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Usage Based Billing for Internet Access and The Future of the Internet

By Roland Renner

What it means for:

- how Canadians will watch video and how much they will pay,
- rebuilding the last mile of the telecommunications networks connecting households to the Internet,
- access to the next generation of telecommunications services.

About the Author

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Executive summary

The paper recommends that the policy and regulatory structure should be consistent with technology advancements, allowing Canadians full access to Internet video and other new services and the opportunity to participate in new service developments.

Bell Canada proposed Usage Based Billing (UBB) as a solution to congestion in the network caused by Internet video users. There are several reasons why this implementation of UBB is inappropriate.

- Bell's UBB proposal has no peak component. Without a pricing element, the Bell UBB pricing proposal is not an effective way to shift demand and manage congestion.
- Bell did not propose to implement the same pricing structure for its Internet Protocol TV (IPTV) service, which delivers video packages using Internet technology. Cable and satellite video are not priced this way either.
- Based on an analysis of publicly available information, the price set for usage beyond the new download cap is vastly greater than costs.
- If managing congestion were the primary issue, construction of new facilities to meet demand would be a component of the overall response.

For these reasons, it appears that Bell is using its dominant market power in the last mile to discourage customers from switching to Internet video in favour of its IPTV system, to delay replacing the old last mile technology and to maintain revenue by changing the pricing structure.

This paper explores the connections between the UBB issue and other major telecommunications questions currently being debated in regulatory and policy circles. A brief review of telecommunications network technology developments and the change from a monopoly to a competitive environment is included here to provide the background information needed to assess the core issues.

These issues are:

- how Canadians will watch video and how much they will pay,
- rebuilding the last mile of the telecommunications networks connecting households to the Internet,
- access to the next generation of telecommunications services.

Regulatory jurisdiction is appropriate in this case because the telco (telephone company) and cableco (cable company) incumbents (incumbent refers to the original monopoly service provider) still have important market power in the last mile. Also, to build the access facilities, municipalities granted critical rights of way (ROW) to these companies when they were monopoly service providers. Now that new technology enables competitive access solutions, it is suitable to revisit the terms and conditions of ROW access. This is similar to the earlier rulings that required the telephone companies to provide competitors with physical access to their switching facilities.

The replacement of obsolete facilities in the last mile of the telecom networks is needed to enable the next generation of Internet and telecom services. How will this be done, when will it be done, who will be served and who will not?

Will the incumbent cable and telephone companies maintain their dominant market power in this network segment into the next generation of services or will the last mile be rebuilt to enable competitive access, releasing the creative forces that have brought about new services and capabilities?

Telecom is a strategic enabler of economic development, making the answers to these questions important for public policy. In the United States, for example, the Federal Communications Commission wants to see 100 million homes with access to 100 Mbps service.

Telecom has the potential to enable Canadians living in rural and remote parts of the country to participate more fully in economic opportunities. What kind of rural broadband access policy is appropriate for next generation services?

The technology choices to replace the last mile include some that will continue the dominant market power of the incumbents and others that will provide for competitive service providers, completing the evolution that has been occurring for the past 30 years. Given that much of the creativity of the past few years has come from new participants such as Google, Facebook, Skype, Netflix and RIM and not from the incumbent telcos and cablecos, it is important that the replacement of the last mile be subject to debate in the public forum and not left for the incumbents to decide on their own. The paper reviews options for replacing the last mile and recommends those that favour customer choice and competition.

For customers, UBB presents a big price increase for watching Internet video. For service providers, customers who drop their video subscriptions are a major loss of revenue. For the Canadian Radio-television and Telecommunications Commission (CRTC) and the Canadian film and video production industry, customers who use Internet video bypass the elaborate system of promotion of Canadian content. While the Commission has been monitoring the growth of Internet video for many years and has already made some adjustments, the recent rapid growth of Internet video threatens the existing regulatory structure. This may tempt some segments in the production sector to support measures that hold back the trend to Internet video.

> ***… it is important that the replacement of the last mile be subject to debate in the public forum and not left for the incumbents to decide on their own.***

Introduction

Why is UBB Important?

Canadians have been changing the way they watch video. Ten years ago, watching video over the Internet was possible, but the quality was poor. Viewers saw a little box in the middle of the screen, and the audio was often out of sync with the video. Downloading was painfully slow and streaming video was full of artifacts (the blocks that appear in a digital video signal just before it stops or crashes) and interruptions.

Today, many consumers watch video over the top, meaning through their Internet Service Provider (ISP), and not through a cable, satellite or IPTV package. In the United States, Netflix downloads are generating the largest growth in Internet traffic.

University and college students sharing apartments for the first time are no longer chipping in for a cable connection. They watch their video online, share their favourite YouTube clips, and upload their own clips to their Facebook pages. They may not even bother getting a TV. Grandparents are sending videos of their grandchildren to relatives in China. Videoconferences, predicted as a coming new service since the mid 1980s, are finally happening in large numbers over Skype. Cable or satellite take-up rates for families moving into new sub divisions, apartment buildings and condos are falling from the historical 90 per cent plus to as low as 50 per cent. All this video requires more bandwidth and higher speeds than residential Internet users have typically required in the past.

This paper recommends that the policy and regulatory structure should be consistent with technology advancements, allowing Canadians full access to Internet video and other new services and the opportunity to participate in new service developments. The paper reviews options for replacing the last mile connecting households to the network and recommends those that favour customer choice and competition.

Bell, one of the largest Internet Service Providers, responded to higher Internet video use with Usage Based Billing (UBB), which consists of critical changes to its pricing structure for Internet access. Other large ISPs have publicly discussed following Bell's lead. This UBB proposal reduces ceilings for the number of Gigabytes (GB) of data that a customer can download within the monthly flat rate price, and it adds charges for additional GB over the new ceilings. Effectively, this means that Bell reduced the amount of video that a customer can watch over the Internet, and it requires an additional charge for exceeding the cap.

Under the UBB proposal,[1] a customer who previously paid $40 per month for high speed or broadband access that included a limit of 60 GB per month would be allowed only 20 GB with a $5 additional charge for every five additional GB. While customers who downloaded less than 20 GB would see no change in their bill, customers who downloaded 40 GB in a month would pay the original $40 plus $20 for the 20 GB over the new ceiling.

This is a hefty price increase for higher volume customers. Is this a fair reflection of the cost of serving these customers and, if so, why was the change proposed now and not before? What other consequences could result from UBB?

Why is this a public policy issue rather than a matter for competitive market forces to sort out? The rationale for any intervention exists because telcos (telephone companies) and cablecos (cable companies)[2] have dominant market power in the last mile of the network connecting to customers. This means that the market for this component of the network is not competitive, and under Canadian law, the terms and conditions of service are regulated by the CRTC. The last mile will be explored in more detail later.

This paper explores the connections between the UBB issue and other major telecommunications issues that are currently being debated in regulatory and policy circles.

These issues are:

- how Canadians will watch video and how much they will pay,
- rebuilding the last mile of the telecommunications networks connecting households to the Internet,
- access to the next generation of telecommunications services.

To understand and explore the impact of UBB on these policy areas, the next section of this paper will describe the telecom infrastructure, the services, the evolution of the industry from monopoly service providers to generally competitive markets, and the current participants in Canada. It defines important acronyms and terms that are needed to describe the industry and the services, but it stays at a general level in order to make the main points clear to a general audience.

Readers with an understanding of the telecom sector will recognize that there are exceptions to the general statements and are asked to accept these generalizations to make the subject easier to understand. It addresses the network from the perspective of the residential household customer and not business services, which has important differences.

The paper also deliberately uses the more generic term "customer" instead of the typical industry use of "subscriber" "sub" or "user." "Telecom" is used in this paper to mean all telecommunications services including voice, video and Internet.

> ***"The rationale for any intervention exists because telcos and cablecos have dominant market power in the last mile of the network..."***

The Infrastructure – Telecom Network Fundamentals

This is a brief introduction to the main concepts. Readers with no background in this subject should read Appendix A, which expands on the topic. Tutorials are available on the net for those who are interested in more detail.[3] The incumbent telco network is described first. Cable networks have important differences.

The telco network consists of terminal equipment (telephones, televisions and computers), inside wiring, local loops, switches and routers and fibre optic transmission capacity.

The customers own the terminal equipment, also called Customer Premises Equipment (CPE), and the inside wiring to the demarcation point at the outside of the house where the telco takes over.

The local loop, a more traditional telco term for the last mile, consists of a pair of copper wires that go from the demarcation point to the central cffice. In many cases, loops are collected at intermediate points where the signals are converted to more advanced technology and transmitted to the central office in bulk.

Asynchronous Digital Subscriber Loop (ADSL) technology enables the copper pairs to carry the amount of data needed for Internet access and video distribution. This consists of the 4”x6”x1” box that customers install when they buy Internet access from a telco, along with associated equipment installed by the telco at the central office.

From the central office, the telco uses routers or switches to direct the information over high-speed fibre optic transmission facilities toward the end destination. Fibre optic transmission has vastly more capacity than earlier transmission technology. This is why the capacity to provide Internet and video exists, and it is also why long distance telephone services are available across the country for a monthly flat rate with no cap and no additional usage charges.

Cablecos used coaxial cable (the cable that attaches to your television is a coaxial cable) to deliver video signals from the headend, where the signals were collected, to customers in a one-way network. With improvements in technology and demand for more video, the cablecos installed digital compression technology. This brought customers new set-top boxes and established the foundation for two-way cable networks. As cablecos expanded and merged into Multiple System Operators (MSOs), they connected the networks using fibre optic technology, invested in long haul transmission capability and competed with telcos for long distance services.

The cable network had the capacity to provide Internet access service using DOCSIS (Data Over Cable Service Interface Specification) and this enabled the cablecos to compete for local phone services using Voice over Internet Protocol (VoIP) technology.

The Last Mile

This is an important concept in the discussion of UBB because incumbent telco and cablecos have dominant market power in the last mile. It is important to understand why this is so. There are two last miles. For telcos, it is still copper. For cablecos, it is coaxial cable, which has far more capacity than copper but far less than fibre optic. In some cases, telcos have installed fibre beyond the central office to local concentrators or pedestals where the traffic is translated back from optical to electronic signals for final transmission to the homes.

The replacement of the last mile or building a third one is expensive. This is not only because the technology is more expensive but also because whole neighbourhoods have to be converted at the same time. This involves negotiations with municipalities, gas, water and hydro companies that share rights of way (ROW), and trenching in established areas. The telcos and cablecos made the original investments in the copper loops and cable distribution system when they were regulated monopolies. Their pricing policies were subject to regulatory review and approval and municipal governments dealt with them as any other public utility. A new competitor would require many years to build these relationships and the knowledge of local conditions required to build a third last mile.

The business case for installing fibre is clear when dealing with the transmission of massive amounts of data across the country on a few strands. It is less clear when the traffic density and potential revenue is smaller the closer the investment is made to the individual household.

Will the existing customers take up new services and make use of the additional capacity in a way that pays for the upgrade? A potential competitor contemplating installing a third last mile would have to estimate how many customers will migrate to its new service and how quickly. Will 30 per cent or 40 per cent change or only 10 per cent? The competitor has to spend a great deal of money before offering services and generating revenue.

The terminology used to describe the extension of fibre optic technology to residential homes is called Fibre to the Home (FTTH). Intermediate steps have also been taken. FTTC means Fibre to the Curb. FTTP means Fibre to the Pedestal or Fibre to the Premise. FTTX is more generic, meaning Fibre to the Whatever.

There are examples of successful competitive FTTX builds. These are generally in greenfield[4] subdivisions or urban apartment buildings and are often connected to local real estate developments and expertise. There are also FTTX builds by incumbent telcos and cablecos. In general, however, the last mile still consists of old copper or coaxial cable technology that needs to be replaced for next generation services to really take hold.

The Services

> ***Many people have discontinued their home phone service altogether*** *and rely on mobile cellular service...*

Twenty years ago, telcos provided local telephone service and long distance services. They also provided private line services and data communications services to larger businesses. Cablecos delivered video services. Direct Broadcast Satellite (DBS) and Direct to Home satellite (DTH) were just beginning (DirecTV services in the United States started in 1994). The Internet existed, but it was not yet a consumer service. Mobile cellular service was on the rise but still a relatively expensive business service on the verge of major inroads into the consumer market.

Today, local and long distance telephone services continue to be important, but prices are low. In many cases, they are provided through the Internet using VoIP technology. Many people have discontinued their home phone service altogether and rely on mobile cellular service that also provides texting and mobile Internet browsing. While mobile bypasses the last mile, it connects back into the terrestrial telecom networks for long haul transmission.

The Internet provides e-mail, browsing and other services including video. Cablecos, with some exceptions, consist of large MSOs that compete with DTH providers (Bell TV and Shaw Direct) to deliver video packages that conform to the regulatory structures of the CRTC.

Household Expenditure

Consumers often purchase telecom services in bundles that can include home phone, a long distance package, Internet access, a video package and mobile. For the whole bundle, customers pay from a low of about $120 per month to $280 or more.

Expenditure can be considerably higher if a household has several mobile phones or subscribes to premium video services or uses Pay per View or Video on Demand. At the high end, this amounts to $3,360 per household per year. A large part of this revenue is the video component.

Table 1: Household Telecom Expenditure (per Month)

	Low	High
Home phone	20	30
Long Distance	20	30
Mobile	30	100
Internet	40	50
Video	30	100
Sobtotal	140	310
Bundle Discount	20	30
Total	120	280

Customers are abandoning traditional cable and satellite video packages in large numbers and watch video on the Internet instead. The impact on revenue is huge. Since downloading video is bandwidth intensive (lots of transmission capacity is needed compared to e-mail, still images or text), charging by the GB is one way to recover the lost revenue and to discourage migration from traditional video services.

> ***Customers are abandoning traditional cable and satellite video packages in large numbers...***

Evolution of Competition

This section is included because some incumbents have brought into the debate the importance of the investments they have made in the telecommunications system, which, they say, makes them more important contributors than the competitors who are opposing UBB. The implication is that the incumbents know best and will make the right decisions regarding pricing and investments in new technology.

A review of the evolution of competition, however, shows that competitors at each stage brought new ideas and new services and dramatically changed the telecommunications system. Incumbents often missed major developments and have had to catch up with the front runners after new markets and services were established.

No one party owns the current inter-connected network of networks, although individual companies own important pieces of it. There are many owners.

Monopoly Telephone and Cable Companies

Telecom has evolved from geographically defined monopolies to interconnected competitive industries for most parts of the sector. In Canada, before 1979, there were monopoly telephone companies that provided end-to-end services and owned all of the network components including the black dial telephone in every customer's home.

In British Columbia and most of Ontario and Quebec, the telephone company was shareholder-owned (BC Tel and Bell Canada respectively) and regulated through a process called rate base, rate of return, which limited the profit the company could make and set prices accordingly. The rationale for this structure was that the industry was a natural monopoly, which meant that under competition, the industry would always end up being owned by one company. Therefore, the government accepted the monopoly, but it regulated the company to prevent abuses of monopoly market power.

In Alberta, Saskatchewan and Manitoba, the provincial governments owned the telephone companies. This occurred because the governments and the voters thought that the shareholder-owned companies were not building telephone service in rural areas quickly enough. The distance between farm households increased the cost of providing telephone service in comparison to more densely populated areas. Since telephone service was so important for safety and economic development, the governments created AGT (Alberta Government Telephones),

Sask Tel and MTS (Manitoba Telephone System) with mandates to serve rural areas as well as the cities. The rural economic development argument for public ownership of the telephone companies was a major driver of public policy.

In the Maritimes, the telephone companies were organized on a provincial basis, but eventually Bell Canada owned a majority of the shares. The provincial governments also held shares and there was special legislation limiting Bell's ownership rights.

Pricing policy was established to promote market take up of telephone service. Local service prices were set at a low flat monthly rate (below the cost of service). Long distance prices were set well above cost to make up the difference. In the early days of telephony, this made sense for the telcos because more customers meant that their existing customers got more value from their phones, and it made it more attractive for the holdouts to subscribe. This was the classic cross subsidy in North American telephony: The construction of local distribution capacity is expensive, so charge an artificially low price for local service and make it up by charging higher prices for long distance services. Later, telcos generated additional revenue from so-called vertical services such as colour phones, designer phones, extension phones, call waiting and voice mail.

This policy accounted for the superior performance of telephony in North America compared with Europe and most other jurisdictions. In North America, almost everyone could afford telephone service. In Europe, until the 1970's, the government controlled telephone service as a military strategic asset. Ordinary people might have a phone if the government felt like providing it, but this was not a priority.

While service quality was better in some countries than in others, the whole continent was plagued with long wait times that could extend to years for service installation, poor service quality and high prices, including charges for local calls (a form of UBB). Europe exported its version of telephony to its colonies, condemning them to generations of poor telephone service as well. The situation was broken up by the arrival of mobile.

The cablecos were established to bring more television stations to Canadian homes as early as the 1950s, and they were very successful growing rapidly in the 1960s. Bell turned down an early opportunity to get into this business. Industry legend has it that the executives could not imagine that there was a need for more than two or three channels. This was not the first or the last time that the established companies missed the market opportunities provided by new technology.

The cable companies, usually founded by groups of local business people, were licensed and regulated by the government because they, too, were monopolies, albeit in smaller geographic zones.

"In North America, almost everyone could afford telephone service. In Europe, until the 1970's, the government controlled telephone service as a military strategic asset."

Competition for Terminal Equipment

In the late 1970s, the predecessor of the CRTC began regulatory proceedings that gradually opened more and more sectors of the telecommunications industry to competition. The first sector was the terminal equipment. This took some time and debate. The telcos argued that they should continue to own all terminal equipment for reasons of network integrity, security and safety. The government did not agree and mandated third party and customer owned terminal connection as long as the terminal equipment met industry standards.

Long Distance Competition by Resale

Resale of long distance service was the next element of competition brought into the system. The reseller leased bulk capacity from the incumbent telco and then sold competitive long distance service using those facilities. By operating at lower cost and providing innovative service packages and a wider range of service quality choices, resellers gained market share in the lucrative long distance market. Call-Net, which later became Sprint Canada, was one of the early successful resellers. Both parties had to develop procedures, under regulatory supervision, for the incumbent telcos to transfer customers to the resellers.

Long Distance Competition Using Independently Owned Facilities

Long distance competitors using their own facilities to transmit calls between central offices came next. Unitel, owned by CNCP, and Rogers, was the first licensed entrant. In this case, the new competitors and the incumbent telcos had to work out procedures to transfer traffic to the competitors' facilities and manage the interconnection points between the two. Competitors required physical access to central offices and substations.

Internet Service Providers

The U.S. Defense Advanced Research Projects Agency (DARPA) created the Internet for U.S. military purposes. From there, the Internet expanded to the universities, where students were exposed to it. Demand began to grow for access in workplaces and residences. As user interfaces improved, more and more people took advantage of the Internet, and companies such as AOL and CompuServe were established to specialize in providing Internet access to households using the residential phone line. A host of small ISPs sprang up to provide this dial-up service. These began to merge and larger organizations such as iStar and PSINet were established. Eventually, the telcos decided this was serious business, and they set up their own services such as Bell's Sympatico.

Browsers such as Explorer and Netscape and search engines such as Yahoo and Google, and new applications such as Facebook and Twitter, were established. The reason for going through this brief summary of Internet development is to show that the incumbent telcos or the cablecos were not owners, inventors or key developers of the Internet at any stage of its development. They jumped on board long after the market was established, leaving room for the growth of new multi-billion dollar companies and a host of smaller ones. This was true on both sides of the Canada-U.S. border. This is an important factor to keep in mind when arguments are made based on ownership of networks or past investments in facilities.

Skype is an excellent example of an Internet start-up company that succeeded in creating a business model where the big telcos had failed. Since the 1980s, telcos have tried to find ways to sell videoconferencing to businesses as a way to save travel costs, but they were unsuccessful. The telcos made the prices for videoconferencing high and usage sensitive, i.e. they charged by the number of connections and by the minute.

Skype began by adapting VoIP technology to provide a service that allowed anyone connected to the Internet to have a voice conversation with anyone else connected to the Internet—no home phone, no long distance charges. Among other enhancements, Skype developed audio conference calls and then video conference calls. Both have proved highly successful. Skype, using a completely different revenue model, made videoconferencing successful, not the telcos, not the cablecos. Many customers use Skype video calls for personal calls, many for business calls. Videoconferencing uses much more bandwidth than audio, and this will count toward the monthly download cap for residential subscribers.

Local Telephone Service Competition

Local telephone service competition using the existing technology attracted few entrants. The large margins that had existed in long distance were not available in local. Cablecos, independent ISPs and resellers became competitors in local service using VoIP technology, riding on the deployment of the Internet.

> ***…the incumbent telcos or the cablecos were not owners, inventors or key developers of the Internet at any stage of its development.***

The Network Today

The cablecos consolidated and have become major participants in long distance competition, Internet access, and finally local telephone service as well.

The network is no longer a single network owned by a single company. It is an interconnected network of networks with multiple participants and multiple owners and contributors. The terminology has adapted accordingly. When people want to represent traffic going to the general Internet network, they represent it as going into a cloud. Companies trade capacity, sometimes through independent brokers such as Arbinet.

A request for a download can travel over facilities owned by many different companies, and the download itself may take a different route back. Subsequent requests may be directed to high capacity computer servers that store popular downloads and are located close to customer population centres, reducing the need to transmit them over long distances.

The old pricing structures have also disappeared. As competitors lowered prices on long distance services and the incumbents responded by doing the same, the ability to subsidize local services disappeared.

Under the impact of new technology, the old long distance pricing systems, charging by time and distance, have been largely replaced by unlimited usage packages that cover a province, a region, all Canada, or all of Canada and the United States. This is a case of a service that had been, but no longer is, priced by usage. Costs and prices have fallen to such an extent that people in the industry say, "The marginal cost of a minute of long distance is essentially zero." The resellers and then the facilities based competitors introduced new pricing plans with different structures. The incumbents kept their loyal residential customers under the old pricing systems as long as they could.

> ***Until the recent Bell proposal, Internet access services have been priced on a monthly flat rate basis.***

The Participants Today

Telco

Bell (Including Bell Aliant) – Local and long distance telephony, video via satellite and IPTV, ISP and mobile. Is the incumbent in most of Ontario, Quebec and the Maritimes. Is a competitor in four Western provinces.

Telus – Local and long distance telephony, video via IPTV, ISP and mobile. Is the incumbent in British Columbia and Alberta. Is a competitor elsewhere.

SaskTel – Local and long distance telephony, video via IPTV, ISP and mobile. Is the incumbent in Saskatchewan.

MTS Allstream – Local and long distance, telephony, video via IPTV, ISP and mobile. Is the incumbent in Manitoba. Is a competitor elsewhere.

Cable

Rogers – Local and long distance telephony, video via cable, ISP and mobile. Is the incumbent in Ontario and Newfoundland. Is a competitor in mobile across the country.

Shaw – Local and long distance telephony, video via cable and satellite, ISP and mobile. Is the incumbent in British Columbia and Alberta. Owns Shaw Direct satellite and is starting mobile.

Videotron – Local and long distance telephony, video, ISP and mobile. Is the incumbent in Quebec.

Cogeco – Local and long distance telephony, video via cable, ISP and mobile. Is the incumbent in parts of Ontario and Quebec.

Independent ISPs

There are 500 independent ISPs, a few of which are of considerable size such as Primus. Many own some of the facilities they use while some are pure resellers. Most also provide local and long distance telephony services, usually using VoIP. ISP's using Digital Subscriber Line (DSL) technology are dependent on telcos to deliver service over the last mile to their customers. The following table provides a sample of independent ISPs according to the technology used. Some ISPs provide service using more than one technology.

Independent Internet Service Providers (Sample)

DSL	Fibre	Fixed Wireless	Satellite
Alberta High Speed	CitéNet	I-Netlink	C-Com
Auracom	Fibrenoir	Manitoba NetSet	Galaxy Broadband
Bike Networks	Novus	Xplornet	Infosat
Blink Broadband	Urban Networks	YourLink	Virgin Technologies
CanNet			
Caneris			
CopperNET			
Future Link			
Leopard Networks			
Montreal-DSL			
Navigata			
NetWest			
Novus			
Primus			
Radiant Communications			
Storm			
Teksavvy			
TeraGo			

Ownership of Content

Bell, Shaw, Rogers and the owners of Videotron have also bought heavily into broadcasters and specialty channels. The Shaw family owns the Corus group, Shaw Cablesystems owns Global, Bell owns CTV, and Rogers owns CHUM, OMNI, Citytv, Sportsnet and specialty channels. Videotron is connected through its ownership structure to TVA and other content properties in the Quebec market. As both video providers and ISPs, there is a conflict of interest, generally described as self-dealing or undue preference, in selecting content for their video services. It also gives them the opportunity to give preference to their own content on the Internet. By traffic shaping or throttling, slowing down traffic if certain routes become congested, these ISPs can reduce the quality of competing content while maintaining high quality for their own content. The CRTC has put restrictions in place to deal with this issue, but the practical impact and effectiveness of these measures are questionable.

UBB – Impact and Alternatives

The UBB proposal

Bell announced the UBB proposal as a means of dealing with congestion in the network, whereby heavy users of the Internet pay more than light users. It promoted and justified the proposal as eminently reasonable in the same way that, for example, people pay for more soft drinks if they want more soft drinks. In the increasingly competitive telecom market, Bell argued, it should be able to price its services as it wishes. The proposal also required resellers to use Bell's pricing structure.

The second component of the UBB proposal generated the strongest political backlash. The public seemed to accept that there is some logic to the usage concept and that the critics, to some extent, appeared to be demanding something for nothing—unlimited use of the Internet for a fixed monthly fee. Imposing the same pricing structure on the competing ISPs went beyond a pricing change, however, and it has been perceived as anti-competitive behaviour and interfering with the ISPs right to set their own prices for their customers. This aspect of the proposal was subsequently withdrawn, leaving the issue of the UBB to Bell's end user customers.

Problems with the Bell UBB Proposal – No Network Peak Usage Component

The UBB proposal does not contain a network peak usage component. Buying Internet access is not like buying soft drinks. Buying Internet access is more like buying electricity. It is a network service and the network must be built to handle peak demand or the service will be unreliable during the very times when the most people need it. In the electricity market, this means brownouts and blackouts. In the telecom world, it means network busy signals and downloads that slow to a crawl.

If the objective of the pricing structure is to manage and reduce congestion, then the price of access during peak periods should be set higher than in off-peak periods, thus reducing the amount of capacity required at the peak. Demand is shifted to off-peak times when there is capacity to handle it.

This assumes that the cost of collecting the usage information and billing accordingly is less than the savings in reduced peak capacity. Electricity utilities are introducing time-of-day pricing, as the cost of smart meters capable of collecting this information has come within reach. In telecom, however, we have an example of a service that has gone the other way. Long distance service used to be priced by time of day, distance and number of minutes used. Today, flat rate packages are available with unlimited usage because providing the service costs so little that it is not worth it to collect the usage

information. If congestion were really the main problem, then there would be a network peak usage component in the UBB pricing proposal to address it.

Competing Services are Priced Differently

The second problem with the UBB proposal is that Internet access has been singled out as the service that will be priced based on aggregate monthly usage measured in GB. If it makes sense for Internet access, it should also make sense for the video services that are sold by the same companies. But they have not suggested that the customer who watches 300 hours of television over cable, satellite or IPTV every month pay more than the customer who watches 30 hours.

The telcos that have introduced IPTV services are reserving capacity on the network for their own service, which is not priced on a UBB basis, while imposing usage fees on Internet access that is in part competing directly with their IPTV services. This looks like a conflict of interest. In a purely competitive market, this would not be an issue, but we are dealing with the last mile where the incumbents have significant market power. They appear to be trying to slow down the growth of Internet video and eventually stop it. Not only will this affect how customers watch the existing services, it will also impede the growth of new and different video services, of which YouTube is one of the best known examples.

Margins – Excess Usage Charges are Much Higher than Costs

The third problem is that the price of additional usage has been set at levels far in excess of the cost of providing the service. Once again, this would not be a problem in a competitive market, but in this case, regulatory oversight is legitimate. Instead of managing congestion, the pricing structure looks as if it is designed to discourage customers from dropping their video service, to discourage them from watching video on the Internet and to maintain overall revenue levels from those customers who have done so.

Managing Congestion by Price Alone

The fourth problem is that the response to congestion appears to be by price management alone. In an expanding market, why not address the congestion by expanding capacity as well? Shaw, for example, initially commented favourably on UBB but has since announced, instead, a range of aggressive upgrading investments to improve service and increase capacity.

Where is the Congestion?

It appears that most of the congestion is occurring from the central office to traffic interconnection points past the central office and possibly, to some extent, in the loop network from intermediate collection points into the central office. Traffic shaping, additional construction in network sectors that are not the most expensive,

and changing interconnection points with ISPs could all contribute to the solution.

More important than congestion in the existing network is that the last mile facilities will not be able to carry the next generation of services that will require much faster speeds and more capacity.

Both the telco copper version and the coaxial cable version of the last mile distribution networks are old. They need replacing, and the fibre optic technology that would vastly increase the capacity of that portion of the network exists. Instead of taking advantage of the opportunity to address the growing demand by building capacity to serve it, the incumbents appear to be holding off, so they can squeeze the last bit of revenue out of the existing plant. In a competitive market, they would not have the opportunity to do this.

We are on the verge of replacing the last mile. Fibre can provide far more capacity than ADSL or DOCSIS, providing an opportunity for competitive service delivery. There are technical options that will take us in a direction that maintains the existing incumbent control over the network in the last mile. For example, relieving congestion up to the pedestal but leaving the last segment to the household with the legacy loop will maintain the scarce capacity issue for a longer period and limit the services that can be provided.

There are options that will extend the competitive environment of interconnected networks to the last mile. If we want to encourage competitive environments and the creativity they generate, then these options need to be considered before the existing holders of market power extend it for another generation. Again, it is the existence of market power that justifies public policy consideration of intervention that will lead to competitive structures as one of the outcomes.

Potential Impact of UBB

Upgrading the Last Mile

UBB can help delay the replacement of the last mile by maintaining scarcity in the network and providing an advantage for incumbent-owned services such as IPTV or cable video services, while also generating substantial revenue. By entrenching their own services before replacing the last mile, the incumbents will gain a permanent advantage over existing and potential competitors.

There are technical and organizational choices that can either enable competitive solutions in the last mile or make it difficult or impossible, thus perpetuating the market power of the incumbents. The cablecos' DOCSIS technology, for example, is difficult to resell. While the CRTC required the cablecos to file interconnection tariffs for purposes of resale, this facility has not been used. Other approaches allow for competitive interconnection at the central office, the pedestal or the customer demarcation point.

Last Mile Options

This section examines options for rebuilding the last mile, many of which have been implemented in other jurisdictions.

The following table lists examples of options for last mile replacement that are not all mutually exclusive. Indeed, policy could be developed to support several of the options. They are listed in the first column in order of the ability to provide consumer choice, and in the second column in order of providing the most

scope of action to the incumbents. While the relative placement of each option can be debated, the main point is clear. The two lists do not align. The government ownership option is last in both columns. It is important to note that most Australians, (this option is being implemented in Australia), would disagree with ranking it last in the first column or there would not have been any support for it. The lesson is that consumers can get so frustrated that they support a nationalized model over a private sector model when they perceive the abuse of market power. This can occur even in a country that would not normally pick government ownership as a consumer friendly service delivery mechanism.

Last Mile Options

Ranked by Provision of Consumer Choice	Ranked by Incumbent Provider Scope of Action
1. Customer owns FTTP	**1.** Telco and cableco incumbent driven
2. Competitive greenfield, apartment and condo installations	**2.** Regulatory direction to incumbents to provide solutions facilitating competitive entry
3. Condominium ownership	**3.** Condominium ownership
4. Auction rights of way	**4.** Competitive greenfield, apartment and condo installations
5. Regulatory direction to incumbents to provide solutions facillitating competitive entry	**5.** Build a 3rd last mile to provide more competition
6. Municipal, University, Schools and Hospital (MUSH) sector initiatives	**6.** Auction rights of way
7. Build a 3rd last mile to provide more competititon	**7.** MUSH sector initiatives
8. Telco and cableco incumbent driven	**8.** Customer owns FTTP
9. Government ownership	**9.** Government ownership

1. Customer ownership of facilities to the pedestal

The incumbents could be required to transfer ownership of the facilities from the current demarcation point to the nearest pedestal or connection point. Customers could connect to a pedestal that includes connection points to more than one service provider. Customers could choose to install fibre from their home to the pedestal and connect from there to the service provider of their choice.

While this approach is possible, it requires community involvement or an entity to recruit groups of householders in neighbourhoods that are willing to upgrade their last mile connections to fibre.

2. Competitive greenfield, apartment and condo installations

Novus Entertainment in Vancouver and Futureway in Toronto are examples of companies that have succeeded, the former primarily in Vancouver apartments and condos, the latter in greenfield subdivisions. Rogers bought Futureway in 2007. Recently, Waterfront Toronto announced that Beanfield Metroconnect will install fibre optics in new developments.

This approach works for high-end, high-density neighbourhoods and new subdivisions, but it leaves out existing neighbourhoods with low density. Also, as in the case of Futureway, incumbents have bought successful companies that provide this service.

3. Condominium ownership of the pedestal modelled on operation of broadcasting towers in urban areas

In closely related fields, private companies have agreed to common ownership of some critical facilities. The broadcasting facilities on the CN Tower are operated by Master FM, which is owned and controlled by the participating broadcasters. In a more traditional model, other broadcasting towers and cell towers are often owned and operated by separate companies (American Tower, for example) that lease space on the tower to multiple telecom providers. The telecom companies have seen fit to outsource this part of the operation. A similar approach could work for the last mile.

4. Using ROW as the basis for auctioning the right to build the last mile with the requirement to enable competitive services

The ROW required for the last mile were established when the telephone company was seen as another utility like hydro, water, sewers and roads. ROW were assigned in much the same way. Since the current technology is better suited to a competitive environment, the ROW to the land under the pedestals could be reassigned in a manner that requires competitive installations.

5. Regulatory direction to select technologies that provide competitive opportunity

The CRTC could direct the incumbents to build the next version of the last mile using technologies that enable competitive outcomes in the same way that it ordered the incumbents to provide physical access to resellers and other competitors for interconnection to their facilities. This is more radical, but the principle is similar. It could also incorporate traditional rate base, rate of return regulation of the last mile to prevent overcharging by the incumbents.

Europe required Unbundled Local Loop, whereby competitors could step in wherever they wanted, providing their own facilities and leasing only the components of the incumbent facility that they needed.

6. Municipal, University, Schools and Hospital sector initiatives

There have been many successful initiatives in North America and elsewhere that have created independent access networks, routing and transmission facilities for this sector, and in some cases associated dwellings such as university residences.

CANARIE, Canadian Network for the Advancement of Research Industry and Education, promoted research and education networks across the country with the assistance of the university community, and these networks function well, using facilities from incumbent and other suppliers. Municipal hydro services have also been successful in setting up competing organizations using their own facilities. In Ontario, they tended to focus on business services and many of these merged and were recently bought by Rogers.

In the United States, the national association for cable systems is lobbying against municipalities being allowed to create these services, claiming unfair competition.

Municipal governments and electric utilities are often interested in doing this because they already have staff with the necessary skills. Electric utilities have installed fibre backbones and are upgrading to smart grids in order to implement peak billing and integrate non-conventional power sources. They, too, have the skills to build FTTH. In Denmark, electric utilities have been instrumental in building FTTH.

While the success of municipal networks is remarkable in a country as averse to public ownership as is the USA, it also indicates that many knowledgeable people see a business case where the incumbents are unwilling to go. In the end, municipal government services, however, do not have the greatest reputation for consumer choice either. Most of these generate revenue from their services, and the debate is over whether their prices reflect their costs. At one extreme, the Saskatchewan! Connected program provided free Wi-Fi Internet access but congestion degraded the quality of service to the point where it is of little value.[5]

7. A third last mile system into households

This option adds another competitor but requires a large amount of capital and a large amount of time as a national strategy. It also requires negotiation of ROW with incumbents, municipalities and other utilities. The result then depends on the market penetration in relation to the two incumbents. Who would undertake this? It is also questionable whether this is the most effective use of resources given that there are other options.

8. Telco and cableco incumbent driven

Leaving the replacement of the last mile to the telco and cableco incumbents is certainly an option. Based on initial results, however, this approach will leave us behind the world leaders in new Internet and telecom services. It will leave us open to managing demand through price changes alone and with high margins to maintain traditional revenue levels. The last mile will be built in ways that maintain the dominant market power of incumbents and their ability to continue these practices with little threat of competitive challenge.

9. Government or independent regulated monopoly utility owners

The government could nationalize the last mile and build the next generation access network itself. Even though this sounds radical, it is happening in Australia. The National Broadband Network (NBN) is being deployed across Australia with the objective of bringing a download speed of 100 Mbs to 93 per cent of the population. NBN Co. Limited will act as a wholesaler to ISPs that provide retail access. Less radically, incumbents have been required to break up, leaving the owner of the last mile as a different company. This company would then build fibre to the home and provide competitive access.

Some of these options are highly interventionist. The objective, however, is to prevent slipping back into a situation where incumbents expand their market power and extend it into new areas that were previously more competitive. There is also a risk that the public will demand increasingly interventionist solutions if they are not getting services that they know are available in other jurisdictions, such as the faster Internet access speeds and lower prices that make South Korea one of the worlds current leaders in broadband market penetration.

Public policy and regulation should support the implementation of options 1 to 4.

> ***...the public will demand increasingly interventionist solutions if they are not getting services that they know are available in other jurisdictions...***

Telecom as a Strategic Enabler

Telecom and associated services are one of the fundamental drivers and enablers of economic development and technical progress. High speed Internet access makes it possible for people to work at home or other geographically distributed environments as opposed to more centralized locations. If a nation's telecom sector is well developed and technically creative, then other sectors also develop. Disruptive technologies are created and spread quickly, changing the ways in which work and entertainment take place. Examples include the impact of technology on music distribution, photography, mail and publishing. The impact will be felt not only in entertainment, such as how people watch movies, but also in whether they can participate in Skype videoconferences from rural Manitoba.

UBB will slow the spread of new and innovative Internet services in Canada and leave us behind the world leaders, putting our economy at a permanent disadvantage. This will happen because higher prices and usage sensitivity will stop many people from using Internet capability to its full potential. In addition, UBB will maintain the current business and ownership structures instead of leaving the way open for next generation disruptive technologies.

Canada is no longer at the forefront of the world in terms of broadband access and the adoption and deployment of the new services that they make possible. We cannot afford a policy that delays investments in next generation technologies in the last mile.

Rural Economic Development and Diversity

This is a specific case of telecom as a strategic enabler. Governments have taken this issue very seriously, providing rural broadband incentive programs to enable Canadians living in rural and remote areas to participate more fully in the economic and cultural life of the country. Having the same communications capability in rural areas makes it possible for people to participate in more economic activity than would be possible otherwise.

The United States has implemented funding programs to assist broadband deployment in rural areas.

In the Prairie provinces, the provincial governments ran the telephone companies (AGT, SaskTel, MTS) for many years, in part to promote rural economic development that shareholder-owned companies were unwilling to do. This structure has already evolved. As the underlying technologies change, should the role of SaskTel as a promoter of rural economic development also change? With new technology, is it time to use competitive environments to achieve economic development?

While the officially rural population of Canada is no longer that large, 20 per cent to 30 per cent of Canadians are living beyond the reach of high speed cable or ADSL. This makes the satellite and fixed wireless providers important participants in overall broadband access policy as well as in the extension of fibre. The economic potential of opening up remote Canada using telecom to expand economic opportunity as well as entertainment is vast.

Competition Policy

The incumbent telcos and cablecos have evolved into businesses with a much wider scope of services. They are the primary owners of the last mile of the telecommunications networks that connect residential customers to the Internet, video packages and other telecom services. UBB may allow these companies to centralize control of various sectors of the telecom market, leading us back to an industry dominated by a small number of large companies with important market power.

Who Delivers Video?

Cable and satellite companies, known in regulatory terminology as Broadcasting Distribution Undertakings, dominate video service delivery. Incumbent telephone companies have begun to compete by using IPTV. Video delivered to customers over their Internet access service competes with all three of the traditional package providers. This capability has existed for over 10 years, and the technology has gradually improved. New companies have developed new services such as YouTube that do not exist in the traditional services. Many people have begun to get their video service from the Internet and the growth of traditional video distribution is threatened.

If customers drop their video subscriptions and watch video over the Internet instead, then that large part of the revenue stream just disappears. With UBB, the Internet access provider will get back some of that money. Given that households pay from $30 to $120 or more for what we still call "cable," there is a great deal of money on the table. The telco and cableco incumbents do not want to lose this revenue to independent ISPs, and they want to prevent the establishment of much lower value and pricing thresholds for video services.

> ***Many people have begun to get their video service from the Internet and the growth of traditional video distribution is threatened.***

CRTC Regulatory Framework

The CRTC regulates telecommunications and broadcasting. Along with associated legislation that limits foreign ownership and promotes Canadian production of film, video, music and the arts, the CRTC has developed the Canadian Broadcasting System. It consists of a complex set of licensing requirements, content requirements, incentives, taxes and regulations all designed to establish, maintain and develop Canadian content and deliver it to viewers and listeners. Each sector, the cable companies, broadcasters, independent producers, the CBC and others, has access to specific revenue sources for which they are required to do their bit to promote Canadian content.

This structure is the main reason there is so little difference in the content and the packages available from the existing video service providers. They are all subject to the same rules. Internet video has the potential to bypass the whole system, making it obsolete. Policy makers have been aware of this for some time and began to adapt the system several years ago. Nevertheless, this structure is under threat by Internet delivered video. Technology is forcing us to pull back on some on the more cumbersome support structures for what has become a successful production sector. Slowing down the move to Internet video will also slow down the reform of the regulatory support structures for the Canadian Broadcasting System.

Some of the underlying economic arguments for national support are likely to continue. It will always be inexpensive to add distribution capability for a program from the United States. It will always be more difficult to recover the full production costs of a television program from advertising in a market of 33 million people than from a market 10 times the size.

In any case, we should ensure that measures to support Canadian content do not prevent or inhibit Canadians from being full participants in the global opportunities that new technology presents.

As this paper is being written, there are two active CRTC proceedings related to this topic.

The first is an online consultation on wholesale Internet access services, which concluded on June 24. This is part of Telecom Notice of Consultation CRTC 2011-77, Review of billing practices for wholesale residential high-speed access services, announced earlier this year, for which there will be a public hearing starting July 11.

The second is a consultation on online broadcasting, Broadcasting and Telecom Notice of Consultation CRTC 2011-344, Fact-finding exercise on the over-the-top programming services in the Canadian broadcasting system. Comments were due June 27.

Promoting a Competitive Environment in Telecom

Regulatory oversight of pricing in the last mile is legitimate because of the continuing dominant market power in the last mile.

The Bell UBB proposal has four major problems that show it to be part of a policy of delay in rebuilding the last mile, using pricing to discourage adoption of new technology and to reserve existing capacity for its own services. The proposal should be denied upon review. While price increases may be appropriate for increased use Internet video, this is not the way to do it.

Much of the *Broadcasting Act* and the *Telecommunications Act,* which form the legislative basis for Canadian policy in this sector, is based on increasingly obsolete technical assumptions.

> ***Policy needs to focus on enabling competitive forces to return Canadians to the front of the pack in telecom.***

Policy needs to focus on enabling competitive forces to return Canadians to the front of the pack in telecom.This will allow us to choose how to take advantage of new opportunities that will help to determine our place not only in the world of broadcasting and entertainment but also in the workplace using the next generation of broadband services.

Competitive market forces have opened up a changed world through telecom, the Internet, and new forms of video. Our public policy should create an environment that allows it to flourish by ensuring that the rebuild of the last mile takes place in a way that opens it to the creativity of competitive options.

Appendix A

The infrastructure – Telecom network fundamentals

This Appendix is intended to provide a basic understanding of telecom networks, and the terminology that is important to the discussion of pricing policy and is likely to be found in other documents on the topic. It is not intended to be technically thorough or complete. Tutorials are available on the net for those who are interested in more detail.[6] The incumbent telco network is described first. Cable networks have important differences.

This is the way telco networks used to look. The telco owned everything end to end and calls over longer distances were sent to long haul transmission facilities through a hierarchical switching network. Two kinds of local loop are illustrated. One consists of twisted copper wire pairs directly from the customer to the central office and one that collects the copper pairs at a remote switch and aggregates them for transmission to the central office using a more efficient carrier system.

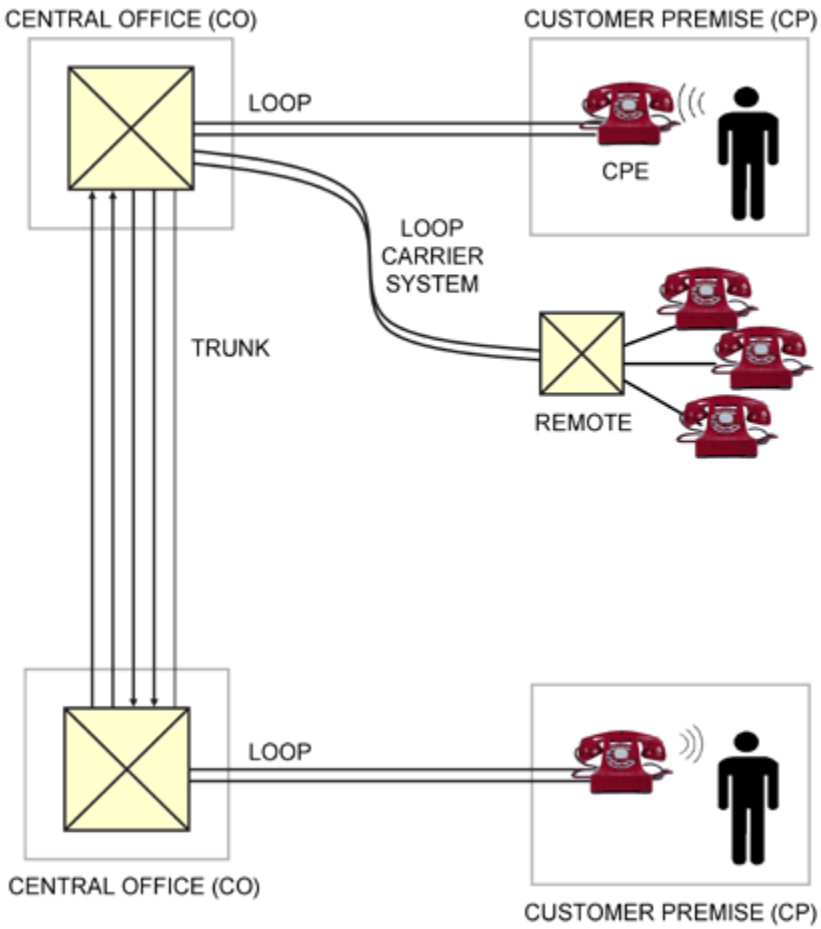

Figure 1 – The Legacy Network

Diagram by TeraCom Training Institute, copyright 2006.

Today, there are important differences. Starting at a residence, the terminal equipment (phone, computer, router, TV) connects to the inside wiring that connects to a demarcation point, usually on an outside wall. The customer owns everything up to the demarcation point; the telco owns everything after it.

From the demarcation point, a pair of copper wires goes to the central office which is sometimes called the wire centre or local switching office. Local loops may also be collected at intermediate steps in pedestals (the boxes or street furniture that you see in your neighbourhood) or concentrators that transfer the content into other technologies that transport it more efficiently to the central office.

For customers who still have a home phone provided by an incumbent (the original monopoly telco), this service may still be provided over old (legacy) technology. High speed Internet connection is provided using Asynchronous Digital Subscriber Loop (ADSL) technology that can use the copper wire in the local loop more efficiently by adding equipment at the customer location and the central office.

From the central office, traffic is sent on very high capacity fibre optic cables to the next central office in town, across the province or around the world. Fibre optics and the associated transmission capability are behind the huge drop in the cost of telecommunications transmission and the massive increase in capacity over the past 20 years.

Fibre optic cables consist of multiple strands, each of which can be subdivided into wavelengths for the purpose of transmitting data. In many cases, the optical equipment at either end of a fibre optic cable can be replaced with the most recent technology without replacing the cable. When laying fibre, companies will usually install a large amount of spare capacity because the cost of rights of way (ROW), trenching and installation are high in relation to the cost of the fibre.

The technical and cost advantages of fibre optic technology are so massive that there is no wireline technology in use beyond the local loop anywhere that fibre can be installed. Satellite technology competes in point-to-multipoint applications such as high capacity video distribution, and it provides services where there is insufficient traffic to warrant the installation of fibre optics. Fixed wireless technology is also used in some cases to provide network access and video distribution.

In earlier telephone technology, telephone calls were switched at the local central office and then aggregated and transmitted to other switches in a hierarchical network system. Telcos handed off traffic at the borders of their territory to the telco in the next jurisdiction. Today, traffic is routed in packets from one place to the next until it reaches its destination. The language used to transmit Internet traffic is called Internet Protocol (IP). Hence, IPTV is the name of the television service that is distributed using the same language and technology as the Internet.

Competitive service providers also carry traffic from the central office onward, sometimes using bulk leased facilities from the incumbent and often using facilities they have constructed. From an Internet perspective, the transmission network after the central office is often represented as a cloud.

Competitors also deliver traffic to central offices or intermediate collection points or into the cloud if they have their own access facilities. Resale competitors lease the loop facility or components of it from the incumbent.

Cable networks were originally installed to provide television signals that customers could not receive over the air. The telcos' copper wire did not have the capacity to carry video. The cable companies used coaxial cable that could carry video signals and the associated audio from the headend where they collected the signals and sent them on to their customers. The original systems transmitted in one direction only, from the headend to the customer.

As technology improved, cable investment and capacity grew. Digital compression technology, satellites and fibre optics enabled them to carry far more channels and established the basis for the ability to include new services when the Internet appeared as the next opportunity. Using a technology called DOCSIS (Data Over Cable Service Interface Specification), the cablecos became important participants in the ISP market. With this capability, they could provide telephone service using VoIP and compete in that market as well.

The Last Mile

This is an important concept in the discussion of UBB because incumbent telco and cablecos have dominant market power in the last mile. It is important to understand why this is so. For telcos, the last mile is still copper. For cablecos, it is coaxial cable, which has far more capacity than copper but far less than fibre optic. In some cases, fibre optic has been installed beyond the central office to local concentrators or pedestals where the traffic is translated back from optical to electronic signals for final transmission to the homes.

The reason the last mile has not been upgraded to fibre is that replacing the existing local distribution system or building a third one is expensive. It is costly because the technology is more expensive and whole neighbourhoods have to be converted at the same time. This involves negotiations with municipalities, gas, water and hydro companies that share rights of way, and it also involves trenching in established areas. The telcos and cablecos originally made the investments in the copper loops and coaxial cable distribution system when they were regulated monopolies with their pricing policies subject to regulatory review and approval and municipal governments dealt with them as any other public utility. A new competitor would require many years to build these relationships and the knowledge of local conditions required to build a third last mile.

The business case for installing fibre is clear when dealing with the transmission of massive amounts of data across the country on a few strands. It is less clear when the traffic density and potential revenue is smaller the closer the investment is made to the individual household. Will the existing customers take up new services and make us of the additional capacity in a way that pays for the upgrade? A potential competitor contemplating installing a third Last Mile in addition to the telco and the cableco will have to project how many customers will migrate to its new service and how quickly. Will 30% or 40% change or only 10%? A great deal of money has to be invested before service is offered and revenue is generated.

The terminology used to describe the extension of fibre optic technology to residential homes is called Fibre to the Home (FTTH). Intermediate steps have also been taken. FTTC means Fibre to the Curb. FTTP means Fibre to the Pedestal or Fibre to the Premise. FTTX is more generic and means Fibre to the Whatever.

There have been successful examples of competitive FTTX builds. These have generally been in greenfield subdivisions or urban apartment buildings and are often connected to local real estate developments and expertise. There have also been FTTX builds by incumbent telcos and cablecos. In general, however, the Last Mile still consists of old copper and coaxial cable technology that needs to be replaced for next generation services to really take hold.

There are technical choices that can either enable competitive solutions in the Last Mile or make it difficult or impossible, thus perpetuating the market power of the incumbents. The cablecos' DOCSIS technology, for example, is difficult to resell. While the CRTC required the cablecos to file interconnection tariffs for purposes of resale, they have not been used.

Similarly, most telco FTTX implementations maintain the single network control model rather than explicitly providing openings for more interconnection at the central office, the pedestal or the customer demarcation point.

Figure 2 illustrates a point-to-point, or P2P architecture that connects every customer with fibre. There may also be intermediate collection points of loops. Competitive interconnection can occur at any of those points. The second diagram illustrates a switched P2P architecture. OLT means Optical Line Terminal, and ONT means Optical Network Terminal.

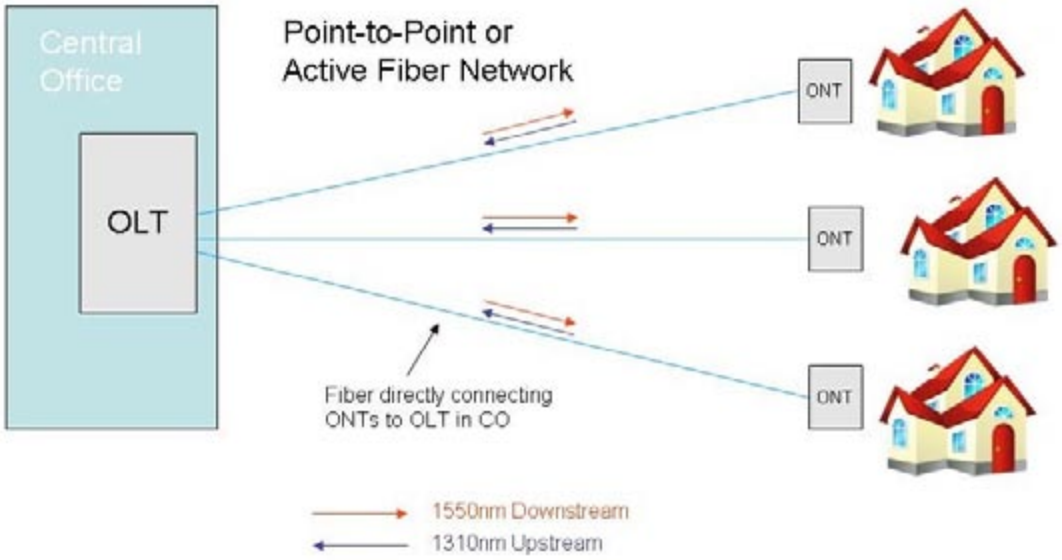

Figure 2 – P2P Fibre

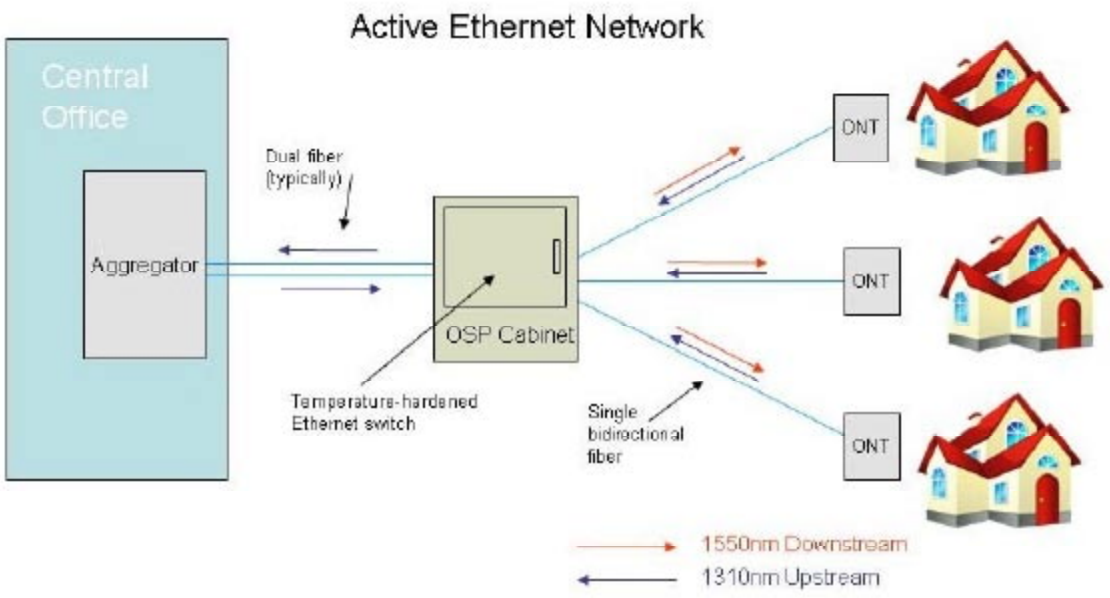

Figure 3 – Switched or Multiplexed P2P Fibre

The alternative architecture, generally favoured by incumbents, is Passive Optical Network (PON), where signals are split, either once, or at intermediate steps.

Because all the signals are sent to each customer, competitive interconnection at the intermediate steps is difficult.

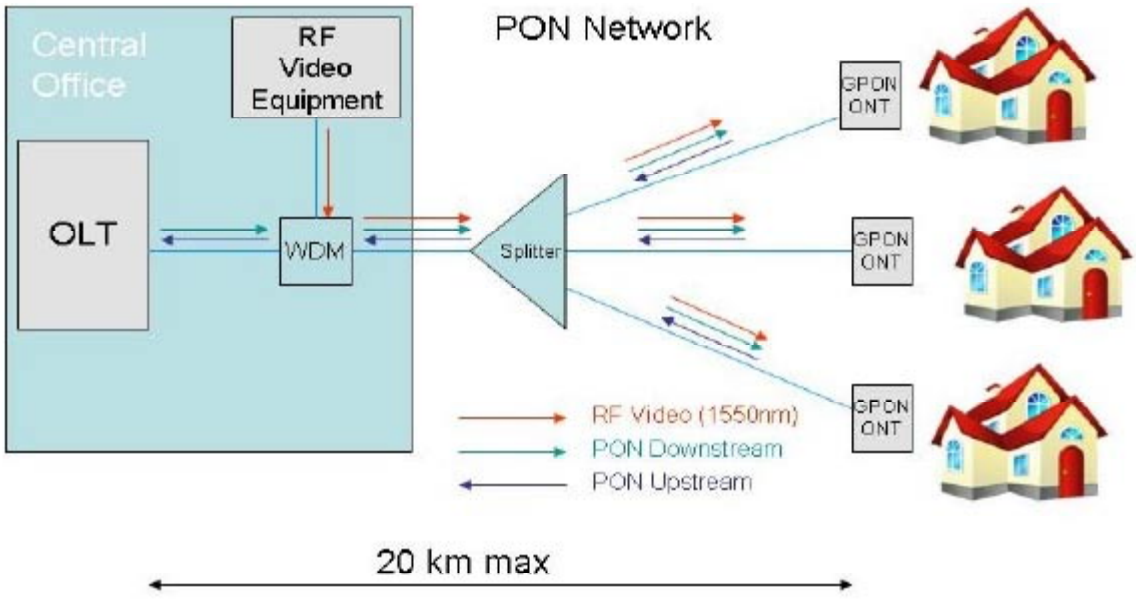

Figure 4 – Passive Optical Network

Figures 2, 3, 4 diagrams by John Bartell, copyright The Product Group LLC

Endnotes

1. This is a general description, condensed to illustrate the principle. The complete tariff is available at the CRTC Web site.
2. Telco and cableco reflect the historical origin of the companies as either telephone or cable television companies. Therefore, Bell and Telus are telcos; Rogers, Shaw and Videotron are cablecos. Today, all are telecom companies that provide all services. Parts of their networks are different, particularly in the last mile, which reflects their origins.
3. See, for example, www.telecomcircle.com or www.teracomtraining.com. There is excellent material at www.ieee.org, as do some of the equipment vendor sites, or even Wikipedia.
4. In a greenfield subdivision, there is no existing infrastructure. All of the houses can be connected with the latest fibre technology installed at the same time as the other utilities. This is much less costly than upgrading existing neighbourhoods.
5. David Seymour, "Saskatchewan! Connected? Why 'free' public Wi-Fi may be the silliest public policy we have," Frontier Centre for Public Policy *Backgrounder* Number 90, March 2011.
6. See, for example, www.telecomcircle.com, or www.teracomtraining.com. There is excellent material at www.ieee.org as well as at some of the equipment vendor sites or at Wikipedia.

Further Reading

March 2011

Saskatchewan Connected!

David Seymour

http://www.fcpp.org/publication.php/3662

June 2011

Telcommuting and Working at Home in the Emerging Environment

Wendell Cox

http://www.fcpp.org/publication.php/3811