varian, H. R. (1999). *Information rules*. Boston, MA: Harvard Business School Press.
So far, Broadband's race goes to the small and urbanized, (2002, September 10). Broadband Networking News, 12(18).
Solomon, J., & Walker, D. (1995). Separating infrastructure and service provision: The broadband imperative. *Telecommunications Policy*, *19*(2), 83–89.
Stein, L., & Sinha, N. (2002). New global media and communication policy: The role of the state in the twenty-first century. In L. Lievrouw, & S. Livingstone (Eds.), *Handbook of new media* (pp. 410–431). Thousand Oaks: Sage Publications.
Verhulst, S. G. (2002). About scarcities and intermediaries: The regulatory paradigm shift of digital content reviewed. In L. Lievrouw, & S. Livingstone (Eds.), *Handbook of new media* (pp. 432–447). Thousand Oaks: Sage Publications.

Further reading

Broadband overview. (2002). *Gongressional Digest*, *81*(3), 69–71.
Caruso, D.B. (2004, Sep 1). Philly Considers Wireless Internet for All. Associated Press.
How many on line? (2004, January). NUA Internet Surveys. Available at http://www.nua.ie/surveys (accessed 9/04).