The Last Mile: Service Tiers Versus Infrastructure Development and the Debate on Internet Neutrality

Kevin G. Wilson
Télé-université/UQAM

Abstract: In this article, the current debate on Internet neutrality is examined in terms of four frames: legislative reform, network economics, Internet practices and culture, and broadband policy. The paper is critical of the broadband carriers' (telephone and cable companies) attempt to institute a "new Internet" based on discriminatory service tiers. It is vital for the Internet community to oppose the introduction of service tiers, but public debate on the future of the Internet should not be limited to the problem of service tiers. A more enlightened framework, consistent with over two decades of network policy, would re-frame the debate at the more fundamental level of infrastructure development. Policy recommendations are made to ensure adequate financing for the development of local broadband networks in the public interest.

Keywords: Telecommunications policy; Internet/IP/WWW; Economics; Convergence; Telephony

Résumé : Cet article examine le débat actuel sur la neutralité d'Internet en fonction de quatre cadres : réformes législatives, économie des réseaux, pratiques et culture d'Internet, et politiques sur les transmissions à large bande. Cet article est critique des tentatives de la part des diffuseurs à large bande (c'est-à-dire des compagnies téléphoniques et des câblodistributeurs) d'instaurer un « nouvel Internet » en établissant des volets de service discriminatoires. Il est essentiel que la communauté des internautes s'oppose à l'introduction de volets de service. En outre, un débat public sur l'avenir d'Internet ne devrait pas se limiter au problème des volets de service. Une approche plus réfléchie, reflétant plus de deux décennies de politiques sur les réseaux, repositionnerait le débat au niveau plus fondamental du développement infrastructurel. Cet article fait des recommandations en matière de politiques en vue d'assurer un financement permettant le développement de réseaux locaux à large bande afin de servir l'intérêt public.

Mots clés : Politiques en télécommunications; Internet; Sciences économiques; Convergence; Téléphonie

Kevin G. Wilson, PhD, is Professor of Communications at Télé-université/UQAM, the distance learning university of UQAM, 100 rue Sherbrooke Ouest, Montréal, QC H2X 3P2. E-mail: kwilson@teluq.uqam.ca.

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Introduction

Two things are required to connect a home computer to the network of computers that constitutes the Internet: a physical connection (or line) and an Internet Service Provider (ISP). During the 1990s, when the Internet was in its infancy, all home users connected to the Internet by signing a contract with an ISP and programming their modems to "dial up" the ISP server. The physical connection was provided by the telephone company, and it was relatively simple to change ISPs. From a technical standpoint, "dialling up" was not unlike dialling another telephone subscriber. In the case of a traditional telephone call, the user dialled into the network of switches owned and controlled by the telephone companies, which then completed the call. In the case of Internet service, the user dialled an ISP server that provided software for routing message packets through the Internet.

In the jargon of the telecommunications industry, the infrastructure that connects a subscriber's telephone to a central office (or first switch) is referred to as "last-mile technology" or "the last-mile network." With the advent of the Internet, last-mile infrastructure was simply adapted to a new type of access service: Internet access. Because the last-mile connection was provided by telephone companies operating as regulated public utilities, traditional principles of common carriage applied. Moreover, the Internet itself embodied a fundamental principle of common carriage: the non-discriminatory treatment of messages. Although both components of the system (last-mile access and the Internet per se) respected principles of common carriage, they did so for very different reasons, which will be explored in the next section.

Last-mile infrastructure is the most costly component of the wireline (telephone and cable) infrastructure. From the point of view of network providers, it embodies a significant "sunk cost"—one that cannot be sold off or economically duplicated by potential competitors. It is largely for this reason that local access service (local telephony) has been the last segment of the old legacy telephone network to be subject to competition, while the market for long-distance services and terminal equipment (devices such as telephones and modems) has been effectively competitive for over two decades.

In 2005, the last-mile network became the focus of public scrutiny in the United States. But the issue was not the slow advance of competition in markets for local telephone service; rather, the issue was access to high-speed Internet. Internet access providers such as Southwestern Bell began to postulate a new Internet that would discriminate between Internet applications and charge service providers, such as Google and Yahoo!, a premium to access subscribers via their last-mile network. Significantly, these proposals coincided with efforts by the former telephone companies to upgrade their last-mile networks to fibre optic (broadband) technology. The Internet community responded to these calls for a two-speed or "two-tiered" Internet with calls for "network neutrality" legislation that would make it illegal to discriminate between Internet applications. It is my contention that the telephone companies are seeking additional revenue sources via service tiers because of the tremendous costs associated with the upgrade to true broadband and not simply because of opportunities for profit. By extension,

it is the search for additional sources of revenue to finance investment in last-mile broadband that is the impetus for the network neutrality debate.

In this article, I argue that the network neutrality debate needs to be reframed in order to incorporate the public interest as it pertains to universal access to broadband connections to the Internet. Public debate on Internet neutrality provides a unique opportunity to consider larger, more fundamental issues related to infrastructure development—more specifically, what policies need to be implemented if we are to ensure not only that the Internet remains "neutral," but also, and just as importantly, that incentives will exist for investment in last-mile, high-speed networks. In what follows, we will undertake an historical reading of public policy related to principles of common carriage and the non-discriminatory treatment of messages. This will be done first in the context of traditional public-utility regulation and then in the context of the Internet. This will be followed by an analysis and comparison of the American and Canadian debates on Internet neutrality. Finally, we will analyze and critique current policy discourses on network economics and Internet neutrality in order to argue that the most efficient policy for ensuring principles of non-discrimination is to increase absolute bandwidth in the last-mile network. In order for this to occur, policymakers will have to design policies that create real incentives for network operators to invest in last-mile infrastructure.

Common carriage and access to the Internet

Traditional common carriers were coachmen, teamsters, ferrymen, and operators of canal boats engaged in the transportation of people and goods to the general public. In the nineteenth century, railroads were added to the list of common carriers. For centuries under common law, and later under public-utility regulation, these enterprises were subject to special economic treatment. They were viewed as businesses "vested with a public interest" because of the vital role they played in the general commerce of the nation. Horwitz has described the traditional obligations of common carriers in the following way: "they must serve all, they must provide adequate (and safe) facilities, they must charge reasonable rates, they must not discriminate against customers" (1989, p. 59).

The framework for state control of common carriers in the modern era was developed in conjunction with the regulation of the railroad industry. It was a simple matter to apply the common-carrier concept developed for the railroad industry to the telegraph and telephone industries. The obligation not to discriminate in the "transportation" of *information* was seen as just as vital to the public interest as the obligation not to discriminate in the transport of goods or people. For example, telegraph operators were instructed to send messages based on the order received.

As the telephone industry matured, local telephone service assumed the status of a geographic monopoly (one provider per local calling area) throughout North America. With monopoly came pressure to regulate prices. Alfred Vail, the founder of AT&T, met the challenge of price regulation by arguing that the telephone industry was a "natural" monopoly. Accordingly, when AT&T accepted price regulation, it did so on the condition that governments protect the industry from "unfair" competition from unregulated carriers. The commitment to non-

discriminatory carriage in the context of regulated monopoly was so fundamental that it led to a more general policy known as the "separation of content and carriage." To ensure that they would have no economic incentive to discriminate in the transport of messages, telephone common carriers were forbidden, as a condition of licence, to own newspapers, publishers, broadcasters, or other producers of content. Their operations were limited strictly to the business of basic common carriage. For example, Bell Canada's federal charter prohibited the company from holding shares in other companies that were not involved in the provision of telephone service (Canada, 1880).

In Canada the federally regulated telephone companies, principally Bell Canada and BC Tel prior to 1993, were regulated under the *Railway Act.* In 1993 the *Railway Act* was superseded by the Telecommunications Act (Canada, 1993), and federal jurisdiction was expanded to include virtually all of Canada's telephone companies. This was the result of a Supreme Court decision (Supreme Court of Canada, 1989). A recent CRTC discussion paper submitted to the Telecommunications Policy Review Panel notes that public policy with respect to telecommunications has been grounded in a consistent set of principles: (1) universal service, (2) the requirement that the telephone companies "treat their customers in a fair and non-discriminatory manner," and (3) network connectivity (Canadian Radio-television and Telecommunications Commission, 2005**,** paragraph 29). Although developed in conjunction with the regulation of telephone service, these principles continue to serve as the basis for CRTC policy and regulation with respect to new services and facilities, including broadband access to the Internet. Moreover, the proscription against discrimination has been enshrined in the *Telecommunications Act,* which states: "No Canadian carrier shall, in relation to the provision of a telecommunications service or the charging of a rate for it, unjustly discriminate or give an undue or unreasonable preference toward any person, including itself, or subject any person to an undue or unreasonable disadvantage" (Canada, 1993, 27.3).

Policies promoting network connectivity have been interpreted in a fairly broad manner to include facilities and services used in conjunction with the Internet. Very early in the evolution of the telephone industry, regulators recognized that it was in the public interest to require maximum interconnection of networks. In the era of digital networks, this has meant that regulators have resisted attempts to create proprietary networks based on software and hardware that are incompatible with other networks. The Internet protocol (IP) used to transmit data over the Internet is the quintessential open network architecture and the backbone of policy designed to promote maximum interconnection. Connectivity, unlike principles of non-discrimination, is not a legal concept. But it has been a fundamental component of public policy with respect to common carriers for over a century in Canada.

As noted previously, the other component of the Internet experience is the Internet itself: the digital network of networks responsible for routing message packets between computers located throughout the world. For very different reasons, the Internet backbone network also functions according to one of the fundamental principles of common carriage: the non-discriminatory treatment of

packets. However, the reasons for this are not a function of public-utility economics that have governed the telephone industry; rather, they are matter of technology, network design, and Internet culture.

Since its origins in the ARPANET, the genius of the Internet has been found in its packet structure: the way that it disassembles messages into discrete packets, assigns each packet a header that identifies the sending computer and the destination computer, and sends each packet to the destination computer (independently of the other packets), where the packets are finally re-assembled. In theory, packets associated with the same message may follow different paths to the destination computer. This architecture takes advantage of the inherently "bursty" character of digital transmission. For the purposes of transmission, the actual message (whether an e-mail, a file transfer, or an HTML page) is not a meaningful unit. Rather, the message has become a stream of packets. Packets are routed through the network of Internet nodes in a "best effort" attempt to respect the principle of "first come, first served." In order to discriminate, the network would have to distinguish between one person's packets and another's, or more precisely, between packets originating in one computer and packets originating in another. Because we are dealing with programmable computers, this can be done, but it requires that a new level of programming be introduced to the network, one that substitutes for the traditional protocol of first come, first served. To summarize, the Internet does not generally discriminate between computers, Internet users, or their messages, because it was designed to operate at the level of the packet and was not designed to discriminate between packets.

It would appear that the Internet has been infused with principles of common carriage as a result of its early and continuing association with the telephone industry at the level of the access network, but also as a result of its egalitarian design and open architecture. Moreover, the early history of its use and co-operative development reinforces the notion of the Internet as a public good.

Setting the stage for the Internet neutrality debate: The demise of open access policy in the United States

During the 1990s, when dial-up connections to the Internet were the norm, the FCC and the CRTC determined that the telephone companies would be allowed to function as Internet Service Providers (ISPs). This presented challenges to longstanding principles of non-discrimination and connectivity. But the decision to allow telephone companies to act as ISPs did not represent a fundamental break with policy trends; rather, it was the culmination of a gradual shift in policy that had begun decades before the arrival of the Internet.

In a series of decisions known as "Computer I" (1971), "II" (1980), and "III" (1985), the FCC established, and subsequently revised, the rules that would allow telephone carriers to engage in what were then referred to as "hybrid or enhanced services." Essentially, enhanced services were services that went beyond basic transmission (common carriage) to include data or information processing. Although it is hard for us to imagine today, services such as call-waiting and voice mail were controversial because they added value using information processing. The Justice Department's Consent Decree of 1956 (*United States v. Western Electric Co.*, 1956) prescribed that AT&T and its subsidiary local Bells

could only operate in regulated markets. With the advent of digital switching in the 1960s, it was possible to add functions to the basic telephone service based on the information processing capabilities of the computer. But information processing was the domain of companies such as IBM operating in markets that were not subject to public-utility regulation. Moreover, data services such as electronic mail and videotext (a precursor of the Internet) also fell on the other side of the regulatory divide. The Computer I, II, and III decisions established the rules for common-carrier participation in markets for services that went beyond basic transmission.

In November 1983, the CRTC issued a major decision on enhanced services that essentially copied the U.S. framework outlined in Computer II, Telecom Decision CRTC 84-18 (CRTC, 1984). Eventually, telephone companies in the U.S. and Canada would be allowed to provide enhanced voice and data services. However, this sanction was conditional: it required that the telephone companies *not discriminate against competitors providing similar enhanced services.* For example, the telephone companies in the United States were required to provide these services through structurally separate subsidiaries for years.

With the advent of the Internet, the shift in policy that enabled the telephone companies to provide more than basic transmission was extended to the provision of Internet access. Again regulatory approval was subject to the requirement that the telephone companies (telcos) not discriminate against other service providers. In telecommunications, this was known as the policy of "open access." Open access is a form of structural regulation that requires providers of last-mile connections (primarily the telephone companies) to operate as bandwidth wholesalers to service retailers such as ISPs. Allowing the telephone companies to act as both wholesalers and retailers (ISPs) with respect to data transmission created the potential for the telephone companies to discriminate against third-party retailers. But it did not entail a change in policy with respect to the more fundamental separation of content and carriage, as ISPs were viewed as essentially *gateways* to third-party content providers and not as producers of content/information.

While the structural requirement of open access applied to the telephone companies, it was less clear whether cable operators should be subject to the same open access requirements when providing broadband connections to the Internet. This was due to the fact that, historically, cable companies in both the United States and Canada have not been regulated as common carriers, but rather as broadcasters—more specifically, as distributors of broadcast programming. When U.S. ISPs attempted to force cable companies to provide them with access to their last-mile infrastructure, the cable companies refused on the grounds that they were not common carriers.

In the United States, the issue went all the way to the Supreme Court. In a landmark ruling in 2005, *National Cable & Telecommunications Assn. v. Brand X Internet Services* (Supreme Court of the United States, 2005), the Court sided with the cable industry. The court ruled that the FCC was correct when it determined that cable modem service was akin to an "information service" (and not a telecommunications service) under the U.S. *Telecommunications Act of 1996* (United States, 1996). It followed that cable operators did not have to provide Internet con-

nections to competitor ISPs such as *Brand X.* This had immediate resonance in the telephone sector, where the telephone companies argued that regulation was asymmetrical. To the extent that telephone and cable operators were providing comparable broadband facilities, it was unfair to subject only the telephone sector to open access requirements. In the wake of the *Brand X* decision, the FCC re-classified telco DSL service. Thereafter, it would no longer be viewed as a telecommunications service, but rather as an information service (United States, 2005). With this order, the FCC, with the complicity of the courts, effectively abrogated the policy of open access to broadband facilities in the United States.

Canada has not witnessed a reversal of open access policy comparable with the United States. In its submission to the Telecommunications Policy Review Panel, the CRTC reaffirmed the Canadian equivalent of "open access." In paragraph 141 of the report, the Commission noted its long-standing commitment to "facilities-based competition as the best means to realize the benefits of competition in terms of price, innovation and choice and as the best means of ultimately forbearing from regulation of the ILECs' services" (CRTC, 2005). The Commission continued by stating that the policy promoting facilities-based competition was itself an integral component of a more comprehensive policy designed to promote "a competitive network of networks with numerous other service providers accessing and utilizing those networks on reasonable terms and conditions. . ." (paragraph 51). The report continued, "The Commission has fostered service-based competition and resale activity *by ensuring access by service providers to the networks and services of facilities-based carriers*" (paragraph 51; emphasis added).

Although it may be tempting to infer that traditional common-carrier principles have been abandoned with the abrogation of open access policy in the United States, one could just as easily argue that common-carrier principles, and in particular the requirement of non-discriminatory treatment, are more important than ever before. This is the case because in the post–dial-up market for high-speed access, the consumer only has two access options: telephone or cable. The market for broadband access is essentially an oligopoly.

Making the others pay: SBC registers its dissatisfaction with the current regime for generating and distributing Internet revenues

By most accounts, the controversy over network neutrality began in November 2005. In an interview with *BusinessWeek Online,* the CEO of SBC (formerly Southwestern Bell Company; AT&T since 2006), Edward Whitacre, was asked whether he was concerned about Internet "upstarts" such as Google. Whitacre responded:

> How do you think they're going to get to customers? Through a broadband pipe. Cable companies have them. We have them. Now what they would like to do is use my pipes free, but I ain't going to let them do that because we have spent this capital and we have to have a return on it. So there's going to have to be some mechanism for these people who use these pipes to pay for the portion they're using. *Why should they be allowed to use my pipes?* The Internet can't be free in that sense, because we and the cable companies have made an investment and for a Google

> or Yahoo! [sic] or Vonage or anybody to expect to use these pipes [for] free is nuts! (O'Connell, 2005; emphasis added)

The telco position is not totally without merit. Patrick Barnard, in an article published on the *Free Press* website, has noted:

> Verizon Communications Inc.'s market capitalization is about $88 billion today, whereas it was $111 billion a year ago. Conversely, Google Inc., which relies in part on Verizon's network to deliver its services, saw its market capitalization grow from $53 billion to $133 billion during the same time period. Allowing the phone companies to charge for premium bandwidth would help tip the see-saw back in their favor. (Barnard, 2006)

Equipment manufacturers such as Cisco Systems have also been keen to alert broadband providers to the fact that they "'risk' allowing their broadband service to become viewed as a 'low-priced bulk commodity'" (Chester, 2006).

It was no coincidence that Whitacre's interview took place in November 2005, following the *Brand X* decision and the subsequent FCC order re-classifying DSL as an information service. The FCC order had the immediate effect of placing the telcos and cablecos (cable companies) on a more even competitive footing in the market for broadband access to the Internet. However, the telcos would still be at a competitive disadvantage. Because high-speed DSL relies on the old last-mile telephone infrastructure based on copper wires, it does not have the bandwidth capacity of the coaxial cable already deployed by the cable industry. With the spectre of open access requirements removed, the way is now open for U.S. and Canadian telcos to compete with the cable companies on equal footing in terms of bandwidth. But in order for this to occur, the telcos will have to accelerate their deployment of fibre optic technology in their last-mile infrastructure.

Although the link between the *Brand X* decision and Whitacre's remarks has been noted by a number of commentators, the connection between Whitacre's remarks and the telco project to upgrade to fibre optics has not been explored. It is important to understand that there is nothing new about this project. The industry has long known that it would have to meet the challenge of cable broadband with its own true broadband offering. The introduction of DSL technology in the late 1990s merely postponed the competitive showdown. The fact that the telcos have postponed this upgrade for more than two decades is a revealing indicator of the tremendous costs and risks this project entails. For example, Verizon alone has announced plans to invest US$20 billion by the year 2010 to reach 16 million residential subscribers from Florida to California (Belson, 2006).

Beyond the *Brand X* decision, how does one explain the telcos' decision to upgrade their networks at this juncture? Essentially the telcos are responding to a triple threat of competition from the cable industry. True competition began 10 years ago, when both telcos and cable companies began to offer Internet access service. More recently, and as direct result of deregulation, cable companies in the United States and Canada have begun to offer local telephone service. It is now possible for cable companies to combine Internet access and local telephony with their legacy television distribution business and to market them to consumers as a comprehensive bundle of communications services. Should the telephone companies fail to upgrade to fibre optic technology relatively soon, they

will lose the bundling battle and find themselves relegated to the role of custodians of the old copper telephone network.

How service tiers would work

Whitacre's remarks did more than signal telco dissatisfaction with the current regime for generating and distributing Internet revenues. They suggested where the telcos will turn for additional sources of revenue. The first source of revenues will be higher service fees for access to true broadband. But there will also be significant opportunities to recover investment in broadband facilities *indirectly.* In today's deregulated, postconvergence market for telecommunications, a broadband operator may own content or programming delivered via its facilities. More controversial is the service-tier option, where a system of "back-door tolls" would be introduced to extract additional revenues from up-market providers of Internet services such as Google and Yahoo!. Although these fees will ultimately be passed on to end users, they will not appear as part of the Internet subscriber's monthly access fee. From the telco/cable perspective, charging service providers a premium to send certain types of content to end users represents an expedient means of recouping investment in last-mile broadband infrastructure.

Two techniques of traffic management will make these back-door tolls possible: "flow classification" and "deep packet inspection." Flow classification looks at factors such as the size of packets in a stream and the amount of time between consecutive packets "to make reasonable determinations about the nature of the packet stream" (Peha, 2006, p. 4). Deep packet inspection entails inspecting and identifying information packets at a deeper level, known as the "application layer" of the Internet protocol, where it is possible to discern the type of content being transmitted, such as music, video, games, and VoIP (Voice over Internet Protocol). The technology is being promoted by equipment manufacturers such as Cisco Services that provide routers to the Internet service providers. A recent Cisco Systems white paper states:

> The Cisco Service Control Platform is comprised of a programmable network element that creates an intelligent overlay, enabling network operators to identify subscribers, *classify application-level traffic,* guarantee service performance and charge for content-based services. The solution allows providers to address the gaps in premium service deployment and to customize solutions for individual subscribers while effectively charging for new service offers. (Cisco Systems, 2005, p. 2; emphasis added)

An Internet access provider, cable or telephone, can use this technology to create "service tiers" based on application type. Differentiating services based on the applications they use will enable Internet service providers to exploit demand elasticities for different services, charging a premium for the delivery of high-end services such as video. The technology is ideally suited to broadband networks that are capable of transmitting packets at the high speeds required for music, gaming, and especially video applications.

Unfortunately for the broadband operators, these schemes run counter to the economics and culture of the Internet, where a "packet is a packet," irrespective of its content or formatting. Alert to this threat, activists have attempted to add

network neutrality clauses to communication bills before the U.S. Congress. The debate on network neutrality is, therefore, largely anticipatory. It is an attempt to prevent the broadband carriers (who in most cases are also operating as ISPs) from discriminating between different types of content and, most importantly, from implementing price discrimination based on this information.

The response

Whitacre's remarks provoked an immediate response from the Internet community. A "Save the Internet Coalition" (http://savetheinternet.com) was formed to lobby Congress for net neutrality legislation. A major conference was organized in April 2006, called F2C: Freedom to Connect 2006 (http://freedom-to-connect.net/2006. Internet founder Tim Berners-Lee registered his concern, noting that in Europe, network neutrality is the rule (Bennett, 2006).

On March 2, 2006, U.S. Senator Ron Wyden (D-OR) introduced net neutrality legislation. Wyden's bill proposed that network operators "not interfere with, block, degrade, alter, modify, impair, or change any bits, content, application or service transmitted over the network of such operator" (United States Senate, 2006b). On May 18, 2006, U.S. Senators Olympia Snowe (R-ME) and Byron Dorgan (D-ND), members of the Senate Committee on Commerce, Science, and Transportation, also introduced net neutrality legislation (United States Senate, 2006a); however, on June 28th, the Senate Committee rejected the amendment by a vote of 11 to 11. On June 8th, the U.S. House of Representatives also rejected a net neutrality amendment proposed by Congressman Markey of Massachusetts, HR5273 (United States Senate, 2006c), this time by a vote of 269 to 152. Essentially, these amendments to the pending communications act would have made it impossible for broadband carriers (both telephone and cable) to implement a multitiered Internet.

In their efforts to oppose the Internet neutrality amendments, the telcos and cablecos resorted to the predictable old saw of the "perils" of regulation. Moreover, key agencies of the U.S. government, including the Federal Trade Commission and the FCC, entered the debate on the side of broadband operators when they endorsed the regulatory status quo. The position of regulatory *laissez-faire* has been neatly summarized by the chairman of the U.S. Federal Trade Commission, Deborah Platt Majoras. Speaking on the subject of network neutrality in August 2006, she noted "I. . . question the starting assumption that government regulation, rather than the market itself under existing laws, will provide the best solution to a problem" (Mark, 2006). The FCC chairman, Kevin Martin, has been similarly reactive, noting that enacting net neutrality legislation would be premature (Reardon, 2006).

In Canada there has been no attempt to legislate Internet neutrality. In 2006 the issue was before then Minister of Industry responsible for communications, Maxime Bernier, in conjunction with his department's review of the Telecommunications Policy Review Panel Final Report (Industry Canada, 2006). According to documents obtained by Canadian Press, senior advisors to Bernier are sympathetic to the arguments of the largest telecommunications companies, such as TELUS and Videotron, which oppose neutrality measures (Goodman, 2007).

How neutral is the Internet?

To what extent do practices designed to shape, manage, or otherwise purposefully control the flow of traffic over the Internet represent a challenge to traditional common-carrier principles of non-discrimination? The answer to this question is more complicated and nuanced than either proponents of tiered service (the broadband carriers) or their opponents (the advocates of neutrality legislation) seem prepared to acknowledge.

In a paper entitled "The Benefits and Risks of Mandating Network Neutrality, and the Quest for a Balanced Policy," Jon M. Peha, associate director of Carnegie Mellon University's Center for Wireless and Broadband Networking, provided a fairly broad, but useful, definition of discrimination in a network context. According to Peha, discrimination occurs "whenever a network treats some network traffic or some network users differently from others" (Peha, 2006, p. 3). By Peha's definition, today's Internet already encompasses practices that are discriminatory, something that opponents of neutrality legislation have been keen to note. For example, there is the problem of asymmetrical bandwidth common to high-speed Internet service (cable modem and DSL), where download speeds are typically three to four times faster than upload speeds. This clearly favours the class of up-market service providers over the class of down-market Internet subscribers. At the application level, this configuration favours one-to-many applications over one-to-one (peer) applications such as file-sharing applications.

McTaggart (2006) notes that networks may have bilateral "peering" agreements that give preferential treatment to each other's traffic. Because these arrangements include customers of the largest ISPs, traffic crossing between peered networks will be transmitted at a discount. Smaller ISPs that do not benefit from peering arrangements (and their customers) will pay more. Moreover, network operators may employ "hot-potato" policies designed to push traffic that does not terminate in their own network outside their network as soon as possible (McTaggart, 2006, p. 11). Finally, opponents of neutrality legislation are keen to observe that the current "best effort" practice of "first come, first served" is itself discriminatory, because it favours data applications (such as e-mail and Web browsing) to the detriment of applications such as real-time video and VoIP that are sensitive to delay (Wu, 2003). Applications that are sensitive to delays in transmission are known as "latency sensitive." In order to meet the requirements of latency sensitive applications, network operators would have to implement "quality of service" (QoS) policies that shape traffic in ways that take into account the latency requirements of particular applications.

At the other end of the spectrum, we find activities associated with the more traditional notion of negative discrimination. Network operators argue that efficient management of scarce network resources requires them to shape and manage the flow of Internet packets. For example, their ability to control applications that are "greedy" users of bandwidth, such as peer-to-peer file-sharing applications, may enable them to keep bandwidth available for the vast majority of users, who simply wish to browse the Web and use e-mail.

Thus, we see that the policy principle of true (absolute) "neutrality" is something of a red herring. Current Internet routing practices already embody a certain

degree of traffic management that must be considered discriminatory according to Peha's definition. For example, the most purposeful traffic-shaping activity embodied in quality-of-service algorithms has the effect of reversing the application-level discrimination associated with the first come, first served protocol. Moreover, it could be argued that one of the most blatant forms of negative discrimination (controlling peer-to-peer file sharing) may be compatible with the public interest. Finally, if as a matter of public policy it is determined that the Internet should be "application neutral," network operators could argue that this can only be accomplished by discriminating between packets based on the latency requirements of the applications with which they are associated. As Peha has noted, the key policy issue is not discrimination, but rather how to differentiate harmful discrimination from beneficial discrimination. Of course, differentiating between harmful and beneficial discrimination will depend on whose interests are being served. Whitacre's remarks are a matter for concern not because he envisions differentiating between different types of applications, but rather because he proposes to differentiate in order to *price discriminate.*

Challenging the premise of scarce network resources

Faced with the knowledge that demand for residential broadband may not produce timely returns on investment, the telcos (with the complicity of the cablecos) are resorting to an alternative financing scheme based on packet discrimination at the application level. But how do you introduce a scheme for discriminating against certain types of content when you are essentially operating as a broadband carrier and the product you are carrying, whether it is e-mail, music files, or video, is reducible in all cases to 0s and 1s—bits and bytes in a data stream? You do so by asserting that certain applications are "greedy" users of bandwidth. Moreover, you contend that if left unchecked, these greedy applications will monopolize scarce network resources.

There is one problem with these arguments: they are based on the false premise that network resources are scarce and will continue to be so. One of the fortuitous consequences of the dot.com boom of the late 1990s was substantial overinvestment in long-line fibre optic infrastructure. In the investment frenzy that preceded the dot.com bust, few questioned the notion (promulgated by network operators such as Bernie Ebbers' WorldCom) that Internet traffic was doubling every 100 days (Malik, 2003). In fact, studies suggested that it was growing at a substantially slower rate, probably doubling every year (Malik, 2003). There was so much overbuild that most of this fibre has remained unused to this day. As Meinrath and Pickard have noted, "Information on both where this dark fiber exists and how much is available is considered a 'trade secret'—keeping information from consumers and allowing for price levels that are out-of-proportion with the supply available" (2003, p. 17-18).

To the extent that it may still be a factor, the dearth of bandwidth is only a problem in the last-mile infrastructure. *But the telco upgrade of this segment to broadband virtually ensures that there will be no bandwidth shortages in the future.* Moreover, the impetus to deploy flow classification and deep packet inspection in order to improve network efficiency is inversely related to bandwidth: when absolute bandwidth increases, the requirement to manage or other-

wise purposely shape the flow of traffic actually decreases. Stated in terms of latency issues, latency problems diminish as bandwidth increases. Where there is an abundance of bandwidth, the requirement to shape or prioritize traffic to ensure application neutrality disappears. Jon Peha has noted that scarcity is, in effect, a function of business strategy. He states:

> Note that the incentive to discriminate with respect to QOS [Quality of Service] and price is based on the assumption that there are limited resources. *In fact, a network has a choice on that.* Networks can deploy far more communications capacity than is usually needed, so congestion is simply not a problem. Their reward is simple traffic control that can be run on cheaper processors, simple billing systems, and pricing that can be easily explained to customers. Alternatively, they can put money into sophisticated traffic control and billing instead of communications capacity. (Peha, 2006, p. 8; emphasis added)

In a similar vein, in testimony before the U.S. Senate, Gary R. Bachula, vice president of Internet 2, has stated:

> For a number of years, we seriously explored various "quality of service" schemes, including having our engineers convene a Quality of Service Working Group. As it developed, though, all of our research and practical experience supported the conclusion that it was far more cost effective to simply provide more bandwidth. With enough bandwidth in the network, there is no congestion and video bits do not need preferential treatment. All of the bits arrive fast enough, even if intermingled. (Bachula, 2006, p. 2)

The telcos would appear to have become ensnared in a Gordian knot that is largely of their own making. As they increase bandwidth in the principal network bottleneck, the last mile, they undermine scarcity arguments for managing traffic in the interests of network efficiency and application neutrality. Paradoxically, their contention that they need to discriminate between packets has come at the very juncture at which packet discrimination may no longer be required to ensure efficient use of network resources.

More troubling is the prospect that incentives may exist for the telcos to arbitrarily discriminate between classes of content (applications) or between service providers in order to create a tiered Internet that is essentially artificial: one that is not grounded in economic fundamentals such as bandwidth scarcity, but rather on the broadband carriers' ability to leverage their market power to extract profits under conditions of near-monopoly. (The market for broadband access in Canada and the U.S. is essentially an oligopoly involving the cable and telephone industries.) Peha notes:

> As in the broadband market, network operators can also deliberately degrade service where it is helpful in capturing profits in upstream markets. As one equipment vendor put it, the ability to adjust QOS for each upstream market 'enables revenue sharing schemes or value-based pricing rather than only "bit retailing."' (Peha, 2006, p. 11)

The "new Internet"

Under what conditions will the broadband carriers be able to orchestrate a scheme to impose premium service agreements, repositioning themselves as gatekeepers of the new Internet while avoiding regulation? It would appear that at least two conditions would have to be met. First, a system for differentiating bits would have to extend to the entire market for high-speed Internet access; it would have to be comprehensive. Second, it would require the co-operation of the most important service providers, such as Google, Yahoo!, and YouTube.

Let us begin with the criterion of comprehensiveness. In order for a premium-service scheme to be credible, the telcos would have to introduce service tiers that operate over the *entire range of high-speed-access* service, from DSL to upper-tier broadband. In other words, there will be fast and slow DSL, fast and slow low-tier broadband, and fast and slow higher-tier broadband. By "fast" and "slow," we mean that although the lane (or pipe) will be fast, content will move at different speeds. More specifically, content will only move at the upper throughput speed of the lane if some entity at the sending end has entered into a premium agreement with the broadband provider.

Contrary to telco rhetoric, it makes little sense from a revenue standpoint to differentiate between content based on generic criteria such as application type (video and music files versus text messaging). What really matters is that *some entity has paid for premium access to the subscriber.* Moreover, it is largely irrelevant from the broadband carrier's point of view whether the premium agreement is limited to the transmission of "greedy" applications or files such as video. The premium agreement could just as easily incorporate the transmission of standard *Web pages* at a premium speed. With respect to this practice, Tim Wu, professor of law at Columbia University, has observed, "if AT&T would ink contracts letting google.com load in one second but other search engines load in three to four seconds, 'that's a serious distortion of competition in that market'" (McCullagh, 2006). From the point of view of the service provider that has entered into a premium agreement, one can easily imagine the appeal of standard Web pages that arrive several seconds faster than those of its competitors. At this point we begin to discern the contours of a "new Internet" that is not based on the identification and segregation of "greedy" content but on arbitrary discrimination motivated by opportunities for control and profit taking.

By necessity, premium service agreements would have to operate within the access tier subscribed to by the end user. In order for fast (premium) transmission to be meaningful in any commercial sense, a subset of service providers must exist whose content moves at a slower rate within the given access tier. Moreover, as we noted previously, this content would move at a slower rate not because of a shortage of bandwidth, but rather because these up-market providers had not had the wherewithal to enter into a premium agreement with the access provider. From the point of view of the service provider, the value of premium access is not pegged to an objective measure of what constitutes "fast" transmission, but rather to a logic of "faster than," where "faster than" is faster than its competitors' content. Stated more pointedly, *premium access necessarily engenders a second, slower Internet in an era of bandwidth abundance.*

The second condition runs contrary to the popular misconception that the very largest service providers, such as Google and Yahoo!, will steadfastly resist pressures for premium carriage—in other words, that they will refuse to deal. Current press coverage would have one believe that the battle for net neutrality is a battle between Internet titans, pitting the telcos and cablecos against service providers. But this may prove to be a mirage. The very largest service providers could transform premium-carriage agreements into an effective tool for stifling competition from smaller or emerging providers. Yahoo! and Google would still compete with each other for "hits," while benefiting from a decisive advantage when competing with smaller players. Moreover, premium carriage arrangements would increase the value of the large service providers with respect to third parties that advertise on their service or depend on the service to act as a gateway to their destinations. Finally, premium-carriage agreements could be used as a marketing tool to reinforce the loyalty of end users.

We see that the issue is not the introduction of generic service tiers designed to tax greedy applications, but the creation of premium service agreements. These agreements would bind the largest service providers to the broadband carriers according to a "club logic" (Tremblay, 1997) that emphasizes exclusivity. In the manner of Air Miles and other loyalty reward programs, these arrangements would attempt to bind the user to a select group of Internet sites. Should it succeed, it would have the effect of balkanizing the Internet into groupings of sub-nets that would discourage change and innovation in favour of stasis and the status quo. At least one analyst has argued that the net neutrality debate is essentially about issues related to innovation on the Internet. Wu has stated this position in the following terms: "A communications network like the Internet can be seen as a platform for a competition among application developers. [sic] Email, the web, and streaming applications are in a battle for attention and interest of end-users. It is therefore important that the platform be neutral to ensure the competition remains meritocratic" (Wu, 2005, p. 144). Finally, the whole artifice would lack transparency: the Internet user would have no way of discerning the web of exclusive agreements that had surreptitiously reconfigured his or her Internet experience.

The policy dilemma

It is clear at this juncture in the evolution of the Internet that a reaffirmation of traditional common-carrier principles of non-discrimination is required. A policy of non-discrimination is consistent with both the history and the culture of "best-efforts" routing practices that were so successful in developing the Internet. The fact that network operators currently manage traffic in order to improve the efficiency of networks should not be confused with application discrimination for the purpose of extracting profits. Moreover, we have demonstrated that the principal technical justification for the purposeful shaping of traffic, the problem of scarcity, does not hold up under scrutiny. While price discrimination may be acceptable under conditions of true market competition, the emerging oligopolistic market for broadband access, composed of telephone and cable companies, will afford ample opportunity for these firms to use their market power to distort prices, stifle competition, and impede innovation. As the Internet market has become more and more concentrated both vertically and horizontally, with com-

petitive conditions becoming more and more of a mirage, it is more important than ever to recognize the status of network operators as true "carriers" operating at the crossroads of commerce and the exchange of ideas.

But enshrining neutrality principles in law in order to "save the Internet" only resolves half of the problem. This is the case because it leaves unresolved the issue of how to finance infrastructure development. As the broadband rollout proceeds, evidence is mounting that the entire process is fraught with risk and may not be economically sustainable (Weiland, 2006). Little consideration has been given to the possibility that consumer take-up of broadband offerings may be slower than anticipated, prompting the telcos to slow or actually halt investment. Should this occur, it would be tempting to discount the telco predicament as self-inflicted or inevitable, but this would be extremely short-sighted from a public-policy point of view. In order to understand why this is the case, some historical perspective is required.

For over three decades, North American policymakers have faced a unique opportunity clothed in a significant challenge. Unlike Europe and most of the rest of the world, the United States and Canada entered the deregulatory era *with two mature wire-line industries:* telephone and cable. Each network had its strengths. The cable industry had the bandwidth but lacked the switched architecture; the telephone network had the architecture but not the bandwidth. The challenge for policymakers has been to create incentives for the cable industry to diversify into the business of switched (addressable) services while simultaneously encouraging the telephone companies to replace their copper networks with fibre. As we have noted, the costs of such an investment are estimated to be in the hundreds of billions of dollars. This is particularly the case with respect to the telcos because upgrading to broadband requires them to replace the entire network of "last mile," copper wire that links local central offices to each and every home. The "last-mile" component of the legacy telephone networks represents a significant sunk investment, one that cannot be sold off or economically duplicated by potential competitors. Elsewhere we have argued that the sunk costs associated with last-mile technology were the principle justification for natural monopoly in the legacy telephone business (Wilson, 2000).

Should the telcos withdraw their plans to deploy fibre optics, the market for residential broadband would become the exclusive domain of the cable industry. This would represent a significant failure of public policy. Eventually, it could spell the demise of facilities-based competition for broadband access, a cornerstone of network policy for over two decades.

A policy for infrastructure development

Implementing a successful policy for broadband requires that we step back from the current deregulatory paradigm of market economics. Clearly, the issue should be framed in terms of infrastructure development and not greedy applications or bandwidth scarcity. Moreover, the issue of infrastructure development has historically been the subject of interest and intervention by the state. It is as old as *Munn v. Illinois* (1877) in the United States (Wilson, 2000). In Canada, public-sector participation in infrastructure development is as old as the Canadian government's nation-building investment in the railroad sector (Wilson, 2000).

Having rejected the questionable premise that infrastructure investment should be left entirely to the marketplace, we may begin to imagine some of the ways in which the state, under the guise of regulation, may intervene to advance universal broadband.

It is important to remember that collectivizing the costs of network development was a key to the development of the early telephone network. Furthermore, the problem is well known within the field of network economics as the problem of "positive externalities." Simply stated, externalities are consequences of economic activity that are not taken into account in the market price. For example, a negative externality would be the costs of pollution that are borne by regions that are down-wind from a polluting source but not accounted for in the price of local hydro service. In the early history of the telephone network, a key externality was related to the inability or unwillingness of potential subscribers to take into consideration the value of their subscription to the entire community of telephone users. In this instance, the externality is referred to as a *positive* externality.

> In a communications network, such as the telephone network, the value of the network to all subscribers increases as the number of subscribers increases. A network that enables a caller to reach millions of potential subscribers is infinitely more useful and, therefore, valuable than one that reaches only ten subscribers. But this characteristic of the network may not play a part in the *individual subscriber's* decision to subscribe, or more importantly not to subscribe, to the service. (Wilson, 2000, p. 58)

The regulatory response to the existence of positive externalities was the policy instrument known as cross-subsidization: "the economic transfer from one class of subscribers to another [enabled] the regulator to compensate for imperfections in the pricing system that [did] not take into account the collective benefit to all subscribers of maximizing the number of telephone users" (Wilson, 2000, p. 59).

Broadband networks exhibit the same positive externalities as the early telephone network. In the current deregulatory/pro-competitive era, where the problem of infrastructure development has been framed in terms of broadband access, the CRTC has underscored the vital link between "technological neutrality" (that is, *inter alia,* application non-discrimination) and "facilities-based competition":

> The Commission has also recognized the importance of regulation that incents [sic] new investment in Canadian telecommunications infrastructure in order to improve the quality of service and service innovation. As mentioned above, in the days of rate of return regulation, this was done through granting the telephone companies a high enough rate of return on investment to finance new infrastructure and by approving construction programs. In the new competitive environment, a policy of technological neutrality doesn't mean that the Commission is necessarily technology blind. Rather, the Commission's role is a more subtle one of encouraging facilities-based competition and trying to ensure that its policies do not act as a damper on new investment. (CRTC, 2005, p. 48)

It is important to emphasize that a policy to promote facilities-based competition while respecting principles of technological neutrality would be compatible with efforts designed to collectivize the costs of infrastructure development.

A public policy for broadband infrastructure would have to respect a number of principles and policy precedents. It would have to recognize as a matter of principle that it is in the public interest to:

- maintain and promote facilities-based competition in the market for broadband access;
- collectivize the costs of investment in broadband in recognition of network externalities;
- promote broadband universality;
- maintain the non-discriminatory Internet protocol of "best effort/first come, first served" as the basis for the movement of traffic on broadband networks; and
- reaffirm the status of broadband carriers as common carriers.

Once a consensus exists on these principles, a twofold approach to financing broadband infrastructure could include 1) the use of public funds to subsidize broadband development in rural areas, and 2) allowing broadband carriers to tax video content at the transmission source, but on a regulated basis, subject to CRTC (or FCC) supervision. This policy would be designed specifically and exclusively to support the introduction of last-mile fibre optic technology. The amount of the video tariff would be set by the regulatory agency with all proceeds being re-invested in local broadband. Moreover, revenues derived from the video tax would have to be matched by investment on the part of the broadband carrier according to a formula (ratio) determined by the regulator. For example, every dollar derived from the video tariff would have to be matched by two dollars (or more) of carrier investment. Tariffs would only apply to video content. More importantly, broadband carriers would be forbidden from engaging in premium-service agreements or taxing other types of content, including websites, gaming, and music files. It would be up to the regulator, in concert with the broadband carriers, to determine the minimum throughput speeds that would qualify as broadband carriage.

While it is important to oppose the broadband carriers' efforts to employ deep packet inspection to reconfigure the Internet according to their economic interests, it is just as important, from a public-policy standpoint, to re-frame the debate on Internet neutrality. A more enlightened discussion would emphasize the importance of collectivizing the costs of infrastructure investment as part of a long-term strategy designed to promote universal broadband under a framework of facilities-based competition involving both the telephone and the cable industries.

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