

Canada's Usage Based Billing Controversy: How to Address the Wholesale and Retail Issues

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Data caps on Internet service – frequently referred to as usage based billing (UBB) – took the political world by storm in Canada earlier this year when over 450,000 Canadians signed a petition calling for an end to the common practice.¹ After the federal government indicated that it would order the Canadian Radio-television and Telecommunications Commission to reconsider its decision to allow large Internet providers such as Bell to implement UBB when it sells wholesale access to independent ISPs, the CRTC announced that it would delay implementing the decision for at least 60 days so it could review it on the merits.² That delay will now likely run until late 2011, as the Commission has announced plans for an oral hearing in July 2011³ and Industry Minister Tony Clement has intimated he plans to address the broader policy issues as part of the forthcoming national digital economy strategy.⁴

While the CRTC reconsideration holds the promise of an amended policy – the government has made it abundantly clear it will reject any attempt to bring back the same approach⁵ – the narrowness of the current regulatory issue, which is focused on wholesale UBB, is likely to leave many dissatisfied. Indeed, the UBB issue is at least three issues rolled into one – wholesale UBB, retail UBB (the imposition of UBB by the large, incumbent providers to their retail customers), and the broader concerns about the competitiveness of Internet access services in Canada.

This paper proposes policy solutions to all three issues, concluding that a one-size-fits-all approach is both unwise and unworkable. Rather, the policy and regulatory measures needed to address wholesale UBB are different from retail UBB, though both are closely linked to the state of competition in Canada.

On the issue of wholesale UBB, the paper proposes several steps including rescinding the earlier series of CRTC decisions, ensuring that speed matching is implemented and vigorously enforced,⁶ reversing the CRTC ADSL-CO decision to promote more facilities-based competition by encouraging independent ISPs to locate closer to residential customers,⁷ examining alternative approaches that allow independent ISPs to differentiate their services, and prioritizing cable TPIA service as a viable alternative for independent ISPs.

¹ StopTheMeter.ca, Half a Million Canadians Against Telecom Price Gouging, www.stophthemeter.ca.

² See e.g., Laura Payton, “Use-based billing court hurt economy: Clement”, CBC News, <http://www.cbc.ca/news/politics/story/2011/03/01/clement-talks-ubb.html>.

³ Canadian Radio-Television and Telecommunications Commission, Telecom Notice of Consultation CRTC 2011-77-1, “Review of billing practices for wholesale residential high-speed access services”, <http://www.crtc.gc.ca/eng/archive/2011/2011-77-1.htm>.

⁴ “Where Canada Now Stands on Usage-Based Billing (UBB) for Internet Services”, <http://epistoli.blogspot.com/2011/03/where-canada-now-stands-on-usage-based.html>.

⁵ See e.g., “CRTC must reverse internet usage ruling: Clement”, CBC News, <http://www.cbc.ca/news/canada/story/2011/02/03/crtc-internet-clement.html>.

⁶ Canadian Radio-Television and Telecommunications Commission, Order 2010-632, “Wholesale high-speed access services proceeding”, <http://www.crtc.gc.ca/eng/archive/2010/2010-632.htm>.

⁷ *Id.*

Given the CRTC's longstanding forbearance of retail Internet services, addressing retail UBB is more difficult. While some have advocated for the elimination of UBB at the retail level, there is little reason to foreclose all forms of UBB. The Canadian Internet access market is best served by a competitive environment in which those providers who wish to offer reasonable UBB plans are entitled to do so. The problem with the current market, however, is that many Canadian consumers have few options that do not include UBB. A truly competitive market, like those found in other countries, would consist of UBB as an option, but not the only option.

The optimal method for addressing retail UBB is a robust competitive environment in which it is consumer ability to switch providers in the event they are dissatisfied with UBB that serves as the chief safeguard against unreasonable UBB practices. Given that the Canadian market does not have that state of competition at the present time, I argue that new guidelines are needed for Internet Billing Usage Management Practices (IBUMPs). Modeled as an extension on the CRTC's Internet Traffic Management Practice guidelines, which received grudging support from across the spectrum as a reasonable method of addressing the concerns associated with net neutrality and Internet provider traffic management, I argue that additional guidelines are needed for retail UBB. The guidelines would include transparency requirements and a reasonableness standard to safeguard against the use of UBB for anti-competitive purposes and against exorbitant pricing schemes that leave consumers on the hook for bills far disproportionate to actual provider costs (including a reasonable profit).

The need for IBUMPs – much like the need for ITMPs – is closely linked to the state of competition in the Internet access marketplace. I point to several steps that should be taken to encourage a more competitive environment. In addition to facilitating competition by revisiting the manner in which independent ISPs compete in the marketplace, I raise additional measures that include opening the door to foreign competitors, working with provincial and municipal governments to foster new innovative broadband networks, expanding the current federal broadband programs to address both access and competition, and enlisting CANARIE, Canada's research and education network, to identify local community networks that would benefit from connecting to its broadband backbone.

The discussion and analysis is divided into two parts. Part one addresses several of the most hotly debated UBB issues including claims that UBB is a reasonable response to network congestion and heavy usage by a small number of subscribers, that UBB is a common Internet provider practice and that the Canadian situation is consistent with practices in other jurisdictions, and that UBB pricing reflects the costs associated with data transmission.

The second part expands on the recommendations for wholesale UBB, retail UBB, and Internet provider competition noted above.

Part One – Setting the UBB Record Straight

1. UBB and Network Congestion

a. A Decade of CRTC Congestion Concerns

UBB supporters have long pointed to concerns about network congestion as a key rationale for imposing usage based billing measures on their subscribers. The argument is easily understood – network capacity is limited and congestion on the network negatively affects all subscribers. By imposing measures designed to limit network congestion, the small number of “heavy” users who contribute most to the network congestion do not adversely affect the large number of light or average users, whose Internet use has a more limited impact on network congestion.

The link between UBB and network congestion dates back over ten years, when the CRTC first approved volume usage rate restrictions for the wholesale service offered by cable Internet providers known as Third Party Internet Access (TPIA).⁸ Shaw and Videotron sought approval for volume usage rate restrictions and the Commission approved the request based on the need to “ensure fair and proportionate use of the service by all end-users.”⁹

At the time, cable Internet was a shared service and the potential for one end user to affect the service of a neighbouring user was widely recognized. Accordingly, the CRTC established the following policy, conditioned on the cable providers establishing the same volume usage rate restrictions on their own residential customers:

Shaw and Vidéotron propose to apply monthly volume usage rate restrictions to end-users. For example, Shaw proposed an \$0.80 charge per 100 megabytes per end-user whose monthly downstream traffic exceeds five Gb and a \$2 per 100 megabytes charge for end-users with monthly upstream traffic exceeding two Gb. The carriers generally submitted that their cable network is a shared network where the quality of service available to one end-user is a function of other end-users' usage. Accordingly, they propose traffic thresholds to ensure fair and proportionate use of the service by all end-users. Shaw and Vidéotron indicated they would apply the same usage restrictions and charges to their Internet service end-users as they propose to apply in respect of ISPs' end-users.

The Commission approves on a final basis the volume usage rate restrictions proposed by Shaw and Vidéotron. To the extent that these carriers do not apply these volume usage rate restrictions and associated volume thresholds to end-users of their own Internet services, the Commission is of the preliminary view that such action would be contrary to s. 27(2) of the Act.

⁸ Canadian Radio-television and Telecommunications Commission, Order CRTC 2000-789, “Terms and rates approved for large cable carriers' high speed access service”, <http://www.crtc.gc.ca/eng/archive/2000/O2000-789.htm>

⁹ *Id.* at para 103.

*Rogers and Cogeco have not proposed volume usage rate restrictions. However, the Commission considers it would be appropriate for each of these carriers to adopt, at its option, volume usage rate restrictions and associate volume usage thresholds similar to those proposed by Shaw and Vidéotron. In this event, to the extent Rogers or Cogeco do not apply the same restrictions to end-users of its carrier's own Internet service, the Commission is also of the preliminary view that such action would be contrary to s. 27(2) of the Act.*¹⁰

While cable providers received regulatory support for UBB, there has since been very limited uptake of TPIA, with some cable providers rendering it difficult for independent ISPs to adopt the service.¹¹

The path to UBB for telecom providers such as Bell, which offer Digital Subscriber Line (DSL) services, was somewhat different. With retail Internet services forborne in 1999,¹² Bell was free to implement UBB for its retail customers, which it did in 2006.¹³

Shifting UBB to its wholesale customers was more challenging, however, since independent ISPs purchase a regulated service known as Gateway Access Service. The regulated GAS, much like the TPIA service for cable, is not an Internet service but rather a connection between end users and the independent ISP. It is important to note that the actual provision of Internet services comes from the independent ISP, not from carriers such as Bell. Independent ISPs need the GAS in order to reach the end users themselves, since only telecommunications and cable companies have the "last mile" connection to the customer (i.e. the copper telephone line or cable connection to the home). Many countries require some form of open access to this last mile (particularly for telecom) in order to enhance competition among Internet providers.¹⁴

The Commission's UBB support as a mechanism to address network congestion was reinforced in the 2009 Internet traffic management practice guidelines as it emphasized its support for economic measures as preferable to "technical measures" that restrict users access through technical means such as "throttling."¹⁵ The Commission started from the position that "parties generally acknowledged that some traffic management is required

¹⁰ *Id.* at paras. 103 – 105.

¹¹ Catherine Middleton & Annemijin van Gorp, Paper presented to the 37th Research Conference on Communication, Information and Internet Policy: How Competitive is the Canadian Residential Broadband Market? A Study of Canadian Internet Service Providers and Their Regulatory Environment (Sept. 25-27, 2009), http://www.broadbandresearch.ca/ourresearch/middleton_vangorp_TPRC2009.pdf.

¹² Canadian Radio-Television and Telecommunications Commission, Telecom Order CRTC 99-592, "Forebearance from Retail Internet Services", <http://www.crtc.gc.ca/eng/archive/1999/O99-592.htm>.

¹³ Karl Bode, "New' Sympatico Caps For new customers starting December 3", DSL Reports, 30 Nov. 2006, <http://www.dslreports.com/shownews/79963>.

¹⁴ See generally Yochai Benkler, Next Generation Connectivity: A review of broadband Internet transitions and policy from around the world, http://www.fcc.gov/stage/pdf/Berkman_Center_Broadband_Study_13Oct09.pdf.

¹⁵ Canadian Radio-television and Telecommunications Commission, Telecom Regulatory Policy CRTC 2009-657, "Review of the Internet traffic management practices of Internet service providers", <http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm>. [ITMP]

to address congestion in order to ensure that all end-users receive acceptable Internet service.” Given the need to address network congestion, the Commission noted that:

*economic ITMPs would generally not be considered unjustly discriminatory, as they link rates for Internet service to end-user consumption. Economic ITMPs also provide greater transparency to users than technical ITMPs, as they are reflected in monthly bills. Furthermore, these practices match consumer usage with willingness to pay, thus putting users in control and allowing market forces to work.*¹⁶

Indeed, the support for economic traffic management measures was firmly ensconced in the test the Commission established for reasonable traffic management practices. The test includes a requirement on ISPs to “explain why, in the case of a technical ITMP that results in any degree of discrimination or preference, network investment or economic approaches alone would not reasonably address the need and effectively achieve the same purpose as the ITMP.”¹⁷

b. The Carriers on Congestion

Although the CRTC has proceeded on the assumption that UBB is a response to network congestion concerns, there is considerable evidence to the contrary. Indeed, both cable and telecom operators have acknowledged – in both statements and practices – that UBB is at best only loosely related to network congestion. For example, in November 2010, Rogers, Shaw, Videotron, and Cogeco wrote to the CRTC in support of UBB and acknowledged that it could not set pricing on the basis of costs:

UBB charges are first and foremost a mechanism for managing Internet traffic, that is to say an economic ITMP. UBB rates and caps are set at levels where they are expected to have an influence on the traffic patterns of end-users, particularly high consumption end users, otherwise they do not achieve their purpose.

*Any attempt to establish rates for wholesale UBB charges based on a narrow assessment of incremental costs is destined to failure, as it would not take into account the broader behavioral impacts that permit the attainment of the underlying carrier’s network management objectives.*¹⁸

Bell has been even more transparent about the profitability of UBB. In a February 2010 conference call with company analysts, CEO George Cope noted:

And, of course, we’re seeing the ever—the growth—the usage of the Internet with the Internet sticks. And I think the really, really important thing for investors, which we are obviously following and executing on, is making sure that it’s a usage-driven model—and

¹⁶ *Id.*

¹⁷ *Id.* at para. 43.

¹⁸ Cogeco Cable Inc., Quebecor Media Inc., & Shaw Communications, Submissions to CRTC re: TNC 2010-803, at paras. 23 – 24, http://www.crtc.gc.ca/public/partvii/2010/8661/c12_201015975/1467242.PDF

*that's the model that we're pursuing, and at this point, the model that the Canadian market is pursuing. And that's important to make sure we monetize this significant opportunity for our investors, and at the same time, for our customers from a great service perspective.*¹⁹

In an August 2010 quarterly call, Cope stated:

*our data revenue growth was 3.8% for our Residential Services business, particularly driven through an increase in Internet ARPU of 3.3%. And interesting, almost all that increase now coming from usage based billing as the demand for Internet use explodes through the use of video services, and we're continuing to see an increase in the revenue per customer.*²⁰

Three months later in November 2010, Cope noted:

*our residential services had an excellent revenue quarter from a data perspective, as well, with data revenue growth of 5%, driven principally by the bandwidth usage revenue being up 83% year-over-year.*²¹

*Later in the same call, Cope linked increased Internet video demands with growing revenues – "as we see a growth in video usage on the internet, making sure we're monetizing that for our shareholders through the bandwidth usage charges."*²²

In other words, while the company has claimed that UBB only affects a small percentage of subscribers, it is the primary driver of increased revenues from its Internet access services division.

Shaw has also told analysts that UBB represents an important monetization opportunity closely linked to customer video usage. In a November 2010 presentation, executives stated:

*In the future, we believe our usage based billing plan will enable the further monetization of our Internet business as data usage becomes more prevalent and common amongst our customer base (ie. streaming of video)*²³

Competitors have made much the same point. For example, in reviewing Bell's pricing, Primus stated "it's an economic disincentive for internet use. It's not meant to recover costs. In fact these charges that Bell has levied are many, many, many times what it costs

¹⁹ BCE Q4, 2009 Conference Call Transcript, http://www.bce.ca/data/documents/reports/en/2009/q4/BCE_TRANSCRIPT_q4_09.pdf

²⁰ BCE Q2 2010 Results Conference Call Transcript, at 6, http://www.bce.ca/data/documents/reports/en/2010/q2/BCE_TRANSCRIPT_q2_10.pdf.

²¹ BCE Q3 2010 Results Conference Call Transcript, at 3, http://www.bce.ca/data/documents/reports/en/2010/q3/BCE_TRANSCRIPT_q3_10.pdf

²² *Id.* at 11.

²³ Shaw Communications Inc., Investor Update, at 5, http://www.shaw.ca/uploadedFiles/Corporate/Investors/Presentations_And_Meetings/InvestorUpdateNovember2010Final.pdf.

to actually deliver it."²⁴

In fact, Bell's proposed UBB pricing for the GAS service similarly demonstrates that it bears little relation to actual costs or network congestion. First, its plan is different in Quebec, where there is a 60 GB cap, and Ontario, where the cap is set at 25 GB. The difference is plainly a function of the competitive environment, where Videotron's 60 GB cap forced Bell to offer a similar cap in order to remain competitive.²⁵ Moreover, Bell's plan features a 60 GB cap with an overage charge for the next 20 GB. After 80 GB, there is no further cap until the user hits 300 GB.²⁶ In other words, using 80 GB and 300 GB costs the same thing. This suggests that the plan has nothing to do with pay-what-you-use but is rather designed to compete with similar cable ISP data caps.

c. A Congested Network?

Network congestion is often treated as a catch-all for a network where demand exceeds capacity and therefore cannot provide all users with maximum speeds. The CRTC has defined it as "a situation whereby the amount of traffic transiting the network may lead to a deterioration in service for some end-users."²⁷ A closer examination of incumbent networks reveals that Internet traffic traverses at least three stages, two of which typically do not raise significant congestion concerns.

The first stage is the so-called "last mile", the link between the end-user and the "Central Office" (CO), where ISPs begin to route user traffic to its intended destination. The last mile is the most coveted part of the network since the ability to serve an end user with Internet services depends on last mile access. While the last mile is a critical component of the network, congestion is limited, particularly for DSL services provided by telecom companies such as Bell. This should come as no surprise since the ISP is able to limit the amount of data carried on the last mile by establishing a bandwidth speed consistent with its network capabilities. Moreover, since DSL services involve a direct connection between the end-user and the CO, there are no other users to congest the network.

The incumbent ISPs have acknowledged the absence of network congestion in the last mile stage. At a recent Standing Committee on Industry, Science and Technology hearing on UBB, Bell's Chief Regulatory Officer Mirko Bibic acknowledged:

There is a copper loop that goes from our central office to the home and all data travels

²⁴ "Internet usage costs to rise", CBC News, <http://ca.news.yahoo.com/internet-downloading-costs-rise-20110107-162621-824.html>.

²⁵ "Internet download limit slashed for many", CBC News, <http://www.cbc.ca/news/business/story/2011/01/31/technology-internet-usage-based-billing.html>.

²⁶ Canadian Radio-television and Telecommunications Commission, Telecom Decision CRTC 2010-255, "Bell Aliant Regional Communications, Limited Partnership and Bell Canada – Applications to introduce usage-based billing and other changes to Gateway Access Services", <http://www.crtc.gc.ca/eng/archive/2010/2010-255.htm>.

²⁷ Canadian Radio-television and Telecommunications Commission, Telecom Public Notice CRTC 2008-19, "Review of the Internet traffic management practices of Internet service providers", at n. 6, <http://www.crtc.gc.ca/eng/archive/2008/pt2008-19.htm>.

*on that pipe: Internet traffic, television traffic, voice traffic, long-distance traffic. But there are no congestion issues there. The real issue is when you get to the central office and go behind it into the Internet. Fibe TV is completely different.*²⁸

The second stage runs from the CO until the ISP hands off the user to another provider. This may occur at several different points. In some instances, an independent ISP may co-locate with the incumbent ISP by installing their own equipment at the CO, so that the user only uses the incumbent's last mile, not their internal network.

In other instances, the incumbent ISP may aggregate the traffic of many users together, delivering the collective traffic to the independent ISP (if the users are customers of an independent ISP) at a later point in the network. Since the ability to deliver faster speeds to users depends in part on shortening the distance between the user and the CO, the investment in the network (which in many urban areas has been built for decades) is focused on a closer connection to the end user. With a close connection to the end user, the traffic is routed along the ISP's internal network until it reaches the third stage – the Internet.

Once the user traffic reaches the Internet stage, it moves between other network providers to its end destination (e.g. a website or an email in-box). For traffic carried by independent ISPs, this traffic transits separately from Canadian ISPs such as Bell since independent ISPs acquire sufficient connectivity to handle their customers' traffic demands. For the incumbent ISP traffic that originates from its own residential customers, it too is managed through peering and transit arrangements (described further below). The Internet stage naturally involves a global network and there are no significant congestion concerns at this stage either (or at least no congestion concerns specific to Canadian ISPs).

The issue of network congestion in Canada is therefore largely limited to the second stage when the user traffic enters the incumbent ISP's own internal network (beyond the last mile) until it is handed off to another provider such as an independent ISP, a peering provider, a Content Distribution Network (CDN) provider, or a provider by way of a transit arrangement for Internet services. While congestion can arise within this internal network if the simultaneous aggregated traffic demands exceeds network capacity, there are no additional costs to the ISP – the congested traffic all runs within its own network.

Moreover, there are many ways to address this congestion. In the case of independent ISPs, the most obvious method is to hand off their user traffic closer to the CO so that it does not contribute to the congestion.

For the larger incumbent ISPs, “technical measures” – also known as traffic shaping – have become a common practice for addressing congestion issues. Virtually all of the

²⁸ Canada, Standing Committee on Industry, Science and Technology, Evidence, (Feb. 20, 2011) at 1735 (Mr. Mirko Bibic), <http://www2.parl.gc.ca/HousePublications/Publication.aspx?DocId=4953635&Language=E&Mode=1&Parl=40&Ses=3#Int-3739006>.

larger Canadian incumbent ISPs use some form of traffic shaping to limit the bandwidth allocated toward high-bandwidth applications during peak periods. The incumbent ISPs apply these measures to all traffic regardless of whether it is their own retail traffic or traffic that originates from independent ISP subscribers.

There is also reason to believe that incumbent ISP networks are large enough to handle the Internet traffic without concern for congestion since the same networks simultaneously carry other high bandwidth traffic such as IPTv. The issue may well be one of bandwidth allocation. If Internet traffic demands continue to grow faster than the other bandwidth demands running on the same connection, carriers could shift some of the “space” reserved for services such as IPTv (or the chicken roasting channel in the case of cable)²⁹ to the Internet and thereby relieve some of the congestion pressures.

None of this suggests that consumer broadband demand is not growing rapidly. Driven by increasing use of the network for streaming and downloading video as well as data intensive games, it clearly is.³⁰ However, the demands on the network are not outside historical norms³¹ nor do they necessarily mean that the network is now “congested.” Rather, it suggests that certain parts of the network may face greater congestion strain during certain periods in the day, which can be addressed through several mechanisms, including increased investment, technical measures such as traffic shaping, and a re-examination of bandwidth allocation on ISP networks.

2. The Canadian Internet Access Market: Comparing UBB Around the World

Canadian telecommunications networks were once the envy of the world. No longer. While there is some debate on the methodology and validity of the many studies that have compared wireless and broadband networks worldwide, there is no disputing that none rank Canada as a leader in either area. Indeed, while Canadian broadband networks were once viewed as a global leader – Canada ranked as high as second only a decade ago on some metrics – today it is at best a middle of the pack player with mounting frustration among both consumers and businesses reliant on a world-class digital infrastructure.³²

The Canadian debate over the competitiveness of its Internet access services has been shaped by the experiences in other countries. Many international studies have concluded

²⁹ “All-chicken roasting TV set for Canada”, UPI News, http://www.upi.com/Odd_News/2011/02/24/All-chicken-roasting-TV-set-for-Canada/UPI-84491298567988/.

³⁰ “Online Video Continues Steady Growth Streak”, Mashable.com, <http://mashable.com/2010/02/05/dec-comscore-video-data/>.

³¹ In fact, the CRTC recently found that network demands are growing at roughly 40 to 50 percent annually. See CRTC, *supra* note 10 at para 5. That is rapid growth, though historically growth rates have been even faster at 100% per year: K.G. Coffman & Andrew Odlyzko, “Internet Growth: Is There a 'Moore's Law' for Data Traffic?”, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=236108.

³² Organisation for Economic Co-operation and Development, OECD Broadband Portal, http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html; Michael Geist, “OECD Report Finds Canadian Broadband Slow, Expensive”, <http://www.michaelgeist.ca/content/view/4019/135/>.

that Canada is no longer a leader, with consumers facing higher prices and slower speeds than those found in other countries. For example, consumers in South Korea, the world Internet leader, have access to basic plans from SK Broadband that feature guaranteed download speeds of 100 MB per second with no data caps and no long-term contracts for 33,000 won or C\$28.62 per month.³³ There is no comparable plan available with any provider in Canada.

The OECD has noted that Canada is one of the only jurisdictions in the world where virtually all providers utilize some form of UBB.³⁴ For most providers, data caps have been in place for years: Rogers established a monthly cap to some of its plans in 2005³⁵ and Bell implemented data caps in 2006.³⁶

While much of the focus has been on the widespread use of UBB in Canada, more instructive is the near-uniform implementation of UBB. In Canada, UBB invariably means a cap on monthly data use combined with overage charges for all data used that exceeds the cap. The plans do not distinguish between peak and off-peak use, the source of the data, or contemplate other solutions beyond overage charges.

The near-uniform Canadian approach is notable because other, more competitive countries feature a wider variation in approach, as highlighted in the comparative chart at Appendix A. Countries such as Germany give consumers the ability to select from among unlimited and capped services. Deutsche Telekom, the largest providers, offers unlimited plans, while providers such as 1und1 offer lower cost plans with a 100 GB data cap. The U.S. market similarly features a mix of capped and unlimited plans. Comcast offers a 250 GB cap and AT&T recently announced plans to implement a 150 GB cap.³⁷ Other leading ISPs such as Cablevision and Verizon offer unlimited plans.

In addition to choice from among unlimited and data capped plans, other countries feature far more variation in approach to UBB. In Australia, data caps are very common, yet exceeding the cap does not result in overage fees. Instead, Australian ISP “rate limit” subscribers that exceed their cap by reducing download speeds for balance of the month.³⁸ In other words, all plans are effectively unlimited plans but with different speeds once a data threshold is met. The use of rate limiting is a relatively common approach in countries with data caps as it is also found in New Zealand, Germany, and India.³⁹ Moreover, in response to competitive pressures, British Telecom recently

³³ <http://www.skbroadband.com/eng/iproduct/evalley.asp>

³⁴ Organisation for Economic Co-operation and Development Directorate for Science, Technology and Industry, OECD Broadband Portal, Prevalence of explicit bit/data caps among surveyed offers, by country (Oct. 2009), <http://www.oecd.org/dataoecd/11/38/39575261.xls>.

³⁵ Karl Bode, “Rogers Applies ‘Generous’ Caps ‘Keeping pace’ with ‘evolving Internet needs’”, DSL Reports, <http://www.dslreports.com/shownews/60361>.

³⁶ Supra, note 13.

³⁷ Nate Anderson, “Is AT&T’s new 150GB DSL data cap justified?”, Ars Technica, <http://arstechnica.com/tech-policy/news/2011/03/is-atts-new-150gb-dsl-data-cap-justified.ars>

³⁸ “Fairly comparing broadband ADSL plans in Australia can be difficult”, Internode Blog, <http://blog.internode.on.net/2010/09/13/comparing-isp-plans-in-australia/>.

³⁹ See Appendix A.

announced plans to eliminate data caps but retain rate limiting for heavy Internet users.⁴⁰

The Australian market also features another notable variation on UBB. Many ISPs feature two separate data caps each month – one for peak time usage and a second for off-peak usage. For example, Optus offers several broadband plans which each feature separate data caps for peak and off-peak usage. The peak period runs from noon until midnight, while the off-peak period runs from midnight until noon. If a subscriber exceeds the peak or off-peak cap, Optus reverts to a rate-limited service.⁴¹ IiNet offers a similar peak/off-peak data capped service with consumers able to purchase as much as 1 TB of data per month.⁴²

Another alternative approach is to distinguish between domestic and international data. For example, Vodaphone Iceland offers a 10 GB capped plan but “all data downloaded domestically is unlimited without any extra cost.”⁴³ The effort to distinguish between the origin or destination of data reflects different costs – regional data transfers may remain within a single ISP’s network or is subject to a peering arrangement that reduces transfer costs. By contrast, international data will typically require a transit arrangement that increases data transfer costs.

Yet another approach is to distinguish between upstream and downstream traffic. Data caps are still relatively rare in Japan, but those ISPs with data caps limit their application to upstream traffic. Moreover, the caps are so high – 900 GB of upstream traffic per month is standard – as not constitute caps in comparison with the policies in Canada.⁴⁴

What makes these UBB approaches noteworthy when viewed from a Canadian perspective is that consumers can typically choose between unlimited and capped plans. Moreover, the capped plans elsewhere bear a more direct relationship to cost and congestion concerns. In contrast, Canadian UBB bears little relation to actual cost, but is instead largely a function of market dynamics and the lack of competitiveness.

3. UBB’s Black Box: How Much Does it Cost To Transport a Gigabyte?

Costs related to Internet access pricing structures sit at the heart of the UBB debate, yet the most important data point remains shrouded in secrecy. The incumbent ISPs have long been reluctant to disclose their actual costs in maintaining their networks, arguing that the information is sensitive, confidential commercial data. In recent months, owing to the fact that data caps and overage charges are typically based on gigabytes of data, the

⁴⁰ Matthew Lasar, “BT to UK Infinity subscribers: no more usage caps!”, Ars Technica, <http://arstechnica.com/telecom/news/2011/03/bt-to-uk-fiber-subscribers-no-more-usage-caps.ars>.

⁴¹ Optus, Naked (standalone) Broadband, http://personal.optus.com.au/web/ocaportal.portal?_nfpb=true&_pageLabel=Template_woRHS&FP=/personal/internet/nakedbroadband&site=personal.

⁴² iinet, broadband plans, <http://www.iinet.net.au/broadband/plans.html>.

⁴³ <http://www.vodafone.is/en/internet>

⁴⁴ Chieh-yu Li & James Losey, “Bandwidth Caps for Residential High-Speed Internet in the U.S. and Japan”, <http://www.newamerica.net/files/Bandwidth%20Caps%20for%20High-Speed%20Internet%20in%20the%20U.S.%20and%20Japan.pdf>. [Losey]

cost issue has crystallized around the question of the cost to transfer 1 GB of data.

Reliable cost information would be extremely helpful in order to respond to at least two issues. First, the claims regarding light users subsidizing heavy users would be a more informed discussion, since it would allow for a realistic assessment of the actual costs of servicing both light and heavy Internet users. Second, reliable cost information would allow for analysis of the reasonableness of current overage charges. While retail Internet access pricing is unregulated, efforts to analogize Internet access to regulated utilities raises the specter of assessing the reasonableness of the markup for Internet access services.

i. Internet facing data costs

Calculating the cost for an ISP to transfer 1 GB of data involves at least two cost components. The first component is the Internet side of the equation. As discussed above, the user's traffic travels through three stages – the last mile, the ISPs internal network, and the public Internet. The public Internet cost is relatively easy to calculate since all ISPs depend upon peering and transit arrangements to carry data between networks. Independent ISPs advise that the cost of a 1 Mbps (megabit per second) connection is roughly \$5 per month (the cost is likely considerably less for large incumbent ISPs given their economies of scale as some estimates put the price at \$3 per Mbps).⁴⁵

With a 1 Mbps connection, an ISP is permitted to transfer 1 Mbps of data per second on a continuous basis. That is the equivalent of 7.5 MB (megabytes) per minute (60 megabits is equal to 7.5 megabytes), 450 MB per hour, and 10,800 MB per day (or approximately 10.5 GB). Over a 30 day month, it adds up to 316.4 GB or roughly 1.58 cents per GB. For larger ISPs able to negotiate lower costs, the \$3 per month fee allows them to transfer a GB of data for under one cent. In fact, when off-peak traffic or demand shifting is factored into the equation, the costs may be further reduced.

Estimates of transit arrangement pricing typically point to between \$3 and \$5 per megabit per second per month. This figure is declining rapidly, with some estimates suggesting that it may drop to under \$1 per megabit by 2014.⁴⁶ Transit arrangements are used when two ISPs do not have a direct connection and therefore rely on an intermediary network provider to complete the Internet connection. Some ISPs may directly connect with one another (known as a peering arrangement) that would further reduce costs since the data transfer travels directly from one ISP's network to another ISP's network with the ISPs agreeing to offset each other's traffic. Yet another alternative for web-based traffic and video streaming is the use of Content Distribution Networks, such as Akamai. These companies are often used by content distributors to manage traffic more efficiently and provide ISPs with the advantage that the traffic may not run on their networks, thereby further reducing costs.

⁴⁵ DrPeering International, "Internet Transit Prices – Historical and Projected", <http://drpeering.net/white-papers/Internet-Transit-Pricing-Historical-And-Projected.php>.

⁴⁶ *Id.*

These numbers are consistent with other public numbers for large-scale data transfers. For example, the Amazon EC2 service, a leading cloud computing provider, charges one cent per GB for all regional data transfers.⁴⁷ Regions include the U.S. East Coast, U.S. West Coast, and Europe. For data transfers outside a single region, the Amazon EC2 service costs ten cents per GB for all in-bound data transfers in North America and Europe and as little as 8 cents per GB for out-bound data transfers.

ii. Internal Network Costs

The far more difficult cost calculation involves the internal ISP network, namely the last mile and the internal network. ISPs zealously guard this information, demanding that virtually any potential disclosure remain confidential. While the ISPs often disclose this information to the CRTC, most of the public record of CRTC proceedings has been redacted of information that would be useful to estimate the costs of increased network traffic on confidentiality grounds.

There is one notable exception, however. As discussed at Appendix B, unredacted information about total costs and total subscriber numbers for Bell's proposals for funding broadband expansion to underserved communities from the deferral account is available. Three separate sets of data were disclosed in 2010, representing different designs for the access network. Bell's preferred option is based on High Speed Packet Access (HSPA) technology. Other options investigated included a pure DSL technology option and a hybrid option, combining both technologies.

It should be noted that Bell's data describes a "worst case scenario" in the sense that Bell was making the case that such a network would not be economically viable and would therefore merit additional support through the deferral account process. The Bell data disclosed the total cost of the project (over 15 years), the number of communities and premises where service would be available, the projected revenue, and the peak number of subscribers.

The detailed analysis of the Bell data, which admittedly involves a number of assumptions, suggests that the costs of building a new network would lead to estimates of roughly seven cents per GB. The actual costs vary considerably between networks – capital expenditures, network usage, subscribers, and properties of the backhaul links all influence actual costs. While the actual numbers may be higher or lower, the ten cents/GB estimate is fairly consistent in several network models.

When combined with the Internet costs of roughly one cent per GB for larger ISPs, a high end estimate of the per gigabyte costs for large Canadian ISPs is approximately 8 cents per GB.⁴⁸ This assumes the creation of a new network and accounts for all aspects of the data transfer – the last mile, internal ISP network, public Internet transfers, and other

⁴⁷ Amazon Web Services, "Amazon EC2 Pricing", <http://aws.amazon.com/ec2/pricing/>.

⁴⁸ Others have even lower estimates, particularly for large U.S. ISPs. For example, Dave Burstein estimates that large U.S. ISPs spend 2 to 5 cents per GB: FastNewsNet, "Wireline Costs and Caps: A Few Facts", <http://dslprime.com/dslprime/42-d/4148-costs-and-caps>.

associated expenditures. While this is higher than the 3 cents per GB that has been invoked in some discussions, it is far lower than overage costs imposed by some ISPs, which run as high as \$10 per GB in Canada.⁴⁹

Part Two – What Should Come Next

With both the CRTC and the federal government now seized with the UBB issue, all parties are looking for market-based solutions that will foster increased competition and fair pricing. As noted above, a one-size-fits-all approach will not work. Instead, politicians and regulators would be well advised to identify targeted solutions for wholesale UBB, retail UBB, and the broader competition concerns for Internet access services in Canada.

i. Wholesale UBB

The immediate issue before the CRTC is limited to wholesale UBB - the effort by Bell to impose UBB on independent ISPs who pay Bell for the GAS service. The CRTC continues to paint the issue as being about "subsidizing" heavy users,⁵⁰ but rather than focusing on the heavy vs. light usage, the CRTC should be driven by a single priority - fostering a competitive market by establishing rules that allow independent ISPs to compete. In the context of wholesale UBB, there are five steps that should be taken to address the competition concerns.

First, the UBB decisions to date should be rescinded. The federal government has made it clear it will accept nothing less, so the Commission appears to have little alternative but to come forward with an alternative approach. The government has been criticized for meddling into a regulatory issue, but in this instance the CRTC's approach desperately requires reform.

Second, the CRTC should ensure that the speed matching decision is implemented and vigorously enforced. Independent ISPs cannot compete with incumbents if they are offering inferior speeds. The CRTC has acknowledged that effective competition requires the ability to offer equivalent speeds to consumers and it should prioritize efforts to ensure that any remaining barriers are eliminated and that incumbent ISPs are fully compliant with their obligations.

Third, the CRTC should reverse its decision on ADSL-CO, a proposal that would have allowed independent ISPs to locate closer to the end customer. As noted above, policies that encourage independent ISPs to affordably locate closer to end users promotes more facilities-based competition as independent ISPs would expand their networks, reduces concerns with network congestion by lessening their use of the incumbent ISP networks, and positions independent ISPs to offer greater customer choice.

⁴⁹ Josh Kerr, "Internet penalties challenged", Yukon News, <http://www.yukon-news.com/news/22089/>.

⁵⁰ Statement from the Chairman of the CRTC on usage-based billing, February 3, 2011, <http://www.crtc.gc.ca/eng/com100/2011/i110203.htm>.

Fourth, for those independent ISPs that do not use ADSL-CO and cannot currently afford to invest in co-location facilities, the CRTC should ensure that those independent ISPs have access to a regulated bulk wholesale service that would allow them to allocate the data usage as they see fit. This would provide for the same overall network usage but without the UBB that limits service differentiation.

Fifth, the CRTC should turn its attention to cable providers with respect to wholesale Internet services. While wholesale access is available using TPIA, it has not proven popular. Some independent ISPs advise that the situation is improving and that they are contemplating offering cable-based Internet access services. The shift to cable has taken far too long since a more competitive environment necessitates wholesale access to both cable and DSL. A marketplace that steadily reduces DSL market share but leaves cable untouched runs the risk of creating de facto cable monopolies for Internet services. The CRTC should prioritize making the cable TPIA service a viable alternative for independent ISPs.

ii. Retail UBB

Given the CRTC's longstanding forbearance of retail Internet services, addressing retail UBB represents a more challenging regulatory and policy issue. While some have advocated for the elimination of UBB at the retail level, there is little political support for directly intervening in the pricing choices of retail ISP services. The optimal method for addressing retail UBB is a robust competitive environment in which it is consumer ability to switch providers in the event they are dissatisfied with UBB that serves as the primary safeguard against unreasonable UBB practices.

In many respects, the current debate resembles the early battle over net neutrality in Canada.⁵¹ Indeed, substitute the words video streaming, Netflix, and heavy users for peer-to-peer, BitTorrent, and file sharers and the discussion points are virtually identical. Net neutrality advocates maintained that fears about traffic shaping practices and preferential treatment of incumbent ISP content were the product of an uncompetitive marketplace that required regulatory intervention. Incumbent ISPs argued that there was no need for CRTC involvement since a market-oriented approach was sufficient to address any public concerns.

The CRTC ultimately adopted guidelines that ensured that Internet traffic management is not a free-for-all.⁵² It rejected arguments that the market would ensure ISPs provide adequate disclosure on how they manage their networks. Instead, it mandated full disclosure of traffic management practices, including information on when they occur, which applications are affected, and their impact on Internet speeds. Moreover, it adopted a new test to determine reasonable traffic management practices. Where a consumer complains, ISPs are now required to describe their practices, demonstrate their necessity, and establish that they discriminate as little as possible.

⁵¹ "Battle over 'net neutrality' arrives in Canada", CBC News, <http://www.cbc.ca/news/technology/story/2006/11/02/tech-neutrality.html>.

⁵² ITMP, *supra*, note 15.

a. IBUMPs – Transparency and Disclosure

Given the current competition concerns and the fears that the UBB could be used for uncompetitive purposes, the CRTC should consider new guidelines for retail UBB - Internet Billing Usage Management Practices (IBUMPs) - expanding on the CRTC's Internet Traffic Management Practice guidelines.

Much like the ITMPs, the IBUMPs would include a comprehensive transparency requirement so that consumers can better understand the limits of their service and reliably track their monthly Internet usage. While ISPs already provide some tracking tools, they have proven unreliable with admissions that there have been errors.⁵³ The CRTC's ITMP decision appears to adopt the position that monthly usage bills provide sufficient transparency to Canadian consumers.⁵⁴ Yet the incumbent ISPs have also sowed some marketplace confusion with marketing that breeds consumer uncertainty about what their data plans actually provide in practice.

Marketing materials often overstate the benefits of data plans by citing unusually compressed and shorter MP3 music or video files to suggest that consumers can download far more than is likely to be the case.⁵⁵ Similarly, discussions often conflate streaming video with downloaded video, leaving consumers with the mistaken impression that they can access hundreds of hours of video each month.⁵⁶ This claim may only be true for low-definition streaming, not for downloaded video from various commercial services.

If UBB is to remain part of the retail Internet access landscape, the transparency and public disclosures must improve. The CRTC should adopt similar requirements as those found with ITMPs to ensure that consumers are better informed about the benefits and limits of their capped services.

b. IBUMPs – Reasonableness

Much like the ITMPs, greater transparency and disclosures are a necessary but not sufficient step to address current concerns. The ITMP process also led to guidelines designed to ensure that ISP traffic management practices are reasonable. The CRTC's basic test for acceptable ITMPs was as follows:

When an ISP is responding to a complaint regarding an ITMP it has implemented, it will use the ITMP framework. In doing so, the ISP shall:

⁵³ See e.g., “Bell admits internet metering problem”, CBC News, <http://www.cbc.ca/news/technology/story/2011/02/09/technology-bell-internet-usage.html>.

⁵⁴ ITMP, *supra*, note 15.

⁵⁵ For example, Rogers currently warns consumers that estimates on video and song downloads are subject to “The times specified are approximations and will vary depending on size and quality of content” without providing specific information for the basis of the advertised claims.

⁵⁶ Mirko Bibic, “Pay for Usage”, Financial Post, <http://opinion.financialpost.com/2011/02/03/pay-for-usage/>.

Describe the ITMP being employed, as well as the need for it and its purpose and effect, and identify whether or not the ITMP results in discrimination or preference.

In the case of an ITMP that results in any degree of discrimination or preference:

- *demonstrate that the ITMP is designed to address the need and achieve the purpose and effect in question, and nothing else;*
- *establish that the ITMP results in discrimination or preference as little as reasonably possible;*
- *demonstrate that any harm to a secondary ISP, end-user, or any other person is as little as reasonably possible; and*
- *explain why, in the case of a technical ITMP, network investment or economic approaches alone would not reasonably address the need and effectively achieve the same purpose as the ITMP.⁵⁷*

The ITMP second-level analysis is limited to instances of discrimination or preference. Although UBB may raise discrimination or preference issues, particularly for competing video products, many UBB plans do not. Applied to the issue of retail UBB, the establishment of an IBUMP policy would ensure that retail UBB is reasonable in light of network congestion concerns and marketplace conditions. It could include the following four conditions.

First, CRTC approval for UBB has long been focused on addressing network congestion. Indeed, incumbent ISPs now argue that the use of UBB is related to congestion concerns and the need for fairness among all subscribers. In the case of a complaint about UBB retail practices, ISPs should be required to demonstrate that the UBB approach is designed to address specific network congestion concerns.

Second, the UBB model should be the least restrictive possible to achieve its intended goals. Much like ITMPs, this may mean giving consumers the option for accounts that are rate-limited after a certain monthly cap is reached instead of imposing overage charges (as noted above, many ISPs around the world have adopted this approach).

Third, if the ISP has implemented traffic shaping or other technical measures, it should be required to demonstrate why those approaches alone would not reasonably address the same network congestion concerns. This requirement is a mirror image of the ITMP requirement that envisions ISPs relying on network investment or economic ITMPs (ie. UBB) rather than technical ITMPs such as traffic shaping. If traffic shaping is in place, ISPs should be required to explain why that has not adequately addressed the network congestion concerns.

Fourth, while the CRTC should not engage in reviews of the retail pricing or size of monthly data caps, it should, under certain circumstances, be entitled to examine overage

⁵⁷ ITMP, *supra*, note 15, at para 43.

charges should ISPs use this economic model (as noted above, many ISPs around the world rate limit rather than impose overage charges). The review of overage charges would only occur in local markets where both the cable and DSL provider employ UBB, thus leaving consumers with limited non-UBB alternatives. In such instances, the CRTC should review overage charges to allow for a reasonable profit but establish safeguards against price gouging in light of actual ISP costs.

The IBUMP approach would provide additional guidance the CRTC neglected to provide in the ITMP decision. That decision recognized that guidance on reasonable traffic management practices could co-exist with a largely unregulated retail Internet services market. The same decision left economic ITMPs largely unregulated, effectively giving the Commission's blessing to UBB. Given recent marketplace developments, it is increasingly clear that was a mistake. Much like the ITMP decision, the Commission should not dictate pricing models, but it should ensure that pricing models are transparent and that those premised on addressing network congestion do so in the least restrictive manner possible.

iii. Fostering Greater Competition

In recent months, there has been considerable public discussion about the benefits of relaxing telecom foreign ownership restrictions as a solution to the competition concerns.⁵⁸ The days of retaining Canadian control over physical telecommunications infrastructure connected to millions of homes are over. The notion that Canadian control guarantees Canadian jobs is part of a by-gone era. Canadian carriers regularly outsource some of their customer service jobs out of the country. Meanwhile, other parts of the organization - retail and business sales as well as network building - involve jobs that will remain in Canada regardless of a company's country-of-origin. While some head office jobs may be at risk, new companies operating in Canada could potentially create more jobs, not fewer.

Beyond the jobs issue, concerns that a foreign competitor will not abide by Canadian law are unfounded. Foreign companies obviously operate in Canada all the time and compliance with local laws - whether privacy requirements, environmental regulations, or reporting obligations - are simply a cost of doing business. There is no reason to believe that a local telecom company is any more likely to comply with Canadian law than a foreign competitor.

Foreign ownership restrictions should be dropped, but there are several reasons why no one should be under the illusion that opening the doors to foreign competitors will solve the competition problems with Canadian broadband. First, the "last mile" will remain a major problem. There may be some willingness by new entrants to lay fibre in urban areas, but it is unlikely to extend much beyond that. Second, the foreign competitors may be just as likely to purchase Canadian companies, rather than investing in new facilities,

⁵⁸ Bea Vongdouangchanh, "Clement top priority: making \$40-billion telecommunications industry more competitive", Hill Times, <http://www.hilltimes.com/page/printpage/clement-03-14-2011>.

yielding deep pocketed competitors but less in the way of new facilities. Third, the foreign ownership issue is most relevant in the wireless context, where the forthcoming spectrum auction⁵⁹ may provide the best hope for new competitors as consumers "cut the cord" and opt for anywhere connectivity that offers reasonable (though not fibre-like) speeds.

The prospect of wireless broadband competition is hugely important - the forthcoming spectrum auction may represent the best case for new competition - and the government policies on that auction (open access requirements for device interoperability, set asides for new competitors, open to foreign bidders, white spaces) are absolutely crucial.

Opening the door to foreign competitors is a necessary but not sufficient step to address the competition problem. At the federal level, the current Canadian broadband programs should be expanded to address both access and competition. To date, the programs have been geared primarily toward providing access to the communities that still do not have broadband. Ensuring all Canadians have access to broadband networks remains essential, but Canada must also begin to transition toward a second policy goal - encouraging new business models, particularly community-based fibre initiatives that hold the promise of new local competition. Providing federal support for innovative approaches might help the business case for new ventures and lessen the risk associated with establishing new facilities. The government's condition on financial support for new local fibre initiatives should be open access requirements - the fibre gets laid, but it is openly available to all competitors.

The federal government should ask CANARIE⁶⁰ to identify local community networks that would benefit from connecting to its broadband backbone as well as support experimental broadband deployments. The U.S. has embarked on something similar, allocating \$60 million in stimulus funds toward USUCAN. That project is described as follows:

*The United States Unified Community Anchor Network (U.S. UCAN) is a new national project dedicated to connecting community anchor institutions, including public libraries, schools, community colleges, research parks, public safety and health care institutions with advanced broadband capabilities. Utilizing the Internet2 Network and in collaboration with regional research and education networks across the country, U.S. UCAN will enable these anchor institutions to serve their communities with telemedicine, distance learning and other life-changing applications not possible with commercially available Internet services.*⁶¹

The federal government can also play a role in promoting new community fibre network initiatives by provincial and municipal governments. Indeed, some of the most competitive Internet access environments come from cities that seized the issue and

⁵⁹ Industry Canada, Press Release, Minister Clement Updates Canadians on Canada's Digital Economy Strategy (Nov. 22, 2010), <http://www.ic.gc.ca/eic/site/ic1.nsf/eng/06096.html>.

⁶⁰ See generally CANARIE, <http://www.canarie.ca/>.

⁶¹ United States Unified Community Anchor Network, <http://www.usucan.org/>.

developed a strategy for fostering high speed open access networks.

For example, the City of Stockholm founded the Stokab system in 1994 after the federal government passed a law with the objective of developing a "sustainable information society for all."⁶² The Stokab network now has thousands of km of cable that is openly available to all competitors. That has led to 90 operators and service providers along with hundreds of additional customers. It is working with building developers to link new developments to the network - it will connect each building to the network and the developer establishes a network within the building. Tenants are then able to choose from several providers. The city has announced plans to provide fibre connections to 90 percent of all households by 2012.⁶³

Measures to spur greater competition is essential, but it will realistically take several years before new competitors can make their mark on the market. In the meantime, it is also crucial to addressing the potential for abuse. The Competition Bureau has not been active on this issue, despite the potential for serious anti-competitive behaviour as the incumbent ISPs could use their position to favour their own content or create economic incentives that favour services such as their own video-on-demand over Internet based alternatives. The Bureau should aggressively investigate abusive behaviour as well as questionable marketing tactics.

The lack of competitiveness of Canadian Internet access is the product of ten years of policy neglect. While it may be true that there are hundreds of independent ISPs, the practical reality for most Canadian consumers is that they see little alternative beyond a single cable provider and a single DSL provider. Moreover, there is little product differentiation between the two dominant providers with similar pricing, data plans, and data caps. The widespread use of data caps in Canada is a function of a highly concentrated market where a handful of ISPs control so much of the market that they can impose wildly unpopular measures without much fear of losing customers. Addressing public concerns over ubiquitous UBB plans therefore requires more than just a quick regulatory fix. It demands a broader public strategy designed to foster a more robust competitive environment for Internet access services in Canada.

⁶² Prop. 2004/05:175 Från IT-politik för samhället till politik för IT-samhället (Swed.).

⁶³ ITU News, A Look at Digital Cities, <http://www.itu.int/net/itunews/issues/2010/04/36.aspx>.

Appendix A – Comparative Global Internet Access Services, March 2010

Market	ISP	Offers unlimited data plans?	Details if cap:
Australia	BigPond (Telstra)	No ⁶⁴	No additional usage charges. All plans include rate limiting that slows speeds once usage allowance is reached. No peak or off-peak restrictions. Offers BigPond Unmetered which offers entertainment content that does not count toward monthly usage limit.
Australia	Optus	No ⁶⁵	No additional usage charges. All plans include rate limiting that slows speeds once usage allowance is reached. Plans include peak and off-peak caps.
Australia	iiNet	No ⁶⁶	No additional usage charges. All plans include rate limiting that slows speeds once usage allowance is reached. Plans include peak and off-peak caps.
Chile	VTR	Yes ⁶⁷	n/a
Chile	Movistar	Yes ⁶⁸	n/a
France	Orange	Yes ⁶⁹	n/a
France	Free	Yes ⁷⁰	n/a
France	Teleconnect	Yes ⁷¹	n/a
Germany	T-Home (Deutsche Telekom)	Yes ⁷²	n/a
Germany	1und1	Yes (both	Rate limited: after exceeding the data cap on the

⁶⁴ <http://go.bigpond.com/broadband/>

⁶⁵ http://personal.optus.com.au/web/ocaportal.portal?_nfpb=true&_pageLabel=Template_woRHS&FP=/personal/internet/nakedbroadband&site=personal

⁶⁶ <http://www.iinet.net.au/broadband/plans.html>

⁶⁷ <http://vtr.com/productos/principal/internet/index.php>

⁶⁸ http://www.movistar.cl/PortalMovistarWeb/appmanager/PortalMovistar/portal?_nfpb=true&_pageLabel=P10001010511291900031885&itemSeleccionado=4&

⁶⁹ <http://abonnez-vous.orange.fr/residentiel/forfaits/decouverte.aspx>

⁷⁰ https://adsl.free.fr/cgv/brochure_tarifaire_28122010.pdf?0.07150634494610131

⁷¹ <http://www.teleconnect.fr/Pages/Internet/Internet.aspx>

⁷² http://www.telekom.de/is-bin/INTERSHOP.enfinity/WFS/EKI-PK-Site/de_DE/-/EUR/ViewProductDetails-Start:sid=AmoUS9KsuB4US5_Nk1Eb_9mpvdxtycttcFz9DEKNIXPCgZ2cmf8lithclXPCgQ==?CatalogCategoryID=jqYFC7IS4T0AAAEdU7cMVfLJ&ProductRefID=0110001000058%40EKI-PK&StageProductRefID=0802101000948_0007%40EKI-PK

		limited and unlimited plans available) ⁷³	limited plans, download speed reduces from 16,000 kbps to 1,000 kbps.
Germany	Kabeldeutschland	Yes ⁷⁴	n/a
Hong Kong	Hong Kong Broadband Network	Yes ⁷⁵	n/a
Iceland	Siminn	No ⁷⁶	Users are notified by SMS or email when they exhaust their cap. Extra bandwidth is available for 1600 kr for 10 GB or 5040 kr for 50 Gb.
Iceland	Vodafone	No ⁷⁷	Only data that originates from outside Iceland counts against the cap; “all data downloaded domestically is unlimited without any extra cost.” Users are notified as they approach the download limit. When the limit is reached, Vodafone “cap[s] the usage” so the customer is not billed. The user can also purchase 5 GB extra for 990 kr [\$5.33 CAD].
India	Bharat Sanchar Nigam Limited	Yes (both limited and unlimited plans are available) ⁷⁸	BSNL offers a wide variety of plans, both with and without data limits. Limited plans are available that are either rate-limited (ie download speed slows after exceeding the cap) or that incur per MB charges for exceeding the cap.
Japan	NTT	No ⁷⁹	900 GB cap on upload only
Japan	KCN	Yes ⁸⁰	n/a
Malaysia	TM Streamyx	Yes (though with an ambiguous Fair Use Policy) ⁸¹	n/a
Malaysia	PersiaSys	Yes ⁸²	n/a

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http://dsl.lund1.de/xml/order/DslLeistungsuebersicht.jsessionid=1E146AAECAEF54E3318F7A85B73BEF44.TCpfix168b?_frame=_top&_lf=Einstieg&linkOrigin=DslEinstieg&linkId=hd.tab.tarifve_rgleichkomplett&linkType=txt

74 http://www.kabeldeutschland.de/static/media/Preisliste_Internet_und_Telefon.pdf

75 https://apply.hkbn.net/orp/eng/orp_nc_step2_plans.jsp

76 <http://www.siminn.is/einstaklingar/netid/verd/nanar/store466/item106478/>

77 <http://www.vodafone.is/en/internet>

78 <http://210.212.169.201/erp/bbplan.php?action=N>

79 Losey, supra, note 44.

80 *Id.*

81 <http://www.tm.com.my/ap/personal/internet/broadband/Pages/standardpackages.aspx>

82 <http://www.persiasys.com/>

Malaysia	Maxis	Yes (both limited and unlimited plans available)	For the limited plans, exceeding the allowed bandwidth incurs a charge of 5 sen / MB
Mexico	Telmex	Yes (both limited and unlimited plans are available) ⁸³	Some plans are advertised as having data caps. However, even the unlimited data plan appears to be covered by the following Fair Use Policy: “Furthermore, in order to protect the quality of the Service, you acknowledge and agree that it may: (i) terminate any SESSION INTERNET when failure to detect the use thereof by the CUSTOMER, (ii) limit the volume of data transferred and (iii) limit time periods, according to the modality of the service.” ⁸⁴
Mexico	Telecable	Unknown – Telecable does not advertise its data usage policy. ⁸⁵	?
Nigeria	JuniSat	Yes (both limited and unlimited plans are available) ⁸⁶	Only incoming traffic counts against the cap for the limited plans. Consequences of exceeding the limit are unclear.
Nigeria	CobraNet	No ⁸⁷	Cobranet uses McWiLL wireless technology. Most plans have data limits; some, however, have unlimited data but limited time.
New Zealand	Actrix	No ⁸⁸	When the bandwidth cap is exceeded, the customer has a choice: “rate limited”, in which there is no extra charge, but the speed is reduced to that of dial-up; or the user can pay \$2 (NZD) per gigabyte.
New Zealand	Telecom	No ⁸⁹	When the bandwidth cap is exceeded, the customer has a choice: “rate limited”, in which there is no extra charge, but the speed is reduced to that of dial-up; or the user can pay \$2 (NZD)

⁸³ <http://www.maxis.com.my/personal/broadband/packages.asp>

⁸⁴ http://www.telmex.com/mx/hogar/pdf/pt_descarga.jsp?a=Terminosycondiciones-Infinitum.pdf

⁸⁵ <http://www.telecable.net.mx/internetPrecios.aspx>

⁸⁶ http://www.junisat.com/index.php?option=com_content&task=view&id=46&Itemid=48

⁸⁷ <http://www.cobranet.org/ugoz.php?id=3>

⁸⁸ <http://www.actrix.co.nz/page.php?id=144>

⁸⁹ <http://www.telecom.co.nz/totalhomebroadband/details?pid=int091>

			per gigabyte.
Philippines	PLDT	Yes ⁹⁰	n/a
Philippines	Digitel	Yes ⁹¹	n/a
Russia	Koptevo.net	Yes (both limited and unlimited plans are available) ⁹²	For the limited plans, users are charged a fee for each MB of excess usage.
Russia	_____ (CentroSet)	Yes (both limited and unlimited plans are available) ⁹³	For the limited plans, users are charged a fee for each MB of excess usage.
Russia	MegaBistro	Yes (both limited and unlimited plans are available) ⁹⁴	For the limited plans, users are charged a fee for each MB of excess usage.
South Korea	SK Broadband	Yes ⁹⁵	n/a
Singapore	SingNet	Yes ⁹⁶	n/a
United Kingdom	BT	Yes (both limited and unlimited plans available ⁹⁷)	Users receive a usage notice after reaching 80% of their cap. The first month one exceeds the cap, nothing happens; the second month, the user is charged £5 per 5GB.
United Kingdom	Virgin Media	Yes ⁹⁸	n/a
United Kingdom	CCS Leeds	No. ⁹⁹	Data cap applies only to “peak” period usage (peak period is generally 8 am – midnight weekdays). Users may choose between “top-up” packages or paying per GB. Top-up packages are: 10Gig for £10.38, 25Gig for £24.98, 50Gig for £49.00, 75Gig for £73.00 and 100Gig for £95.95. Without a top-up the price is £1.31 per Gigabyte.

⁹⁰ <http://myworldmydsl.com/plan.aspx>

⁹¹ <http://lec.digitel.ph/content/view/60/88/>

⁹² <http://www.koptevo.net/index.php?alias=uslugi>

⁹³ <http://centroset.ru/texts.php?way=159&id=159>

⁹⁴ <http://megabistro.ru/view/services/9/docs/14.html>

⁹⁵ <http://www.skbbroadband.com/eng/iproduct/evalley.asp>

⁹⁶ http://www.singnet.com.sg/plans_and_services/broadband/snbb.asp?snbb=15Matl

⁹⁷ http://www.productsandservices.bt.com/consumerProducts/displayCategory.do?categoryId=CON-TOTAL-BB-R1&s_cid=con_FURL_broadband

⁹⁸ <http://shop.virginmedia.com/broadband/compare-broadband-packages.html>

⁹⁹ <http://www.ccsleeds.co.uk/residential-dsl.html>

United Kingdom	Breathe	Yes ¹⁰⁰	n/a
United States	Comcast	No ¹⁰¹	250 GB data cap
United States	Verizon	Yes ¹⁰²	n/a

Country	Are unlimited plans available at all?
Australia	No
Chile	Yes
France	Yes
Germany	Yes
Hong Kong	Yes
Iceland	No
India	Yes
Japan	Yes
Malaysia	Yes (although with ambiguous Fair Use Policy)
Mexico	Yes (although with ambiguous Fair Use Policy)
Nigeria	No
New Zealand	No
Philippines	Yes
Russia	Yes
South Korea	Yes
Singapore	Yes
United Kingdom	Yes
United States	Yes

¹⁰⁰ <http://www.breatheinternet.com/>

¹⁰¹ Losey, supra, note 44.

¹⁰² *Id.*

Appendix B – Estimating the Cost to Transfer 1 GB of Data Based on Bell's Network Costs

Unredacted information about total costs and total subscriber numbers for Bell's proposals for funding broadband expansion to underserved communities from the deferral account is available. Three separate sets of data were disclosed in 2010, representing different designs for the access network. Bell's preferred option is based on High Speed Packet Access (HSPA) technology. Other options investigated included a pure DSL technology option and a hybrid option, combining both technologies.

i. Raw Data

The raw data for this analysis are taken from Table 2, which is reproduced from the public record of proceedings related to the disposition of funds in the deferral account.¹⁰³ The table was part of an economic study filed by Bell in support of its proposal to use deferral account funds to cover the shortfall between the cost of this proposed network expansion and the revenues that would be derived from it. It represents an essentially new network, including both access network and backbone segments. Since Bell is attempting to justify its claim that, without deferral account funds, this project would be uneconomical, the study adopts a comprehensive approach to costs.

However, some of the cost inputs have been redacted. In particular, the entry for Costs Causal to the Program, which covers expenses such as advertising and billing costs, is not directly itemized. Note 4 in that Table indicates these costs have been included in the uneconomic costs. Specifically, the sum of the uneconomic costs plus the revenues must equal the total costs, including the capital and costs causal to the program. Bell has also included an amount to cover the loss of revenue from dial-up customers switching to the new broadband service. From Table 2, the total cost of the program, including the dial-up cross impact is \$498,345,813.82.

Table 1 presents a higher level summary, comparing three slightly different proposals. It has been organized in a different way. Here, the total cost is reported as \$494 M, and the dial-up cross impact is not included. From this, we can conclude that \$494 M figure includes the costs causal to the program. This figure therefore represents the cost that is of interest for this analysis.

¹⁰³ Bell Aliant/Bell Canada, "Response to Interrogatory The Companies(CRTC)9Mar10-506 DA- Attachment- Appendix 1" (30 March 2010), CRTC File No 8638-C12-200817505 at para. 18 online: CRTC <http://www.crtc.gc.ca/public/partvii/2008/8638/c12_200817505/1376452.zip>.

	Proposed HSPA Solution (\$M)	DSL-Only Scenario (\$M)	Hybrid Scenario (\$M)
Capital (including replacement)	#	#	#
Costs Causal to the Program (Capital & Expense)	#	#	#
Expenses	#	#	#
Total Cost	\$ 554	\$ 494	\$ 508
Less: Broadband Revenues (Note 2)	\$ 94	\$ 92	\$ 93
Dial Internet Service Cross Impact	#	#	#
Uneconomic Cost before Contingency (Note 3)	\$ 463.6	\$ 407	\$ 419
Plus: Contingency (10%)	(Note 4)	\$ 41	\$ 42
Uneconomic Cost	\$ 463.6	\$ 447	\$ 461

Table 1: Summary of Results Estimated Present Worth of the Companies' Broadband Expansion Program Over the 15-Year Study Period (2010\$)

Number of approved communities (Note 1)	112
Number of premises passed (Note 2)	61,369
Number of subscribers (end of 2024) (Note 3)	41,048
PWAC Broadband Capital and Expenses (2010 \$)	\$489,587,262
PWAC of Broadband Backbone Capital (2010 \$)	#
PWAC of Broadband Access Capital (2010 \$)	#
PWAC of Broadband IP Core Capital (2010 \$)	#
PWAC of Broadband Expenses (2010 \$)	#
PWAC Costs Causal to the Program (2010 \$)	#
PW of Broadband Revenues (2010 \$)	\$91,823,281
PW of Dial Internet Service Cross Impact (2010 \$)	#
PW of Uneconomic Cost (2010 \$) (Note 4)	\$406,522,533
Total Upfront Capital Expenditures (CapEx) (Note 5)	\$277,050,827
Upfront CapEx per premise passed	\$4,515
Upfront CapEx per subscriber (based on number of subscribers at end of 2024)	\$6,749
Notes:	
1. The number of communities approved for the program by the Commission.	
2. Eligible lines (premises passed) located in the approved communities.	

<p>3. Estimated number of broadband subscribers located in the approved communities at the end of the 15-year study period (in 2024).</p> <p>4. PW of Uneconomic Cost is equal to PWAC Broadband plus PWAC Costs Causal to the Program minus PW of Broadband Revenues minus PW of Dial Internet Service Cross Impact.</p> <p>5. Total Upfront Capital Expenditures include Upfront Capital Expenditures per Community plus Upfront Capital Expenditures Causal to the Program.</p> <p># Filed in confidence with the CRTC.</p>	
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Table 2: Bell Canada and Bell Aliant's Proposed Broadband Expansion Program Deploying DSL Technology - Summary of Results

ii. Service Roll-out

The economic study assumed a progressive service roll-out over a finite period of time. The precise details about number of customers have been redacted.

It was assumed that # of the potential residential subscribers would actually subscribe to the retail broadband service in Year 1, growing to # by Year 5 and levelling out at a constant # in Years 10 to 15.¹⁰⁴

Bell's model is based on a rising subscription base over ten years, followed by a constant level for the remaining five. It is not clear from the redaction whether the growth is linear, or exponential; nor whether the reference to the Year 5 level represents a change in the pattern at that point. Some assumptions are therefore necessary.

A simple working assumption is that the growth is linear, and that there is only one slope (m) over the ten year period.

$$N_{t=1} = N_1 \quad (1)$$

$$N_{t=2..10} = N_1 + \sum_{t=2}^t m, \quad (2)$$

$$N_{t=10..15} = N_{max}, \quad t \geq 10 \quad (3)$$

N_{max} is a known quantity. N_1 and m can therefore be related.

$$m = \frac{N_{max} - N_1}{9} \quad (4)$$

The model assumes a constant average revenue per subscriber:

For the same communities, the Average Revenue Per Unit (ARPU) for each residential and business subscriber over the 15-year study period was derived as follows: the monthly rate of \$31.95 plus \$2.50 per Gigabyte (GB) of additional usage, assuming # GB of additional usage per month, less the

¹⁰⁴ Bell Aliant/Bell Canada, "Response to Interrogatory The Companies(CRTC)9Mar10-506 DA-Attachment" (30 March 2010), CRTC File No 8638-C12-200817505 at para. 18 online: CRTC <http://www.crtc.gc.ca/public/partvii/2008/8638/c12_200817505/1376452.zip> [footnotes omitted, redactions per original].

*\$5.00 Bell Bundle discount per subscriber per month. The average monthly usage of # GB per customer is based on the average customer usage metrics associated with the Companies' Internet Essential Plus service in Ontario for the January to December 2009 period. The revenues generated from the application of the \$35.00 one-time activation fee are included in the calculation of the total revenues.*¹⁰⁵

The average overage charges are an unknown parameter. However for a given annualized revenue per subscriber R, and an annual interest rate of i, the present value of revenues can be computed.

$$PV_R = \sum_{t=1}^{15} \frac{R \sum N_t}{(1+i)^t} \quad (4)$$

Although it is not entirely clear what interest rate should be applied, the study does specify an average cost of capital of 8.47%.¹⁰⁶ It seems reasonable to adopt this value for all present value calculations.

PV_R is a known quantity.¹⁰⁷ Using equation (3), (4) and (1) can be solved for N₁, using the goal seek function in a spreadsheet. This allows the number of subscribers to be computed for each year of the study.

iii. Network Usage

Knowing the number of subscribers allows for a model prediction of network usage. Assuming a monthly cap of C, and an average monthly overage O, predicted total usage U is:

$$U = \sum_{t=1}^{15} 12 C N_t + O N_t \quad (5)$$

However, it must be noted that this quantity may not be of much interest, since it depends on cap thresholds that are not obviously related to network properties. In the present study, C is known to be 2 GB/month. O is unknown, but is likely to be less than 1 GB/month, based on the following redacted discussion.

As noted in the response to The Companies(CRTC)28Jan10-2 Decision 2008-1, based on the usage levels of the Companies' Essential Plus-Ontario customers who can only realize a maximum of 2 Mbps of download speed, the usage of the majority of customers (#) does not, on average, exceed the 2 GB monthly usage. Further, of the # of Essential Plus-Ontario customers whose usage exceeds the 2 GB monthly usage allowance, about one third (i.e., only # of customers) only used one extra GB per month.

¹⁰⁵ *Ibid* at para. 22 [redactions per original].

¹⁰⁶ *Ibid*, Table 2.

¹⁰⁷ The revenue figure must be adjusted to remove the activation fees of \$35/subscriber that have been included in the model. However, on the assumption that the model includes no subscriber churn, this is just a fixed offset of \$1,436,685.53.

*The Companies anticipate that only a small proportion of customers in the approved communities will have high monthly usage levels. As a result, the 2 GB monthly usage allowance will satisfy the vast majority of customers.*¹⁰⁸

Usage of 3 GB per month, on a 2 Mbps download/800 Kbps upload line, represents only 0.336% of the theoretical line capacity.

The communities in question are presently underserved specifically because the revenue that would be obtained in serving them is not enough to fund the cost of the network. It is therefore of little surprise, and of little use, to discover that the cost per GB obtained by dividing the total cost by that small usage figure is quite high: in the range of \$10-\$40/GB.

Figure 1 shows the result of solving the subscriber numbers in equation (4) for revenues based on 0 to 5 GB of usage above the 2 GB cap. Total traffic is then computed by summing the average traffic per user over the subscribers, over the study period. Cost per GB of usage is computed by dividing the total cost by the total usage

This merely confirms that Bell has modelled an unprofitable network. However this is plainly not a reflection of the costs of network operations, generally. If it was, Bell would not be in the business of providing network services at all.

Given a fixed total cost, there is an inverse relationship between traffic levels and cost per GB. Figure 2 shows the cost per GB if total traffic is computed as a fraction (labeled as Utilization) of the advertised link capacity of 2 Mbps download/800 Kbps upload, with the number of subscribers determined as per Figure 1. However this is only meaningful to the extent that the network is capable of sustaining the traffic. Although, in proposing to fund this project primarily from the deferral account, Bell is not really spending its own money, it nonetheless seems unlikely that it would provision backhaul links that can carry 300 times the predicted average traffic levels unless it needs to. It is therefore necessary to estimate the aggregated carrying capacity of the network links included in the study.

¹⁰⁸ Response to Interrogatory The Companies(CRTC)9Mar10-106 DA at 2 [redactions per original].

Figure 1: Cost/GB in low-usage scenario

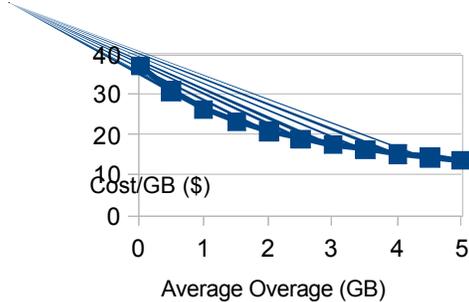
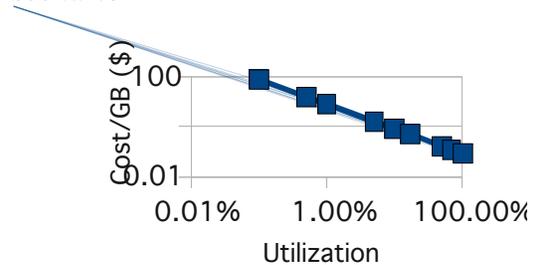


Figure 2: Cost/GB in high-usage scenario



iv. Network Capacity and Usage

Bell's proposed network architecture for the project is complex, but relatively typical of a DSL-based network. It involves a multi-tied backbone architecture linking serving Central Offices (COs) to the existing Core network, and in some cases extension feed lines (which may be copper or fibre-optic) from serving COs to remote Digital Subscriber Line Access Multiplexers (DSLAMs), and local copper loops from the DSLAMs to the subscriber premises.¹⁰⁹ The proposal contemplated using existing facilities where possible, or building new where necessary. Consequently, the precise path linking any given subscriber to the core would vary from community to community.

In order to estimate the total capacity of the proposed network, two simplifying assumptions are necessary. First, it will be assumed that subscribers are uniformly

¹⁰⁹ See e.g. Bell Aliant/Bell Canada, "Broadband Expansion Proposal" (1 September 2006), CRTC File No 8638-C12-200602708 at 22-26, online: CRTC <http://www.crtc.gc.ca/public/partvii/2006/8638/c12_200602708/662133.zip>.

distributed among the 112 wire centres involved, such that each represents an equal traffic load. Table 3 summarizes the average properties of each wire centre. Second, it will be assumed that each wire centre is served by a single CO, with a fibre-optic link to the Core network.

subscribers	41048
wire centres	112
subscribers/ wire centre	366.5
DL bandwidth/subscriber (Mbps)	2
UL bandwidth/subscriber (Kbps)	800
Total wire centre DL demand (Mbps)	733
Total Wire centre UL demand (Mbps)	286.33

Table 3: Wire Centre summary

Under these assumptions, the properties of the backhaul links will determine the overall capacity of the network. Three hypotheses will be considered: OC3 (155 Mbps), OC12 (622 Mbps), or OC48 (2500 Mbps), each of which will be assumed to be operating in full duplex mode. Each will be restricted to 80% of theoretical capacity, to reflect Bell's typical working fill factor.¹¹⁰ Table 4 summarizes the traffic characteristics of these links, if each subscriber link was 100% saturated both in uplink and downlink, 100% of the time. The contention ratio indicates the extent to which the capacity of the access network exceeds the capacity of the backhaul link. Where the ratio is 1:1, the traffic on the backhaul is determined entirely by the load of the access network. Otherwise, the backhaul is capped at the target 80% of maximum.

As can be seen in the table, an OC3 would be oversubscribed both in uplink and downlink capacity, while an OC48 would be overprovisioned in both. The intermediate case of an OC12 is oversubscribed in downlink, by a contention ratio of 1.47:1, but is overprovisioned in uplink.

Total usage over the 15 year period must therefore reflect this upper limit on network capacity. This has been included by computing annual usage based on the $N(t)$. The model assumption is that annual usage rises with the number of subscribers until the backhaul saturates. Any subsequent increase in subscribers does not result in any increase in potential traffic.

¹¹⁰ See e.g. Bell Aliant/Bell Canada, "Response to Interrogatory The Companies(CRTC)20Aug09-7 TN 242 & 7181", CRTC File No 8740-B2-200904989 at 3, online: CRTC <<http://www.crtc.gc.ca/public/8740/2009/b2/1281758.zip>>. However, note that Bell's thresholds run as high as 90% in some instances. http://www.crtc.gc.ca/public/partvii/2008/8622/c51_200805153_1/926702.zip para. 71.

	OC3	OC12	OC48
Half-duplex (Mbps)	155	622	2500
80% fill (Mbps)	124	497.6	2000
DL contention	5.91:1	1.47:1	1:1
UL contention	2.31:1	1:1	1:1
DL/month (GB)	39806.54	159739.8	235308.94
UL/month (GB)	39806.54	91917.55	91917.55
Traffic/month (TB)	77.75	245.76	319.56

Table 4: Backhaul traffic

v. Per GB Network Costs

Table 5 summarizes the effective cost per GB of traffic within networks (not for Internet transit) under a variety of scenarios. Cases B through F are based on the total cost of \$498M, representing the pure DSL scenario, with differing total usages. Case B computes the number of subscribers from the solution to Equation (4) with 1 GB/month of average overage. Case C uses the same method, but assuming 0 GB average overage. Case D assumes identical usage to Case C over the first 10 years, but then assumes that the number of subscribers continues to grow until, at year 15, all premises that could receive the service are subscribers. Case E assumes that all premises are subscribers for the entire study period, with no ramp-up in numbers. Case F representing maximum possible usage (and therefore lowest possible costs per GB) assumes the backhaul is fully saturated over the entire study period. Finally, Case A uses the higher costs (\$554 M) associated with the HSPA deployment, with the same usage as in Case B.

case	OC3	OC12	OC48	Notes
A	\$0.3452	\$0.1192	\$0.1007	HPSA costs; usage per Case B
B	\$0.3078	\$0.1063	\$0.0898	subscribers assuming 1 GB overage
C	\$0.3078	\$0.1016	\$0.0844	subscribers assuming 0 GB overage
D	\$0.3078	\$0.0980	\$0.0759	more subscriber growth
E	\$0.3078	\$0.0825	\$0.0501	max subscribers, no roll-out
F	\$0.3078	\$0.0767	\$0.0191	saturated backhaul

Table 5: Cost per GB Capacity

It is difficult to know with precision which, if any, of these scenarios best reflects average network costs, across the country. First, it must be recognized that the costs are not actually independent of the choice of backhaul links. Consequently, the variation of up to an order of magnitude reflects a real uncertainty in these estimates, rather than alternatives that can be selected. At best, the assumptions about the choices in the network design are educated guesses. Second, the 80% saturation may vary, as Bell has indicated that its thresholds for existing networks range as low as 61% to as high as 90%. Significant variation on either end would naturally increase or decrease per GB costs.¹¹¹

Indeed, the scenario of a completely new construction project involving remote communities, may significantly inflate the costs, when compared to on-going expansion of capacity in existing networks. Without more information, it is impossible to know how well this would offset the inflated estimate of network capacity. However, if the growth in subscriber numbers is viewed as a proxy for growth in traffic demand from a stable subscriber base, this model may nonetheless provide a conceptually reasonable estimate. In any case, it would seem to be the best estimate—or range of estimates—that can be obtained from this data.

vi. Alternative Capital Model – Cost Estimates With More Typical Capital Expenditures

As noted in Table 2, Bell's model for this project included an upfront capital expenditure (CapEx) of \$4,515 per premise passed. This value is unusually high, reflecting the increased cost of construction in reaching low density populations. Table 6 canvases the range of CapEx per premise passed reported for a variety of Next Generation Access Networks, worldwide. Note that in some cases costs have been reported as per subscriber, rather than as per premise passed. For the sake of comparison, a conversion

¹¹¹ “Link utilization measurements are taken every 15 minutes, however these figures hide the instantaneous traffic peaks that can be higher than actual measured utilization. This is highlighted by the fact that latency and dropped packets occur well below 100% link utilization. Bell Canada has developed thresholds for each type of link using the same methodology:

DS-3: 61%;
OC-3: 84%; and
OC-12 and OC-48: 90%.
[...]

The Company is able to actively monitor congested links in order to take appropriate action to resolve the problem. For a link to be considered congested today, the threshold must have been exceeded at least once on 5 or more different days of a 14 consecutive day period. Bell Canada believes that this approach to measuring and identifying congestion in its network is consistent with the methodology used by many other service providers throughout North America and the UK.”

http://www.crtc.gc.ca/public/partvii/2008/8622/e51_200805153_1/926702.zip

para. 71.

factor of 2/3 was applied, which corresponds to the approximate take rate in Bell's model. (That is for 60k premises passed, Bell forecasts 40k subscribers.)

While reported costs clearly vary significantly based on factors such as choice of technology, network architecture, labour cost and population density, none of the reported costs are remotely close to Bell's value. Canada will likely be on the high-end of the cost spectrum based on both labour costs and population density. However the worst case scenario based on Table 6 is the New England network modelled by the Telemarc Group, which suggests a plausible upper limit of around \$2000 per premise.¹¹² In reality, since Canada is highly urbanized and network builds will concentrate on the high-density areas, true deployment costs may well be similar to the ~\$1000-\$1500 per premise range that seems to be typical of other industrialized countries. It must also be noted that these figures are mostly for FTTx networks. Lower capacity VDSL, DOCSIS 3.0 and 4G networks should be somewhat cheaper to build, while still providing a significant upgrade relative to the 5-10 Mbps access networks that are widely deployed in Canada, currently.

Network Type and Location	Source and Year	CapEx per Premise Passed
FTTx deployment, Central and Eastern Europe	Analysys Mason, 2010 ¹¹³	\$100-\$800
DOCSIS 3.0 upgrade of existing cable network, US	Columbia Institute for Tele-Information, 2009 ¹¹⁴	\$70-\$100
Verizon FiOS (FTTP), US	Tellabs Inc., 2006 ¹¹⁵	\$825-\$1000
FTTP, Vermont & New Hampshire (low density)	The Telemarc Group, 2006 ¹¹⁶	\$1500-\$2300 (\$2000-\$3500 (USD) per subscriber)

¹¹² By comparison, Australia's NBN is \$2,700 per premise passed, which includes the satellite and fixed wireless build. See p. 134 NBN Co Limited (2010). *Corporate Plan 2011 – 2013*. <http://www.nbnco.com.au/wps/wcm/connect/main/site-base/main-areas/publications-and-announcements/latest-announcements/nbn-co-corporate-plan-released>.

¹¹³ "Central and Eastern Europe" (2010), online: Analysys Mason <http://www.analysismason.com/Research/Content/Reports/RDTW0_FTTx_roll-out_forecast_Aug2010/Sample-pages/>.

¹¹⁴ Robert C Atkinson & Ivy E Shultz, *Broadband in America: Where It Is and Where It Is Going (According to Broadband Service Providers)* (New York: Columbia Institute for Tele-Information, 2009) at 22, online: Columbia University <http://www4.gsb.columbia.edu/null/download?&exclusive=filemgr.download&file_id=7212786>.

¹¹⁵ Bruce Ross, "Challenges Operators Face in Deploying FTTX" (2006) at 12, online: Commsday <http://www.commsday.com.au/Archive/2006/presentations/Bruce_Ross_Tellabs.ppt>

¹¹⁶ Terrence P McGarty, "Fiber to the Home; Capital Costs and the Viability of Verizon's FIOS" (2006) at 21, online: The Telemarc Group <http://www.telmarc.com/List_By_Date/2006%2009%2001%20FTTH%20Capital%2001.pdf> [McGarty].

Network Type and Location	Source and Year	CapEx per Premise Passed
VDSL, UK	CSMG, 2007 ¹¹⁷	~ \$700 (£670 per subscriber)
FTTP, UK	CSMG, 2007 ¹¹⁸	~ \$1075 (£1030 per subscriber)
FTTB, Athens	Athens Information Technology, 2007 ¹¹⁹	\$1250
Generic WiMAX deployment	Huawei, 2009 ¹²⁰	\$400 (\$600 USD per subscriber)
FTTP, Japan	Institute for Information and Communications Policy, 2006 ¹²¹	~ \$1200 (¥158,000 per subscriber)
Generic Next Generation Access, France	Caisse des Depots, 2011 ¹²²	Dense urban: \$270-\$540 (200€-400€) Non-Urban: \$1350-\$1625 (1000€-1200€)
WiMAX, India	Beyond 4G, 2010 ¹²³	\$160-\$550 (\$240-\$800 USD per subscriber)
DSL, India	Beyond 4G, 2010 ¹²⁴	\$350-\$800 (\$500-1200 USD per subscriber)
FTTH, Netherlands	Reggefiber, 2011 ¹²⁵	~\$1350 (~1000€)

Table 6: Estimates of CapEx per Premise Passed for various networks

Bell's model predicts \$277 M in total CapEx, which represents approximately 56% of the total costs of the project. It is a simple matter to calculate an adjusted cost by scaling this CapEx value. Figure 3 presents the variation of cost per GB with CapEx, based on the same assumptions as in Case B of Table 5. However, as noted above, 80% utilization of

¹¹⁷ CSMG, "Broadband Comes of Age: Bandwidth-intensive Video" (2007), online: TMNG Global <<http://www.tmng.com/print/236>>.

¹¹⁸ *Ibid.*

¹¹⁹ Siamak Azodolmolky & Ioannis Tomkos, "Techno-Economic Study of a Modeled Active Ethernet FTTB Deployment" (2007) at 4, online: The Universitat Politècnica de Catalunya <http://personals.ac.upc.edu/siamak/articles/CSNDSP08_v0.8.pdf>.

¹²⁰ Li Zheng, "Fast track to the broadband market", (2009) 48 Huawei Communicate 19 at 20, online: Huawei <<http://www.huawei.com/publications/view.do?id=5853&cid=10809&pid=61>>.

¹²¹ Keisuke Takachi & Hitoshi Mitomo, "Estimating the Cost of Nationwide Optical Fiber Network Development in Japan: A Step toward a Cost-Benefit Analysis of the Fiber-to-the-Home Initiative" (2006) at 11, online: Institute for Information and Communications Policy <<http://www.soumu.go.jp/iicp/chousakenkyu/seika/pdf/2006-01.pdf>>.

¹²² He_lide_o Costa Elias, "When and why PPPs are an option for NGA ?" (Presentation delivered at Rome, 15 February 2011) at 2, online: European Investment Bank <<http://www.bei.org/epec/resources/presentations/nga-roundtable-costa-elias.pdf>>.

¹²³ BP Tiwari, "State and Opportunity of Broadband in India" (2010) at 12, online Beyond 4G <<http://www.beyond4g.org/whitepaper-state-and-opportunity-of-broadband-in-india>>.

¹²⁴ *Ibid.*

¹²⁵ Mark Meijer, "Financing FTTH Networks in Netherlands" (Presentation delivered at the FTTH Conference, Milan, 8 February 2011) [unpublished], online: Slideshare <<http://www.slideshare.net/ceobroadband/ftth-conference-2011-workshop-mark-meijer>>.

the backhaul may not be a supportable assumption. Figure 4 therefore repeats the calculation with the backhaul traffic limited to only 15% of theoretical capacity, reflecting reported utilization levels of backbone segments. Table 7 summarizes the results.

With the exception of the case of the OC3 link limited to 15% capacity, which is highly oversubscribed, the results indicate a range of \$0.05-\$0.30. This is consistent with Table 5, which would tend to confirm that this is the best estimate available.

Given that the installation labour is substantially more expensive than the material, it seems rather unlikely that Bell would lay new fibre with less than 48 strands. In fact, 96 strand cable is slightly cheaper, per strand-mile. The Telemarc model of the New England FTTH network assumes 48 strand fibre throughout, except for single strand drops to the house.¹²⁶ Construction costs per mile are approximately \$17.6k, vs. \$2.6k material cost per mile for the fibre.¹²⁷ This tends to support a result near the low end of the range.

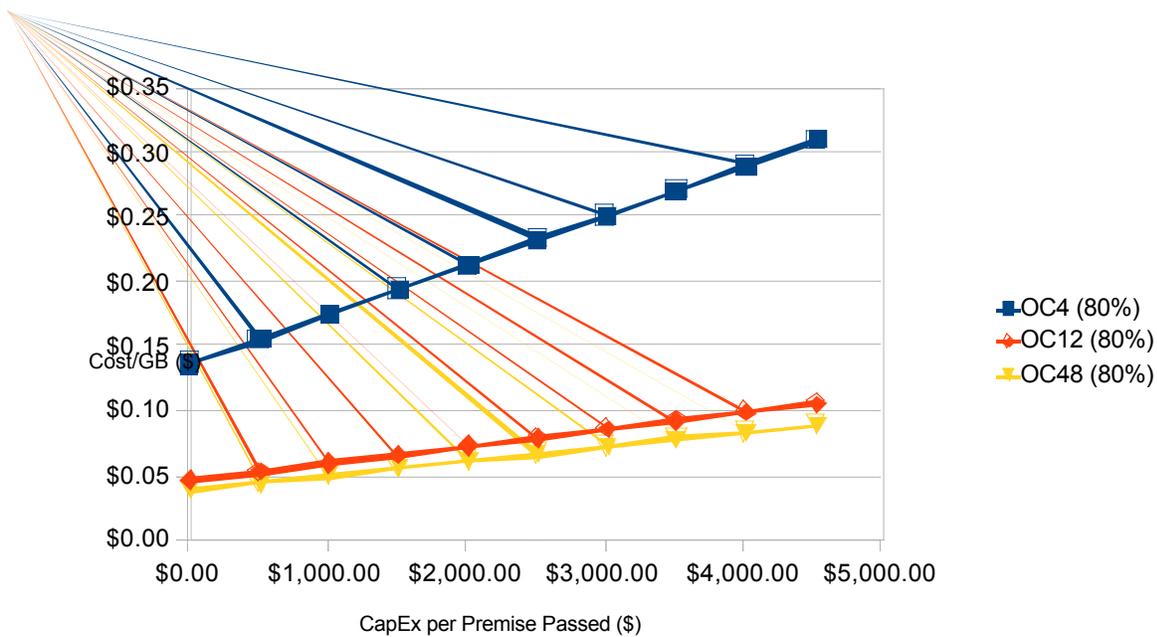


Figure 3: Cost/GB, max 80% utilization of backhaul links

¹²⁶ McGarty, *supra* note 116 at 18-19.

¹²⁷ *Ibid.*

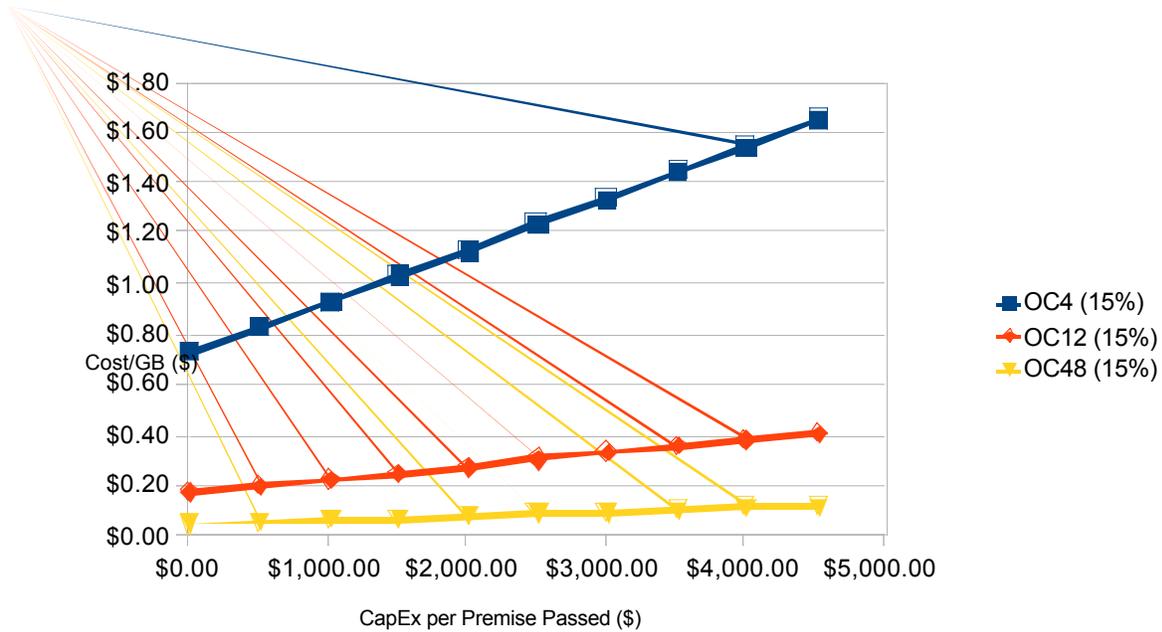


Figure 4: Cost/GB, max 15% utilization of backhaul links

CapEx Per Premise Passed	\$500.00	\$1,000.00	\$1,500.00	\$2,000.00
OC3 (15%)	\$0.8373	\$0.9393	\$1.0412	\$1.1432
OC12 (15%)	\$0.2087	\$0.2341	\$0.2595	\$0.2849
OC48 (15%)	\$0.0635	\$0.0712	\$0.0789	\$0.0867
OC3 (80%)	\$0.1570	\$0.1761	\$0.1952	\$0.2144
OC12 (80%)	\$0.0542	\$0.0608	\$0.0674	\$0.0740
OC48 (80%)	\$0.0458	\$0.0514	\$0.0569	\$0.0625

Table 7: Cost per GB capacity, variable CapEx

Bell may well prefer to leave some of the installed fibre dark for future use. So it is not possible to rule out the low-capacity alternative. And it is noteworthy that the resulting estimate of up to \$1.15/GB is comparable to Ericsson's published estimate of the end-to-

end costs of HSPA networks.¹²⁸ Nonetheless, an installed-base of dark fibre would simply provide a low cost path to scale up the backhaul capacity, as needed. Moreover, there is no reason to presume that an underprovisioned link would be limited to 15% of its actual capacity. On the contrary, the low-capacity link is much more likely to be saturated.

So, in the long run, the low end of the range would again seem to be the better estimate as demand for peak bandwidth increases. Consequently, while there is a range of plausible values, a comparison of Tables 5 and 7 suggests a figure of \$0.07/GB may be the best single estimate for the costs of the internal network.

¹²⁸ Ericsson claims 0.92€/GB, all-in. See “Don’t worry – Mobile broadband is profitable” (2009) 2009:2 Ericson Business Review 54 at 56, online Ericsson <http://www.ericsson.com/ericsson/corpinfo/publications/ericsson_business_review/pdf/209/209_BUSINESS_CASE_mobile_broadband.pdf>.